BURNY 5

Operation and Maintenance Manual

Revision: March 2001
(For use with software version 8/10/94 and later)

AO-73307 (REVISION C)

Cleveland Motion Controls
An IMC Company

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Burny 5

Documentation for compliance with the EMC Directive (EC)

These instructions must be followed during the installation of the Burny 5 control. This insures compliance with the EC's EMC Directive, and provides the best protection against outside RFI interference. These installation procedures should be used for ALL installations.

Contents:

- Installation instructions for EMC compatibility
- Drawings

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AO-72105	

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Burny 5 -- Installation Instructions to insure compliance with EMC Directive

1. All Cabinet screws on the **Burny 5** enclosure must be installed and securely tightened.

2. All cables connected to the **Burny 5** must be supplied by Burny-Etek, or must be built to Burny-Etek cable specifications. Specific cable construction drawings will be supplied upon request.

3. All cables connected to the **Burny 5** must have external braid shielding, with metal ground clamps at each end of the cable to connect the braid to the equipment. Metal grounding clamps must fit tightly onto the external braid-- if clamp is loose, gently crimp the clamp onto the braid to provide a secure connection. Don't crimp any harder than necessary to avoid damaging the internal cable. (Customer supplied cables which do not use external braid must be approved by Burny-Etek).

   All cables that connect to the back of the Burny 5 enclosure must have their external braid grounded to the Burny 5 enclosure with metal clamps:

   - Encoder cables, the RS-232 Cable, Power/Oxy, Plasma interface, and Drive interface cables connected to the back of the Burny 3 should have it's external braid shielding connected to one of the cabinet grounding screws provided on the back of the **Burny 5** enclosure-- using a metal, 360 degree contact grounding clamp. See drawing AO-72105.

   Cables to rack mounted encoders (H20 or H25 type) require that their external braid shield be connected to the housing of the encoder using a metal grounding clamp.

   - See drawing AO-72103 for details on grounding the encoder cable to the case of this type of encoder.

4. The enclosure of the **Burny 5** must be grounded to the machine frame's earth ground connection point by a braided ground strap-- at least 12 mm in width. A wide flat ground strap provides a better RF ground path therefore a strap is preferred. The strap can be terminated with standard crimp terminals at both ends. The strap should connect to one of the chassis grounding screws on the back of the **Burny 5** per drawing AO-72102.

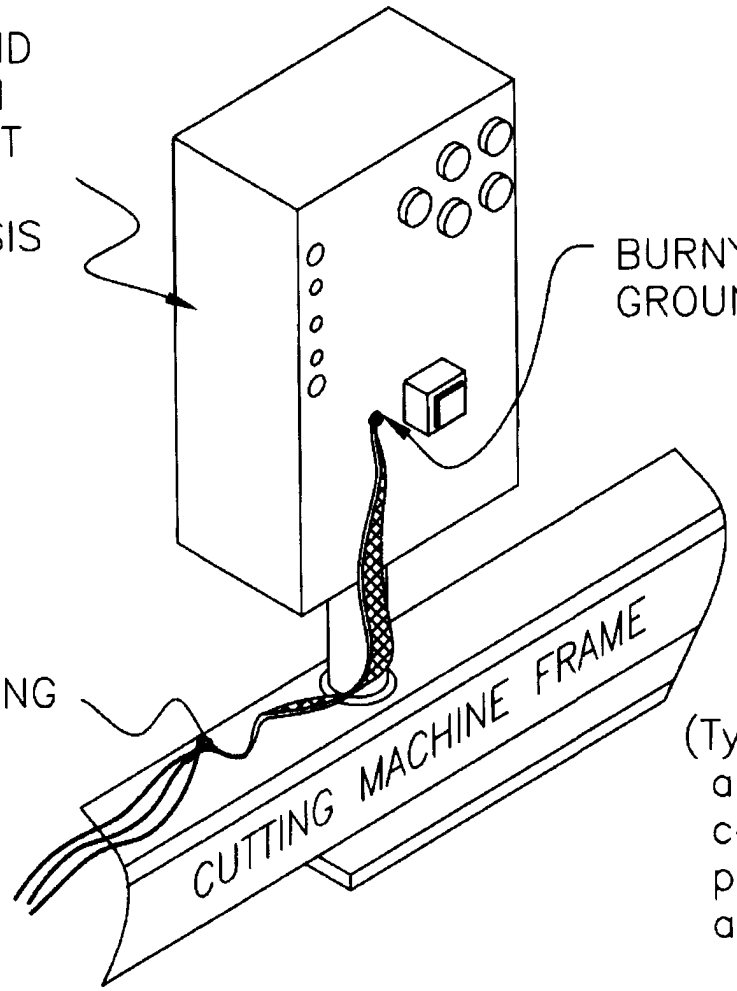
5. Any connectors on the back of any Burny-Etek product that do not have a cable connected must have plastic protective cover installed. This can either be the red disposable type or the attached screw thread covers.

6. If motor mounted encoders are used the MO-11124 Kit must be installed over the junction of the plastic connectors between the encoder cable, and the short lead coming from the encoder. This kit and instructions are shipped with each of the following cables, and are also shown on drawing AO-72107.

   Cables which require connector shield kit: MO-08798-XXX
   MO-09938-XXX

7. Service must be performed by trained authorized technicians only. Service technicians must wear a static grounding wristband connected to the equipment enclosure when removing or installing any boards or EPROMS in the system. All circuit cards must be shipped in protective anti-static shielding bags, and any card or part removed from a Burny-Etek product must be immediately placed into one of these anti-static bags. Any circuit card or electronic component returned for credit or repair must be shipped in an anti-static bag. If a circuit card is returned without the proper anti-static packaging, no warranty or credit will be issued. Contact Burny-Etek for specifications or help with anti-static packaging.

INSTALL WIDE (12mm) GROUND STRAP BETWEEN BURNY PRODUCT CABINET AND MACHINE CHASSIS GROUND POINT



(Typical cabinet shown— all Burny products have cabinet grounding screws provided for ground straps and cable connection)

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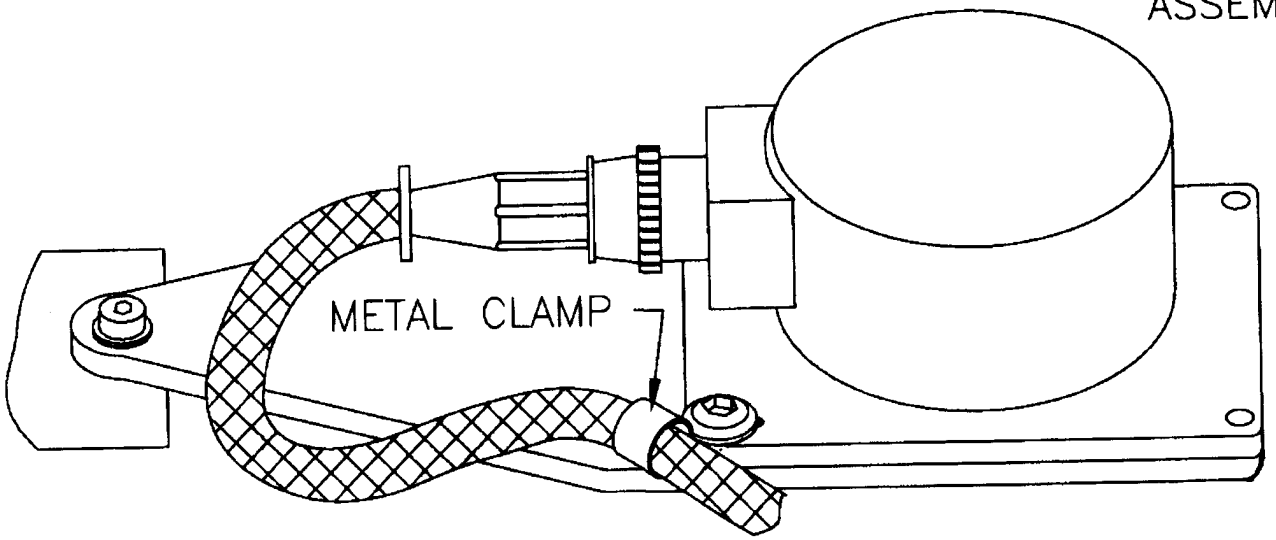
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CUSTOMER INSTRUCTION GROUND STRAP INSTALLATION

CAD DWG NO. : D(XX)-XXXXX_X.DWG		SIZE	DRAWING NUMBER	REV
DRAWN BY KJB	APPROVED BY KJB	A	A0-72102	A
DATE 12/12/95	DATE 12/95	SHEET 1 OF 1		

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ENCODER BRACKET ASSEMBLY



GROUND EXTERNAL CABLE SHIELD TO ENCODER BASE USING EXISTING HARDWARE AND 360° METAL CLAMP

METAL CLAMPS PROVIDED WITH ALL BURNY CABLE ASSEMBLIES

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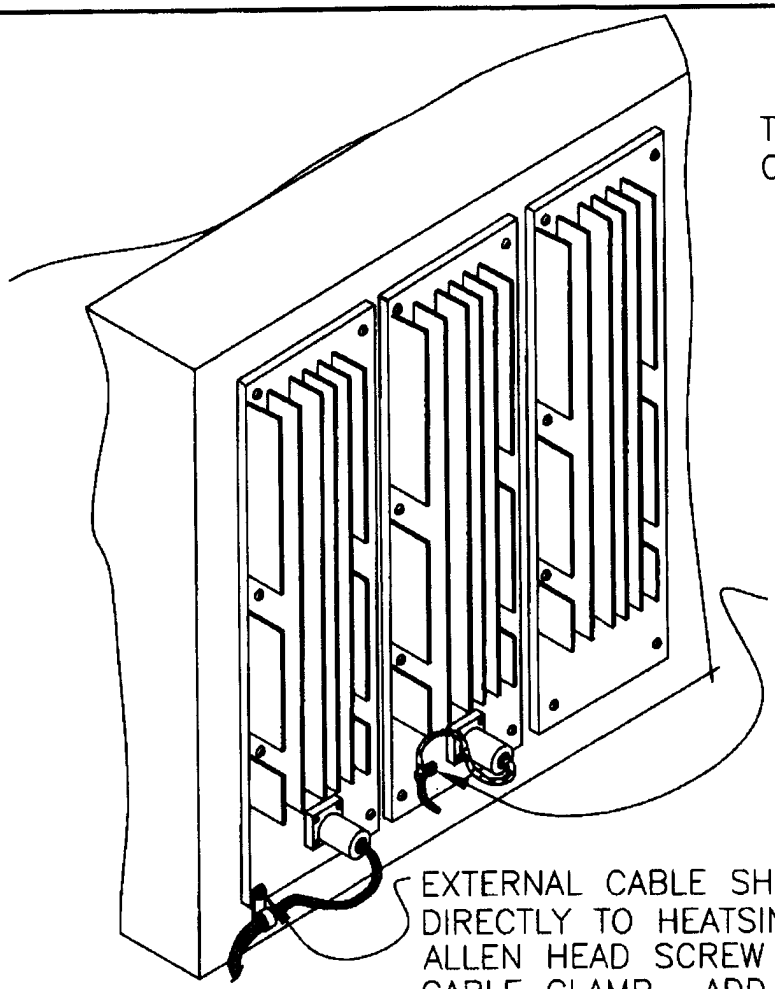
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RACK MOUNTED ENCODER CABLE GROUND CLAMP INSTRUCTIONS

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SHEET 1 OF 1

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TYPICAL BACKPANEL ON BURNY 2.8
OR SERVOPAK 150.

NEW HEATSINK HAS CABLE GROUNDING SCREW PROVIDED – IF PRESENT,THIS SCREW SHOULD BE USED TO CONNECT EXTERNAL BRAID TO HEATSINK

EXTERNAL CABLE SHIELD GROUNDED DIRECTLY TO HEATSINK BY EXISTING ALLEN HEAD SCREW WITH 360° METAL CABLE CLAMP– ADD FLAT WASHER IF NECESSARY

METAL CLAMPS PROVIDED WITH ALL BURNY CABLE ASSEMBLIES.

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MATERIAL NOTE | FINISH NOTE | SCALE 1 : 1 | REF

ServoPak MOTOR/TACH. GROUND

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DATE 12-95 | DATE 12-95

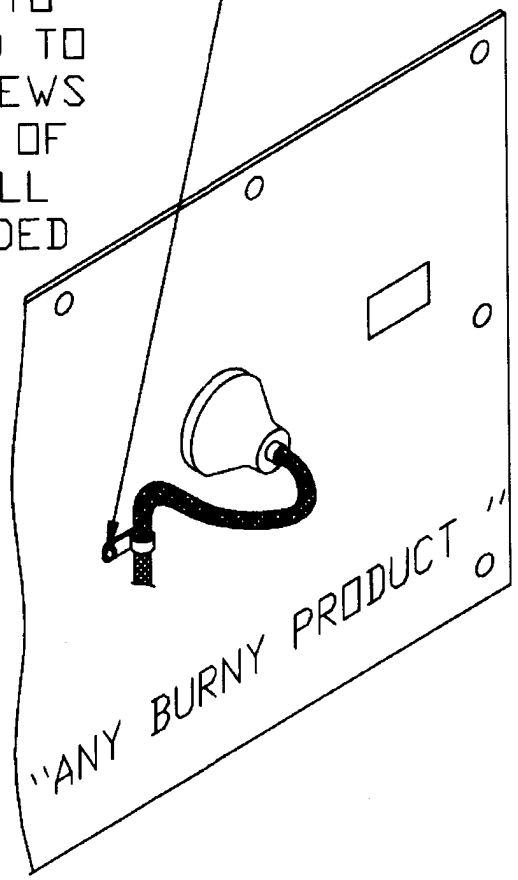
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USE 360° METAL CLAMP TO GROUND EXTERNAL BRAID TO CABINET GROUNDING SCREWS PROVIDED ON THE BACK OF ALL BURNY PRODUCTS. ALL CABLES MUST BE GROUNDED IN THIS FASHION

METAL CLAMPS PROVIDED WITH ALL BURNY CABLE ASSEMBLIES



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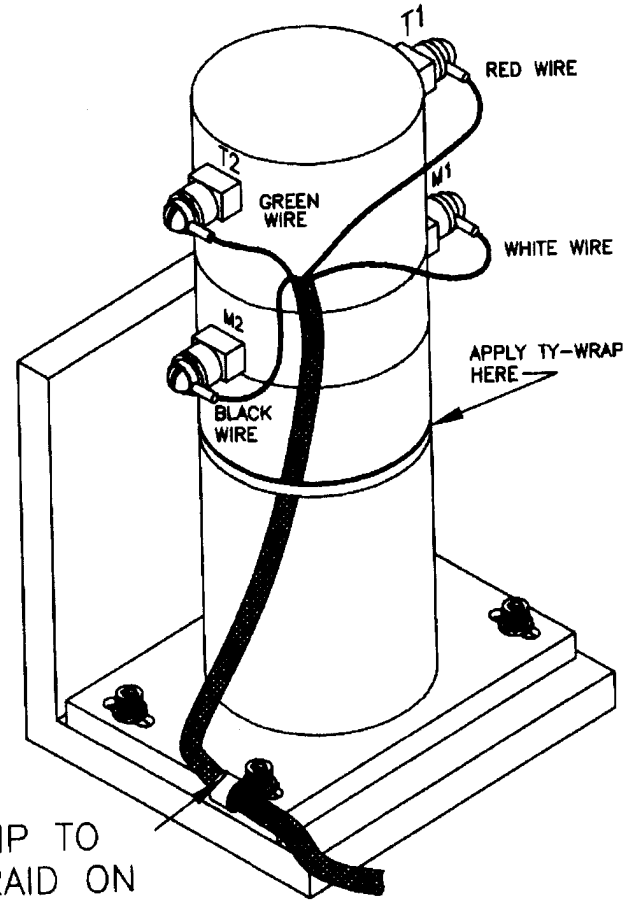
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CABLE GROUND TO BACK OF CABINET

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USE 360° METAL CLAMP TO GROUND EXTERNAL BRAID ON MOTOR/TACH. CABLE TO ONE OF THE SCREWS ON THE MOTOR MOUNTING PLATE AS SHOWN

METAL CLAMPS PROVIDED WITH ALL BURNY CABLE ASSEMBLIES

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MOTOR CABLE GROUND CLAMP INSTALLATION (2630)

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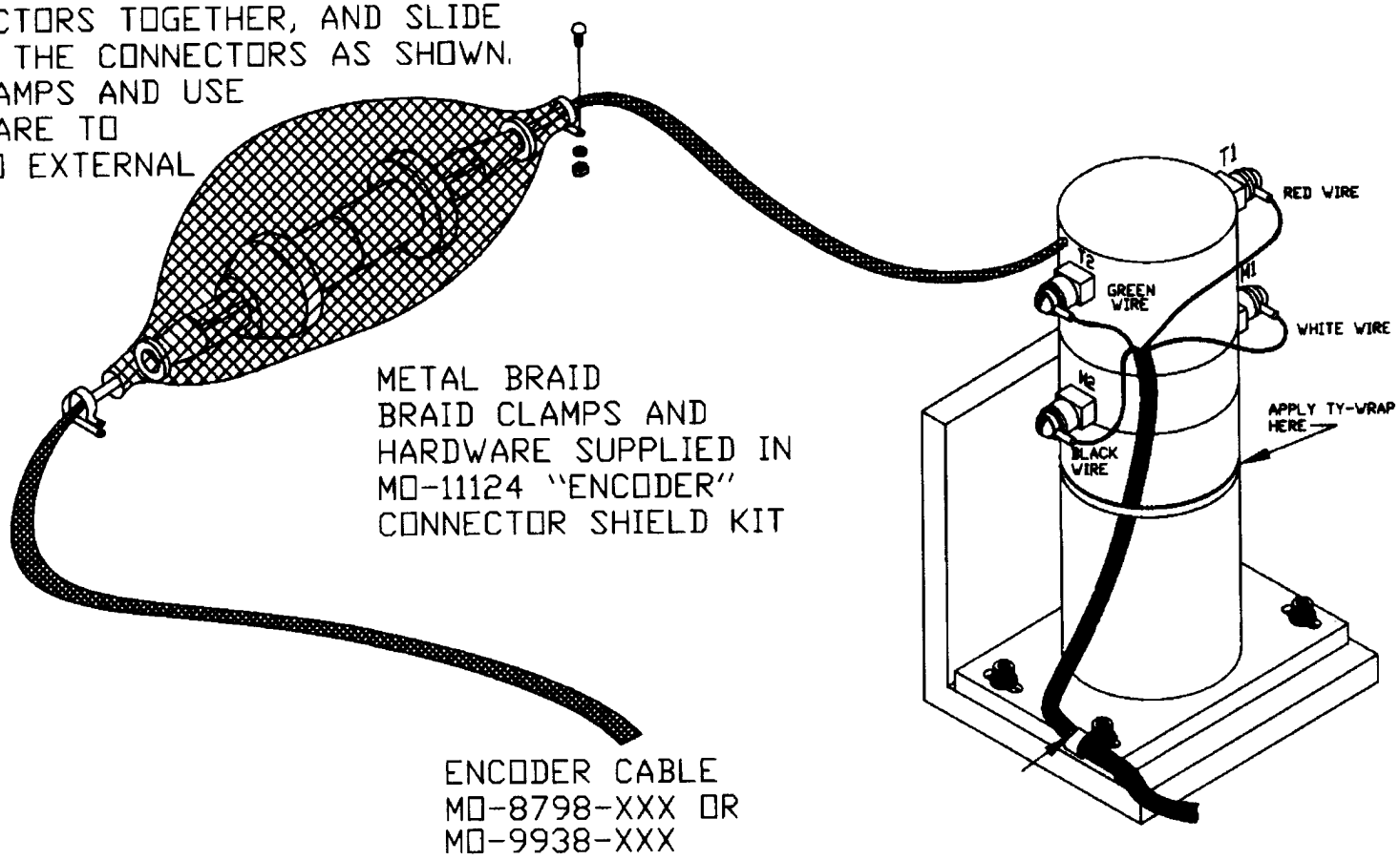
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WITH CABLES DISCONNECTED, SLIDE METAL BRAID COMPLETLY ONTO THE ENCODER CABLE. PLUG THE CONNECTORS TOGETHER, AND SLIDE THE BRAID OVER THE CONNECTORS AS SHOWN. APPLY METAL CLAMPS AND USE SUPPLIED HARDWARE TO GROUND BRAID TO EXTERNAL CABLE SHIELD.



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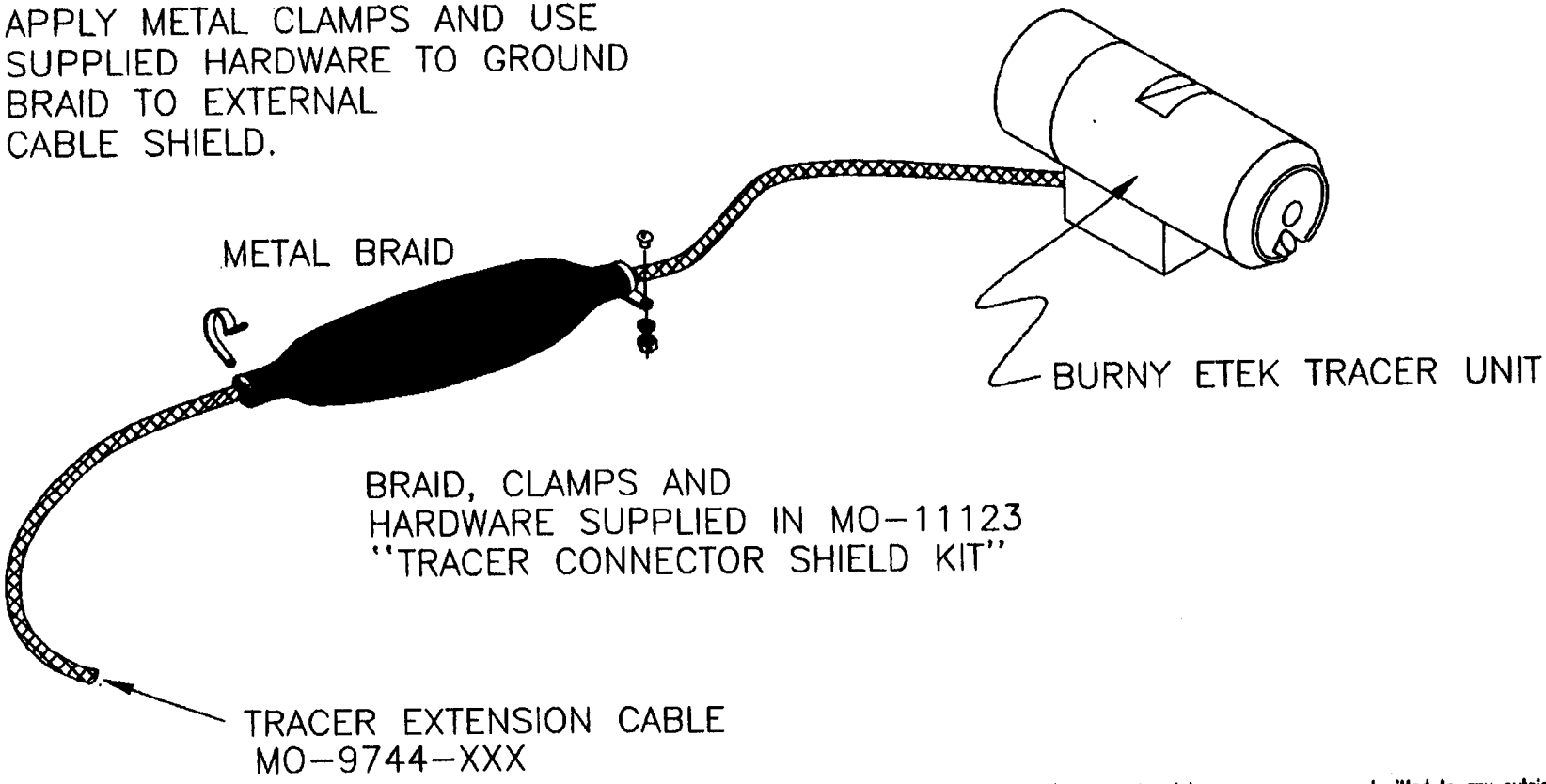
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CUSTOMER INSTRUCTION ENCODER CONNECTOR SHIELD

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WITH CABLES DISCONNECTED,SLIDE METAL BRAID COMPLETLY ONTO THE TRACER CABLE. PLUG THE CONNECTORS TOGETHER,AND SLIDE THE BRAID OVER THE CONNECTORS AS SHOWN.
APPLY METAL CLAMPS AND USE SUPPLIED HARDWARE TO GROUND BRAID TO EXTERNAL CABLE SHIELD.



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CUSTOMER INSTRUCTION
TRACER CONNECTOR SHIELD

CAD DWG NO. : DXXX-XXXXX_X.DWG		SIZE	DRAWING NUMBER	REV
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PART 1 - SYSTEM OVERVIEW

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INTRODUCTION

The BURNY 5 is the newest member of the BURNY line of CNC controls. The BURNY 5 comes with a CRT monitor which is used for both graphical program display and user prompting. The user interacts with the control using the flat membrane type keyboard which includes several status LED's and an audible "beeper" for "key pressed" indication.

NOTE

There are now two versions of the BURNY 5, one with a color monitor (BURNY 5) and the other with a monochrome monitor (BURNY 5 MC). This manual describes the original BURNY 5 with the color CRT. Any reference to screen colors should be disregarded when using a BURNY 5 MC.

INTRO.1 PROMPTING AND MENUS

There are several common methods used to guide the user through the various screens and menus:

**** WHITE ** FOR DATA ENTRY**

Regardless of which screen is shown when a data value or parameter selection is required, the value to be entered will appear in WHITE. There will be no other WHITE field on the screen. Therefore, the user should always watch for this WHITE area. If a menu is shown, there will be a WHITE cursor next to one of the entries to indicate the current default selection. To use the default selection, just press ENTER. To change the selection, move the WHITE cursor to the desired entry using the up or down cursor keys which appear to the immediate right of the <IV>, <V>, and <VI> keys. More directly, the selection can be made by pressing the entry number on the numeric keypad.

NOTE

The MONOCHROME BURNY 5 prompts appear underlined to aid in distinguishing them from other text fields. Look for the underlined fields when prompting operations are required. (Underlined prompting can also be enabled on the COLOR BURNY 5.)

Whenever a numeric value is required for a prompt (for example a kerf dimension, program number, etc.), its current default value will be displayed in WHITE. If the displayed value is to be reused, just press <ENTER>. However, if a different value is required, directly enter it with the numeric keys. The left cursor key can be used as a "backspace" to remove incorrectly entered digits. After the new value has been specified, pressing <ENTER> the first time shows the value as it will be used by the system (justified for the correct number of decimal places, etc.). Pressing <ENTER> a second time completes the entry process and causes the system to go to display the next prompt.

Non-numeric entries (such as "YES"/"NO") are defined using the up and down cursor keys or the <+/-> key to select the desired response and pressing <ENTER>. Numeric assignments (which are displayed in the "HELP" pop-up menus) can also be directly entered to make the desired selection. (These "HELP" pop-up menus, which can be "called up" with the <IV> key, will be described later).

INTRO.2 KEYBOARD LAYOUT AND DESCRIPTION

RST KEY

The <RST> key acts as a "RESET" key to end the current operation, and return to the MAIN MENU screen. If it is pressed while a part program is running, the machine stops and inhibits all cutting functions, then the control returns to the MAIN MENU. During other operations (SERIAL LOAD/STORE, TEACH, etc.), this key either finishes the process or simply aborts the current operation. In some cases, as in the PROGRAM TEXT EDITOR, it is necessary to press the <RST> key more than once to completely exit out of the current active operation and return to the MAIN MENU.

NUMERIC KEYPAD, DECIMAL POINT and +/- KEYS

When a prompt requires a numeric value (part dimension, kerf, etc.), the value is entered using the 0-9 numeric keys and the decimal point key. If a negative value is required, the <+/-> key must be pressed before the numeric digits are entered.

NOTE

On the BURNY 5 keyboard, the "-" key is labeled "+/-". However, in the BURNY 5, this key does not "toggle" the sign of a numeric value. If it is pressed twice, two minus signs "--" appear on the screen. To enter a "+" sign, the user must press the <SHF> key before pressing the <+/-> key.

CE and SHF KEYS

The <CE> key performs two basic operations. Whenever a numeric value is being entered, pressing <CE> (before the ENTER key) causes the BURNY to clear the value field and wait for another value to be entered. However, when not entering a numeric value, <CE> causes the previous prompt, menu, or screen to be displayed. This provides an easy method to step backward through the prompting to check or change an earlier value without restarting the entire sequence. Since all entered values are retained as defaults for the next time through the prompting sequence, stepping backward displays all previous prompts with the users selections still set.

The <SHF> key also performs different functions depending on the current prompt or screen. Although <SHF> alone is used to "toggle" the ZOOM cursor between small and large step sizes, this key is typically used as a "shifted function" key to expand the capabilities of the keyboard.

In most cases, <SHF> is used as the first key in a two key sequence to perform a special "shifted" function. For example, to enter a "+" sign in a numeric value, press <SHF> and then the <+/-> key. Hexadecimal digits "A" through "F" are entered by pressing <SHF> and then a <0> through <5> digit key. On some screens, the sequence <SHF> <ENTER> forces the system to bypass some of the prompting operations normally performed and reuse previously entered values (as on the RUN and SERIAL LOAD screens). The sequence <SHF> <CE> is used to inhibit the SERIAL LOAD/STORE prompt bypass operations that can be defined through SYSTEM SETUP DATA for a specific serial device operation.

I and II KEYS

These two keys are used to quickly page through a long list or menu instead of stepping through it one entry at a time. Pressing the <I> key will "Page up" toward the top of the list, while the <II> key will "Page down" toward the end of the list.

These keys are also used to select other operating screens when displaying one of the function menus or graphically showing the path of a "running" part program. For example, the <I> key can be used to "call up" the AXIS POSITION/SPEED utility screen. From this screen, the user can clear the X and Y positions, "jog" the rotary "C" axis, and perform "digital feedrate" operations, when enabled. (For additional information, see the UTILITIES OVERVIEW section, AXIS/POSITION SPEED, in this manual).

III KEY

Pressing this key causes a special large character status screen to appear in place of the normal prompting or graphic display. The data on this screen appears in double size characters for easier reading at greater distances from the monitor. This screen displays the same X/Y position, feedrate, operation status, time and date values that are normally shown at the bottom of the screen. When the part is actually running, information about the current data block is also shown. Pressing the <CE> key (or the <III> key again) returns the system to the previously displayed prompting or graphic image screen. When the BACKGROUND option is enabled and a BACKGROUND operation is initiated, the <III> key is used to display the LOAD/STORE/SETUP QUEUES.

NOTE

This key does not operate at all times. It is only enabled when one of the function menus is displayed, when actually running a part program, or when performing a TEACH operation.

IV KEY

This key is used as a "HELP" key in the BURNY 5 to provide additional prompting information for the user. Although it is not enabled when one of the function menus is being displayed, it is enabled when prompting for non-numeric values. For example, when the "LOAD FROM :" prompt is displayed, the <IV> key can be used to "call up" the following "HELP" pop-up menu.

1. STANDARD SHAPE MEM
2. GENERIC SHAPE MEM
3. PANEL DEVICE
4. SERIAL DEVICE

This menu shows the user the numeric assignments and the responses allowed for the prompt. With or without this menu displayed, the user can directly select the desired response with the numeric keys, or use the <UP> and <DOWN> cursor keys and the <+/-> key to scroll through the possible selections before pressing the <ENTER> key.

When the system is prompting for a program number or shape number, the <IV> key can be used to "call up" a directory list to aid in the selection. With long directory lists, the pop-up window list is displayed with the current program number positioned at the center of the displayed window, unless it is too close to the top or end of the list. Additional entries can be displayed using the <I> and <II> keys.

When a part is actively "running" and the RUN TRACE screen is displaying the cut path, the <IV> key can be used to "call up" the UTILITIES menu. This allows the user to do multitasking operations if the option is enabled. Later, other utility functions will be supported while RUN is active. Pressing the <CE> key one or more times returns the user to the RUN TRACE graphic screen. Do NOT press the <RST> key to return to the RUN TRACE graphic screen. This will cause the RUN process to abort and the control will return to the MAIN MENU.

V KEY

The <V> key is used to draw the currently selected part when a program number selection is being done. This key along with the <SHF> key, for a <SHF> <V>, two key sequence is used to "toggle" an internal "NOVICE"/"EXPERT" prompt mode flag. In "EXPERT" mode, the "HELP" pop-up menus and directory lists are only displayed when the <IV> key is pressed. However, in "NOVICE" mode, all "HELP" pop-up menus and program directory lists are automatically displayed when the associated prompt is displayed, eliminating the need to press the <IV> key.

NOTE

> The two key sequence described here and throughout the manual requires that the second key be pressed within 2 seconds of the first. Otherwise, the double key sequence will not be done and only the second key will be read.

The initial state of this "NOVICE"/"EXPERT" mode flag is defined through SYSTEM SETUP DATA variable 38, SYSTEM CONFIGURATION 2. See the SYSTEM SETUP DATA VARIABLES section for additional information.

VI KEY

This key along with the <SHF> key, for a <SHF> <VI> two key sequence is used to "toggle" an internal "MAIN"/"ALTERNATE" language mode flag. This flag determines which language strings should be used for new prompts written to the screen. Strings already written to the screen are not affected by this flag. Therefore, to change the language displayed, press the <SHF> <VI> key combination and then "back up" and re-display the current screen. To be operational, an alternate language table must be included in the system. If not, this key sequence performs no operation.

The initial state of this "language" mode flag is defined through SYSTEM SETUP DATA variable 38, SYSTEM CONFIGURATION 2. See the SYSTEM SETUP

DATA VARIABLES section for additional information.

CURSOR ARROWS, ZOOM AND ROTATE KEYS

Located below the right side of the monitor are 4 keys arranged in a diamond pattern with triangular symbols inside. These keys are the cursor control keys. They perform many similar but slightly different functions depending on which screen is displayed. When a function menu is displayed, the <UP> and <DOWN> keys are used to move the WHITE cursor block to the desired entry before pressing the <ENTER> key. When prompting for a program number, the <UP> and <DOWN> keys are used to step through the program directory list, one entry at a time, while the left cursor key removes accidentally entered digits when performing direct numeric entries. In long data lists, moving the cursor past the top or end of the list with these keys causes the previous or next page of data to be displayed. When prompting for a non-numeric entry, the <UP> and <DOWN> keys are also used to scroll through the possible responses.

Whenever a part program is selected to RUN and has been graphically displayed on the screen for an "inspect" operation, pressing any of the 4 cursor keys causes a YELLOW locator box to appear on the screen. This locator box is used to define the center of the region for a ZOOM operation. Additional cursor key presses move the box around the screen. There are two step sizes provided for positioning. To toggle between the small and large step size, press the <SHF> key.

Two <ZOOM> keys are located directly below the 4 cursor keys. The positive zoom (+ZOOM) contains a symbol showing a small part going to a large one. When pressed, the size of the displayed image doubles (with the YELLOW box shown as the center of the zoomed area). The negative zoom (-ZOOM) contains a symbol showing a large part being made smaller. This key causes the image to be reduced by a factor of 2, again with the YELLOW box shown as the center of the displayed area.

Two other keys in this area of the keyboard show Clockwise and Counter-clockwise arrows. These keys are used by the graphic nest editor when rotating parts for optimum plate utilization. These keys are NOT used by the RUN program process when performing "part rotation" and "plate rotation" operations.

In the TEXT EDITOR the <UP> and <DOWN> keys are used to scroll through the ASCII alphanumeric characters. The ZOOM keys are used in the text editor to edit the current text string, one deletes a character from the string and the other inserts a space in the string. The ROTATE keys are used to clear the edit line. One deletes from the cursor to the end of the line, the other deletes the entire line.

MACHINE FUNCTION CONTROLS

The block of keys located on the right side of the control are used to perform various machine related functions. The 4 directional arrows with the center JOG key are used for positioning the machine. Pressing one of these JOG arrow keys causes the machine to move in that direction at the defined feedrate value. When the key is released, the machine decelerates to a stop. If a maintained jog is desired, first press the center JOG key and then the desired direction arrow. This causes the machine to jog in the desired direction without the key being held down. Press another jog direction arrow (for the same axis) or the <STOP> key to remove the latched jog operation. Jog speed can be directly defined by the speed dial setting, or if enabled, by a user defined "digital feedrate" value. A HIGH SPEED jog capability can also be enabled for selection whenever the "A" key is latched on. (See SYSTEM SETUP DATA variable 37, SYSTEM CONFIGURATION 1, for additional information).

The <GO> and <STOP> keys are used to control the execution of a part program once it has been setup to "Run". Pressing the <GO> key causes the machine to begin running a part program and the LED next to the <GO> key to light. Pressing the <STOP> key halts program execution, stops the cutting functions, and turns "OFF" the LED next to the <GO> key.

The <REV> key is used to perform "backup" operations when in the RUN mode and the "CYCLE START" state. In other machine states, this key is used to return to the last "running" position or last position where the <RST> key was pressed.

The <RET> key is used to perform "return" operations to one of three pierce positions (last pierce point, start of piece and start of part) depending on the number of presses (1, 2 or 3), but only when in the RUN mode and the "CYCLE STOP" state. In other machine states, this key returns the machine to the last defined "home" position (that is, the X=0, Y=0 position).

The <CNC> key is used to ENABLE and DISABLE BURNY 5 control of the machine. When the associated LED is "ON", the BURNY 5 is in control. Otherwise, the BURNY just monitors motion so that machine position can be displayed and it can hold the current position when it regains control of the machine.

Five other "drive related" keys are provided on the keyboard panel and are labeled "A" through "E". Each key is associated with a status LED which can be toggled "ON" or "OFF" to select the desired state. In earlier software versions, these keys were only used in the special BURNY 5 / PLC SYSTEM configurations. Now however, the "A" key can be enabled as a "HIGH SPEED" jog select function. When enabled, jog operations are performed at "TRAVERSE SPEED" whenever the <A> key LED is "ON". When the <A> key LED is "OFF" (or the function is not enabled), jog operations are performed at the speed dial defined feedrate. The other keys, <B> through <E> still perform no function in the standard BURNY 5 system.

MENU SUMMARY

All of the operations performed by the BURNY 5 are selected through the various prompting menus that appear on the screen. After the initial power-up diagnostics screen is acknowledged and the date and time parameters are entered (or modified) on the banner screen, the system displays the following MAIN MENU:

```
MAIN MENU

1. RUN PROGRAM
2. TEACH PROGRAM
3. LOAD PROGRAM
4. STORE PROGRAM
5. DELETE PROGRAM
6. UTILITIES

SELECT (1-6)
```

This is the main system menu from which all other BURNY functions are selected. As such, pressing the <RST> key one or more times will always return the user to this menu to select the next required operation. Most of the entries in this menu cause the BURNY to go directly to an operation such as RUN or LOAD. However, the "6. UTILITIES" entry allows the user to display a secondary menu of additional features. This menu appears as follows:

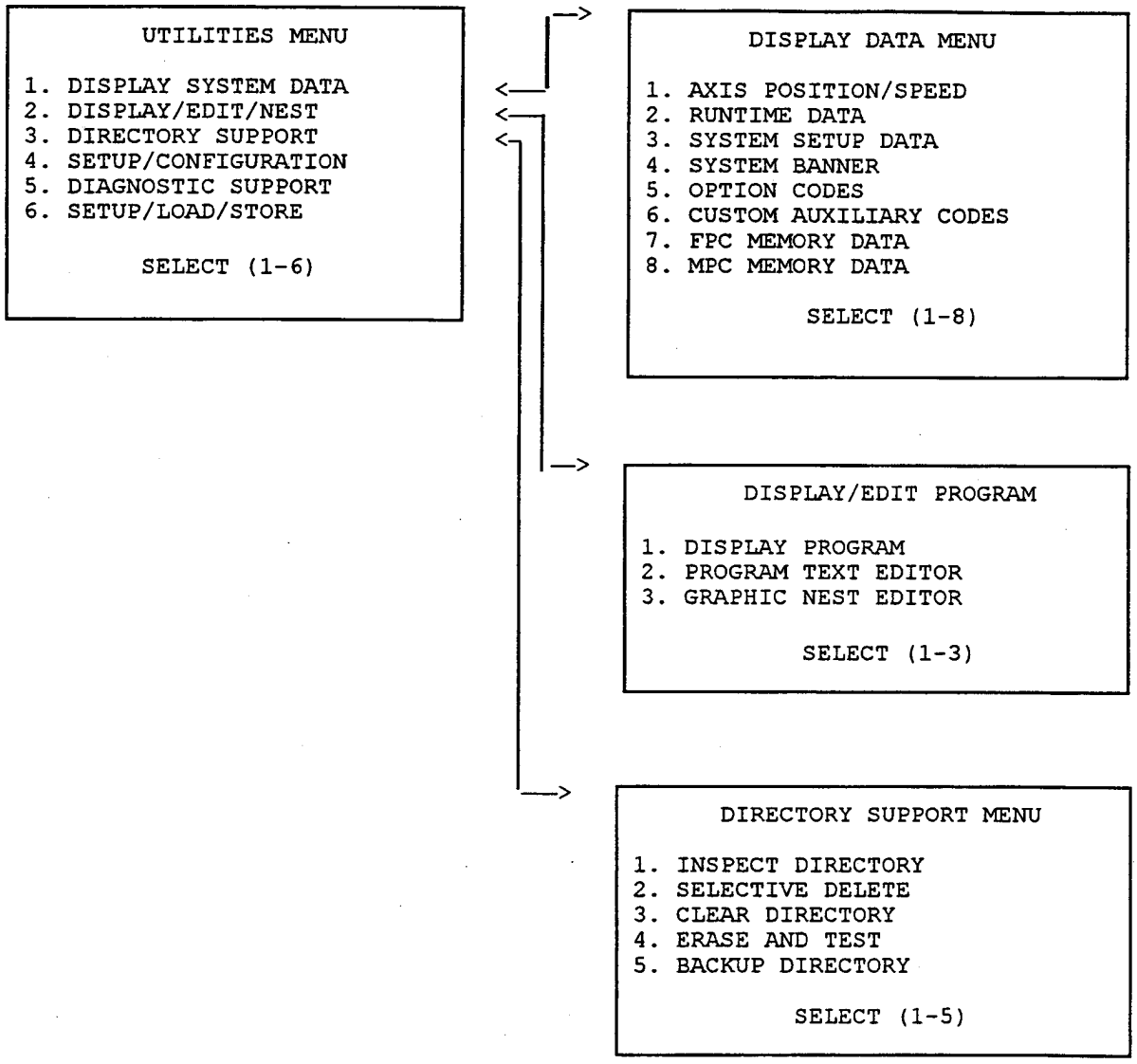
```
UTILITIES MENU

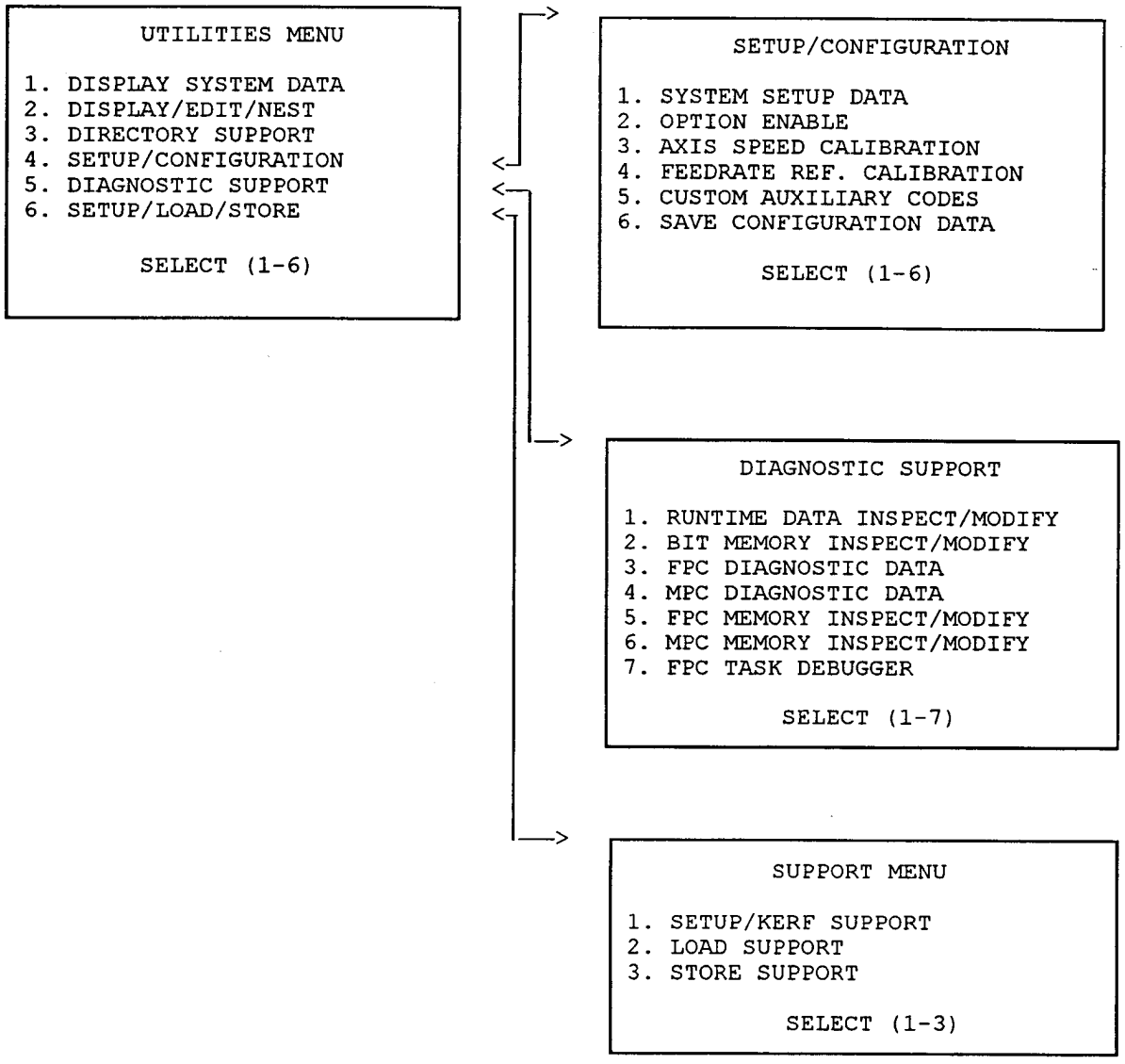
1. DISPLAY SYSTEM DATA
2. DISPLAY/EDIT/NEST
3. DIRECTORY SUPPORT
4. SETUP/CONFIGURATION
5. DIAGNOSTIC SUPPORT
6. SETUP/LOAD/STORE

SELECT (1-6)
```

Each entry in this menu allows the user to access a third level menu. Each entry in this menu executes the supported utility feature. However, some of these menus are protected by a system password which is unique for every control. For additional information on these passwords and the operations performed by these functions, see the SYSTEM UTILITIES section in this manual.

The following "third level" menus are accessed through the "second level" UTILITIES MENU:




UTILITIES MENU
1. DISPLAY SYSTEM DATA
2. DISPLAY/EDIT/NEST
3. DIRECTORY SUPPORT
4. SETUP/CONFIGURATION
5. DIAGNOSTIC SUPPORT
6. SETUP/LOAD/STORE
SELECT (1-6)
SETUP/CONFIGURATION
1. SYSTEM SETUP DATA
2. OPTION ENABLE
3. AXIS SPEED CALIBRATION
4. FEEDRATE REF. CALIBRATION
5. CUSTOM AUXILIARY CODES
6. SAVE CONFIGURATION DATA
SELECT (1-6)
DIAGNOSTIC SUPPORT
1. RUNTIME DATA INSPECT/MODIFY
2. BIT MEMORY INSPECT/MODIFY
3. FPC DIAGNOSTIC DATA
4. MPC DIAGNOSTIC DATA
5. FPC MEMORY INSPECT/MODIFY
6. MPC MEMORY INSPECT/MODIFY
7. FPC TASK DEBUGGER
SELECT (1-7)
SUPPORT MENU
1. SETUP/KERF SUPPORT
2. LOAD SUPPORT
3. STORE SUPPORT
SELECT (1-3)

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PART 2 - MAIN MENU OPERATION

Tab Page - Part 2

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RUN PROGRAM

The RUN process consists of four separate screens. They are as follows:

RUN SELECT SCREEN
RUN SETUP SCREEN
RUN CUT MODE SCREEN
RUN GRAPHIC TRACE SCREEN

The first screen allows the operator to select and graphically inspect a part program from NC PROGRAM MEMORY for cutting. The second screen allows the operator to alter the geometry of the selected part (KERF, SCALE, and MIRROR) and then graphically inspect the resulting geometry. The third screen allows the operator to select the cut mode parameters such as AUTO/MANUAL mode and the number of parts required. The fourth screen is used to graphically display the actual cutter path in real time as the machine moves around the part. The following sections describe each of these RUN screens in detail.

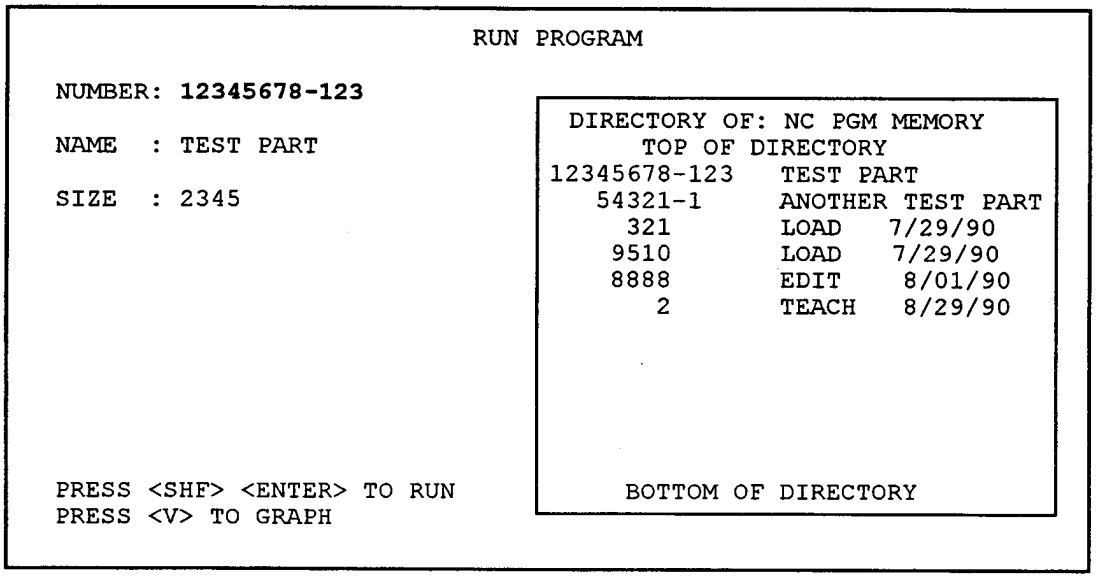
RUN.1 RUN SELECT SCREEN

To cut a part, select "1. RUN PROGRAM" from the MAIN MENU. This displays the RUN SELECT screen that shows the currently selected program number, its name and internal memory size.

NOTE

The control allows programs of up to 128K bytes of INTERNAL program memory size to be run. This 128K limit includes any KERF compensation that may be added to the program by the control. Programs that exceed this size limit produce the error "PGM SIZE EXCEEDS MAX ALLOWED" when selected for run. For additional information, see the ERROR MESSAGES section in this manual.

The format of the RUN SELECT screen is shown below. If the control is in NOVICE prompting mode, the directory list is automatically displayed. However if no directory is displayed but one is desired, press <SHF> and then <V> to toggle the prompting mode to NOVICE or just press the <IV> key to call up the directory of programs in NC PROGRAM MEMORY.



While on this screen, the operator must select a program to cut from those shown in NC PROGRAM MEMORY directory list. If more than one page of programs exists in the list, the <I> and <II> keys can be used to page backwards and forwards through the directory list. The program number can be entered directly with the numeric keypad or the <UP> and <DOWN> cursor keys can be used to scroll through the programs stored in NC PROGRAM MEMORY. When scrolling, an "END OF LIST" message at the bottom of the screen indicates the last program in memory is displayed.

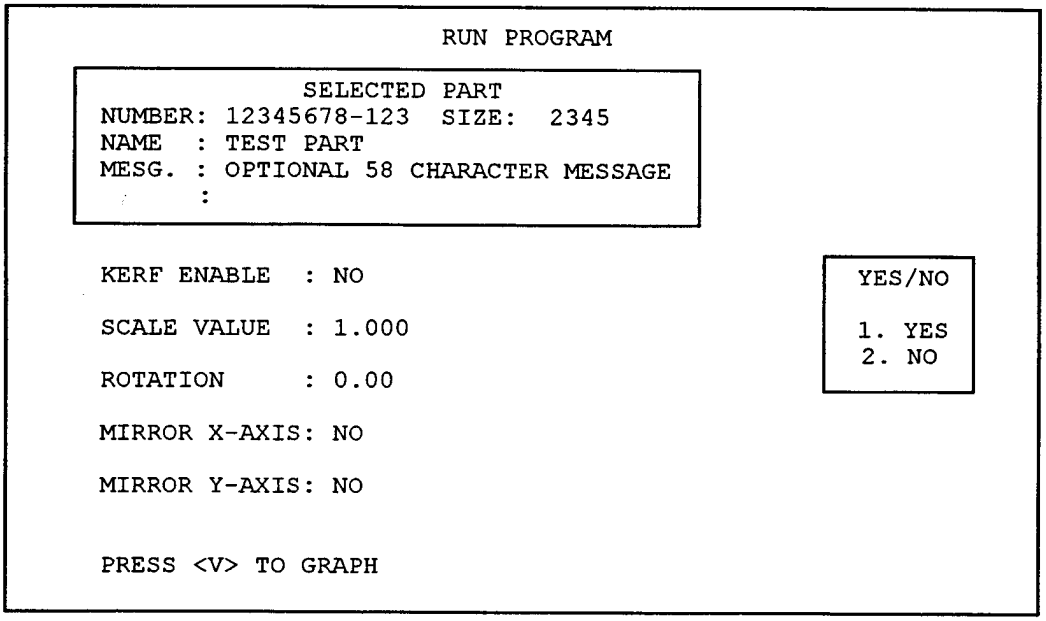
Once a program number has been selected, the <V> key can be used to graphically inspect the part. On the graphic inspect screen, the "PRESS <ENTER> TO CONTINUE" message at the bottom of the screen reminds the operator that the graph process can always be aborted by pressing <ENTER>. If the displayed part is not the correct part, press the <CE> or <V> key to return to the RUN SELECT screen to select another part. The graph process is complete when the white scale bar and dimension message are displayed. As on other "graphic inspect" screens, the <ZOOM UP> and <ZOOM DOWN> keys can be used to change the size of the image and the cursor keys can be used to adjust the zoom position. For additional information, see the GRAPHIC INSPECT section in the SYSTEM OVERVIEW part of this manual.

Once a valid program number has been selected, pressing the <ENTER> key causes the RUN SETUP screen to be displayed. However, to skip directly to the RUN CUT MODE screen and the "PRESS <GO> TO RUN" prompt, press the <SHF> key before pressing <ENTER>. This reduces the number of keystrokes required before the part can be cut, especially when the part has been previously cut and all KERF and ACCEL/DECEL operations have been completed. After the "PRESS <GO> TO RUN" prompt appears, the part can be still be graphed by pressing the <V> key before pressing <GO>.

RUN.2 RUN SETUP SCREEN

The second RUN screen allows the operator to change the geometry of the selected part. This includes KERF COMPENSATION, SCALE, PART ROTATION and MIRROR operations.

A typical RUN SETUP screen is shown below. Note the "MESG." field displayed below the "NAME" in the selected part box. This is an optional message that can be provided following the program number block in the NC part program. This 58 character message can be used to give the operator special instructions or extra information about the program.




```
POSITION(IN):X0.00   Y0.00          FEED: 150.00    TIME : 11:31:00
OPERATION    : RUN                  MODE: OXYGEN    DATE : 09/27/1992
FUNCTION     : CUT OFF CCW KRF OFF  KERF: 0.00      PARTS: 0
BLOCK: 0     X0.00      Y0.00    I0.00      J0.00     TBL:  0
STATUS: WAITING FOR PARAMETERS      MSG:
BACKGROUND:  INACTIVE
```

To change a displayed value, toggle the "NO" response at the "WANT TO CHANGE PARAMETERS:" prompt to "YES" and press <ENTER>. Each prompt appears in sequence.

KERF VALUE

The prompt for KERF appears as "KERF ENABLE : NO". This prompt is only displayed when the selected program has kerf codes. If <ENTER> is pressed to select the "NO" response, no further KERF prompting is done. However if the response is toggled to "YES", the next prompt is "KERF VALUE : X.XXXX". The value displayed is the KERF used the last time the part was RUN. The KERF dimension entered should be the total width of the path created by the cutting process. This value can be derived by cutting a 4 inch square with no KERF entered and measuring the actual size of the part. The difference between the actual size and the programmed dimension size is the KERF value. Enter this as a positive KERF dimension. This alters the cut path and causes the actual piece to be the correct dimensions. The value entered for KERF is in inches for "ENGLISH" operating systems and in millimeters for "METRIC" systems. The standard allowable KERF range is +/- 2.5 inches or +/-63.5 millimeters.

A negative KERF value is also valid, however it is not normally used. If entered, it shrinks the size of the part, rather than increasing it.

PROGRAMMED KERF

Whenever a PROGRAMMED KERF value is defined in a program and the program is selected to RUN, the control automatically selects "KERF ENABLE : YES" on the RUN SETUP screen and then displays the first encountered PROGRAMMED KERF value as the selected KERF value. This allows the operator to simply press <ENTER> to perform the RUN SETUP process. However if the operator wants to disable KERF or change the displayed KERF value, he simply changes the "WANT TO CHANGE PARAMETERS" prompt to "YES" and then modifies the desired entry. Once a KERF value is changed, the operator defined value remains in effect until the KERF value is cleared or KERF is disabled by a "KERF:NO" selection. This allows the control to redisplay the PROGRAMMED KERF value the next time the program is selected to RUN. The current RUN SETUP operation is always performed as defined by the RUN SETUP screen selections.

SWIVEL KNIFE COMPENSATION

If the special KNIFE COMPENSATION option is enabled, the prompt "KNIFE ENABLE: NO" is displayed. If no KERF was selected, the operator can specify if special knife processing should be performed on the part. If the "YES" response is selected, a special type of KERF process is used to modify the cut path to counteract the rounding effect of the swivel knife offset and cause sharp corners to be cut correctly. When knife processing is selected, the normal "DIAL-IN-KERF" function is bypassed since both cannot be used at the same time.

For further information, see the KNIFE OPTION section in this manual.

GEOMETRY MODIFICATION FEATURES

There are several prompts on the RUN SETUP screen which allow the geometric appearance of a part to be altered:

SCALE VALUE - Allows part size to be magnified up to 65 times or reduced to 1/1000 of the original size.

ROTATION - Allows the part to be rotated from its programmed orientation to allow alignment with the plate or nesting among other parts.

MIRROR - Allows the part to be mirror imaged in either the X, Y or both axes.

SCALE VALUE

The prompt "SCALE VALUE : XX.XXX" is used to enter the required part scale factor. The value displayed is the scale factor used the last time the particular program was RUN. The scale factor is used to enlarge or reduce the size of the entire part, either to produce a different size part, or to allow a "test run" to be performed on a smaller plate. The value entered is used as a multiplier for all the part dimensions. Scale values may range from 0.001 to 65.500 (use 1.000 for actual size).

Examples:

If SCALE = 1.000, the part is the original 1:1 size.
If SCALE = 10.000, the part is 10 times larger than original size.
If SCALE = 0.125, the part is 1/8 the original size.

ROTATION

The prompt "ROTATION : XXX.XX" is used to enter the rotation angle. The value displayed is the rotation angle used the last time the particular program was RUN. An angle of 0.00 degrees represents the original programmed geometry. A positive angle indicates a counter-clockwise rotation. A negative angle may also be entered for a clockwise rotation, however it is converted to its equivalent positive angle. If the part is selected to RUN a second time, the positive equivalent angle appears, not the negative. For example, if -45.00 degrees is entered, it is stored as +315.00 degrees.

X/Y AXIS MIRROR

There are two prompts for MIRROR. The first is for the X axis: "MIRROR X-AXIS : NO". Pressing the <+/-> key toggles the response between "NO" and "YES". Press the <ENTER> key when the desired response is shown. A "NO" response causes the X axis to be cut as programmed. A "YES" response causes the X axis to be inverted so the part appears "upside down" on the plate.

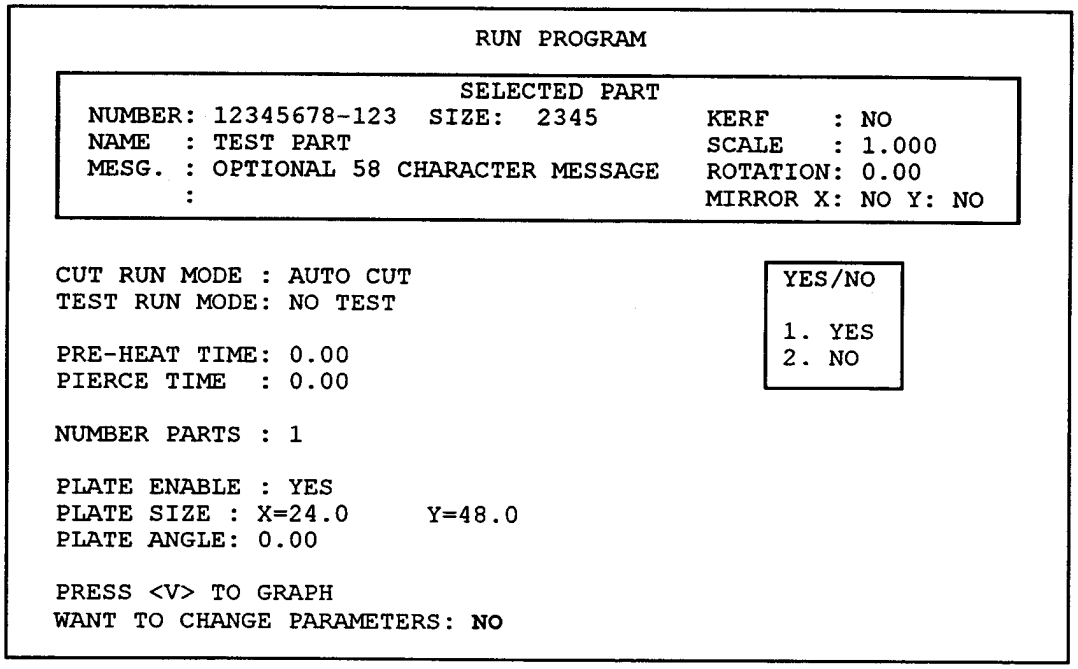
After the X mirror selection is entered, there is a prompt for "MIRROR Y-AXIS : NO". Again, toggle the selection with the <+/-> key and enter the desired choice. As before, the "NO" response causes no change to the part. A "YES" response mirrors the Y axis which reverses the left to right appearance of the part.

If these parameters do not need to be changed, just press <ENTER> to select the "NO" or default response. The control then responds by performing the necessary KERF and ACCEL/DECEL operations.

During the KERF operation, the control displays "KERF XX.XX PERCENT COMPLETE", where the "XX.XX" is an increasing percentage display that reaches 100.00 percent when the KERF operation is complete. The ACCEL/DECEL SETUP operation is similar to KERF but the display reads "SETUP XX.XX PERCENT COMPLETE". After the KERF/SETUP operations are complete, the "WANT TO CHANGE PARAMETERS: NO" prompt is redisplayed. This allows the operator to graphically inspect the geometric changes made to the part by pressing the <V> key and then correct any mistakes before continuing. If no changes are required, press <ENTER> to advance to the RUN CUT MODE screen.

RUN.3 RUN CUT MODE SCREEN

Once all of the part geometry parameters are entered, the control performs the necessary processing and displays the RUN CUT MODE screen shown below.



To change any of the CUT MODE parameters, toggle the "WANT TO CHARNGE PARAMETER" response "YES" and press <ENTER>. If no changes are required, press the <ENTER> key to run the program or the <V> key to graph the program. If <ENTER> is pressed the prompt "PRESS <GO> TO RUN" is displayed.

RUN CUT MODES

If changes are required, the first prompt, "CUT RUN MODE:", selects the desired cutting mode. The two possible selections are shown below.

"MANUAL CUT" - Allows the part to be cut. The operator is required to pre-heat and manually start the cutting process (using the machines cutting controls). The control turns off the cutting process at the end of each cut.

"AUTO CUT" - Allows the part to be cut with all pre-heat and cutting processes started and stopped by the control.

TEST RUN MODE

The next prompt, "TEST RUN MODE:", determines if the control runs the program in test mode. The selections are listed below.

"NO TEST" - Normal cut mode (not a test run).

"CONTINUOUS" - Runs through the same machine movements as during a cut, however all cutting outputs are prohibited. This is useful to check and correct the position of the part on the material to be cut.

"SINGLE STEP" - Similar to "CONTINUOUS", however only one program move is done each time the <GO> key is pressed. Thus the dimensions at the end of each data block can be checked.

OXYGEN TORCH PRE-HEAT

If "AUTO CUT" and "NO TEST" are selected and the machine is cutting with OXYGEN, then the prompt "PRE-HEAT TIME : XXX.XX" is displayed. Enter the time in seconds for the high PRE-HEAT cycle. The maximum PRE-HEAT time that can be defined is 655.3 seconds. While the PRE-HEAT timer is active, the message "RUN- PREHEAT ###.#" is displayed in the status window at the bottom of the screen with the remaining time displayed in the ###.# format. The PRE-HEAT timer can be canceled after it has been started by pressing the <GO> key.

PIERCE RAMP

The PIERCE RAMP TIMER function allows the operator to define a time interval in which the machine accelerates at a reduced rate. This function is supported both in AUTO and MANUAL cutting modes with both OXYGEN and PLASMA operations. This function is also supported when operating in the PLC system configuration. The PIERCE RAMP prompt is displayed on the RUN MODE screen whenever "NO TEST" is selected. When specified as a non-zero time value, the PIERCE RAMP value defines the time in seconds to be used to accelerate from 0 to the selected cutting speed.

If a time of 0.00 is entered, the machine will wait for the cutting process to be turned on, and then accelerate quickly to the selected cutting speed. This is acceptable for thinner material since it is pierced almost instantly when the process is turned on. However, on thicker material, it takes a considerable amount of time to burn down through the metal. If the machine moves too fast at this point, the beginning portion of the part will not be cut off completely. Entering the pierce ramp time causes the machine to slowly accelerate from the pierce location. The machine will start from its halted position when the process is turned ON, and accelerate up to the desired cutting speed in the time entered for the PIERCE RAMP TIME. By setting this value sufficiently long, the material will be pierced during the leadin portion of the cut so that by the time the machine has reached the actual part, the material is cutting all the way through. The maximum PIERCE RAMP time that can be defined is 655.3 seconds.

While the PIERCE RAMP timer is active, the message "WAIT-PIERCE RAMP ###.#" is displayed in the status window at the bottom of the screen with the remaining time displayed in the ###.# format. Like the OXYGEN PRE-HEAT timer, the PIERCE RAMP timer can be canceled after it has started by pressing the <GO> key again.

NUMBER OF PARTS

Next, the prompt "NUMBER PARTS : XXX" appears. Enter the desired number of part cycles to produce the required parts. The maximum number that can be entered here is 32000.

Example: 100 parts required, 4 torches cutting

Enter 25 to get correct count. If an additional part is required after the preset count is reached, press the <GO> key to execute one more part cycle.

PLATE ALIGNMENT

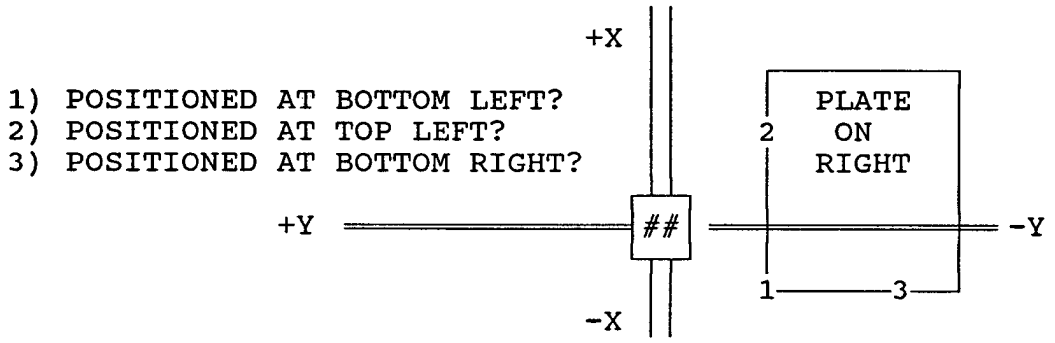
The next prompt is for plate alignment. This allows the operator to define a PLATE SIZE and PLATE ANGLE for use in "graphic imaging" and "part cutting" operations. Once the PLATE ALIGNMENT values are defined, they remain defined until power is removed from the control.

To perform PLATE ALIGNMENT operations, select "YES" at the"PLATE ENABLE" prompt and press the <ENTER> key. The system responds with a prompt for the X and Y plate dimensions. These values are used to define the scale factor for graphic plate imaging operations. Although these dimensions need not be the actual plate dimensions, they should be large enough to fit the number of parts specified.

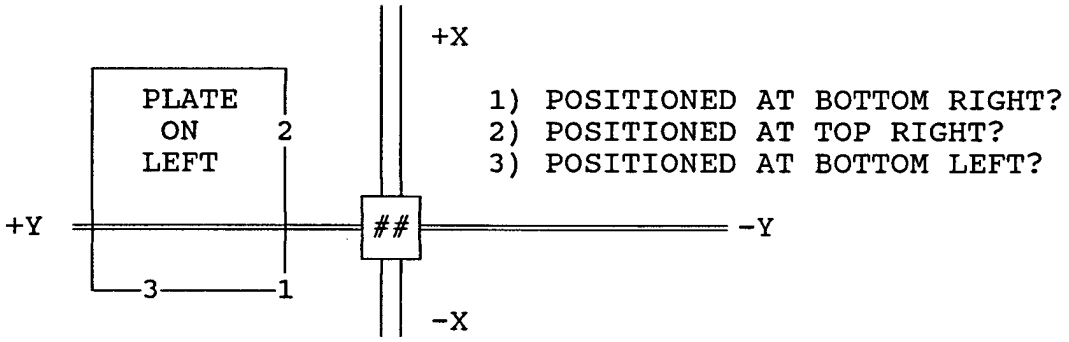
After the plate dimensions are defined and the existing plate angle is displayed as degrees in the counter-clockwise direction, the system displays the "WANT TO CHANGE PLATE ANGLE" prompt with a default value of "NO". To change the angle, select "YES" and press the <ENTER> key. The plate angle is calculated by the system from two points defined by the operator. These points are defined by jogging to the desired position and selecting "YES" at the appropriate prompt.

Three prompts are used to prompt for the two positions. The first asks if the torch is at the (0,0) position of the plate ("HOME"), the second, if the torch is at the vertical edge of the plate above the "HOME" position, and the third, if the torch is at the horizontal edge of the plate to the left or right of the "HOME" position. The actual prompt text used depends on whether the plate side is on the left or right (as defined in the SYSTEM DATA SETUP variable, PLATE SIDE).

When the plate is on the RIGHT side of the operator, the following prompts are used to describe the three possible positions:



When the plate is on the LEFT side of the operator, the following prompts are used to describe the three possible positions:



The first point, "HOME", is typically defined as the corner closest to the operator. When this position is defined, the X and Y position values in the status window are cleared and the jog return position is set to (0,0). This allows the operator to later return to this position by pressing the <RET> key. After specifying the second point along the side or bottom edge of the plate, the control calculates the plate angle using (0,0) as the first point. The resulting value is then displayed as the current plate angle and the control re-displays the "WANT TO CHANGE PLATE ANGLE" prompt. This allows the operator to repeatedly define the second point at the side or bottom edge of the plate until the desired plate angle is obtained.

After the plate angle is defined and no additional parameter changes are required, the "WANT TO CHANGE PARAMETERS" prompt is displayed. If the <V> key is pressed at this time, the graphic screen is displayed and an image of the plate is drawn at the calculated angle with the specified number of parts shown on the plate. If the plate size or angle is not correct, press the <CE> key to return to the "RUN MODE" screen and change the appropriate parameters. If <ENTER> is pressed, the "running" process is started and the "PRESS <GO> TO RUN" message is displayed. Once this occurs, the plate angle cannot be adjusted. Only the plate size and other run mode parameters on the "RUN MODE" screen can still be modified. Plate angle can only then be changed by pressing the <RST> key and restarting the "RUN" process from the MAIN MENU.

NOTE

The graphics process always draws the part starting at the "HOME" (0,0) position. If the part is rotated or does not have a traverse move from the correct corner, it will be displayed off the plate. This is a reminder to the operator that the machine must be jogged to position the part on the plate. The operator should then do a "TEST RUN" to insure the part correctly fits on the plate.

After all cutting parameters are entered correctly, the prompt "WANT TO CHANGE PARAMETERS: NO" should be answered with the <ENTER> key. This causes the "PRESS <GO> TO RUN" prompt to be displayed. Pressing the <GO> key causes part execution to begin. It also causes the screen to automatically change to the RUN GRAPHIC TRACE screen. Similarly, the <STOP> key can also be pressed at this point to toggle to the GRAPHIC TRACE screen before pressing <GO>.

RUN.4 RUN GRAPHIC TRACE SCREEN

Once all of the required data has been entered and the "PRESS <GO> TO RUN" prompt has been displayed, the GRAPHIC RUN TRACE screen can be displayed by either pressing the <GO> key to start cutting, or the <STOP> key. In fact, once this prompt has been displayed, the <STOP> key can be used to toggle between the RUN CUT MODE screen and the GRAPHIC TRACE and back whenever the running process is stopped and the machine is holding position.

When the RUN GRAPHIC TRACE screen is first displayed, it may contain the graphical image of the part to be cut, but only if it was previously graphed in a graphic inspect operation. Otherwise, no graphic image of the part is displayed. Only the status window at the bottom of the screen is immediately displayed. However as the machine moves, the actual cutter path is plotted in YELLOW for cut on moves, GREEN for the traverse moves, MAGENTA for marker moves and WHITE for jogging moves.

Program messages are displayed on the line just above the status window. A program message is displayed as it is encountered by the RUN process (including the first special program message). It remains displayed until the next program message is found or until a "BACKUP" or "PIERCE RETURN" operation is performed. Once the run trace screen is displayed, there are several keys that have special functions. They are defined below.

I	-	Displays the AXIS/SPEED DISPLAY screen.
III	-	Displays the large RUN status display screen.
IV	-	Allows access to the UTILITIES MENU.
0	-	Redraws the graphic image of the running part.
5	-	Redraws the graphic image centered about the current cut position (if zoom active). Allows a pan operation when in zoom trace mode.
ZOOM UP	-	Redraws the part at increased magnification centered at the current cut position.
ZOOM DOWN	-	Redraws the part at decreased magnification centered at the current cut position.

RUN.5 RUNNING DESCRIPTION

Due to the variations in cutting machines, it is not possible to give an exact description of the operating sequences to be used while running a part. The following descriptions serve to illustrate the various control functions and typical operating sequences.

If MANUAL CUT mode is selected, the program moves to the pierce point and waits for the cut to be started by the operator. At the end of the cut, the cutting process stops automatically and the machine advances to the next pierce position. When it reaches the new point, the cut switch must be turned off and back on to restart the cut.

For oxy/fuel cutting, the operator must manually start the cutting oxygen using the machine's cutting oxygen switch or controls. The BURNY 5 automatically turns the cut off at the end, or the operator can stop the cut by turning off the machine's cutting oxygen switch. For plasma cutting, the operator must manually start the plasma cut. This can be done in one of two ways. If the machine is equipped with a separate plasma control station, the cut can be started by pressing the START button on the plasma operator's console. The plasma cut can also be started manually by pressing the "CYCLE START" key on the BURNY 5. This allows manual cutting to be done on machines which do not have a separate manual control station.

If AUTO CUT mode is selected, the program advances to a new pierce point and then automatically turns on the cutting process. If the machine is setup for oxy/fuel cutting, the high pre-heat turns on for the specified time and then the cutting oxygen. To extend or shorten the high pre-heat time, press the green <GO> key and hold for the desired pre-heat time. To shorten the time, just press and release the <GO> key when the cut is to start.

NOTE

The AUTO CUT cycle does not start if the manual cutting switch is in the ON position.

If CONTINUOUS mode is selected at the "TEST RUN MODE:" prompt, the program begins running but with all cutting functions inhibited. Program steps which would be cut are run at the speed set on the machine speed dial while traverse moves are done at the high traverse speed.

If SINGLE STEP mode is selected, the program executes one program step each time the <GO> key is pressed. However, holding this key causes continuous stepping to occur.

In either the CONTINUOUS or SINGLE STEP modes, the part may be repositioned on the plate as follows. Allow the machine to run through the program to a point where it is apparent that the part needs to be moved to keep it on the available plate. Then press <STOP> to stop the machine at that point. Now use the 4 directional jog keys to move the torch to the desired position on the plate. Once it is in the correct position, press <GO> to continue the test run. This process of stopping the test, jogging the torch and then continuing may be repeated as many times as needed to position the part correctly. Once the part is positioned, press the <STOP> key and then the <RET> key 3 times to return to the home position of the part. Press the <STOP> key again to return to the RUN CUT MODE screen to alter the cutting prompts and/or select the desired cutting mode.

The <RET> key actually allows returning to one of 3 different positions on the part being cut. Pressing the <RET> key the first time returns to the most recent pierce point on the part. Pressing the <RET> key a second time returns to the start point of the current part which is defined by the "CHAIN TOP" auxiliary function code or the (0,0) position if not provided. Pressing the <RET> key a third time returns to the home starting position for the entire operation.

The <REV> key can be used in any mode to retrace the cut path either for verifying the positioning or in the case of a lost cut. When pressed, it backs up at a preset BACKUP speed. If the preset backup speed is set to 0, the speed dial speed is used as long as the key is held in. A "latched backup" capability is also provided. However, this feature must be enabled in SYSTEM SETUP DATA variable 38, SYSTEM CONFIGURATION 2, in order for the latched capability to be operable. In either case, when the desired point has been reached, cancel the backup to automatically restart the cut in the forward direction.

To stop the program at any point, press the red <STOP> key. To continue, press the green <GO> key again.

After stopping, it is possible to jog away from the part (to clean a torch tip for example). By pressing the <REV> key, the machine returns directly to the position where the <STOP> key was pressed, provided that the control is not operating in the CONTINUOUS or SINGLE STEP test mode. Pressing the <GO> key then continues the part by piercing at the current machine position. If after jogging away from the part the <GO> key is pressed, the machine pierces and cuts a straight line back to the path where the machine was stopped and then continues cutting the part.

To stop executing the program and return to the top prompting level, press the <RST> key.

RUN.6 RUN GRAPHICS

The selected part can be graphically displayed at several points during the run prompting. The first is on the run select screen. The program shown in white on this screen can be graphically displayed by pressing the <V> key. The selected part can be graphed on the second and third screens by pressing the <V> key at the prompt "WANT TO CHANGE PARAMETERS: NO". The part can also be graphed at the prompt "PRESS <GO> TO RUN".

The graphics process must move the part from NC PROGRAM MEMORY to graphics memory so that it can be scaled and graphed. The "PLEASE WAIT" message displayed after the <V> key is pressed and before the switch to the graphics page indicates the program is being transferred. The time to transfer a program is insignificant for small programs (a 5k program transfers in about 4 seconds), but can take up to 1 minute for large programs (100k byte). After the program has been transferred, it must be scaled and drawn. It takes the control about 5 seconds to draw a 5k program and about 1 minute to draw a 100k program. These times can vary depending on the number of lines and arcs in the program.

Once graphically displayed, the part can be zoomed about any point for closer inspection. Press the <IV> key to display the yellow graphics cursor. The cursor can be moved by pressing the 4 cursor keys and/or the numeric keys (1, 2, 3, 4, 6, 7, 8, 9 keys) according to the legend on the key. The distance the cursor moves can be toggled between small and large by pressing the SHF key. To use the zoom feature, position the cursor over the section of interest and press the left zoom key. The part is redrawn at twice the original size, with the section under the cursor appearing at the center of the screen. The zoom key can be pressed as many as 5 times for a magnification of 32. To return to normal size, press the 0 (zero) key, or press the right zoom key the same number of times as the left was pressed. To pan the zoomed part, move the cursor to a new position and press the 5 key. This redraws the part at the same scale, but centered about the new cursor position.

The graph process is complete when the scale bar is drawn. This can be used to determine the size of the part.

RUN.7 RUN STATUS DISPLAY

The status display at the bottom of all the run screens contains useful information about the run process. Each field is described below the typical run status window.

```
POSITION(IN):X0.00  Y0.00          FEED: 150.00    TIME : 11:33:00
OPERATION    : RUN                 MODE: OXYGEN    DATE : 09/27/1992
FUNCTION     : CUT OFF CCW KRF OFF KERF: 0.00      PARTS: 0
BLOCK: 0      X0.00      Y0.00     I0.00      J0.00       TBL:   0
STATUS: WAITING FOR PARAMETERS     MSG:
BACKGROUND:  INACTIVE
```

"POSITION( ):" - Displays the system type inside the parenthesis as "IN" for an inch system and "MM" for a metric system. The 'X' and 'Y' position is also displayed in either inches or millimeters.

"FEED:" - The feedrate is displayed in IPM (inches per minute) or MPM (millimeters per minute) depending on the system type or optionally, as a percentage (see SYSTEM CONFIGURATION 1 for more information).

"OPERATION:" - Displays the current operating mode of the control. The following table describes the possible OPERATION messages during the run process.

CUT RUN MODE	TEST RUN MODE	MESSAGE
AUTO CUT	NO TEST	"RUN-AUTO"
AUTO CUT	CONTINUOUS	"RUN-TEST"
AUTO CUT	SINGLE STEP	"RUN-TEST"
MANUAL CUT	NO TEST	"RUN-MANUAL"
MANUAL CUT	CONTINUOUS	"RUN-TEST"
MANUAL CUT	SINGLE STEP	"RUN-TEST"

"MODE:" - Shows the current cut process: "OXYGEN" or "PLASMA".

"FUNCTION:" - Displays the current "CUT ON"/"CUT OFF", "CW"/"CCW", and "KRF ON"/"KRF OFF" conditions.

"KERF:" - Shows the KERF in realtime as different programmable KERF values are encountered in a part program (even when an operator-defined KERF value has overridden all of the programmable KERF values).

Note that the KERF value at the top of the RUN mode and RUN TRACE screens show the values selected or accepted by the operator on the RUN SETUP screen, and do not change in realtime.

"PARTS:" - The number of parts cut.

"BLOCK:" - Shows the current block of the program being cut and the dimensions in the block.

"STATUS:" - Current status of the machine operation, see the list of status messages at the end of this section.

"MSG:" - Any messages in the program are displayed in this field, up to 24 characters. The entire message is displayed just above the status window when the run trace screen is active.

"BACKGROUND:" - This field is displayed if the BACKGROUND option is enabled. If so, it identifies the current state of the task (INACTIVE, LOADING, STORING, etc.) and the number of the program being processed.

"TBL:" - In RUN SETUP, this field identifies the number of the first (and possibly only) overlay data table used by the program. When actively running a part program, this field is updated in realtime to identify the currently active overlay table.

Note that when auxiliary function overlay table selections are overridden by a direct operator selection from the RUN SETUP screen, the table number in this status window will display that selection and will remain fixed.

RUN STATUS MESSAGES

The following messages are displayed in the STATUS field at the bottom of the screen while running.

"WAITING FOR PARAMETERS" - The control has been returned to the prompting screen. The machine is holding position.

"HOLDING POSITION" - The program execution has been stopped. The machine is holding position.

"RUN-TEST RUN MODE"	- The program is executing a test run of the program.
"RUN-VENT XXX.X"	- The program is running, oxygen bleedoff timer is counting down, machine is holding position.
"RUN-TRAVERSE MOVE"	- The program is running, current block is non-cutting, running at high traverse speed.
"RUN- OXYGEN CUT MODE"	- The program is running, machine is cutting in manual fuel mode, machine speed dial controls speed.
"RUN- PREHEAT XXX.X"	- The program is running, machine is holding position and auto-cutting high pre-heat is in progress.
"RUN-AUTO OXY CUT MODE"	- The program is running, machine is cutting in automatic oxy/fuel mode, speed controlled from speed dial.
"RUN-PLASMA CUT MODE"	- The program is running, plasma cut is in progress, speed controlled by operators speed dial.
"RUN-DELAY XXX.X"	- The program is running, plasma arc has just started, the machine holds position until timer = 0, then begins moving along the programmed path.
"RUN-PLASMA START"	- The program is running, machine has started plasma system for auto plasma cutting.
"RUN-BACK UP MOVE"	- The program is running, operator has pressed the <REV> key causing machine to re-trace cut path backward. Speed is limited by setup value BACKUP SPEED.

"RUN-PLASMA OFF XXX.X" - Program is running, PLASMA CUTTING is selected. Although a plasma cut was being performed, the sense input has detected that the arc has gone out. Program continues running until timer reaches 0, then the control stops the machine and performs a "CYCLE STOP" operation.

"RUN-MARKER # 1 ON" - Program is running, machine is performing a PLATE MARKING OPERATION.

"RUN-MARKER # 2 ON" - Program is running, machine is performing a PLATE MARKING OPERATION.

"RUN-DWELL XXX.X" - The program is running, the control is holding machine position and waiting for programmed dwell timer to reach 0 before continuing along programmed path.

"RUN-*** PATH ERROR ***" - The machine is not responding to positioning commands and the part that is being produced is out of tolerance.

"RUN-NORMAL CYCLE" - A part program is running in auto or manual mode while the control is configured for PLC operation.

"RUN-TEST CYCLE" - A part program is running in continuous or single step mode while the control is configured for PLC operation. Also, this status message is displayed during a special "TEST MODE" enabled by setting SYSTEM SETUP DATA variable "2. MINIMUM POSITION HOLD SPEED" to 0. When set to 0, normal "RUN MODE" and speed calibration operations are inhibited. See SETUP VARIABLE 2 for more information.

"RUN-PIERCE RAMP XXX.X" - The program is running, programmed PIERCE RAMP timer extends the acceleration ramp until the timer reaches 0 before continuing at cutting speed.

"RUN-MESSAGE TRANSMIT" - A command message is being sent. See the COMMAND MESSAGE OPTION section in this manual.

"RUN-** MESSAGE ERROR **" - A command message error has occurred. See the COMMAND MESSAGE OPTION section in this manual.

"STOP-** E-STOP INPUT **" - When an E-STOP is pending, the control stops program execution and disables its outputs. Once the E-STOP condition is removed, press "GO" to resume operations.

"STOP-AUX TABLE ERROR" - The custom auxiliary code conversion table does not contain the correct data for the PLC link. Setup the custom auxiliary code table values through the "SETUP/CONFIGURATION" utilities menu and re-run the part.

"STOP-HOLDING POSITION" - The <STOP> key was pressed while running a part.

"STOP-END OF PART" - The "PROGRAM END" auxiliary function has been executed or the specified part count that was defined for the AUTO CUT operation has been obtained. A "double beep" accompanies this status message.

"STOP-PROGRAM STOP" - The "PROGRAM STOP" auxiliary code has been executed. A "double beep" accompanies this status message.

"STOP-*** PATH ERROR ***" - The program stops running when the path error exceeds 4 times the "ERROR WARNING DISTANCE" value defined in SYSTEM SETUP DATA variable 32 AND STOP feature is enabled by setting the "0000 0010" bit of SYSTEM CONFIGURATION 1 to a ONE. Unless enabled, only the "RUN - PATH ERROR" message is displayed and running continues.

"STOP-** EXT. E-STOP **" - The program has stopped because of an external E-STOP condition. When SYSTEM CONFIGURATION 3 has the "0000 0001" bit set, the control uses 3 of its inputs as E-STOP status inputs.

"STOP-** DRIVE FAULT **" - The program has stopped because of a drive fault condition. When SYSTEM CONFIGURATION 3 has the "0000 0001" bit set, the control uses 3 of its inputs as E-STOP status inputs.

"STOP-** OUT OF SYNC **" - The program has stopped because of a drive out of sync condition. When SYSTEM CONFIGURATION 3 has the "0000 0001" bit set, the control uses 3 of its inputs as E-STOP status inputs.

"STOP-* MESSAGE ERROR *" - The program has stopped because a command message error was detected. See the COMMAND MESSAGE OPTION section in this manual.

"WAIT-OXY CUT SWITCH ON" - The program is running, oxy/fuel cutting is selected. The control has finished one cut, moved to a new pierce location and is waiting for the "OXY CUT SW" input to be turned off, then back on to start the new cut. The machine is holding position.

"WAIT-OXY CUT SWITCH OFF" - The program is running, oxy/fuel cutting is selected. The control is waiting for the cutting oxygen to be turned on before starting to move. The machine is holding position.

"WAIT-PLASMA ARC ON" - The program is running, PLASMA CUTTING is selected. The control has finished one cut and has moved to a new pierce location. The plasma arc on signal is still applied, the control is waiting for it to be removed before allowing new cut. Machine is holding position.

"WAIT-PLASMA ARC NOT ON" - The program is running, PLASMA CUTTING is selected. The control is waiting for arc to be started before moving. The machine is holding position.

"WAIT-MARKER ON XXX.X" - The program is running, the program has performed a plate marker "ON" function. The control is waiting for the marker delay timer to reach 0 before starting to move. Machine is holding position.

"WAIT-INHIBIT" - The program is running, but machine has stopped due to an input to its "INHIBIT" input line. This is used on some machines to hold the position until an auxiliary operation (raising torches) is completed.

"WAIT-CNC RUN NOT ON" - Manual controls are active, control is only monitoring position.

"WAIT-MESSAGE VERIFY" - The control is waiting for an acknowledgement of a command message sent to an external device. Program execution will continue when acknowledgement has been received.

"WAIT-MESSAGE DELAY" - The control is waiting for a timer to expire or for an acknowledgement before program execution can continue. See COMMAND MESSAGE OPTION section in this manual.

"SEARCH-X HOME SWITCH" - An X axis home command in the part program has caused the control to move toward the X home position switch. Once the switch is found, the status window briefly displays the switch found message. The control then begins searching for the X home encoder index pulse.

"SEARCH-Y HOME SWITCH" - Same as the function described above only for the Y axis.

"SEARCH-X INDEX" - The X home switch was found and the control is now searching for the X home index pulse. When found, the control stops at the home position.

"SEARCH-Y INDEX" - Same as the function described above only for the Y axis.

"SEARCH-SWITCH FOUND" - This switch found message is briefly displayed when either the X or Y home switch has been found.

"PLC-LINK BUSY" - Communication between the control and PLC is in progress.

"PLC-VERIFY READBACK" - The control is waiting for verification that a message previously transmitted has been executed by the PLC before continuing.

"PLC-*** LINK ERROR ***" - An error has occurred in the communication between the control and the PLC. Communications is continuously retried until successful.

"RETURNING TO POSITION" - Run active, the machine was stopped and jogged off path, this message is displayed after the <GO> key is pressed while machine returns to path.

"RETURNING TO HOME" - The machine is returning to position (0,0).

"RETURNING TO START" - Run active, the machine returning to start of part.

"RETURNING TO PIERCE" - Run active, the machine returning to last pierce point.

"RETURNING TO HOLD" - The machine is trying to maintain hold position.

"HOLD-ZERO FEEDRATE" - Speed dial has been turned to zero or a zero digital feedrate value has been defined by the operator.

"CNC RUN NOT ON" - The BURNY is not in control of the machine because the CNC override key has been pressed.

"JOG OPERATION ACTIVE" - One of the <JOG> keys has been pressed.

"E-STOP JMP5-C SET WRONG" - To prevent problems in systems with older interface cards, the "E-STOP" input logic has been designed to accept any initial state as the "NOT E-STOP" state whenever the "E-STOP" jumper is not removed. However, any change from this initial state is interpreted as an "E-STOP" and the system is automatically forced into a permanent "E-STOP" state. This permanent condition causes the status "E-STOP: JMP5-C SET WRONG" to be displayed. Therefore, systems generating state changes on this input must be modified to prevent permanent "E-STOP" conditions from occurring.

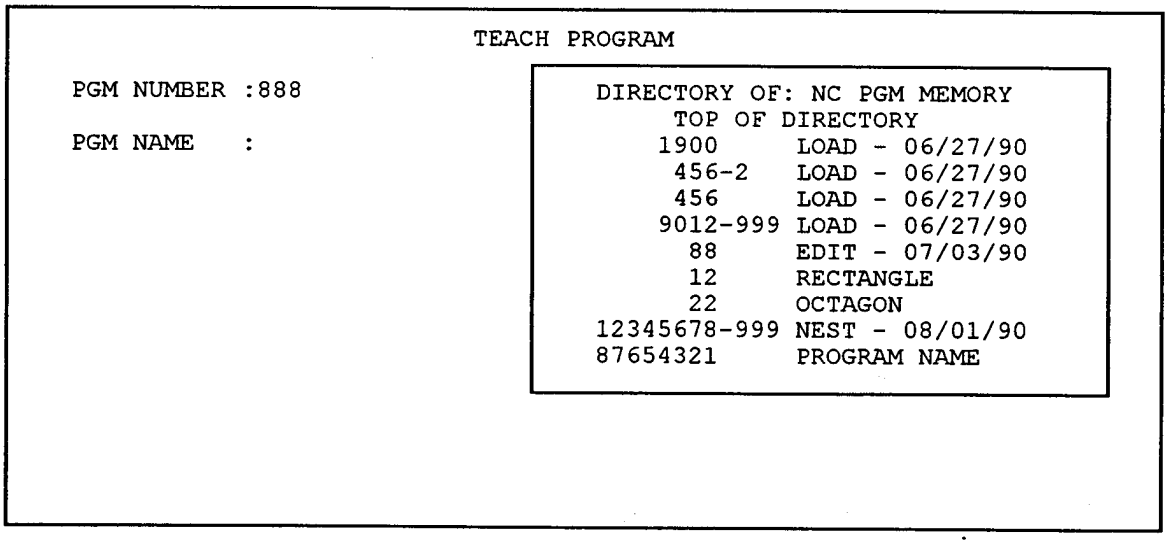
"MESSAGE NOT DEFINED" - Internally used message - should not appear in normal operation.

TEMPLATE TEACH TRACE

The "TEMPLATE TEACH" function is used with the machines optical tracing system. This process allows the BURNY 5 control to teach a template. The taught template is stored as a part in NC PROGRAM MEMORY. The part can then be cut, any number of times, without the template.

BEGINNING THE TEACH PROCESS

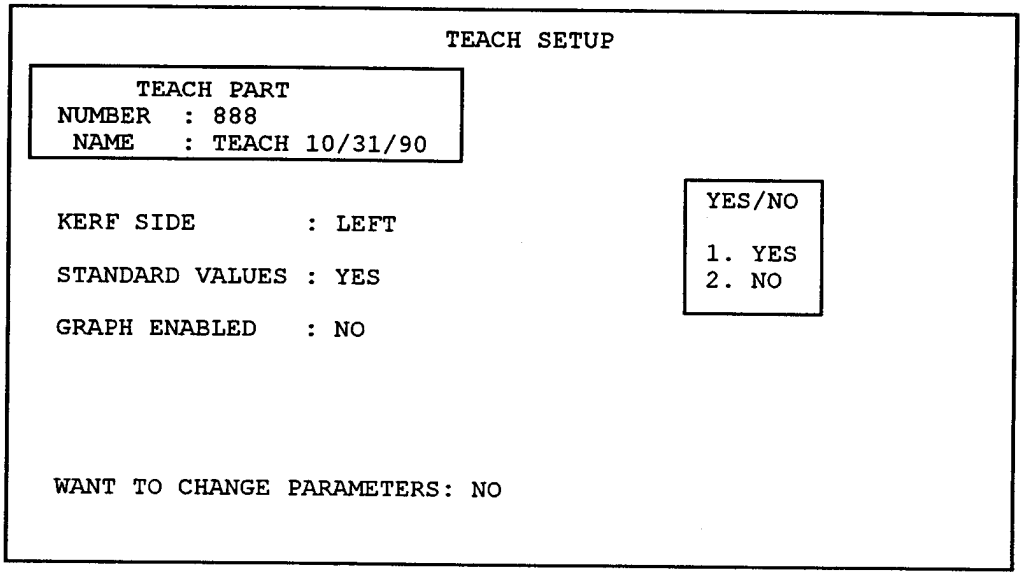
The teach process is invoked from the top level menu. It is activated by selecting "2. TEACH PROGRAM" from the main menu. The control then displays the TEACH PROGRAM screen.



Enter the program number for storing the taught part. The control then prompts for the program name (only if alphanumeric prompting is enabled), the user is required to supply the program name. After the name has been accepted by the control, a prompt "REPLACE OLD? NO" is displayed at the bottom of the screen. If it is a unique program number, pressing <ENTER> will display the teach setup screen. If this program number already exists in the directory, then either a new number has to be selected, or the program already in memory has to be deleted. The old program is deleted by responding with a "YES" to the "REPLACE OLD?" prompt.

SETUP PARAMETERS

Once the program number is accepted by the teach process, the control displays the TEACH SETUP screen. This screen displays the program number, name and a list of parameters. The parameters are KERF, STANDARD VALUES and GRAPH ENABLED. Also displayed is the prompt "WANT TO CHANGE PARAMETERS: NO". If "YES" is selected, then the values of these parameters can be modified.



KERF SIDE

This parameter is used to set the kerf direction command in the created program either to the LEFT or RIGHT of the cut. This value is used by the "DIAL IN KERF" feature when the part is cut. Most parts are cut or taught with the kerf to the LEFT.

NOTE

When the Dial-In-Kerf option is used on a taught program, the program length is increased 25-30%. The extra space is used to store the kerf information without altering the original program dimensions. This permits the kerf to be adjusted and changed as necessary since the original dimensions are available for the re-calculation. If the Teach KERF SIDE is set either LEFT or RIGHT, the extra space required for the kerf data is allocated during the teach process. By allowing the space ahead of time, the actual kerf calculation runs about 20% faster.

STANDARD VALUES : YES

This prompt is used to accept as is, or modify the preset values used by the teach process. These values help to optimize the taught program length and its accuracy. The various teach setup parameters can be used to tailor the accuracy of the teaching process for different applications. The STANDARD values result in a good compromise of teach resolution versus memory storage.

To choose the Standard Values, select "YES". Then press the <ENTER> key and continue at section "BEGINNING THE TEACHING PROCESS".

If some of the values are to be altered, press the < +/-> key so that the "STANDARD VALUES : NO" appears. Then press the <ENTER> key to go on to the individual parameter settings listed below.

STANDARD VALUES : NO

This prompt is used to change the variables used for the TEACH operation. A description of each variable is provided below.

LINEAR ERROR

LINEAR ERROR, which can range from 0-3200, sets the allowable error boundary used to determine when a new point is created. (a value of 16 equals approximately .0025" in the normal resolution mode). Making this number smaller results in a more accurate representation of the part. However, it creates more points and therefore uses more memory to store the program. Making this number larger results in less memory being used, but the program begins to lose some accuracy. The factory set default is 50.

LINE REDUCTION

LINE REDUCTION is used by the teaching process to determine when a series of short straight lines can be replaced by a single long line, thus saving memory. Its value ranges from 0-3452 with a value of 16 equaling approximately .0025"). Setting this parameter smaller causes more lines to be stored while making it larger results in some loss of part definition. The factory set default is 32.

RADIAL ERROR

RADIAL ERROR is used to convert a series of lines into an arc, which saves memory. To determine if an arc should be created, the lines are tested to see if they fall along the same arc, or are within the radial error distance of the arc. Making this number large results in more lines being converted to arcs. However, there is some rounding and smoothing of the shape. Making RADIAL ERROR very small limits the number of arcs created since the lines must be very close to the perfect radius. The factory set default is 0.02".

MINIMUM RADIUS

MINIMUM RADIUS sets a limit on the minimum radius size which is created by the teach process. It is used mainly for testing purposes. The factory set default is 0.20"/5.08mm

MAXIMUM RADIUS

MAXIMUM RADIUS sets a limit on the size of the arcs that are created by the teach process. This parameter is not usually altered and is mainly used for testing purposes. The factory set default is 20.0"/508mm.

GRAPH ENABLED

The GRAPH ENABLED prompt when set to "YES" allows the operator to graphically display the part as it is being taught. The operator must enter the maximum X and Y dimensions of the template. This size is used by the graph process to scale the screen. The operator is also prompted for "START POSITION". There are eight possible selections for the start point. This point represents the home position for the part.

BEGINNING THE TEACH PROCESS

Once the teach setup parameters are entered, either as the STANDARD or ALTERED values, a prompt appears to "POSITION TRACER TO START". At this stage the X and Y position can be reset to zero. Pressing the "1" key resets the X position to 0.00, pressing the "2" key resets the "Y" position to 0.00, and pressing the "3" key resets both X and Y position displays to 0.00. Use the readouts to position the tracer at the starting point for the program to be taught. (In most cases, the program is taught starting from the corner of the plate.)

When the tracer is in the correct position to start the program, (usually where the corner of the plate is when it is cut), make sure the machine cut switch is off, and that the speed dial is set to 0. Then press the <ENTER> key.

> If the oxy cut switch is on, the program issues a warning message. Turn OFF the oxy cut switch then press the <ENTER> key again.
>
> If the machine speed dial is not set to 0, a different warning is displayed. Set the machine speed dial to 0 and press the <ENTER> key again.

The program is "TAUGHT" by running the tracing eye around the template just as if the part was actually being cut. In addition, the operator must indicate when the cut should be ON or OFF. When the << CUT OFF >> mode is selected (the "FUNCTION:" field in the status display indicates the current operation), the actual path is not stored, only the final position is remembered. This gives a straight line traverse from one cutting segment to the next. When the eye is positioned at the next pierce location, the operator should change to the << CUT ON >> mode and begin tracing the template. In the << CUT ON >> mode, the actual path or "CONTOUR" of the part is stored. When the cutting path is complete, the operator should leadout away from the template and then switch back to the << CUT OFF >> mode before moving to the next pierce point.

There are two methods that can be used to select between the << CUT ON >> and << CUT OFF >> modes:

The preferred method is to use the <GO> and <STOP> keys. Pressing the <GO> key switches to the << CUT ON >> mode. Pressing the <STOP> key switches to the << CUT OFF >> positioning mode. This works for either Plasma or Oxy/Fuel cutting systems.

An alternative method is to use the actual machine OXY CUT SWITCH. The << CUT ON >> mode is selected any time the OXY CUT SWITCH is turned "ON", while the << CUT OFF >> mode is used when the OXY CUT SWITCH is turned "OFF". While this method is sometimes more convenient than going back to the BURNY 5 front panel, it does not work on certain machines due to the type of cutting circuitry.

A new feature has been added to the teach process, that makes the jog keys active during the teach process. The jog keys can be made active by pressing the <CNC> key any time during the teach process (as long as the feedrate is 0.00). The jogged path becomes part of the template trace. The jogged path can be taught with either the << CUT ON >> or the << CUT OFF >> mode enabled. As in the normal template teach, if the mode is << CUT ON >>, the entire jog contour is traced. Conversely, if the mode is << CUT OFF >>, then only the end point is retained. The teach process can be switched back to template photo tracing by pressing the <CNC> key again.

The remainder of this description refers only to << CUT ON >> or << CUT OFF >> and does not specify the method used to make the selection. The unit "BEEPs" any time the mode is changed, and the status display indicates the cutting status along with other information.

During the << CUT OFF >> mode, the path of the machine is not stored, only the last position before the cut is turned "ON" again. Thus from the end of one cut segment to the start of the next only stores one point to point move. When the << CUT ON >> mode is selected, the beeper again indicates the change and the "FUNCTION:" field in the status display shows "FUNCTION: CUT ON".

IMPORTANT

Due to the software processing time, the speed during the teaching process must not exceed 25ipm (635 MPM) or the resulting part appears choppy due to the loss of data.

The template/tracing system must be set so the taught path compensates for the cutting kerf of the torch. This can either be accomplished by having the template drawn with the correct kerf modified dimensions, or by using the kerf offset feature of most tracing systems to offset the path. In either case, if the template/tracing eye combination produces a correct size part when cut optically, the resulting taught program is the correct size also.

NOTE

Although the "Dial In Kerf" feature on the BURNY 5 allows either a positive or negative kerf to be added to the program after it is taught, the best results are still obtained by teaching the program with the kerf included in the template or tracing eye, and then using the "Dial In Kerf" to Fine Tune the resulting program.

The TEACH process allows parts to be taught in either a chain cut mode or as a pierce, step and repeat type part. To allow for the initial move from the corner of the plate to the first part, any positioning moves before the first cut are only performed the first time and are not repeated on each part.

TEACHING A PROGRAM WHERE EACH PART IS PIERCED

To TEACH a pierce and cut type part, the tracer should be positioned at a point on the template that represents the corner of the plate, before the <ENTER> key is pressed to start the teach process. Then the tracer should be moved to the pierce location for the first cut. The X/Y COORDINATES OF THIS POINT SHOULD BE WRITTEN DOWN as they are needed later to teach the repeat to the next part. Turn the << CUT ON >> and lead the tracer into the pattern. Continue to trace around the pattern to the end of the CUT. Then turn the << CUT OFF >>. Move the tracer to the next cut segment and repeat the cut on/trace/cut off sequence until all the cutouts and the outside profile of the part are taught. The final operation is to teach the repeat step move by positioning the tracer at the new pierce location for the next part. This can be done by marking the template with the next pierce point and moving the tracer over that point. However, a more accurate method is to use the X/Y readouts to position the machine exactly at the desired location. This can be calculated by adding the total size of the part to the original pierce point location (the coordinates which were written down earlier) and moving the machine to the resulting coordinates.

Once the machine is positioned at the repeat coordinates, press the <RST> key to complete the teaching process.

TEACHING A CHAIN CUT PART

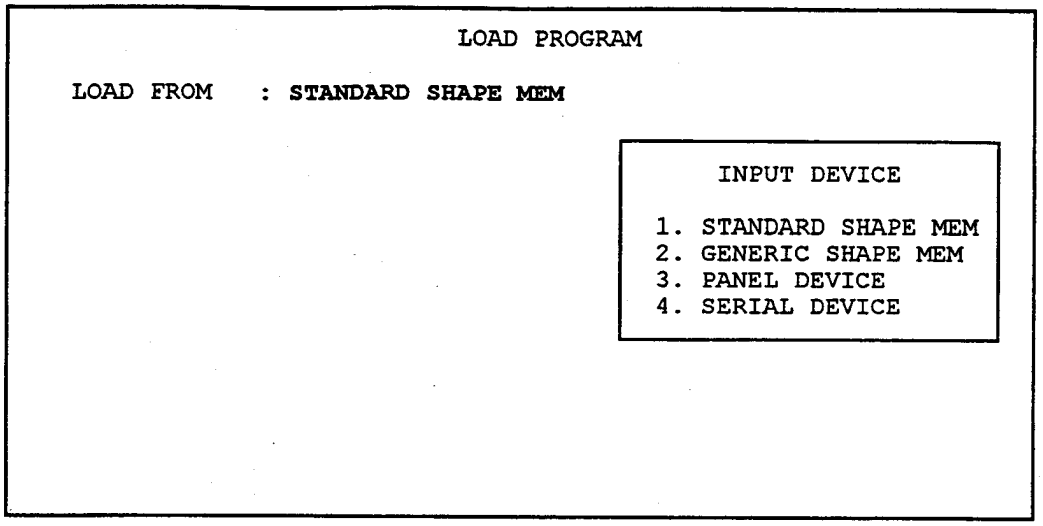
First position the tracer at the location on the template that represents the corner of the plate, then press the <ENTER> key. Move the tracer to the location where the chain cut is to be started. Note the X/Y position of the start position as they are needed later. Now turn the << CUT ON >>, lead into the template and trace the part. When the tracer returns to the start position, lead it out of the part and then move it up the plate to the start position for the next part. This position may either be drawn on the template or may be calculated by adding the size of the part to the start position of the first part. Remember, since the cut has not been turned off, the leadout and move to the next part are taught as a contour and not as a point to point move. After reaching the start position for the next part, press the <RST> key to end the teach process. Since the cut was never turned off, the entire part, including the move to the next part, is cut and results in a continuous chain of parts being cut.

NOTE

TEMPLATE TEACH is an option on the monochrome version control, while it is standard on the color controls.

LOAD PROGRAM

The selection of "3. LOAD PROGRAM" from the MAIN MENU displays the "LOAD PROGRAM" screen, shown below. The LOAD PROGRAM operation allows the operator to load a program from STANDARD SHAPE MEMORY, GENERIC SHAPE MEMORY, a PANEL DEVICE or a SERIAL DEVICE.



The first prompt, "LOAD FROM :", allows the operator to select the type of load operation to perform. If the INPUT DEVICE selection menu is not displayed, press the <IV> key. (Remember, the control can be put in the "NOVICE" mode to display all menus automatically). The default operation is the last type of load performed. Select the desired menu entry and press the <ENTER> key. Each type of operation is described in the following sections.

LOAD FROM: STANDARD SHAPE MEMORY

The selection of "LOAD FROM : STANDARD SHAPE MEM" allows the operator to select a generic part from the STANDARD SHAPE LIBRARY and create a part program that can be cut. There are 50 shapes from which to choose. Use the scroll keys or direct numeric entry to make the shape selection. Press the <V> key to graphically display the currently selected shape number. Once a shape is displayed, use the <UP> and <DOWN> cursor keys to scroll through the STANDARD SHAPES graphically. When the correct shape is found, press the <ENTER> key to return to the prompting screen to select that shape and continue.

NOTE

Special shape number 99 is the "PART CONSTRUCT" utility. The "PART CONSTRUCT" utility allows virtually any part to be programmed and cut with the control. The operator combines lines and arcs to "CREATE" the desired cutting path. Several auxiliary functions are also provided for controlling the program repeat, cutting oxygen and other auxiliary functions. See the "PART CONSTRUCT OPERATIONS" section in this manual for a description of this special shape.

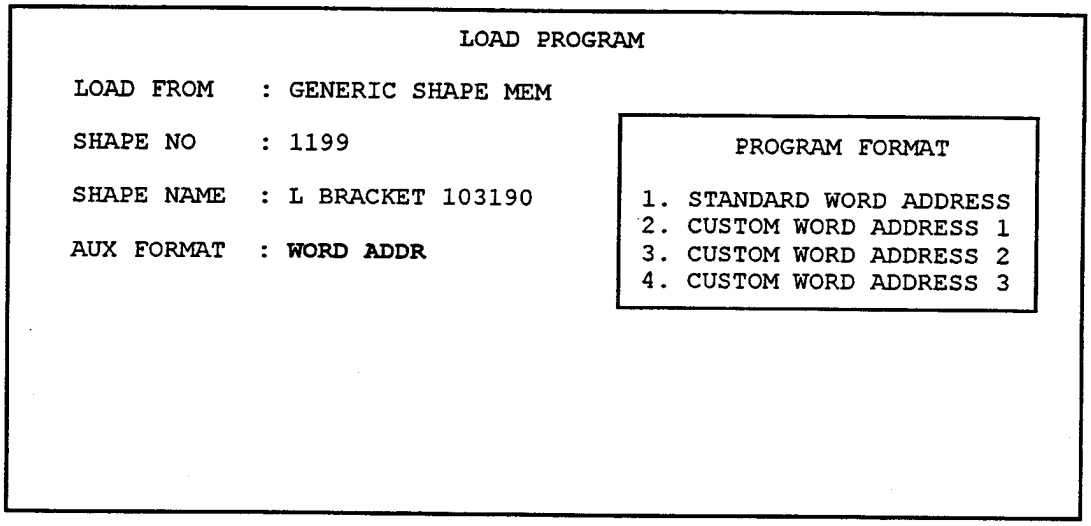
After a shape has been selected, a number must be assigned to the program to be made. Enter a valid program number and the program name is automatically assigned from the name of the shape. For example, if standard shape number 8 is selected, the resulting NC program is given the name "FLANGE". This name can be changed if "ALPHANUMERIC" prompting is enabled. When a valid program number has been selected and the <ENTER> key pressed, the prompt "REPLACE OLD ? NO" is displayed on the screen. The operator must decide if a program with the same program number should be replaced. If "NO" is selected and the program exists, a "DUPLICATE FILE NAME" error appears on the screen. If "YES" is selected and the program exists, the existing program is deleted and a new program created. Prompting then continues on to the SHAPE PROMPTING SCREEN.

For further information on STANDARD SHAPES see section:"STANDARD SHAPE OPERATIONS".

LOAD FROM: GENERIC SHAPE MEMORY

The selection of "LOAD FROM : GENERIC SHAPE MEM" allows the operator to select a SHAPE from GENERIC SHAPE MEMORY. GENERIC SHAPE programs like STANDARD SHAPE programs cannot be directly "RUN". Instead, they must be used in a "LOAD" operation to allow prompting to be done to create the desired custom program. The resulting program is then automatically placed in NC PROGRAM MEMORY ready to RUN.

After making the selection of a GENERIC SHAPE program number, the operator is prompted for the "AUX FORMAT :". This prompt is for the program format to be used. Normally this would be set to "STANDARD WORD ADDRESS". However, when the control must interpret NON-STANDARD 'M' and 'G' codes, this selection must be set to reflect this.



The prompt "WANT TO GRAPH THE SHAPE: YES" allows the operator to do a "QUICK INSPECT" of the part (graphic display) on the screen.

IMPORTANT

The generic part must be programmed with some default values in order for the part to be displayed graphically on the screen. These default values are put in the last field of a dimension block.
FOR EXAMPLE: D15 'ENTER [X] DIMENSION' 3,2,A;999.99

The value 999.99 is the default dimension size needed for the "QUICK INSPECT". All dimensions must have a default dimension size for a "QUICK INSPECT". If there are no default dimensions in the generic shape program, the error "NO PREVIEW DATA IN FILE" appears on the screen.

For more information on GENERIC SHAPES, see the "GENERIC SHAPE OPERATIONS" section in this manual.

LOAD FROM: PANEL DEVICE

The selection of "LOAD FROM : PANEL DEVICE" allows the operator to load programs from a "RAM" or "ROM" cartridge or panel mounted FLOPPY DISK. The prompting that follows the "PANEL DEVICE" selection depends on how the control is configured. If only a floppy disk is installed, then the prompt "DEVICE TYPE : FLOPPY DISK" is displayed and the prompt for program type is displayed. If only a cartridge port is installed, then the cartridge port is examined to see what type of device is present. The prompt "DEVICE TYPE : RAM CARTRIDGE" or "DEVICE TYPE : ROM CARTRIDGE" is displayed depending on the type of cartridge installed. If both cartridge port and floppy disk are installed in the panel, the operator must select between the CARTRIDGE and the FLOPPY DISK. Configuration bits exist to enable and disable the prompting for the panel mounted FLOPPY DISK and CARTRIDGE.

FLOPPY DISK

A panel mounted floppy disk allows programs stored on 3½ inch floppy disks to be loaded. After the DEVICE TYPE has been specified as FLOPPY DISK, either automatically or manually, the PROGRAM TYPE prompt appears next. This prompt specifies which internal directory the program is loaded to. Normally, NC PROGRAM is selected to allow programs to be run once loaded. However, there are certain circumstances where another directory is selected. To load a generic program, select GENERIC SHAPE. This allows generic programs to be loaded into the control to be used in a separate "LOAD" operation to have an NC PROGRAM created from the generic program. (See LOAD FROM : GENERIC SHAPE MEMORY).

Another alternative is to load into the ASCII DATA directory. This directory is used to hold special ASCII files used to configure SYSTEM SETUP DATA and also CUSTOM AUXILIARY CODES. (See the CONFIGURATION FILES section in this manual).

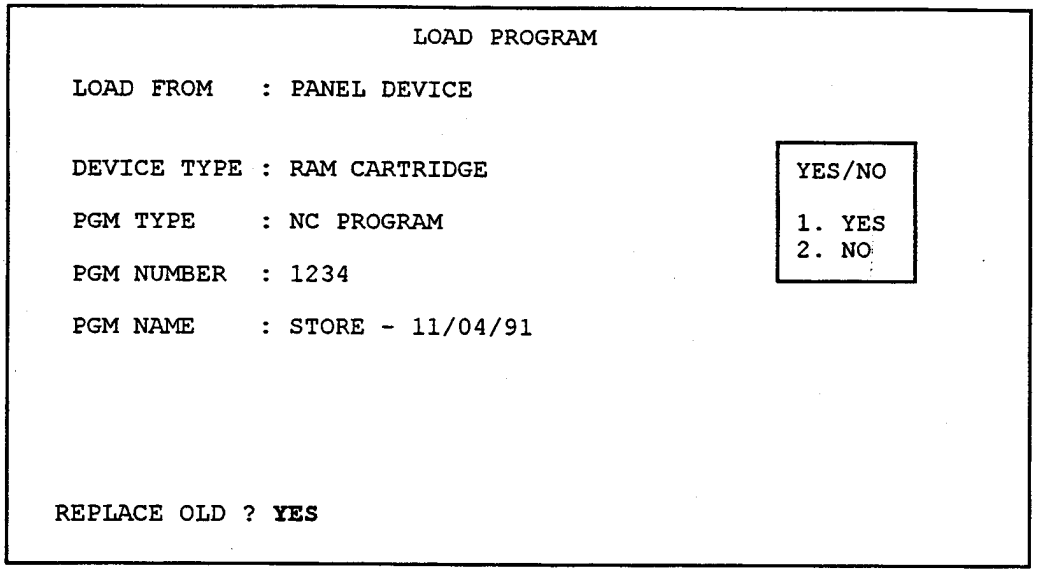
If NC PROGRAM is selected as the program type, the next prompt is for the program format. The program format is the programming language used to create the program. The three type are WORD ADDRESS, ESSI and INTERNAL. The other "CUSTOM" formats allow the control to interpret almost any programming codes through the use of the CUSTOM AUXILIARY CODE conversion feature. Select the type of program contained on the floppy disk. If the program type is not NC PROGRAM, the program format prompt is skipped because it only applies to NC PROGRAMS.

The next prompt allows the operator to select the actual program to load. For more information see the section titled "FLOPPY SUPPORT OPTION" in this manual.

RAM CARTRIDGE

When the device is a "RAM" type cartridge, the prompt "PGM TYPE" is displayed. The PROGRAM TYPE can be "NC PROGRAM", "GENERIC SHAPE", "ASCII DATA" or "REMNANT". Once the program type is selected, a directory listing of all the programs of that type can be displayed by pressing the <IV> key. This directory may already be displayed if the control is in the "NOVICE" mode.

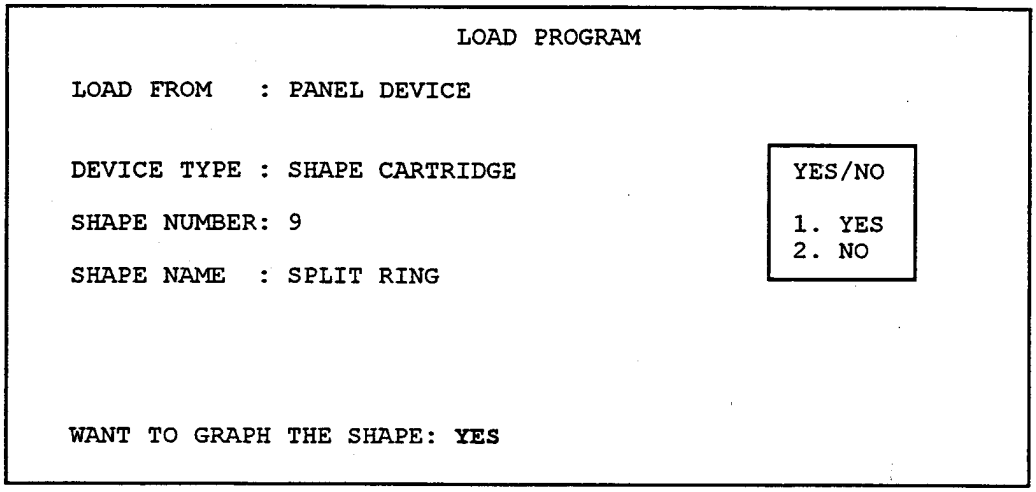
Select the desired program to load by either entering the exact number or by using the <UP> and <DOWN> cursor keys to scroll through the list. As with most program number prompts, the <V> key can be used to graph the part before loading it from the cartridge. Press <ENTER> to accept the number. The prompt "REPLACE OLD ? NO" is displayed next. Press <ENTER> to load the part. If a part with the same number is in memory, the loaded part will get an extension of -1. To delete the existing part and replace it with the new part, toggle the "NO" to "YES" and press <ENTER>.



The program is then loaded from the RAM CARTRIDGE and placed in NC PROGRAM memory. To load another program, press <ENTER> when the message "PRESS <ENTER> TO CONTINUE" is displayed. The initial prompts are displayed but skipped and prompting continues at the "PGM NUMBER:" prompt. Enter another program to load or press <CE> or <RST> to return to the main menu.

ROM CARTRIDGE (SHAPE CARTRIDGE)

When the device is a "ROM" type cartridge, the DEVICE TYPE is automatically set to "SHAPE CARTRIDGE". The next prompt is for a SHAPE NUMBER. The SHAPE NUMBER is selected by either entering the exact number or by using the <UP> and <DOWN> cursor keys to scroll through the list. A directory of the shapes stored on the cartridge is displayed if "NOVICE" mode is enabled. If "NOVICE" mode is not enabled, the directory may be viewed by pressing the <IV> key. Press <ENTER> to accept the shape number.



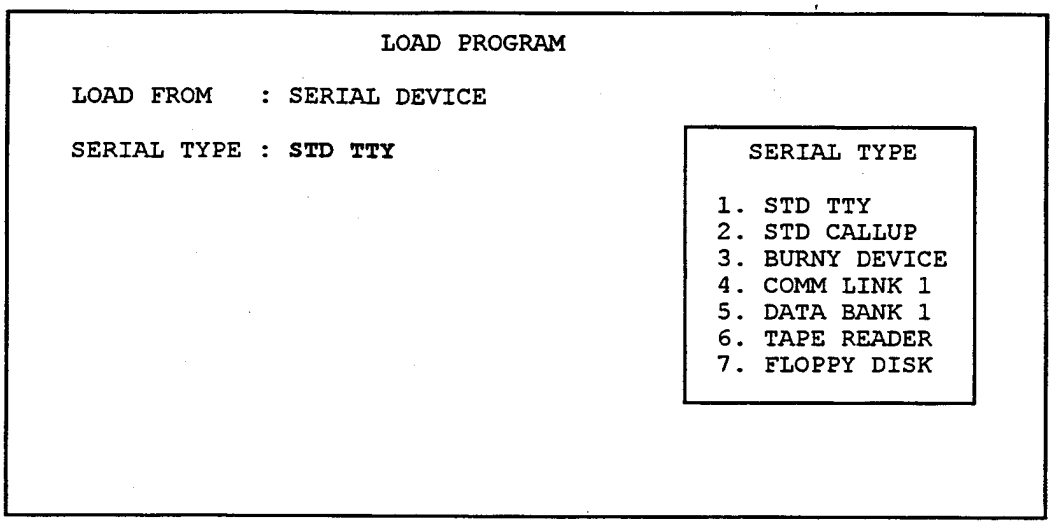
Once a shape has been selected, the prompt "WANT TO GRAPH THE SHAPE: YES" appears. If <ENTER> is pressed, the shape is graphed. The generic shape must have "PREVIEW DATA" programmed into it. If the ROM CARTRIDGE shape does not have "PREVIEW DATA" in it a "NO PREVIEW DATA IN FILE" error message appears on the screen.

After the shape is displayed, press <ENTER> to continue to the shape prompting screen. Follow the prompts as they are displayed and respond accordingly. When prompting is complete, the part can be displayed again graphically before it is saved permanently in NC PROGRAM memory. If the part is not correct, simply restart the prompting when asked to do so.

LOAD FROM: SERIAL DEVICE

The selection of "LOAD FROM : SERIAL DEVICE" allows the operator to load programs through the serial port located on the back panel.

Once "LOAD FROM SERIAL DEVICE" is selected, a "SERIAL TYPE" must be entered. This selection can be predefined in the "41. SERIAL LOAD DEVICE" variable (SYSTEM SETUP DATA), or selected each time a "LOAD" is performed.



The control communicates with most serial devices with the selection of the "SERIAL TYPE: STD TTY". Special serial types such as "STD CALLUP" (STANDARD CALLUP), "BURNY DEVICE", "COMM LINK 1", "DATA BANK 1", "TAPE READER" and "FLOPPY DISK" use special protocols that make communications with a computer or tape reader automatic.

Once the SERIAL TYPE is selected, additional prompting for BAUD RATE, CHAR FORMAT, PGM TYPE, and PGM FORMAT appears if not predefined in system setup data. Select the parameters needed to match the device to be communicated with. If these prompts are bypassed and the prompt for the program number is displayed, the "BAUD RATE", "PROGRAM TYPE" and "PROGRAM FORMAT" prompts have been predefined in the SYSTEM SETUP DATA.

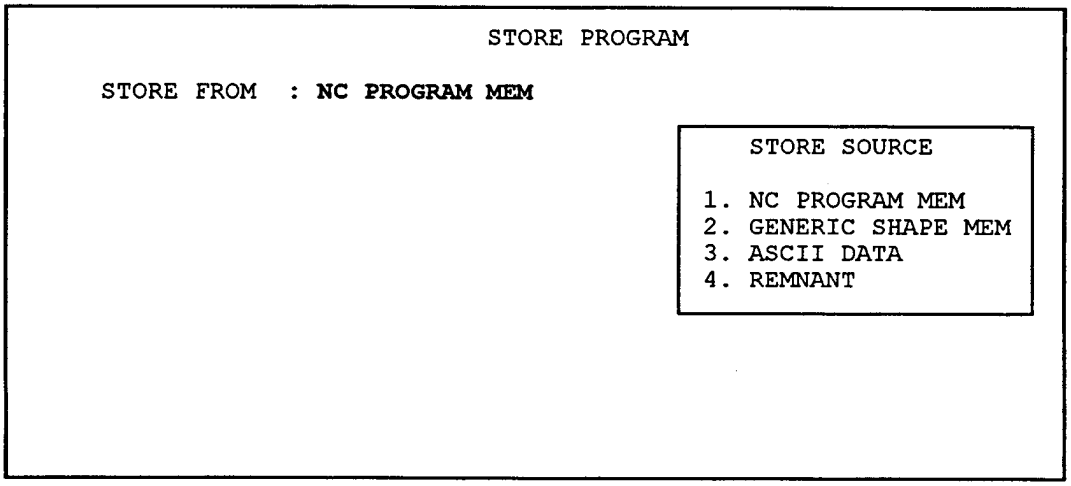
Once the device specific information is entered, a program number must be selected. Enter the number of the program to be loaded and press ENTER. The prompt "REPLACE OLD ? NO" appears on the screen. The operator must decide if a program with the same program number should be replaced. If "NO" is selected and the program exists, the program is loaded and an extension will be added to the program number. For example, if a requested program number of 12345678 is loaded, an extension of -1 is assigned, or the program number in the directory will be seen as 12345678-1. If "YES" is selected and the program exists, the existing program is deleted and the new program loaded.

For further information on loading from serial devices, see section "SERIAL COMMUNICATIONS".

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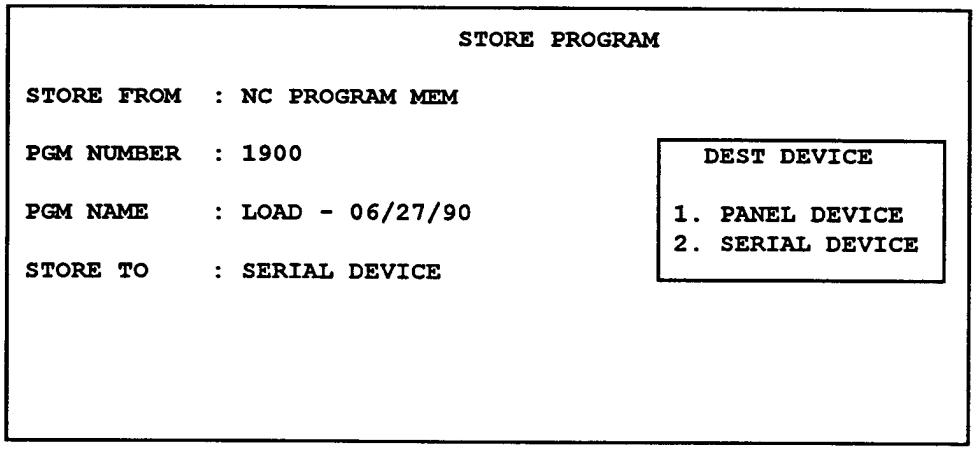
STORE PROGRAM

The selection of "4. STORE PROGRAM" from the MAIN MENU displays the STORE PROGRAM screen, shown below. The STORE operation allows programs stored in any of the internal directories to be copied to an external or panel mounted device.



Select the directory from which the program is to be stored. Once this has been selected, the program number must be specified. If not already displayed, a list of programs in the specified directory can be displayed by pressing the <IV> key. Use the cursor keys to scroll to or use the numeric keypad to directly enter the program number to store. Remember, if the "ALPHANUMERIC" feature is turned on, the program "NAME" is also prompted for and can be used as the DOS file name when storing to a DOS compatible device (such as the panel mounted floppy).

Once the program number has been specified, the destination device must be selected. Available destination devices are PANEL DEVICE and SERIAL DEVICE. A panel device is either a FLOPPY DISK or a RAM CARTRIDGE. A serial device can be any device such as a computer running the FILE SERVER software or a tape punch.




```
POSITION(IN) :X0.00      Y0.00      FEED: 150.00   TIME : 11:30:00
OPERATION    : STORE                MODE: OXYGEN   DATE : 10/31/90
FUNCTION     : CUT OFF
MEMORY AVAIL: 196596                MEMORY USED: 65548
STATUS: WAITING FOR PARAMETERS      ERROR:
```

The "STORE TO : PANEL DEVICE" is used to STORE the selected program on a "RAM" type cartridge installed in the cartridge slot (make sure a ram cartridge with the write protect switch set to the "OFF" position is installed in the holder-see description "STORE TO RAM CARTRIDGE") or to an internally mounted FLOPPY DISK DRIVE.

The "STORE TO : SERIAL DEVICE" is used to store the selected program to a serial device (REMOTE COMPUTER, TAPE PUNCH, etc) via the RS-232 port. See description "STORE TO SERIAL I/O PORT".

STORE TO: FLOPPY DISK

The BURNY 5 internally mounted FLOPPY DISK DRIVE allows programs to be saved on a 3.5" floppy diskette. Part programs are stored in the root directory of the floppy disk. Programs can not be saved in a sub-directory.

STORE TO: RAM CARTRIDGE

The BURNY 5 cartridge port accepts two types of cartridges. The "ROM" type cartridges described in the "LOAD" operation (SECTION "LOAD PROGRAM MODE") are permanently programmed and cannot be altered after they are originally programmed. The "RAM" type cartridge uses a different type of memory circuit which allows programs to be stored and erased as often as needed. Each "RAM" cartridge contains its own battery backup system which insures that no data is lost when the cartridge is removed from the system. Several sizes of "RAM" cartridges are available. There is no limit to the actual number of part programs which may be stored in a "RAM" cartridge, as long as the total number of bytes does not exceed the cartridge capacity.

The "RAM" cartridges have a small switch located on the side, toward the connector end of the case (See drawing). This switch is used to "WRITE PROTECT" the cartridge to prevent accidentally erasing or re-writing a program. The switch should be moved toward the connector end to "WRITE PROTECT" the cartridge. However, storing a program requires the switch be moved to the unprotected position (away from the connector) to allow new data to be written into the cartridge. After the new program is stored, the switch can be moved back to the protected position.



PROTECTED <---> UNPROTECTED-ALLOWS WRITING NEW DATA

When the store to "RAM" cartridge operation is selected, the program is copied from system memory into the cartridge with the same program number. If a program with this number already exists on the cartridge, the BURNY 5 displays a "DUPLICATE FILE NAME" error message.

When the store operation is complete, a "PRESS <ENTER> TO CONTINUE" message is displayed indicating that the program is now stored on the cartridge.

FILE/DEVICE PROTECTION ERROR

If after a store to cartridge is attempted and a "FILE/DEVICE PROTECTION ERROR" is displayed, make sure that the cartridge is a RAM type and that the "WRITE PROTECT" switch is moved away from the connector end.

This error message can also occur if a FLOPPY DISK is write protected and a store operation is attempted to it. Remove the floppy disk from the drive and move the write protect tab.

FILE STRUCTURE FORMAT ERROR

If after a store to cartridge is attempted and a "FILE STRUCTURE FORMAT ERROR" error message occurs, this indicates that the data on the cartridge has become corrupt. The cartridge must have the "ERASE AND TEST" function performed on it. This is done through the UTILITIES MENU, "3. DIRECTORY SUPPORT", "4. ERASE AND TEST" and select "RAM CARTRIDGE" as the device type. The BURNY 5 tests and erases the RAM cartridge. If the error appears again, the battery in the cartridge may be defective and need replacement.

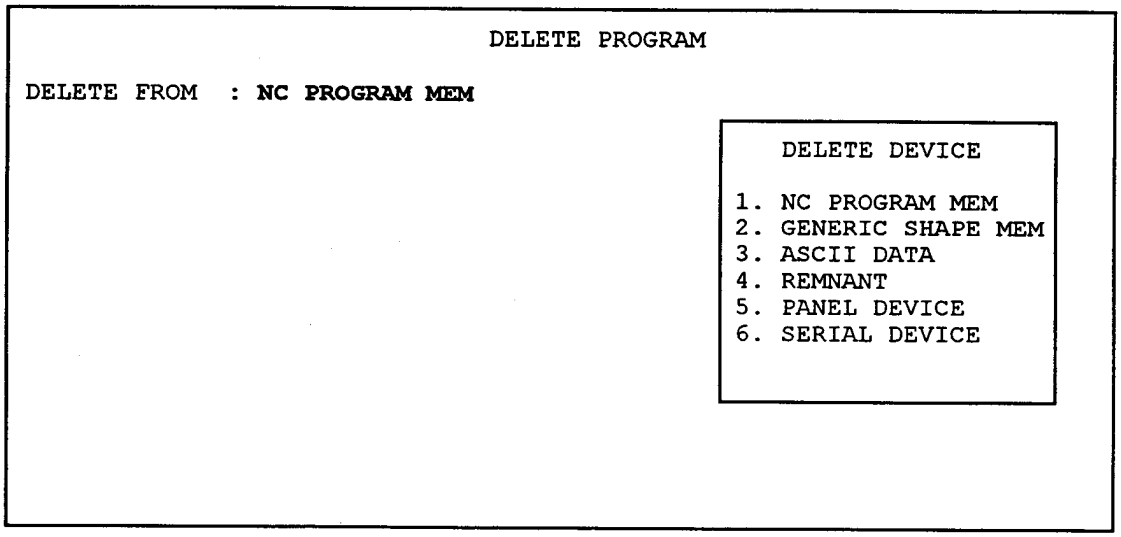
STORE TO: SERIAL I/O PORT

Programs can be stored to a variety of serial (RS-232) devices including portable floppy disk drives, paper tape punches and remote computer systems through a suitable communication link.

Since operations involving serial data transmission are almost identical whether the data is being transmitted or received, the section "SERIAL COMMUNICATIONS" of this manual describes the procedures for both receiving data ("LOAD") via the serial port as well as transmitting data ("STORE") out of the port. Turn to SECTION "SERIAL COMMUNICATIONS" for a description of the various SERIAL I/O "LOAD/STORE" commands.

DELETE PROGRAM

The selection of "5. DELETE PROGRAM" from the MAIN MENU displays the "DELETE PROGRAM" screen shown below. This screen prompts the operator for various parameters needed to delete a program from memory.



Once the delete device has been selected, a program number must be entered. The <IV> key can be used to display the directory of a supported device. Use the cursor keys or direct numeric entry to select the program to be deleted. Once a valid program number is entered the prompt "ARE YOU SURE ? NO" is displayed. Press the <ENTER> key to abort the delete operation. To delete the program, use "+/-" key or the "1" key to toggle the word "NO" to "YES" and then press <ENTER>. The program is deleted from the selected device.

NOTE

Although a "DELETE DEVICE" of "SERIAL" is displayed as a valid choice, it is not currently implemented. Selecting "DELETE FROM : SERIAL DEVICE" displays an "INVALID DEVICE" error.

If all programs in a particular directory need to be deleted, rather than by individual program numbers, the "DIRECTORY SUPPORT" utility should be used. The DIRECTORY SUPPORT utility can be reached from the MAIN MENU by selecting "6. UTILITIES" and "3. DIRECTORY SUPPORT" from the UTILITIES MENU.

PART 3 - SYSTEM UTILITIES

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SYSTEM UTILITIES

The UTILITIES MENU provides access to utility functions that are supported by the control. This menu can be selected directly from the MAIN MENU or selected indirectly with the HELP menu key <IV> while another process, such as RUN, is still active. Each entry in the UTILITIES MENU allows the operator to reach a third level menu for additional support functions. The UTILITIES MENU appears as follows:

```
        UTILITIES MENU

  1. DISPLAY SYSTEM DATA
  2. DISPLAY/EDIT/NEST
  3. DIRECTORY SUPPORT
  4. SETUP/CONFIGURATION
  5. DIAGNOSTIC SUPPORT
  6. SETUP/LOAD/STORE

        SELECT (1-6)
```

Although most of the functions available through the UTILITIES menu are still operable while a "background type" process is active, several are not. Of these functions, some perform diagnostic and system data storage operations that can only be done when the system is in an "IDLE" state. Therefore, some functions cause a "BACKGROUND PROCESS BUSY" error message to be displayed when they are used with the RUN process still active. Like other menus, entries from this menu can be selected directly by pressing the numeric keys 1 through 6 or by using the up and down cursor keys to select the desired entry before pressing <ENTER>. However, unlike other menus, access to some of these menus require a password to be entered or an option to be enabled before access can be granted. For additional information on access to these menus, see their associated sections that follow.

1. DISPLAY SYSTEM DATA (UTILITIES MENU)

The DISPLAY DATA menu provides a safe "read only" access to all system data. Since no "write" operations are supported by these functions, no special passwords or special code sequences are required. In addition, all are accessible while RUN and other "background type" processes are active. The DISPLAY DATA menu appears as follows:

```
        DISPLAY DATA MENU

  1. AXIS POSITION/SPEED
  2. RUNTIME DATA
  3. SYSTEM SETUP DATA
  4. SYSTEM BANNER
  5. OPTION CODES
  6. CUSTOM AUXILIARY CODES
  7. FPC MEMORY DATA
  8. MPC MEMORY DATA

        SELECT (1-8)
```

Like other menus, entries from this menu can be selected directly by pressing the numeric keys 1 through 8 or by using the up and down cursor keys to select the desired entry before pressing <ENTER>. Once selected, the associated function either prompts for additional information or immediately displays the required data values. Some functions continuously re-display these values as they change in realtime. Update rates are dependent upon the amount of data being displayed. Typically, display updates are performed once or twice a second.

1.1. AXIS POSITION/SPEED (DISPLAY DATA MENU)

This function allows the user to display axis position and speed for both the X and Y axes, and the current feedrate value. It also displays the rotary "C" axis position as a -180 to +180 degree value where:

```
     0 => machine is traveling in +X direction
   +90 => machine is traveling in +Y direction
   -90 => machine is traveling in -Y direction
+/- 180 => machine is traveling in -X direction
```

All values are displayed in double size characters. Updates are continuously performed approximately twice a second.

This function can also be used to do a "measure" operation since the JOG keys are operable whenever the RUN process is not active. The <1>, <2>, and <3> numeric keys are used by this function as follows:

<1> - Resets the X position value to 0
<2> - Resets the Y position value to 0
<3> - Resets both position values to 0

The rotary "C" axis can also be jogged in the positive and negative direction from this utility function screen, if the BURNY is in the "CYCLE STOP" state. If not in this state, a "BACKGROUND PROCESS BUSY" error message is displayed. The <4> and <5> numeric keys are used by this function as follows:

<4> - Rotate C axis in negative direction
<5> - Rotate C axis in positive direction

When enabled through SYSTEM SETUP DATA variable 37 (SYSTEM CONFIGURATION 1), digital feedrate values can also be entered through this utility function screen. Feedrate values can be defined numerically or by using the up and down cursor keys to perform "stepping" operations. The "step" size used is normally 1 inch per minute. However, if the <SHF> key is pressed before the cursor key, the "step" size is 10 inches per minute.

<6> - Enter new feedrate value directly
<UP> - Increment feedrate value by 1
<DOWN> - Decrement feedrate value by 1
<SHF> <UP> - Increment feedrate value by 10
<SHF> <DOWN> - Decrement feedrate value by 10

When digital feedrate operations are enabled, the <6> key is used to initiate a direct feedrate entry. When pressed, the feed value at the top of the screen is highlighted in WHITE, showing that this value is ready for entry. After typing the desired feedrate value and pressing <ENTER>, the BURNY validates the entered value against the allowable range for the current speed dial setting. If necessary, the specified feedrate value will be reduced so that the "100%" equivalent value does not exceed the RUN SPEED LIMIT value defined in SYSTEM SETUP DATA. (These validation operations are also done when "stepping" the feedrate with the cursor keys). The highlighted feedrate value is then cleared and the resulting accepted value is displayed as the new feedrate.

NOTE

The feedrate value can be changed while "running" or "holding" position. However, the newly defined digital feedrate value may not be immediately displayed, due to an active HIGH SPEED jog or a "traverse", "marker" or "backup" move in progress.

To return to the previous menu, press the <CE> key.

1.2. RUNTIME DATA (DISPLAY DATA MENU)

This function allows the user to display various internal data values for "troubleshooting" and diagnostic purposes. After being selected from the DISPLAY DATA menu, the first 10 parameters are immediately displayed. These data values are automatically updated approximately every second to show changes in real time. To display additional parameters, enter the parameter number and press <ENTER>. Additional parameters can also be displayed using the <I> and <II> page keys or by directly entering the line number to display and press <ENTER>. To return to the previous menu, press the <CE> key. For a description of these parameter values see the SYSTEM RUNTIME DATA VARIABLES section.

1.3. SYSTEM SETUP DATA (DISPLAY DATA MENU)

This function allows the user to safely display the SYSTEM SETUP DATA values that were defined through the protected SETUP/CONFIGURATION menu. After being selected from the DISPLAY DATA menu, the first 10 parameters are immediately displayed. Additional parameters are displayed by paging through the list with the <I> and <II> keys or by using the up and down cursor keys to step past the top or bottom of a page. The <ENTER> key is not supported by this function. To return to the previous menu, press the <CE> key. For a description of these parameter values, see the SYSTEM SETUP DATA VARIABLES section.

1.4. SYSTEM BANNER (DISPLAY DATA MENU)

This function allows you to display the system banner data that is initially displayed after the "power-up diagnostic" display. The banner contains the copyright message, system name, serial number, version, date and a list of enabled options, if any. This function also allows you to modify the date and time.

After being selected from the DISPLAY DATA menu, the system banner screen is immediately displayed. Note that the actual data displayed will be based on the system configuration and version.

The following illustrates the format of the banner screen.

```
                    CLEVELAND MACHINE CONTROLS

                              BURNY 5

        COPYRIGHT - CLEVELAND MACHINE CONTROLS - 1985-1994
                     SERIAL NUMBER : 12345678
                  MPC VERSION(14-2): 08-10-94
                   FPC VERSION(1-6): 08-10-94

        OPTIONS:  MULTITASKING
                  BACKGROUND
                  ALTERNATE LANGUAGE
                  FONT GENERATOR
                  COMMAND MESSAGES
                  KNIFE COMPENSATION


WANT TO CHANGE DATE/TIME? NO
```

To change the date and time, first use the up or down cursor keys or the <+/-> key to change the "WANT TO CHANGE DATE/TIME?" prompt reply to "YES" and press <ENTER>. Enter the date as a 6-digit value representing month, day and year as MMDDYY and press <ENTER>. Enter the time as a 6-digit value representing hour, minute and second as HHMMSS (or a 4-digit value as HHMM) and press <ENTER>. After the values are entered, they are immediately used by the system. Therefore, you should check that the correct date and time appear in the status window at the bottom of the screen before exiting from this screen. To return to the previous menu, press the <CE> key.

MPC Versions:

Two version date codes are displayed, one for the main process controller (MPC) and one for the front panel graphics controller (FPC).

The first number after the MPC VERSION is the MPC processor type, which can be 4, 6, or 14. The second number after the MPC VERSION is the MPC I/O card type, which can be 0 or 2. The following summarizes these types:

MPC processor type:	Description:
Type 4 (B3.2 card)	Original BURNY 5 MPC Processor card.
Type 6 (B3.3 card)	All capabilities of Type 4 plus more on-board program memory (128k), more system RAM (1 to 3 tests), and more scratch RAM (1 to 4 pages).
Type 14 (B3E card)	All capabilities of Type 6 plus more on-board program memory (512k), and more non-volatile EEPROMs (3 NVM chips).

MPC I/O card type:	Description:
Type 0	Original BURNY 5 MPC I/O card.
Type 2 (B3E card)	All capabilities of Type 0 plus a consolidation of I/O, internal floppy port, secondary RS-422 serial port, and MPC/FPC communication hardware modules on a single card. When used with Type 14 Processor card, provides larger encoder count accumulators to support higher speeds and higher resolution encoders.

The following summarizes the necessary MPC processor types for options and features:

Multiple setup overlay tables: Type 6 or higher. Both Type 6 and Type 14 provide the necessary scratch RAM to retain these additional setup tables. Type 6 can only store data for Overlay Table #1, while Type 14 has the necessary non-volatile memory to retain the values in tables 1, 2, 3, and 4 when power to the control is removed.

Multitasking option: Supports single entry LOAD / STORE operations from serial devices, EDIT, NEST, and other operations while cutting on Type 4 processor hardware. Requires Type 6 or Type 14 to LOAD / STORE from RAM CARTRIDGE while cutting.

Background option: Requires Type 6 or higher processor hardware in order to be enabled.

Marker Font Generator option: Requires Type 6 or higher processor hardware in order to be enabled.

Command Messages option: Requires Type 6 or higher processor hardware in order to be enabled.

Floppy Support option: Although Type 6 or higher processor hardware is not required to enable the option, it is highly recommended. Without sufficient scratch RAM, the BURNY Floppy Directory operations are slow.

FPC Versions:

The first number after the FPC VERSION identifies the graphic card hardware type. The second number after the FPC VERSION identifies how many alternate languages are installed.

It is important that serial number, MPC, and FPC date codes be supplied when calling the factory for assistance. The numbers next to the versions should also be provided when calling for assistance.

Custom Banner Screen:

If you have enabled the CUSTOM BANNER SCREEN in SYSTEM SETUP DATA variable 38 and have created a file that is stored in the ASCII DATA directory as "BANNER.DAT", the custom banner screen will be displayed before the SYSTEM BANNER SCREEN. If either of these conditions are not met, only the standard banner screen will be displayed.

The custom banner screen file can be created either on-line with the TEXT EDITOR or off-line and then loaded into the ASCII DATA directory. The custom banner screen file uses the same header and termination record formats as other ASCII DATA files, but uses special record formats to specify commands and text.

This file must begin with "BA100000" (see the example that follows) and uses special file commands.

These file commands are as follows:

CA	This is a "clear all " command, and clears the portion of the screen used for custom banner (21 rows and 68 columns).
CCnn	This clears column nn, where nn is 2 to 69.
CRnn	This clears row nn, where nn is 2 to 22.
Dnn	This delays execution by nn seconds (1 to 99).

Note that usable columns are numbered 2 through 69 (2 is at the left side of the screen). Usable rows are numbered 2 through 22 (2 is at the top of the screen). Row and column limits cannot be exceeded, or an error condition will terminate the CUSTOM BANNER process. Additionally, the column position plus the string length, adjusted for single or double width characters, must not exceed the column limit or a "Column Error" message will be displayed.

A command in the form of:

color/csize/attribute/row/column/text_string

is used to define the text or block characters for display, where:

"color" is a single letter

B	is used for BLUE
C	is used for CYAN
G	is used for GREEN
M	is used for MAGENTA
R	is used for RED
Y	is used for YELLOW
W	is used for WHITE

"csize" is a single digit defining the character size

0	is single height, single width
1	is single height, double width
2	is double height, single width
3	is double height, double width

"attribute" is a single digit that specifies whether the character string should be displayed as is or displayed by a fully lighted cell

0	is normal display
1	is graphic display

"row" specifies the row number in which the character string is displayed (2 to 22)

"column" specifies the column number where the display begins (2 to 69)

and

"text_string" contains the text to be displayed.

***** NOTE *****

If you are using the PROGRAM TEXT EDITOR, the line length in the editor may be too short to create or edit lines in the custom banner screen file, If so, these lines will have to be broken into two command lines. Also, extra space characters at the end of a command line can cause the CUSTOM BANNER process to display the "Column Error" message.

Custom Banner Screen Example:

A simple custom banner screen program example follows. In this example, a green block is drawn using a "block" character and the text "CMC - BURNY 5" is displayed in the block using double high, double wide yellow characters. Then, after a short delay, red block characters are displayed in the four corners of the banner screen's usable area.

```
D
PBA100000 (CUSTOM BANNER SCREEN EXAMPLE)
CA
G/0/1/5/10/##################################################
G/0/1/6/10/#                                                #
G/0/1/7/10/#                                                #
G/0/1/8/10/#                                                #
G/0/1/9/10/#                                                #
G/0/1/10/10/#################################################
Y/3/0/8/22/CMC - BURNY 5
D05
R/0/1/2/2/#
R/0/1/2/69/#
R/0/1/22/2/#
R/0/1/22/69/#
/*
```

1.5. OPTION CODES (DISPLAY DATA MENU)

This function allows the user to display the option lockout code values currently defined in the system. No "modification" operations are allowed. For additional details, see the SETUP/CONFIGURATION menu OPTION ENABLE function. To return to the previous menu, press the <CE> key.

1.6. CUSTOM AUXILIARY CODES (DISPLAY DATA MENU)

This function allows the user to display, but not modify, the CUSTOM AUXILIARY CODE table values defined in the system. After being selected from the DISPLAY DATA menu, the first 40 definitions are immediately displayed using a 2-column format. Additional definitions are displayed by paging through the list with the <I> and <II> keys. To return to the previous menu, press the <CE> key.

1.7. FPC MEMORY DATA (DISPLAY DATA MENU)

This function allows the user to inspect, but not modify, internal system memory in the front panel graphics controller. It is provided for "troubleshooting" and diagnostic operations. After being selected from the DISPLAY DATA menu, additional prompts are issued by this function to address the data to be displayed and the display format to be used. For additional details, see the DIAGNOSTIC SUPPORT menu FPC MEMORY INSPECT/MODIFY function. To exit this function and return to the DISPLAY DATA menu, press <CE> one or more times.

1.8. MPC MEMORY DATA (DISPLAY DATA MENU)

This function allows the user to inspect, but not modify, internal system memory in the main process controller. It is provided for "troubleshooting" and diagnostic operations. After being selected from the DISPLAY DATA menu, additional prompts are issued by this function to address the data to be displayed and the display format to be used. For additional details, see the DIAGNOSTIC SUPPORT menu MPC MEMORY INSPECT/MODIFY function. To exit this function and return to the DISPLAY DATA menu, press <CE> one or more times.

2. DISPLAY/EDIT/NEST (UTILITIES MENU)

The DISPLAY/EDIT/NEST utility menu provides access to several special functions that can be used to inspect and modify internally resident programs in any of the standard and custom program formats (WORD ADDRESS, ESSI, GENERIC, etc.). The program editor found in this menu can also be used to create new programs. The graphic nest editor allows internally resident NC part programs to be graphically assembled into a large nested part for more efficient plate usage.

NOTE

A "Password Protection" capability can be enabled to prevent unauthorized users from using the PROGRAM TEXT EDITOR and the GRAPHIC NEST EDITOR utility functions. When enabled, an "ENTER PASSWORD:" prompt appears on the screen whenever these functions are selected from the DISPLAY/EDIT PROGRAM menu. To continue, the user must enter the same 3 digit password used to gain entry to the SETUP/CONFIGURATION menu (the default password from the factory is the last three digits of the system's serial number in reverse order). This feature is enabled through SYSTEM SETUP DATA variable 38, SYSTEM CONFIGURATION 2. See the SYSTEM SETUP DATA VARIABLES section for additional information.

The DISPLAY/EDIT PROGRAM menu appears as follows:

```
    DISPLAY/EDIT PROGRAM

1. DISPLAY PROGRAM
2. PROGRAM TEXT EDITOR
3. GRAPHIC NEST EDITOR

        SELECT (1-3)
```

2.1. DISPLAY PROGRAM (DISPLAY/EDIT PROGRAM MENU)

This function allows the operator to safely display NC part programs in any of the standard and custom program formats (WORD ADDRESS, ESSI, etc.), whatever the format used when the programs were created and/or loaded. It also allows GENERIC SHAPE MEMORY files and ASCII DATA files to be safely displayed since modifications are never allowed in this utility function.

After the program type, number and format have been selected, the first 20 lines of the program file are displayed. For others, use the <I> and <II> keys to display the previous page or next page of the program. The <1> key displays the beginning of the program. The <7> key displays the end of the program.

NOTE

When displaying a large program, the <7> key may cause a "PLEASE WAIT" message to be displayed. However, this message will disappear when the DISPLAY PROGRAM process has internally found the last line of the program.

The DISPLAY PROGRAM utility can also be used to graphically display NC part programs. After the NC program number has been selected, press the <V> key to display the graphic image. This can be done before or after the NC program text has been displayed on the screen.

2.2. PROGRAM TEXT EDITOR (DISPLAY/EDIT PROGRAM MENU)

This function allows the operator to edit and/or create NC part programs in any of the standard and custom program formats (WORD ADDRESS, ESSI, etc.). It also allows GENERIC SHAPE MEMORY files and ASCII DATA files to be edited and/or created.

After the program type, number and format are selected, the editor reads the entire program into the edit buffer for modification and updates the screen with the first 10 lines of the program. It also displays an EDIT command menu at the top of the screen. This menu displays the operations supported by the editor. For additional information on the use and operation of the program editor, see the PROGRAM TEXT EDITOR section in this manual.

2.3. GRAPHIC NEST EDITOR (DISPLAY/EDIT PROGRAM MENU)

This function allows the operator to create nested part programs from individual part programs already residing in NC PROGRAM MEMORY. It also allows programs created with the nest editor to be merged with other NC part programs and/or other nested part programs. For additional information on the use and operation of the graphic editor, see the GRAPHIC NEST EDITOR section in this manual.

3. DIRECTORY SUPPORT (UTILITIES MENU)

The DIRECTORY SUPPORT menu provides access to several special functions that are used to initialize and maintain "read"/"write" directory devices. A directory device is any device or memory structure supported by the BURNY 5 that can store one or more programs for later access in any order. The DIRECTORY SUPPORT menu appears as follows:

```
   DIRECTORY SUPPORT MENU

1. INSPECT DIRECTORY
2. SELECTIVE DELETE
3. CLEAR DIRECTORY
4. ERASE AND TEST
5. BACKUP DIRECTORY

        SELECT (1-5)
```

Like other menus, entries from this menu can be selected directly by pressing the numeric keys 1 through 5 or by using the up and down cursor keys to select the desired entry before pressing <ENTER>. Once selected, the associated function prompts for additional information to define the device type, program type and any other required data.

NOTE

A "Password Protection" capability has been provided to prevent unauthorized users from using the CLEAR DIRECTORY and the ERASE AND TEST utility functions. Now, whenever the ERASE AND TEST function is selected, an "ENTER PASSWORD:" prompt appears on the screen and the user must enter the 3 digit password before access to the function is allowed. "Password Protection" for the CLEAR DIRECTORY function is not automatic. It must be enabled through SYSTEM SETUP DATA variable 38, SYSTEM CONFIGURATION 2, before the password operation is activated for this function. (Like other SYSTEM SETUP DATA variables, this setup parameter must be saved in non-volatile memory to retain the protection after the next power-up is performed).

To define the device type, use the up and down cursor keys or the numeric keys to "call up" the desired response and press <ENTER>. To display the DIRECTORY DEVICE help menu, press the <IV> key while the "DEVICE TYPE:" prompt message is displayed.

```
DIRECTORY DEVICE

1. INTERNAL MEMORY
2. RAM CARTRIDGE
3. INTERNAL FLOPPY
4. EXTERNAL FLOPPY
```

The up and down cursor keys and the numeric keys can also be used to define the program type. To display the PROGRAM TYPE menu to help in the selection by direct numeric entry, press the <IV> key while the "PGM TYPE:" prompt message is being displayed. When performing INSPECT DIRECTORY and DELETE DIRECTORY operations, the PROGRAM TYPE menu appears as follows:

```
PROGRAM TYPE

1. NC PROGRAM
2. GENERIC SHAPE
3. ASCII DATA
4. REMNANT
```

When performing CLEAR DIRECTORY operations, an additional entry is defined in the PROGRAM TYPE menu to allow the user to select "ALL TYPES" as the desired program type. For additional details, see the following sections.

3.1. INSPECT DIRECTORY (DIRECTORY SUPPORT MENU)

This function allows the user to safely display, in tabular form, the number, name, size and status of all programs residing in the specified directory. No "delete" capability is provided by this function.

After this function has been selected from the DIRECTORY SUPPORT menu and the desired DEVICE TYPE and PROGRAM TYPE values are defined, the screen is updated with the first 10 entries of directory using the following format.

INSPECT DIRECTORY

DEVICE TYPE : INTERNAL MEMORY TOTAL AVAILABLE : 127712
PGM TYPE : NC PROGRAM TOTAL USED : 3360

#	PGM NUMBER	NAME	SIZE	CHSM	STAT
1	99999999-999	WEDGE PAIR	214	5A5A	4000
2	1111	STRAIGHT LUG	206	52B	4000
3	8	FLANGE	534	67BD	4000
4	20045	SPLIT RING	154	7F21	4000
5	351	LUG FRAME	194	1432	4000
6	1845	LIFT LUG	206	3C2F	4000
7	9541	SLANT SLOT	168	2234	4000
8	88888888	OCTAGON	306	E921	4000
9	1453	SQUARE	314	FC17	4000
10	1453-1	SQUARE	314	8C10	4000

The "TOTAL USED" value at the top of the screen defines the amount of INTERNAL MEMORY in bytes currently used by just the NC PROGRAM directory, not the total INTERNAL MEMORY space used. The "TOTAL AVAILABLE" value, however, defines the total amount of space available to all directories in INTERNAL MEMORY.

Additional entries in the directory list are displayed by pressing the <I> and <II> keys. The <ENTER> key is not supported by this function. To return to the previous menu, press the <CE> key.

3.2. SELECTIVE DELETE (DIRECTORY SUPPORT MENU)

Like the INSPECT DIRECTORY function, this function allows the user to display, in tabular form, the number, name, size and status of all programs residing in the specified directory. However, this function also allows the user to select and delete programs from the directory.

After this function has been selected from the DIRECTORY SUPPORT menu and the DEVICE TYPE and PROGRAM TYPE values are defined, this function immediately displays the first 10 directory entries using the following format. Additional entries are displayed by pressing the <I> and <II> keys or by stepping past the top or bottom of the page with the up and down cursor keys.

DELETE DIRECTORY ENTRY

DEVICE TYPE : INTERNAL MEMORY TOTAL AVAILABLE : 127712
PGM TYPE : NC PROGRAM TOTAL USED : 3360

#	PGM NUMBER	NAME	SIZE	CHSM	STAT
1	99999999-999	WEDGE PAIR	214	5A5A	4000
2	1111	STRAIGHT LUG	206	52B	4000
3	8	FLANGE	534	67BD	4000
4	20045	SPLIT RING	154	7F21	4000
5	351	LUG FRAME	194	1432	4000
6	1845	LIFT LUG	206	3C2F	4000
7	9541	SLANT SLOT	168	2234	4000
8	88888888	OCTAGON	306	E921	4000
9	1453	SQUARE	314	FC17	4000
10	1453-1	SQUARE	314	8C10	4000

DELETE PGM **1845**

A program is deleted from the list by first selecting it with the paging keys (<I> or <II>) or the cursor keys (up and down) and pressing <ENTER>. This causes the "DELETE PGM 1845" message to change to "DELETE PGM 1845 ? NO" and the line containing the selected number to turn YELLOW. Then, to delete the program, press the up or down cursor key or the <+/-> key to change the "NO" to "YES" and press <ENTER>. When the operation is complete, the directory list is updated to remove the deleted entry and the prompt line is updated to allow additional programs to be selected for deletion. The "TOTAL AVAILABLE" and "TOTAL USED" values at the top of the screen are also updated to reflect the change in usage. To return to the previous menu, press <CE>.

This function is not supported during RUN. If this functions is used while the RUN mode is active, the message "NOT ENABLED DURING RUN" is displayed.

3.3. CLEAR DIRECTORY (DIRECTORY SUPPORT MENU)

This function allows the user to delete all programs residing in a specific program directory. Like other DIRECTORY SUPPORT operations, this function requires the user to first define the DEVICE TYPE.

NOTE

A "Password Protection" capability can be enabled to prevent unauthorized users from using the CLEAR DIRECTORY utility function. See the overview description in the DIRECTORY SUPPORT section for additional information.

The "directory type" devices that are supported allow several directory lists to be maintained on each device. Currently, four directory lists are supported on each directory device. These are for NC PROGRAMS, GENERIC SHAPES, ASCII DATA files and REMNANTS. (The REMNANT directory is currently unused). This prevents programs in NC PROGRAM MEMORY and GENERIC SHAPE MEMORY from being intermixed when stored to a RAM CARTRIDGE or any other directory device that may be supported in the future.

When specifying the PROGRAM TYPE in a CLEAR DIRECTORY operation, one additional choice appears in the HELP menu that allows the user to clear all programs from a directory device whatever the program type. This menu appears as follows:

```
PROGRAM TYPE

1. NC PROGRAM
2. GENERIC SHAPE
3. ASCII DATA
4. REMNANT
5. ALL TYPES
```

After the PROGRAM TYPE is defined, the screen is immediately updated using the following format.

```
                    CLEAR DIRECTORY

DEVICE TYPE : RAM CARTRIDGE

PGM TYPE    : GENERIC SHAPE



TOTAL AVAILABLE : 127712

TOTAL USED      : 3360



ARE YOU SURE ? NO
```

NOTE

The "TOTAL USED" value displays the total space used on the directory device when "ALL TYPES" is the selected program type. Otherwise, "TOTAL USED" only reflects the space used by the selected program type. "TOTAL AVAILABLE" always shows the total space available in the directory device since no artificial size limits are defined for any of the supported directory lists. Directory size is only limited by the amount of physical space available on the device.

To delete all of the programs in the selected directory, press the up or down cursor key or the <+/-> key to change the "NO" to "YES" and press <ENTER>. When the operation is complete, the screen updates to reflect the new "AVAILABLE" and "USED" values for the selected program directory. To return to the previous menu, press the <CE> key.

This function is not supported during RUN. If this functions is used while the RUN mode is active, the message "NOT ENABLED DURING RUN" is displayed.

3.4. ERASE AND TEST (DIRECTORY SUPPORT MENU)

This function allows the user to erase, initialize and test the directory device. Unlike the CLEAR DIRECTORY function, this function always clears all of the programs, whatever the program type.

For INTERNAL MEMORY, this function also clears all of the CUSTOM AUXILIARY CODE table definitions that are also saved in internal memory. Thus, this function should only be done on internal memory when it is absolutely necessary.

For the internal and external BURNY FLOPPY DISK devices, this ERASE AND TEST function not only initializes and tests the operation of the floppy controller but also performs a "FORMAT" operation on any disk installed in the unit. Both high and low density disk formatting operations are supported. After the "FORMAT" operation, this function then writes a configuration file to the disk to verify disk read/write operations. This file can also later be used to automatically re-configure the floppy controller by applying power to the unit with this disk installed. When the ERASE AND TEST operation is complete, the screen is updated with the "AVAILABLE" and "USED" byte sizes for the floppy disk. For additional information, see the FLOPPY SUPPORT section in this manual.

NOTE

A "Password Protection" capability has been provided to prevent unauthorized users from using the ERASE AND TEST function. See the overview description in the DIRECTORY SUPPORT section for additional information.

After this function has been selected from the DIRECTORY SUPPORT menu and the DEVICE TYPE is selected using the appropriate numeric keys or the up and down cursor keys and pressing <ENTER>, this function opens the selected device to find out the current "AVAILABLE" and "USED" allocations and updates the screen accordingly.

NOTE

When performing this initial access an error will be displayed if the device data is unreadable. This, however, does not prevent the operator from performing the ERASE AND TEST operation.

After opening the selected device, the screen displays the following:

```
                    ERASE AND TEST DIRECTORY
DEVICE TYPE : INTERNAL MEMORY

    .

TOTAL AVAILABLE : 127712
TOTAL USED      : 3360



ARE YOU SURE ? NO
```

To perform the ERASE AND TEST operation, change the "NO" to "YES" using the up and down cursor keys or <+/-> key and press <ENTER>. As the operation is performed, the screen is updated to display an INDEX and an OFFSET value. For the INTERNAL MEMORY and RAM CARTRIDGE, the OFFSET shows the address being tested. For FLOPPY, these values only approximate the status of the "FORMAT" operation.

NOTE

Due to the number of tests performed and/or the large quantity of memory, several minutes may be required to complete the ERASE AND TEST operation. For example, performing the operation on 256k bytes of INTERNAL MEMORY requires approximately 40 seconds.

When the operation is complete, the display is updated to reflect the new "AVAILABLE" and "USED" byte size values for the selected device. To return to the previous menu, press the <CE> key.

This function is not supported during RUN. If this functions is used while the RUN mode is active, the message "NOT ENABLED DURING RUN" is displayed.

3.5. BACKUP DIRECTORY (DIRECTORY SUPPORT MENU)

The BACKUP DIRECTORY utility function allows all of the programs from a selected internal directory, which do not have program number extensions, to be saved with a single operator request to the internal or external BURNY FLOPPY or any other external SERIAL DEVICE. Each directory type can be selected and backed up individually. Programs are transferred one at a time to the selected device as separate files so that individual files can later be recalled using the normal LOAD function. Program files are saved sequentially as they appear in the BURNY 5 directory list.

Once the BACKUP DIRECTORY function is started, the process continues until all programs have been stored or the operator aborts the operation with the <RST> or <CE> key. When a duplicate program number exists on the backup device, such as the BURNY FLOPPY or the FILE SERVER, the existing program is automatically replaced with the new backup file.

For additional information, see the "BACKUP DIRECTORY FILES" section in this manual.

4. SETUP/CONFIGURATION (UTILITIES MENU)

This menu provides access to several system data setup and system configuration data utilities that are used to define the operating parameters of the system. As such, access to this menu is protected by a 3-digit password to prevent unauthorized modification of these values. To get to this menu from the UTILITIES menu, the user must first select the SETUP/CONEIGURATION entry and then, in response to the "ENTER PASSWORD:" prompt, type the 3-digit password and press <ENTER>.

NOTE

The factory default 3-digit password is the last three digits of the system's serial number, which are used in reverse order. For example if the serial number is 12345678, the 3-digit password is 876.

If an incorrect password is entered, the UTILITIES menu remains displayed. Otherwise, the SETUP/CONFIGURATION menu is immediately displayed as follows:

```
        SETUP/CONFIGURATION

  1. SYSTEM SETUP DATA
  2. OPTION ENABLE
  3. AXIS SPEED CALIBRATION
  4. FEEDRATE REF. CALIBRATION
  5. CUSTOM AUXILIARY CODES
  6. SAVE CONFIGURATION DATA
  7. OVERLAY TABLE DATA

          SELECT (1-7)
```

Like other menus, entries from this menu can be selected directly by pressing the numeric keys 1 through 7 or by using the up and down cursor keys or the <+/-> key to select the desired entry before pressing <ENTER>. Once selected, the associated function prompts for additional information. For additional details, see the following sections.

NOTE

Most of the functions available through this menu allow the user to calibrate and/or adjust operational values used by the system. When these values are changed, only the values being used in operating memory are changed, not the permanently stored values in non-volatile memory. Thus to permanently retain these values, the user must perform the SAVE CONFIGURATION DATA operation before machine power is removed.

4.1. SYSTEM SETUP DATA (SETUP/CONFIGURATION MENU)

This function allows the user to display and modify the operating parameters used by the control and thus, optimize its operation for a particular machine. Other parameters are also defined by this function to assign system defaults for "serial" program storage devices, the CUSTOM PROGRAM FORMAT definition enable, and other miscellaneous features.

When the SYSTEM SETUP DATA function is first entered from the SETUP/CONFIGURATION menu, the first 10 parameter entries are immediately displayed. Additional entries can be displayed by paging through the parameter list with the <I> and <II> keys or by stepping past the top or bottom of the page with the up and down cursor keys. A solid block cursor (in WHITE) appears on the left side of the screen to show the current line position.

To modify a parameter value, first select the desired entry using the paging keys (<I> and <II>) and/or the cursor keys (up and down) and press <ENTER>.

NOTE

> While the cursor is being displayed on the left side of the screen, it is also possible to directly enter the parameter number (followed by <ENTER>) and quickly skip to a desired position in the list.

Once the cursor is positioned at the desired entry, pressing <ENTER> causes the cursor block on the left side of the display to disappear and the value on the right side to be highlighted in WHITE. Once the value field is selected, the numeric keys can be used to enter new numeric values, and the cursor keys (up and down) or the <+/-> key can be used to "toggle" non-numeric values. While entering a new value, the <CE> key can be used to clear the existing value. After the new value is entered, pressing <ENTER> again restores the value field to its original color and causes the cursor to reappear on the left side of the screen. To return to the previous menu, press the <CE> key. For a description of the SYSTEM SETUP DATA variables, see the SYSTEM SETUP DATA VARIABLES section in this manual.

4.2. OPTION ENABLE (SETUP/CONFIGURATION MENU)

This function allows the user to enable and disable the use of special features in the control. To enable a feature, a special "key" value must be entered into the appropriate position in the option lockout table. Since an incorrect value can disable a currently enabled feature, this function should only be attempted by qualified users. To return to the previous menu, press the <CE> key. This function is not supported during RUN. If this functions is used while the RUN mode is active, the message "NOT ENABLED DURING RUN" is displayed.

For additional information, see the OPTION ENABLE section in this manual.

4.3. AXIS SPEED CALIBRATION (SETUP/CONFIGURATION MENU)

This function allows the user to perform a calibration process that balances the servo outputs of the control. The calibration process actually performs 4 speed calibrations, each at a different speed. In this way, any differences between high and low speed operation of the machine can be adapted to. At the completion of the process, the calibration values are only stored in the operating memory of the control. Therefore, to permanently retain these values, the user must perform the SAVE CONFIGURATION DATA operation before machine power is removed.

NOTE

To reset the calibration tables for "no servo output adjustment", simply select the SPEED CALIBRATION function, set the speed dial to full reference and press <ENTER> as instructed by the screen. Then, instead of pressing the <GO> key, press <RST> to stop the process with all values reset to their initialized values.

4.4. FEEDRATE REF. CALIBRATION (SETUP/CONFIGURATION MENU)

This function allows the user to calibrate the input circuitry that converts the voltage from the user's speed dial into the numerical feedrate value used by the system. This operation only needs to be performed when the system is first installed or when service work on the tracing system alters the speed dial voltage.

To perform the calibration, turn the speed dial to "full speed", set any high/low speed range switches to high speed and press <ENTER>. At the completion of the process, the feedrate calibration value is only stored in the temporary operating memory of the control. The feedrate calibration value must be saved in non-volatile memory. Therefore, to permanently retain this value, the user must perform the SAVE CONFIGURATION DATA operation before machine power is removed.

4.5. CUSTOM AUXILIARY CODES (SETUP/CONFIGURATION MENU)

This function allows the user to define special CUSTOM AUXILIARY CODES to use with WORD ADDRESS and ESSI programming formats. Any external "M," "G," or ESSI function code can be re-defined as an internally supported operation code. (Only codes that are different need to be re-defined.)

This feature is enabled through SYSTEM SETUP DATA variable 51, STANDARD PROGRAM FORMAT, and/or variable 52, CUSTOM PROGRAM FORMAT. See SYSTEM SETUP DATA VARIABLES in this manual.

The user is first prompted for TABLE NUMBER. Type the index into the table and press <ENTER>. The user is then prompted for the code type. Choose from a list or type "0" for none, "1" for an ESSI function, "2" for a WORD ADDRESS "G" function, or "3" for a WORD ADDRESS "M" function. Press <ENTER>.

The user is then prompted for the CODE VALUE. This is the program's code that you wish to re-define. Type the value and press <ENTER>.

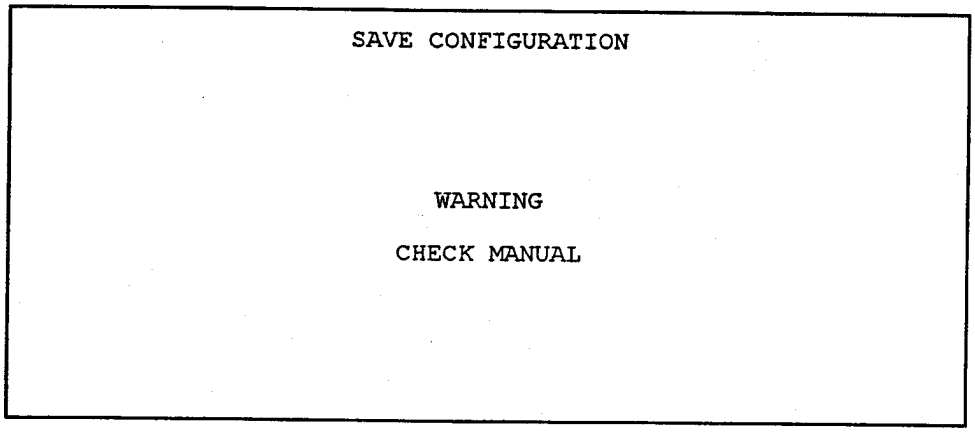
The user is then prompted for the FUNCTION NUMBER. This is the internally supported operation code. Choose from a list or type in the number. The FUNCTION NAME will be displayed along with the FUNCTION NUMBER. See the following list for supported internal functions.

AUXILIARY FUNCTION CODE INTERNAL NUMBER / NAME

0. NO OPERATION
1. CW ARC
2. CCW ARC
3. CHAIN TOP
4. CHAIN BOTTOM
5. CUT OFF
6. CUT ON
7. KERF OFF
8. KERF LEFT
9. KERF RIGHT
10. MARKER 1 OFF
11. MARKER 1 ON
12. OFFSET 1 OFF
13. OFFSET 1 ON
14. INCH DIMENSIONS
15. MM DIMENSIONS
16. ABS. PROGRAM DIM.
17. ABS. POS. REG. LOAD
18. INCR. PROGRAM DIM.
19. PROGRAMMABLE DWELL
20. LEAD-IN DIM. MOVE
21. PROGRAM STOP
22. PROGRAM END
23. PGM. END W/RWIND
24. PGM. DATA SKIP ON
25. PGM. DATA SKIP OFF
26. MARKER 2 ON
27. MARKER 2 OFF
28. OFFSET 2 ON
29. OFFSET 2 OFF
30. CUT SPEED MODE
31. HIGH SPEED MODE
32. XF BEFORE MOVE/RUN
33. XF AFTER MOVE/WAIT
34. EXT. VARIABLE LOAD
35. X AXIS HOME
36. Y AXIS HOME
37. X HOME DIM. RETURN
38. Y HOME DIM. RETURN
39. MULTI SETUP SELECT
40. AUX OUTPUT 1 ON
41. AUX OUTPUT 1 OFF
42. AUX OUTPUT 2 ON
43. AUX OUTPUT 2 OFF
44. AUX OUTPUT 3 ON
45. AUX OUTPUT 3 OFF
46. AUX OUTPUT 4 ON
47. AUX OUTPUT 4 OFF
48. AUX INPUT 1 ON
49. AUX INPUT 1 OFF
50. AUX INPUT 2 ON
51. AUX INPUT 2 OFF
52. AUX INPUT 3 ON
53, AUX INPUT 3 OFF
54. AUX INPUT 4 ON
55. AUX INPUT 4 OFF
56. PART INCREMENT
57. PROGRAMMED FEEDRATE
58. HOME OFFSET
59. PROGRAMMED KERF
60. AUX STATE RESET
61. NO MIRROR, NO SWAP
62. MIRROR Y, NO SWAP
63. MIRROR XY, NO SWAP
64. MIRROR X, NO SWAP
65. SWAP XY, MIRROR XY
66. SWAP XY, MIRROR X
67. SWAP XY, NO MIRROR
68. SWAP XY, MIRROR Y
69. MASTER TORCH ON
70. MASTER TORCH OFF
71. INC LINE IN2 MM0
72. INC CW ARC IN2 MM0
73. INC CCW ARC IN2 MM0
74. INC LINE IN3 MM1
75. INC CW ARC IN3 MM1
76. INC CCW ARC IN3 MM1
77. ABS LINE IN2 MM0
78. ABS CW ARC IN2 MM0
79. ABS CCW ARC IN2 MM0
80. ABS LINE IN3 MM1
81. ABS CW ARC IN3 MM1
82. ABS CCW ARC IN3 MM1
83. X SIGN TOGGLE
84. Y SIGN TOGGLE
85. XY SWAP TOGGLE
86. OFFSET 3 ON
87. OFFSET 3 OFF
88. OFFSET 4 ON
89. OFFSET 4 OFF
90. OFFSET 5 ON
91. OFFSET 5 OFF
92. OFFSET 6 ON
93. OFFSET 6 OFF
94. OFFSET 7 ON
95. OFFSET 7 OFF
96. OFFSET 8 ON
97. OFFSET 8 OFF
98. HT. SENSOR DISABLE
99. HT. SENSOR ENABLE
100. OVERLAY SETUP TBL 1
101. OVERLAY SETUP TBL 2
102. OVERLAY SETUP TBL 3
103. OVERLAY SETUP TBL 4
104. INT. VARIABLE LOAD

4.6. SAVE CONFIGURATION DATA (SETUP/CONFIGURATION MENU)

This function is used to permanently store the currently defined SYSTEM SETUP DATA, FEEDRATE CALIBRATION, SPEED CALIBRATION and other internal values in non-volatile memory. When this function is selected from the SETUP/CONFIGURATION menu, the following screen is immediately displayed.



If any key other than the <SHF> key is pressed, the function is canceled and the previous menu (or main menu) is displayed. However, when the <SHF> key is pressed, the last line of the window displays the "SAVE CONFIGURATION : NO" prompt message as a verification. To continue with the SAVE operation, use the up or down cursor key or <+/-> key to "toggle" the "NO" response to "YES" and press <ENTER>. When the operation has been completed, press the <CE> or <ENTER> key to return to the previous menu.

4.7. OVERLAY TABLE DATA (SETUP / CONFIGURATION MENU)

The OVERLAY TABLE DATA feature allows a main table and four overlay tables, each containing SYSTEM SETUP DATA parameters associated with machine performance characteristics, to be defined in the system at the same time. Table 0 is the main table, which contains the default values defined and accessed through the SYSTEM SETUP.DATA utility.

OVERLAY TABLES contain the following 13 parameters. Note that the number to the left of each parameter is its position in the SYSTEM SETUP DATA table.

4) LOOP GAIN
5) ACCELERATION TIME
6) CORNER SPEED
7) SLOWDOWN DISTANCE
8) SLOWDOWN RADIUS
14) MINIMUM OFF TIME
15) DEFAULT DWELL
17) RUN SPEED LIMIT
81) HEIGHT SENSOR DISABLE DISTANCE
82) MINIMUM RADIUS SPEED
83) MINIMUM SLOWDOWN ANGLE
84) MAXIMUM SLOWDOWN ANGLE
85) START DELAY TIME

Setup Information:

OVERLAY TABLE variables are displayed and modified through the SETUP/CONFIGURATION menu. Changes to the OVERLAY TABLE variables only modify the values in operating memory, not the permanently stored values in non-volatile memory. To permanently retain changes to these values, you must perform the SAVE CONFIGURATION DATA operation while not actively running a part program. Otherwise, any changes that have been made will be lost when power to the control is removed.

After selecting "7. OVERLAY TABLE DATA" from the SETUP/CONFIGURATION menu, you will be prompted for the overlay table number. Table 0 is the default, and if you press <ENTER> you will immediately enter the overlay table setup process. If Table 1 through 4 is specified, you will be asked if you want the table's variables to be re-initialized with the default values from Table 0. Toggle the "YES" or "NO" switch and press <ENTER> to go to the overlay table setup process.

When you enter the overlay table setup process, the screen is updated with the first 10 entries of the selected table. Use the up and down paging keys (I and II) or the up and down cursor keys to display the other values in the table.

You can also use the left and right cursor keys to display values from other overlay tables. A "T#:" value to the left of each numeric value identifies the table number of the displayed overlay values. You can display, compare, and adjust all of the values in all of the overlay tables without exiting the overlay table setup process.

Although the setup operations performed on the OVERLAY TABLE data are accessed through a separate utility, almost all of the internal operations treat this data as part of the SYSTEM SETUP DATA. As such, both the SYSTEM SETUP DATA and the OVERLAY TABLE DATA setup processes perform the same ASCII FILE build and restore operations when selected by the ZOOM UP and ZOOM DOWN keys. Both processes build a single ASCII DATA file containing all of the SYSTEM SETUP DATA and all of the OVERLAY TABLE DATA. In these files, a special variable number format is used to identify both the setup variable number and the table number when necessary. This allows existing ASCII DATA files that retain a backup image of the SYSTEM SETUP DATA to still be compatible with the current software. All newly created ASCII DATA backup files simply contain additional entries for the four overlay tables.

Hardware Limitations:

Although all four of the new overlay data tables can be setup and saved in non-volatile memory in the latest MPC processor hardware version (Type 14), they cannot in older versions.

MPC Processor Type 6 only has enough non-volatile space for the main table (Table 0) and one overlay table (Table 1). As a result, overlay tables 2 through 4 are always built in RAM at power-up using the values from Table 0. You can still use all four overlay tables, but only after manually re-entering the desired values into tables 2 through 4, or by using the ASCII DATA file transfer process to redefine the required overlay table values after each power-up.

MPC Processor Type 4 does not have enough RAM to hold any of the four overlay data tables. In this hardware, the default Table 0 values are always used. Any attempt to use overlay data tables will by rejected by the system.

Accessing OVERLAY TABLE DATA:

Tables 1 through 4 can be selected by one of the following:

1. An auxiliary function in an NC program
2. Direct selection from the RUN SETUP screen
3. Automatic selection based on the PLASMA SELECT input

1. OVERLAY DATA TABLE selection by auxiliary function in an NC program:

By default, every part program starts by selecting Table 0, but the default can be overridden by selecting a different table through an auxiliary function code. You can use any or all five setup tables in a single part program.

You can choose the tables by auxiliary function through one of two formats.

The first, and most direct, format is to use one of the following standard auxiliary function assignments:

	WORD ADDRESS	ESSI
TABLE 0 SELECT:	G46	65
TABLE 1 SELECT:	G247	266
TABLE 2 SELECT:	G248	267
TABLE 3 SELECT:	G249	268
TABLE 4 SELECT:	G250	269

This technique can also be used with any WORD ADDRESS M or G value or ESSI function value assigned through CUSTOM CODE CONVERSION. This allows programs written for other NC controls that use tool select function codes to use these codes as OVERLAY DATA TABLE select codes. The CUSTOM AUXILIARY CODE conversion process identifies these internal functions by the following index values:

39: TABLE SELECT 0
100: TABLE SELECT 1
101: TABLE SELECT 2
102: TABLE SELECT 3
103: TABLE SELECT 4

The second format allows the function code for TABLE SELECT 0 to be used as a base code, which is then followed by an additional data field. The overlay tables are selected as follows:

	WORD ADDRESS	ESSI
TABLE 0 SELECT:	G46T0	65+0
TABLE 1 SELECT:	G46T1	65+1
TABLE 2 SELECT:	G46T2	65+2
TABLE 3 SELECT:	G46T3	65+3
TABLE 4 SELECT:	G46T4	65+4

With this format, the base code can also be reassigned to any required value using the CUSTOM CODE CONVERSION utility. That is, any value assigned to the TABLE SELECT 0 function can be used as Table 0 (with no extra field) or may be followed by an additional field identifying the number of the desired overlay table.

2. Direct operator OVERLAY DATA TABLE selection:

The OVERLAY TABLE PROMPT must be enabled in SYSTEM CONFIGURATION 2 (variable 38). See SYSTEM SETUP DATA VARIABLES in this manual.

When enabled, you can choose any of the five possible tables from the RUN SETUP screen. The RUN SETUP screen displays an additional prompt line: "OVERLAY TABLE NUMBER : ___." The default for this prompt is usually "0" but if the program uses an auxiliary function to select a different table, that table number is displayed.

The displayed value may be changed at this prompt, and will cause the entire program to use this specified table, overriding any and all table assignments made by auxiliary functions. Once selected by this prompt, the OVERLAY DATA TABLE remains in effect until you directly change it again.

3. Automatic TABLE 1 SELECT in PLASMA mode:

You can use Table 1 automatically in the PLASMA mode. This allows all existing programs and programs created by LOAD SHAPE or TEACH to use Table 1 for PLASMA operations and Table 0 for OXY / FUEL operations, without any additional prompts.

AUTO SELECT OVERLAY TABLE 1 WITH PLASMA must be enabled by SYSTEM CONFIGURATION 3 (variable 39). See SYSTEM SETUP DATA VARIABLES in this manual. Additionally, the NC program cannot contain any auxiliary function codes to select a different table. When these conditions are met, the BURNY 5 will automatically select Table 0 or Table 1 depending on the state of the PLASMA SELECT input.

The PLASMA SELECT input must be set before leaving the RUN SETUP screen. If it is not, the setup operation will be performed using the wrong table.

When this feature is used, both the mode field (MODE: OXYGEN or PLASMA) and the table index field (TBL: 0 or 1) in the status window can be used to verify that the proper table has been selected. Table 0 should be selected for OXYGEN mode, and Table 1 should be selected for PLASMA mode (provided the feature is enabled, the cut mode has been selected before leaving the RUN SETUP screen, and you have not overridden the automatic assignment).

Note that the AUTOMATIC TABLE select feature can be used with or without the OVERLAY TABLE PROMPT enabled in SYSTEM CONFIGURATION 2. If it is, direct selection of Table 2, 3, or 4 overrides the state defined by the PLASMA SELECT input. Only a direct selection of Table 0 or 1 allows the automatic selection function to operate normally.

5. DIAGNOSTIC SUPPORT (UTILITIES MENU)

This menu provides access to several system diagnostic displays and system memory modification utilities. As such, access to this menu is protected by a 5-digit password to prevent unauthorized modification of the system. To get to this menu from the UTILITIES menu, the user must first select the DIAGNOSTIC SUPPORT entry and then, in response to the "ENTER PASSWORD": prompt, type the five digit password and press <ENTER>.

NOTE

The actual 5-digit password used is defined by the last four digits of the system's serial number, which are used in reverse order, and the <I> key. For example if the serial number is 12345678, the 5-digit password is 8765I.

If an incorrect password is entered, the UTILITIES menu remains displayed. Otherwise, the following DIAGNOSTIC SUPPORT menu is immediately displayed.

```
        DIAGNOSTIC SUPPORT

1. RUNTIME DATA INSPECT/MODIFY
2. BIT MEMORY INSPECT/MODIFY
3. FPC DIAGNOSTIC DATA
4. MPC DIAGNOSTIC DATA
5. FPC MEMORY INSPECT/MODIFY
6. MPC MEMORY INSPECT/MODIFY
7. FPC TASK DEBUGGER

          SELECT (1-7)
```

Like other menus, entries from this menu can be selected directly by pressing the numeric keys 1 through 7 or by using the up and down cursor keys to select the desired entry before pressing <ENTER>. Once selected, the associated function either prompts for additional information or immediately displays the required data. When necessary, data is continuously re-displayed to show values as they change. Update rates are dependent upon the amount of data being displayed. Typically, display updates are performed once or twice a second.

6. SETUP/LOAD/STORE (UTILITIES MENU)

This menu provides access to operations that allow the user to more efficiently perform LOAD/SETUP/KERF operations in a "BATCH" processing mode. With the necessary options enabled, MULTITASKING and BACKGROUND LOAD and STORE operations from the BURNY FLOPPY and other external serial device can also be performed through this menu while cutting operations are still in progress.

When selected from the UTILITIES menu, the following menu is immediately displayed.

```
        SUPPORT MENU

1. SETUP/KERF SUPPORT
2. LOAD SUPPORT
3. STORE SUPPORT

        SELECT (1-3)
```

For additional information on SETUP/KERF operations, see the BATCH SETUP/KERF section in this manual.

The UTILITY LOAD and UTILITY STORE operations performed through this menu operate identically to the MAIN MENU operations when the MULTITASKING and/or BACKGROUND options are not enabled. Without these options enabled, access to these functions is only allowed when not actively running. Otherwise, the message "NOT ENABLED DURING RUN" will be displayed and access will be denied.

With MULTITASKING option enabled, the UTILITY LOAD and UTILITY STORE functions allow the user to read and write program files from and to any enabled serial device and/or BURNY FLOPPY device while actively cutting. However, MULTITASKING still only allows one LOAD or STORE operation to be requested at a time. The BACKGROUND option further extends this capability by allowing up to 30 UTILITY LOAD operations and 30 UTILITY STORE operations to be queued up for processing while running. BACKGROUND also allows the operator to return to the running process screens while the queued up operations are performed. A special status line at the bottom of the status window allows the operator to monitor the active BACKGROUND LOAD/STORE operations from the running process screens and most of the utility screens.

For additional information on LOAD and STORE operations while actively running a part program, see the MULTITASKING and BACKGROUND sections in the manual.

PROGRAM TEXT EDITOR

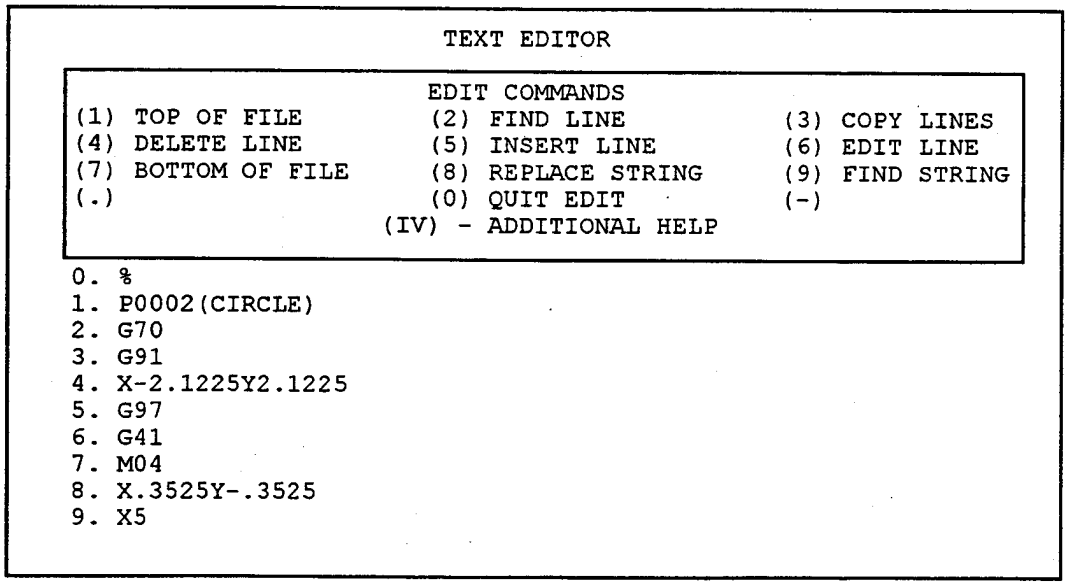
The BURNY 5 ASCII TEXT EDITOR allows the operator to edit an existing program in any of the standard and custom program formats (WORD ADDRESS, ESSI, etc.). It can also be used to create a new NC part program and supports operations on SHAPE programs written in the special GENERIC SHAPE programming language. The text editor can also perform operations on files in the ASCII DATA directory.

The first prompt displayed when "PROGRAM TEXT EDITOR" is selected from the "DISPLAY/EDIT PROGRAM" menu, is the "PROGRAM TYPE :" prompt. Select the directory of the program to edit. This choice comes from the following list:

1. NC PROGRAM
2. GENERIC SHAPE
3. ASCII DATA
4. REMNANT

Press the <ENTER> key when the desired entry is displayed. The next prompt is for the program number of the program to edit. Use the scroll keys or directly enter the program number and press the <ENTER> key to select it.

After the program type, number and format are selected, the screen is updated with the EDIT command menu and the first 10 lines of the program. The following example assumes that the WORD ADDRESS format was selected.



The line cursor (which is positioned to the left of the first line number) identifies the currently selected line. It can be moved from line to line with the <UP> and <DOWN> cursor keys. When the cursor is moved passed the last displayed line, the next 10 program lines are displayed. When the cursor is moved up past the first line displayed, the previous 10 lines are displayed. The <1> key can be used to move the cursor to the beginning of the program (TOP OF FILE) and the <7> key is used to move it to the end of the program (BOTTOM OF FILE). The <I> and <II> keys scroll through the displayed program 10 lines at a time.

If the selected program number does not already exist in NC PROGRAM MEMORY, the editor assumes a new program is being created so it automatically displays the edit screen with five lines of text as shown below.

```
                              TEXT EDITOR

                            EDIT COMMANDS
(1) TOP OF FILE          (2) FIND LINE          (3) COPY LINES
(4) DELETE LINE          (5) INSERT LINE        (6) EDIT LINE
(7) BOTTOM OF FILE       (8) REPLACE STRING     (9) FIND STRING
(.)                      (0) QUIT EDIT          (-)
                      (IV) - ADDITIONAL HELP

0. %
1. P1234(EDIT - 01-19-93)
2.
3.
4.



EDIT:
```

The first line of this example has a "%" to mark the start of program. The "%" block marks the start of all NC programs and must not be deleted. If this program was a GENERIC program, the first block would contain a "G" as the start of program. The next line contains the program number and name. The editor makes a "P" block (in this example, "P1234(EDIT - 01/19/93)") in the second line using the program number selected (1234) and the current date to make the program name ("EDIT - 01/19/93"). The program number and name can be changed by editing this block and are the same ones seen in program directory listings used when selecting programs for RUN, STORE, NEST, ETC. Two blank lines are placed at the end of the program.

After displaying these 4 lines, the editor immediately enters the INSERT LINE mode so that new lines can be easily added. After each program line has been entered, press the <ENTER> key to accept this line and move to the next. The editor places the new text in the program and inserts another line to hold the next line of the program. Press the <CE> key when all the lines have been added to the program.

The current editor functions are described in the sections that follow.

QUIT EDIT

The QUIT EDIT function (<0> key) allows the operator to end the edit session and save the modified program. Pressing the <0> key (the <RST> and <CE> keys have the same effect) causes the "QUIT EDIT : NO" prompt to be displayed. Pressing <ENTER> continues the edit session. Toggling the "NO" to "YES" causes the display to change to the "SAVE PROGRAM : YES" prompt. Pressing <ENTER> here causes the "SAVE PGM XXXX" prompt to be displayed, where "XXXX" is the number of the program to be saved. At this point, the program number may be changed. Any valid program number and extension can be defined. Pressing <ENTER> then causes the program to be saved. If the program number already exists in program memory, the "REPLACE OLD ? NO" prompt is displayed. If "NO" is selected, a "DUPLICATE FILE NUMBER ERROR" message is displayed, the file is not saved and the editing session resumes. However if "YES" is selected, the old program is replaced with the program in the current edit buffer and the edit operation is ended.

NOTE

The editor "save" process performs the same operations as the SERIAL DEVICE LOAD operation. Thus, the normal END-OF-PROGRAM process and any special format operations that are enabled for the specified program format are also performed during the "save". Like in the LOAD operation, any data following the normal END-OF-PROGRAM or an enabled SPECIAL END-OF-PROGRAM sequence is ignored.

GRAPHIC DISPLAY

The GRAPH function (<SHF> then <1>) key sequence or just the <V> key) allows the operator to graphically inspect the program being edited without ending the edit session. This allows programming changes to be verified before saving a modified program in memory. This command appears in the ADDITIONAL HELP menu, which can be selected by pressing the <IV> key whenever the EDIT COMMANDS menu is displayed.

When the <V> key is pressed, the graphics' screen is displayed with the current block (if it is a line or arc) highlighted in yellow and an "X" cursor is placed at the start of the line or arc. If the selected line contains only a function code (M, G, etc.), then the "X" cursor is placed on the part drawing at that point in the program. To the right of the part drawing is the actual text of the current line of the program. The <UP> and <DOWN> cursor keys can be used to move a line at a time through the program. As these keys are pressed, the drawing is updated with the new program block highlighted.

The <ZOOM> keys can be used to enlarge or reduce the part drawing. The center of the zoom operation is located where the "X" cursor is drawn. If the <UP> or <DOWN> cursor key is pressed after the part has been zoomed, the "X" cursor can be moved to the center of the screen by pressing the "5" key to redraw at the current scale. As on other graphics screens, the "0" key can be used to redraw the part at the normal size, undoing any zoom operation.

Although the GRAPHIC DISPLAY command was primarily added to graph NC programs, it can also be used to graph GENERIC SHAPE programs that contain "preview data" values. These values supply prompt values for the "quick inspect" operation that can be performed when loading programs from GENERIC SHAPE MEMORY. However, these values can also be used to help debug and test the correctness of the GENERIC SHAPE program being created or edited. For additional information on the GENERIC SHAPE programming language, see the GENERIC SHAPE OPERATIONS section in this manual.

TOP OF FILE

The TOP OF FILE function (<1> key) allows the operator to position the cursor on the first line of the program. Pressing the <1> key causes the first 10 lines of the program to be displayed with the line cursor positioned on line number 0 (the first line of the program).

FIND LINE

The FIND LINE function (<2> key) allows the operator to position the cursor on a specific line in the program. When the <2> key is pressed, the prompt "ENTER LINE NUMBER :" is displayed at the bottom of the edit screen. This prompt accepts any valid line number. The first line number in the program is 0 (zero). An invalid line number causes an "ENTRY MUST BE BETWEEN 0 AND XX" error message to be displayed, where "XX" is the number of last line in the program.

COPY LINES

The COPY LINES function (<3> key) allows the operator to duplicate one or more lines of a program. Pressing the <3> key causes the "COPY FROM LINE NUMBER :" prompt to be displayed at the bottom of the edit screen. Any valid line number can be entered here. This number is the first line number to be copied. Pressing <ENTER> then displays the "NUMBER OF LINES :" prompt below the previous prompt. This prompt accepts any number up to the maximum number of lines in the program. The next prompt is the "TO LINE NUMBER :" prompt. It also accepts any number up to the maximum line number. This number is the destination line number for the copy operation. Pressing <ENTER> causes the selected lines to be duplicated and inserted into the program at the destination line number position. All text currently at the destination position is moved down to provide space for the duplicated lines.

DELETE LINE

The DELETE LINE function (<4> key) allows the operator to remove a line from a program. The deleted line is saved in a special buffer so that it may be restored with the UN-DELETE LINE function (<SHF>, <4> key sequence). Only the most recently deleted line can be restored.

UN-DELETE LINE

The UN-DELETE LINE function (<SHF>, <4> key sequence) allows the operator to insert the last line deleted with DELETE LINE function back into the program. The line is inserted at the current line cursor position, forcing the line currently at this position to move down. The "un-deleted" line may be inserted into the program as often as needed. This command appears in the ADDITIONAL HELP menu that can be selected by pressing the <IV> key whenever the EDIT COMMANDS menu is displayed.

DELETE LINES

The DELETE LINES function (<SHF>, <3> key sequence) allows the operator to remove one or more lines from a program. Similar to other edit functions, this function requires the operator to specify the number of the first line and the number of lines to delete. All lines following the deleted block of lines are then automatically renumbered.

NOTE

Unlike the DELETE LINE function, which removes one line that can be immediately restored using the UN-DELETE LINE function, this delete operation cannot be reversed. Whenever one or more lines are removed with this function, they cannot be restored.

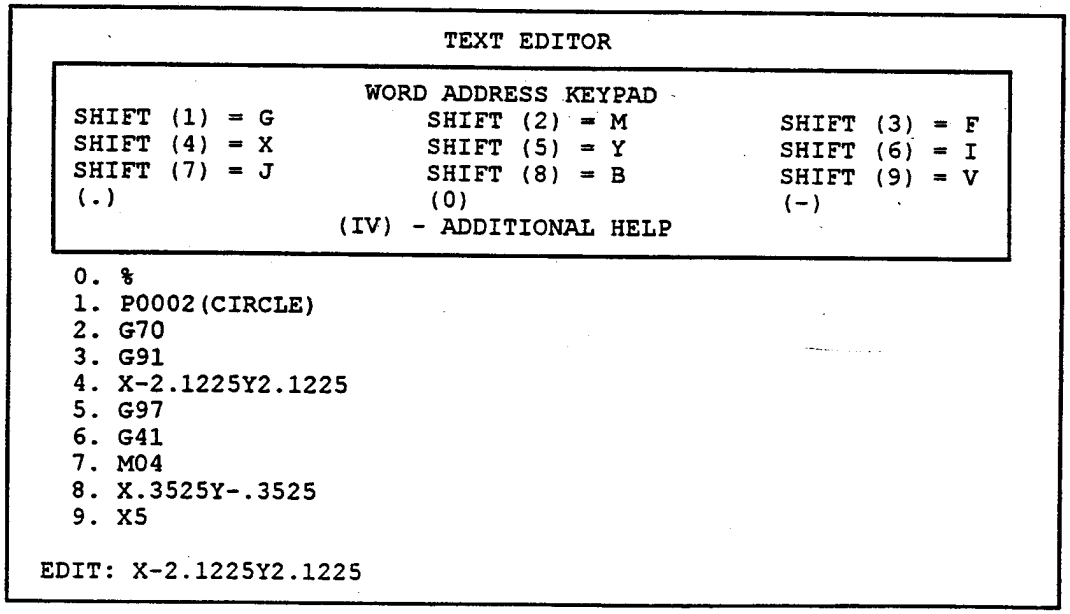
This command appears in the ADDITIONAL HELP menu that can be selected by pressing the <IV> key whenever the EDIT COMMANDS menu is displayed.

INSERT LINE

The INSERT LINE function (<5> key) allows the operator to insert one or more lines into a program. When the <5> key is pressed, the editor enters the INSERT mode. This causes a blank line to be inserted at the current line position and all the following lines to be moved down one line. A blank line then appears at the bottom of the edit screen, ready to accept text. The new text is entered with the same edit commands used by the EDIT LINE function. When the text entry is complete, press <ENTER> to place the new line into the program where the blank line was inserted. This also causes another blank line to be inserted after the new line to allow the next line to be entered. The INSERT process continues until the <CE> key (or <RST> key) is pressed.

EDIT LINE

The EDIT LINE function allows the operator to modify any line of a program. To edit a line, position the line cursor to the left of the line and press the <6> key (or the <ENTER> key). This causes the cursor to turn YELLOW and the selected line to be duplicated at the bottom of the edit screen. The menu at the top of the screen is then updated to show the new keyboard definitions. The actual menu displayed depends on which program format was selected at the beginning of the edit session. Different menus are defined for each of the program formats so that the numeric keypad can be used for the most commonly used letters in the selected program format. The following example assumes one of the WORD ADDRESS program formats was selected.



A WHITE edit cursor (^) is positioned below the first character in the line at the bottom of the edit screen shows the current character position. It can be moved to the right or left with the cursor keys, but cannot be moved past the end of the line. This character cursor must be placed under a character to change it. The up and down cursor keys are used to modify the character above the cursor. When the up and down keys are used, the ASCII character set is scrolled through in order. Use the menu at the top of the screen to directly enter (with a <SHF> key combination) some of the most commonly used characters. This menu is different for WORD ADDRESS and ESSI.

The <IV> key is used to display an ADDITIONAL HELP menu. This menu describes the function of other edit keys including the ZOOM and ROTATE keys. These keys have a special meaning while in the program editor. The ZOOM keys are used to insert and delete spaces in the line. The left ZOOM key inserts spaces in the line at the current cursor position and moves all existing text to the right. The right ZOOM key deletes spaces (or characters) at the cursor position and moves the remaining text to the left to fill the available position. The ROTATE keys are used to clear the edit line. The left ROTATE key clears the entire line. The right ROTATE key is used to clear all the text from the cursor position to the end of the line.

The edited line is inserted back into the program when the <ENTER> key is pressed. This causes the line at the bottom of the edit screen to be removed and the original line that is next to the YELLOW cursor to be replaced with the new text line. The line cursor then returns to WHITE. However, if the <CE> key is pressed before the <ENTER> key, the EDIT LINE function is aborted and the currently selected line remains unchanged.

BOTTOM OF FILE

The cursor can be moved to the last line of the program by pressing the <7> key.

REPLACE STRING

Pressing the <8> key activates the REPLACE STRING function. This function allows the operator to find a text string and replace it with another. As in the FIND STRING function, the search starts at the current line cursor position and proceeds to the end of the program. No search takes place before the line cursor position. If the entire file is to be searched, position the cursor on the first line of the program before starting the search. The <1> key can be used to move the cursor the top of the program.

The first prompt "OLD STRING :", is for the search string. This string is entered using the same text edit commands used for EDIT LINE. The default search string is the previously replaced string. The next prompt "NEW STRING :", is for the replacement string. The next prompt "NUMBER TO REPLACE :" allows the operator to enter the number of strings to find and replace. If 0 (zero) is entered, all strings are replaced. Otherwise, the replacement is limited by the number specified. As the strings are replaced, a count at the bottom of the edit screen is incremented to show how many strings have been replaced. The REPLACE STRING function may be canceled before the count reaches the specified limit by pressing the <ENTER> key.

FIND STRING

The FIND STRING function (<9> key) allows the operator to locate a specific text string in the program and position the cursor at that line. When the <9> key is pressed, the prompt "FIND STRING:" is displayed at the bottom of the edit screen. This string is entered with the same text edit commands used for EDIT LINE. The default search string is the previous search string entered. After <ENTER> is pressed, the search starts at the current cursor position and continues to the end of the program. If the string is not found, the line cursor remains on the current line and a "NOT FOUND" error message is displayed. If the string is found, the screen is updated and the cursor is place on the line containing the selected string.

BLANK

GRAPHIC NEST EDITOR

The BURNY 5 GRAPHIC NEST EDITOR allows the user to create nested part programs by graphically placing and connecting individual part programs. The basic approach to making a NEST is to select the plate size (or a remnant), select the parts to put in the nest and go to the NESTING SCREEN and place the parts on the plate. The parts can then be connected and the nest saved to NC PROGRAM MEMORY. The newly created nest can then be run just like any other part in memory.

The BURNY 5 GRAPHIC NEST EDITOR is entered by selecting "3. GRAPHIC NEST EDITOR" from the DISPLAY/EDIT PROGRAM menu. It can be used while the BURNY is in the RUN mode only if the MULTITASKING option is enabled. If it is not enabled, the NEST EDITOR can only be used while the control is in the IDLE mode (not while in the RUN mode).

The NEST EDITOR contains many features to make the construction of nests as simple and flexible as possible. These features are all accessed through easy-to-use menus found on the various nesting screens. The GRAPHIC NEST EDITOR consists of the screens listed below.

MAIN MENU
SETUP OPTIONS
TEMPORARY STORAGE OPTIONS
ROW AND COLUMN NESTING
SAVE/EXIT OPTIONS
GRAPHICAL NESTING SCREEN
CONNECTION MENU
ICON SELECT

These screens and their functions are described in detail in this section.

IMPORTANT

The GRAPHIC NEST EDITOR is an optional feature on the monochrome version of this control. The option must be enabled before this feature can be used. See the "OPTION ENABLE" section in this manual for more information.

NEST.1 MAIN MENU

The GRAPHIC NEST EDITOR MAIN MENU is the origin of all part nesting activities. From this menu the user selects the plate size for the nest, the parts to be included in the nest and the starting corner for the ACTIVE PART. The main menu also leads to several other menus including setup options, temporary storage, row and column nesting and save/exit.

The NESTING MAIN MENU is shown below.

```
                          BURNY 5 NESTING
                            -MAIN MENU
       PLATE SIZE
 1.   REMNANT
 2.   LENGTH - 50.0
 3.   WIDTH  - 50.0

 4.   ACTIVE PART - 1
 5.   STARTING CORNER
          LOWER LEFT

       WORKING PARTS
 6.   PART 1 - 1111
 7.   PART 2 - 2222
 8.   PART 3 - 3333
 9.   PART 4 - 4444

10.   SETUP OPTIONS
11.   TEMPORARY STORAGE AND MISC
12.   ROW AND COLUMN NESTING
13.   SAVE/EXIT OPTIONS

SELECT ITEM (1-13) OR ENTER
```

When the NEST EDITOR is first entered, the first nine entries are automatically prompted for in order. If the correct value is already present, simply press the <ENTER> key to skip to the next entry. Only PLATE SIZE, ACTIVE PART and STARTING CORNER are required by the BURNY to continue nesting. Pressing the <CE> key at any one of these prompts cancels the auto-entry feature and the prompt "SELECT ITEM (1-13) OR ENTER" appears at the bottom of the screen. Any of the menu items can then be selected individually by entering the item number and pressing the <ENTER> key.

Pressing the <ENTER> key at the "SELECT ITEM (1-13) OR ENTER" prompt switches to the GRAPHICAL NESTING SCREEN. If any of the required parameters (PLATE SIZE, ACTIVE PART or STARTING CORNER) were left blank, an error message is displayed and entry into the NESTING screen is denied. The invalid entry must be corrected before the BURNY allows part nesting to start. Each of the MAIN MENU items is described in this section.

A REMNANT is a part program that is used to define an irregularly shaped plate. Any program stored in NC PROGRAM MEMORY can be used as a REMNANT. A remnant is displayed on the NESTING screen as a dark blue outline. All parts placed on the remnant must be within the boundary of the blue lines to be on the plate. If a remnant part is selected, the BURNY uses the maximum dimensions of the part to fill in the length and width parameters of the plate. The length and width prompts are then skipped and prompting continues at the ACTIVE PART entry. If part program "0" is selected as the remnant, the BURNY clears the remnant field and prompts for the plate length and width. Entering either the plate length or width fields manually also clears the remnant field.

If a previously nested part is used as a remnant, the original plate dimensions are retrieved from the nest program and placed in the LENGTH and WIDTH fields. When the NESTING screen is displayed, the previously nested parts are drawn in BLUE in their original positions and show what has been cut out of the plate. Only the parts in the NEST used as a remnant are shown, no previous cut outs are displayed. The remaining unused plate area can be used for creating a new nest by placing parts only in the unused area.

The PLATE LENGTH is depicted on the NESTING screen as the vertical dimension (the machine X axis). The PLATE WIDTH is depicted on the NESTING screen as the horizontal dimension (the machine Y axis). They are both entered and displayed in inches for an ENGLISH machine, and millimeters for a METRIC machine. (The machine type is defined by SYSTEM SETUP DATA variable 1, INTERNAL SYSTEM UNIT).

The ACTIVE PART is the part program that can be moved into position and placed in the nest. To select the ACTIVE PART, simply enter the number for the first part to be placed in the nest. Program selection can be made by direct numeric input or by using the cursor up and down keys to scroll through the directory entries before pressing <ENTER> to select the part. The <V> key can be used to display a graphical image of the part selected. If not already displayed, the <IV> key can be used to display the directory of NC PROGRAM MEMORY to select the ACTIVE PART. The <I> and <II> keys can be used to scroll through the directory list. If a nonexistent part is selected, an error message is displayed. When the correct part number is displayed in white, press the <ENTER> key to select that part as the active part. The color of the part number changes to light blue and prompting continues.

The STARTING CORNER selected by this entry defines the starting point for the ACTIVE PART. For large plates and small parts it is convenient to start the ACTIVE PART as close to the placement point as possible to avoid extra part moves.

The numeric keys are used to define area of the plate as follows:

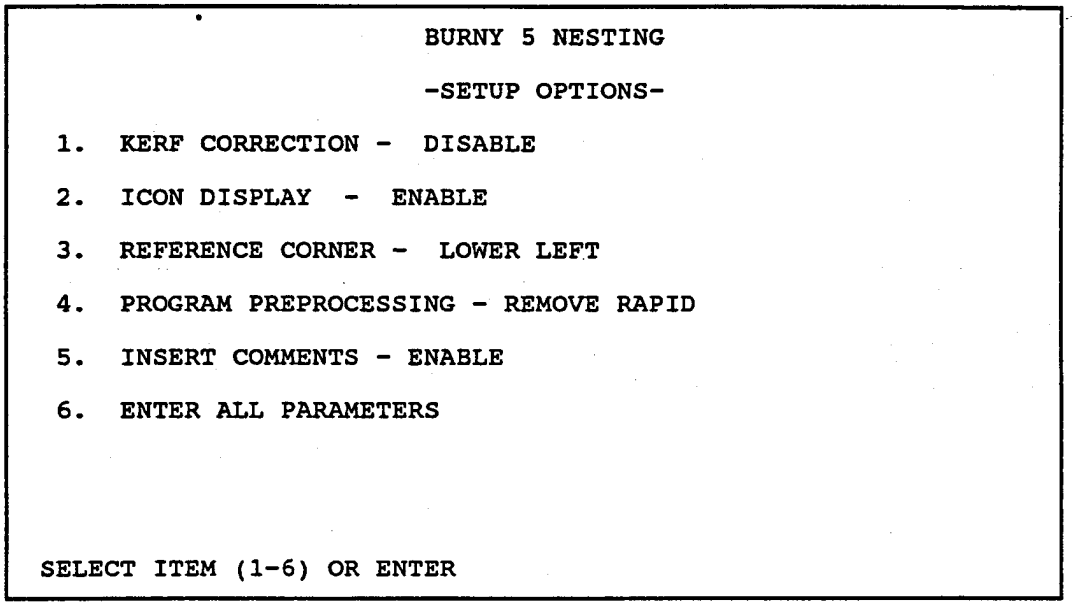
1) UPPER LEFT
3) UPPER RIGHT
5) CENTER
7) LOWER LEFT
9) LOWER RIGHT

The cursor keys can also be used to scroll through the starting corner selections. A pop-up "HELP" menu can be displayed using the <IV> key.

To maximize speed and ease of operation, the GRAPHIC NEST EDITOR allows the selection of four additional part programs along with the ACTIVE PART. If more than one part program is to be included in the nest, the additional parts can be entered as WORKING PARTS. By specifying the WORKING PARTS here, the selection of the ACTIVE PART can be done graphically from the SELECT MENU gotten to from the NESTING screen. If the WORKING PARTS are not used, ACTIVE PART selection can only be done from this menu. WORKING PART selection is the same as for the ACTIVE PART.

NEST.2 SETUP OPTIONS

The GRAPHIC NEST EDITOR includes several setup options to allow more flexibility in the nesting operation. The SETUP OPTIONS screen is shown below with the default values assigned at power up. A description of each option follows.



The KERF CORRECTION option, when enabled, adds any kerf compensation values in a program to the existing program dimensions. Otherwise, the kerf compensation values are discarded. These compensation values only exist if kerf processing has been performed on the program by the RUN SETUP or BATCH SETUP functions. When enabled, the kerf correction only takes place when the program is moved from NC PROGRAM MEMORY to the GRAPHIC NEST EDITOR'S local directory. Changing this option does not effect parts already moved to the local directory.

The ICON DISPLAY option determines if the icon representations of the ACTIVE and WORKING PART programs are displayed on the SELECT screen. Large programs may take some time to graph, so a provision has been made to disable the graphing of programs on the SELECT screen. Pressing the <2> key to change this option displays the prompt "ICON DISPLAY (1-YES 2-NO):". Pressing the <1> key enables the ICON display. Pressing the <2> key disables it. Icon display is enabled by default when nesting is first entered.

The REFERENCE CORNER is the starting point at the beginning of the nest. If this option is enabled, the BURNY calculates the traverse move from the selected corner to the start of the first part in the nest. If this option is disabled, no traverse move is made to the first part. At power-up, this option is enabled and assigned a default value defined by SYSTEM SETUP DATA variable 31, PLATE SIDE. If PLATE SIDE is RIGHT, the traverse move is from the lower left corner of the plate. If PLATE SIDE is LEFT, the traverse move is from the lower right corner of the plate.

The reference starting corner can be changed using the numeric keypad as follows:

0) DISABLE OPTION
1) UPPER LEFT
3) UPPER RIGHT
7) LOWER LEFT
9) LOWER RIGHT

Note the <0> key disables the reference corner option.

The PROGRAM PREPROCESSING option can be changed by pressing the <4> key. This displays the prompt "ENTER PREPROCESSING OPTION:". To inhibit program preprocessing, press the <0> key to select "NONE". To remove rapid traverse moves before the first CUT ON command and after the last CUT OFF command, press the <1> key to select "REMOVE RAPID". The "REMOVE RAPID" option is the default option since the NEST EDITOR adds its own traverse moves before as well as between parts.

NOTE

The REMOVE RAPID option also removes all marker moves before the first CUT ON function and after the last CUT OFF function in the part program. If the marker moves are to be retained in the final nest, this option must be set to NONE by pressing the <0> key at the prompt.

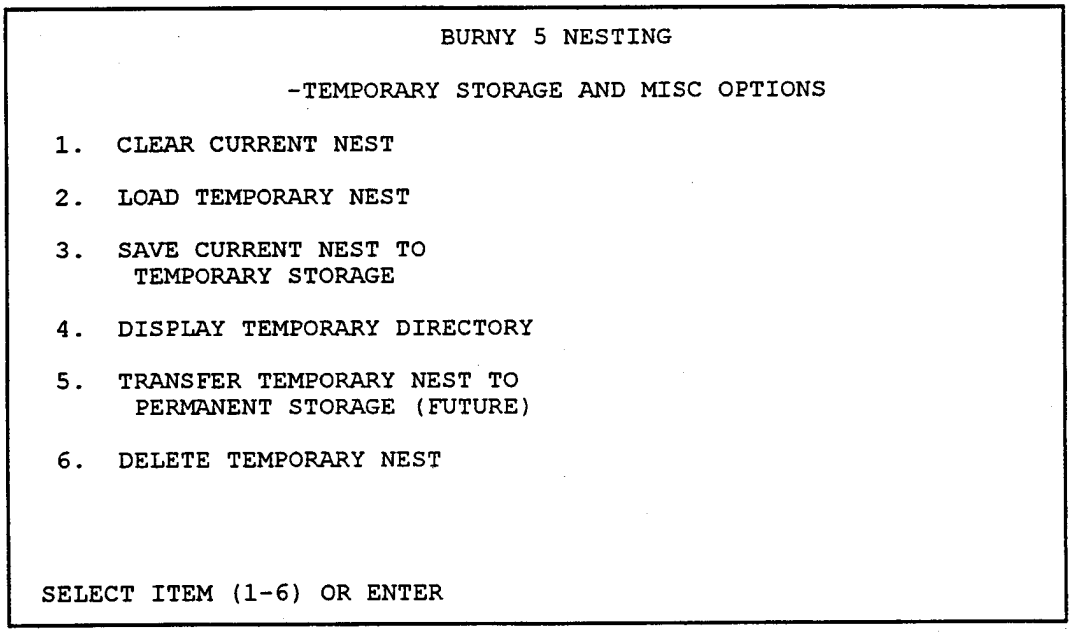
When the BURNY creates a nest, a comment field is inserted between each program added to the nest. This comment field contains the program number and the rotation value (if non-zero) used when the part was added to the nest. This comment field (as are all comments) is displayed while cutting the nest. If a large nest is created with many small parts, the amount of space used by a nest can increase by as much as 15 percent from these comments. This increases processing time for nested parts. The INSERT COMMENTS option can be used to prevent these comments from being placed in the nest. The default setting for this option is ENABLE, so that the comments are inserted into the nest.

The ENTER ALL PARAMETERS option allows the nest MAIN MENU auto-prompt sequence to restart as if the GRAPHIC NEST EDITOR was entered from the EDIT PROGRAM MENU. This is useful when starting a new nest.

NEST.3 TEMPORARY STORAGE

The TEMPORARY STORAGE AND MISC OPTIONS MENU contains functions dealing with the GRAPHIC NEST EDITOR'S local directory. The GRAPHIC NEST EDITOR retains its own directory for the ACTIVE and WORKING PARTS selected in the MAIN MENU. These parts are moved into the local directory to speed up the nesting operation.. To return to the NEST MAIN MENU, press the <ENTER> or <CE> key at the prompt "SELECT ITEM (1-6) OR ENTER". The six functions contained in this menu are described here.

The TEMPORARY STORAGE AND MISC OPTIONS screen is displayed below.



The CLEAR CURRENT NEST function allows all the parts in the current nest to be removed quickly without exiting and reentering nesting. Pressing the <1> key to clear the current nest displays the prompt "ARE YOU SURE? NO". To clear the nest, change the "NO" to "YES" and press <ENTER>. The current nest is entirely deleted without affecting the individual parts. After the nest has been cleared, returning to the MOVE screen displays a blank plate with the ACTIVE PART ready for manipulation and placement.

If a nest was saved to temporary storage (item 3, this menu), it can be restored using the LOAD TEMPORARY NEST function. Pressing the <2> key to load a temporary nest displays the prompt "LOAD PROGRAM NUMBER:". The numeric keys can be used to enter the program number. An error message is displayed if the a nonexistent program number is entered. A valid program number entry causes the selected nest to be loaded from the local directory. All the parts that make up the nest must be available in the BURNY 5 (either in NC PROGRAM MEMORY or the local directory). If the parts are in NC PROGRAM MEMORY, they must be selected as ACTIVE and/or WORKING PARTS so they can be moved into the local directory for use by the GRAPHIC NEST EDITOR. Once the nest has been restored, it can be modified by returning to the GRAPHICAL NESTING screen.

By selecting "3. SAVE CURRENT NEST TO TEMPORARY STORAGE", the current nest can be saved to the local directory as a "list nest". A "list nest" contains the part numbers, positions, rotations and connections of all the parts in the nest. It does not contain the actual part programs. A "list nest" takes up much less storage than a complete nest but all the part programs included in it must be available in the BURNY 5 for a complete nest to be built. This type of nest can be later restored and modified or moved into permanent NC PROGRAM MEMORY.

The local directory files can be displayed by pressing the <4> key to select the DISPLAY TEMPORARY DIRECTORY option. The local directory is the directory maintained by the GRAPHIC NEST EDITOR. This directory is only temporary, meaning if power is interrupted to the BURNY 5, all files are lost.

There are three types of files supported by the local directory. TYPE 1 files are "list nests" saved by using item 3 in the TEMPORARY STORAGE AND MISC OPTIONS MENU. TYPE 2 files are "mini-nests" saved by using item 3 in the EXIT OPTIONS MENU. TYPE 3 files are part programs that have been moved to the local directory by specifying them as ACTIVE or WORKING PARTS. File types 1 and 2 are retained in the local directory after exiting the GRAPHIC NEST EDITOR. Type 3 files (part programs) are deleted from the local directory upon exiting nesting.

The LOCAL DIRECTORY can hold up to 20 files. If the directory becomes full, files can be removed with the delete function (item 6). If more than one page of file entries exists, any key can be used to display the next page. Once the last page has been displayed, any key press returns to the TEMPORARY STORAGE AND MISC OPTIONS MENU.

An example LOCAL DIRECTORY screen is displayed below.

```
                        BURNY 5 NESTING

                       -LOCAL DIRECTORY


    PART          SIZE       CREATION DATE      TYPE  STATUS
-----------     -------   -------------------   ----  ------
8                   421   10/31/1992 13:29:35      3    6001
9510     -2         725   10/31/1992 13:29:37      3    6001
333                 461   10/31/1992 13:29:55      1    2001
444      -15        871   10/31/1992 13:30:13      2    2001









 ANY KEY TO CONTINUE
```

The TRANSFER TEMPORARY NEST TO PERMANENT STORAGE function allows a nest saved as a temporary nest (using item 3, this menu), to be transferred to permanent NC PROGRAM MEMORY. All of the part programs used in the temporary nest must still exist in the local directory. The BURNY prompts for the source program number (a temporary file) and then the destination program number (a permanent program number for the saved nest). The nest is made into a single part program as it is transferred to permanent storage.

The DELETE TEMPORARY NEST function allows any file contained in the local directory to be deleted. When the <6> key is pressed, the BURNY prompts for the number of the file to be deleted. If the file exists, it is deleted, otherwise an error message is displayed.

NEST.4 ROW AND COLUMN NESTING

The ROW AND COLUMN NESTING utility that can be found in the GRAPHIC NEST EDIT main menu, allows repetitive nesting operations to be completed very quickly and accurately. By selecting "12. ROW AND COLUMN NESTING" from the NEST MAIN MENU, prompting automatically starts at the top of the ROW AND COLUMN NESTING screen. Press the <ENTER> key at each prompt on this screen to move to the next entry. Pressing <CE> causes prompting to continue at the bottom of the screen with the "PRESS ENTER TO CONTINUE" prompt. To return to the NESTING MAIN MENU, press the <ENTER> key. To return to the ROW AND COLUMN NESTING prompts press the <CE> key. Prompting then restarts at the top of the screen.

A typical ROW AND COLUMN NESTING screen is shown below.

```
                              BURNY 5 NESTING

                          -ROW AND COLUMN NESTING

PLATE LENGTH: 50.0
PLATE WIDTH : 50.0

PART NUMBER : 1

PART LENGTH : 10.0
PART WIDTH  : 10.0

ROWS        : 2
COLUMNS     : 4

ROW SPACING : 0.5
COL SPACING : 0.5
EDGE SPACING: 1.0

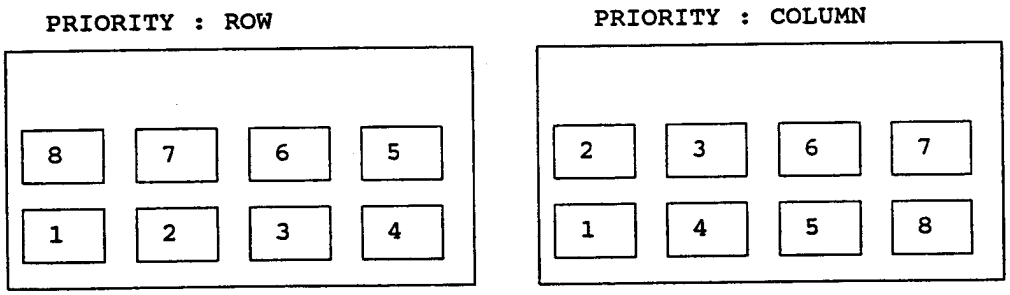
PRIORITY    : ROW


PRESS <ENTER> TO CONTINUE
```

The first two prompts define the size of the plate in the same manner as on the NEST MAIN MENU. The default values for the PLATE LENGTH and WIDTH displayed on this screen are the values that were entered on the NEST MAIN MENU screen. If these values are not defined, they must be entered for the nest to be displayed. The default values can be used by pressing <ENTER> or can be changed by using the numeric keys. Pressing <ENTER> continues to the PART NUMBER prompt below.

The PART NUMBER prompt selects the part that is to be nested. This part can be any part in NC PROGRAM MEMORY or any part saved to the local nest directory as a MINI-NEST. The <UP> and <DOWN> cursor keys can be used to scroll to any part in NC PROGRAM MEMORY or the numeric keys can be used to directly enter the program number. As in other part program prompting, the <IV> key can be used to display the directory of programs and the <V> key can be used to graphically display the program. Once the correct program number is displayed, press <ENTER> to select it for nesting. There may be a short delay as the program is transferred from NC PROGRAM MEMORY to the local directory. When this operation is complete, the part size is displayed in the PART LENGTH and PART WIDTH fields and prompting continues with the row and column size prompts. The PART SIZE displayed can be used as an aid to calculating how many ROWS and COLUMNS will fit on the selected PLATE SIZE.

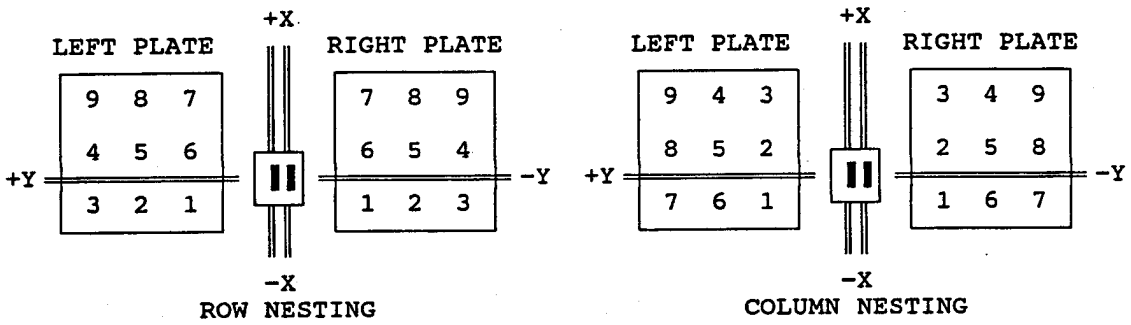
The ROWS and COLUMNS prompts decide the number of parts in the final nest. For example, a nest with 2 ROWS and 4 COLUMNS will have 8 parts nested as shown below. The number inside each part represents the order in which parts are placed in the nest (also the order that they are cut). This example assumes RIGHT plate and shows the difference between ROW and COLUMN PRIORITY.



The next three prompts (ROW, COLUMN, and EDGE SPACING) define the relationships between the parts themselves and with the plate. The ROW SPACING prompt defines the value used when calculating the distance between the rows of parts. This value is normally entered as a positive number, but can also be entered as a negative number when the part geometry requires it for optimum placement. The COLUMN SPACING defines the value used when calculating the distance between the columns of parts. The value can be either positive or negative as with the ROW SPACING. The EDGE SPACING defines the value used when calculating where to put the first part on the plate. For example, if one inch is required between the edge of the plate and the nest, enter 1.00 as the EDGE SPACING value.

The PRIORITY prompt decides whether the parts are placed first in ROWS or COLUMNS. The default value of ROW causes the parts to be placed along the Y axis first. Parts are placed in the -Y direction for machines defined as RIGHT and in the +Y direction for machines defined as LEFT. (See system configuration 31. PLATE SIDE.) By changing the PRIORITY from ROW to COLUMN, parts are placed along the X axis first. Parts are placed in the +X direction on the left edge of the plate for RIGHT machines and along the RIGHT edge for left machines.

The picture below shows the various ways that nests can be created based on the PRIORITY and PLATE SIDE values. The numbers represent parts placed in a 3 -ROW by 3-COLUMN nest. The number sequence shows the order in which the parts are cut.



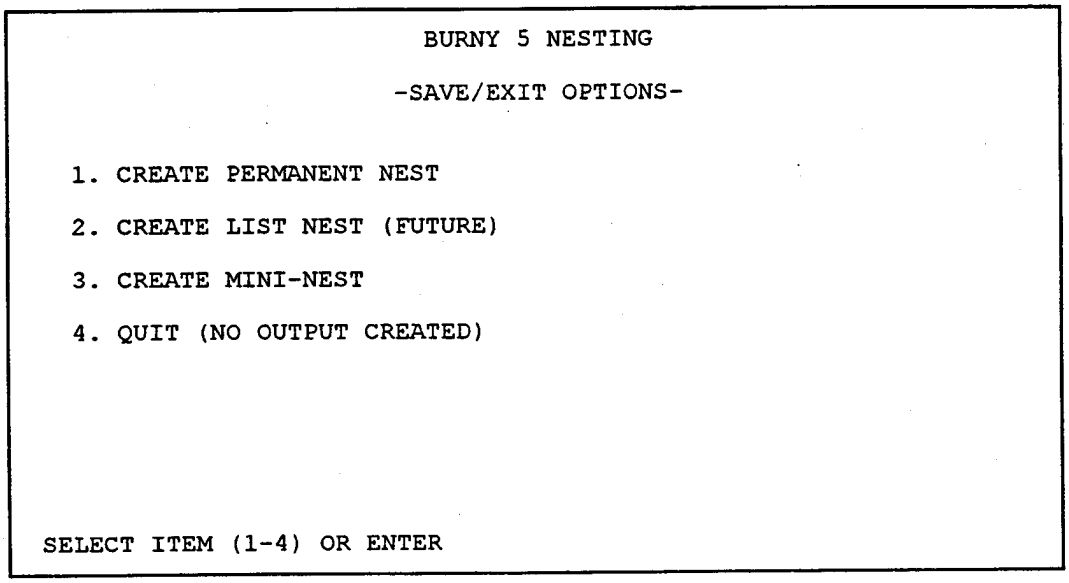
PRIORITY is the last prompt before the nest is created. If a nest already exists, the prompt "DELETE EXISTING NEST? : NO" is displayed. Toggle the "NO" to a "YES" and press <ENTER> to create the row and column defined nest. Press <ENTER> at the "PRESS ENTER TO CONTINUE" prompt to return to the MAIN NEST MENU. Press <ENTER> again to go on to the GRAPHICAL NESTING screen. This screen now displays the newly created nest ready for the connections to be made. Corrections can be easily made by returning to the ROW AND COLUMN NESTING screen and changing the required values.

The ROW AND COLUMN NEST utility warns the user about nests that extend outside the plate boundaries with the message "PLATE LIMITS EXCEEDED!". This warning however, does not prevent the nest from being created. As with any nest, the part count is limited to 50 parts. For example, if both ROWS and COLUMNS have a value of 10, the error message "MAX PART COUNT EXCEEDED!" is displayed and the nest is not created because the total number of parts in the nest is 100 which exceeds the maximum value of 50. However, MINI-NESTS can be used by the ROW AND COLUMN NESTING utility to extend this value. The actual nest size is also checked and the error message "MAX NEST SIZE EXCEEDED!" is displayed if the nest is larger than the maximum allowed.

NEST.5 SAVE/EXIT OPTIONS

The SAVE/EXIT OPTIONS screen is entered by selecting entry number 13 or pressing the <RST> key from the NEST MAIN MENU. To return to the NEST MAIN MENU, press <ENTER> or <CE> at the "SELECT ITEM (1-4) OR ENTER:" prompt at the bottom of the screen.

The SAVE/EXIT OPTIONS screen is displayed below.



The CREATE PERMANENT NEST function allows the operator to save the current nest as a single part program in NC PROGRAM MEMORY. This function only allows complete nests to be saved. If all the parts in the nest have not been connected, the nest cannot be saved, and the message "WARNING - MISSING CONNECTIONS" is displayed in RED. If this happens, go back to the GRAPHIC NESTING screen and connect all the parts in the nest. Then return to the SAVE/EXIT screen and save the nest.

The program number entered in response to the prompt "SAVE NEST AS:" can be up to 8 numeric digits plus 3 extension digits (for example, 12345678-123). If the program number already exists in NC PROGRAM MEMORY, the prompt "REPLACE OLD? NO" is displayed. To save the nest, change the "NO" to "YES" and press <ENTER>. This causes the existing program to be deleted before the nest is saved.

When the nest is saved, it is given the name "NEST - xx/xx/xx", where the "xx/xx/xx" is the current date. This makes nests easy to see in directory lists and simplifies deletion when they are no longer needed. While creating the nest, the BURNY inserts a comment line at the start of each of the nested programs containing that program's number. The comment line looks like the following: (Pxxxx). The "xxxx" is the actual program number of the part included in the nest. This comment line makes the start of a program.easy to find in the editor. As with all comment lines, it is displayed on the RUN GRAPHICS screen while the nest is being cut.

For example, if program 1234 was placed in the nest, the comment (P1234) would be inserted before the actual part program in the NC PROGRAM. If this part was rotated 45 degrees and then placed in the nest, the comment would be (P1234, ROT=45.00). Note the rotation value placed along with the part number to show that the part was rotated before being placed in the nest.

At the beginning of each NC PROGRAM created by the NEST EDITOR is the comment (<PLATE SIZE> X=xx.xx Y=yy.yy). This comment tells the plate size used when creating the nest. The "xx.xx" and "yy.yy" values reflect the length and width values in effect when the nest was created.

The CREATE LIST NEST (FUTURE) function is for future development and has no function at this time.

The CREATE MINI-NEST function creates a "mini-nest" that can only be used by the BURNY 5 GRAPHIC NEST EDITOR. This "mini-nest" can be selected as the ACTIVE PART or as a WORKING PART in the MAIN NEST MENU. It can then be used as any other part program would be used. The "mini-nest" program is stored in the NEST EDITOR'S local directory. This is only a temporary program and as such if power is interrupted to the BURNY, the program is lost.

Pressing the <4> key to select the QUIT (NO OUTPUT CREATED) function causes the prompt "QUIT NEST: NO" to be displayed. To exit NEST, toggle the "NO" to "YES" and press <ENTER>. This leaves the GRAPHIC NEST EDITOR and returns to the EDIT PROGRAM MENU. The current nest is lost if it was not saved before executing this function.

NEST.6 GRAPHICAL NESTING SCREEN

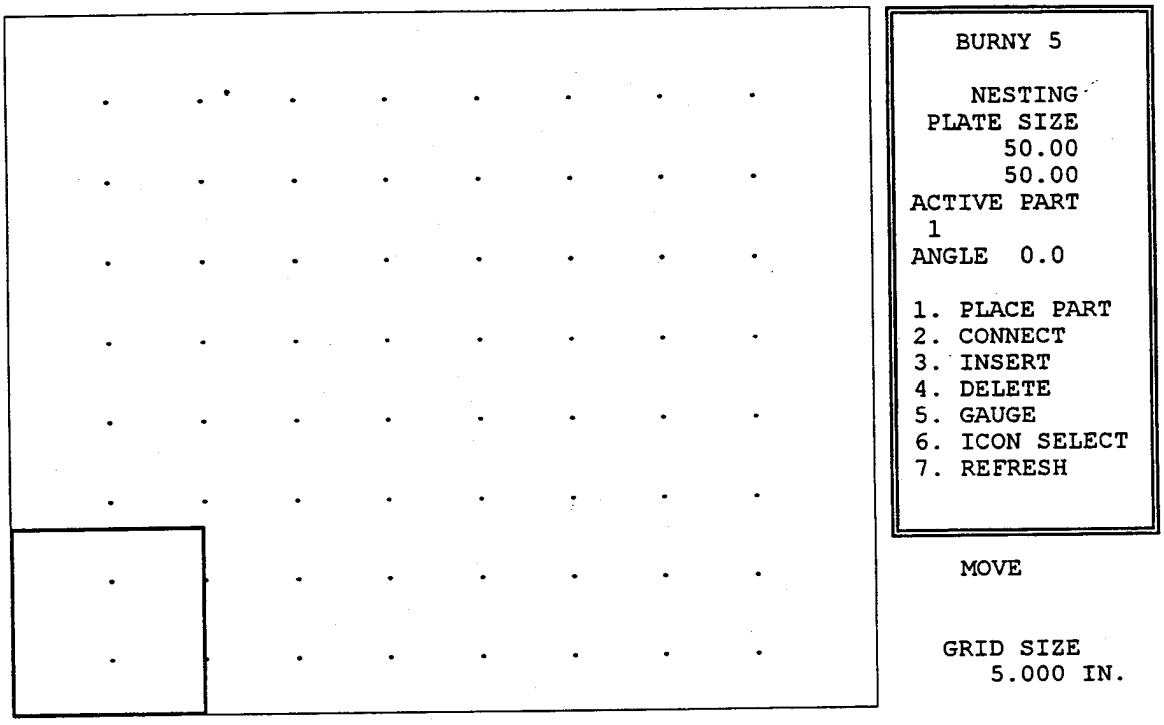
After all the required parameters are entered on the MAIN MENU, the prompt "SELECT ITEM (1-13) OR ENTER" appears at the bottom of the screen. If all parameters are correct, pressing <ENTER> causes the GRAPHICAL NESTING SCREEN to be displayed. (There may be a short delay while the NEST EDITOR loads the selected programs into its local directory and draws the ACTIVE PART). Once the GRAPHICAL NESTING SCREEN is displayed, the ACTIVE PART (drawn in magenta) can be moved about the screen with the cursor keys. The move increment can be modified by pressing the <.> key followed by a numeric key (1-9 or 0). The <0> key defines the default and largest move increment. The <1> key defines the smallest move increment.

The red box on the right side of the screen contains the GRAPHICAL NESTING MENU and the current plate size and the ACTIVE PART's number and rotation angle. Below the menu box is where the prompting for the GRAPHICAL NESTING SCREEN takes place. The distance between the white "grid" dots in the NESTING window is defined in the lower right corner. The grid size is in inches for an English system and in millimeters for a Metric system. Whenever the <CE> or <RST> key is pressed from the NESTING screen, operation returns to the NEST MAIN MENU. Valid keys for the NESTING screen are the <1> through <7> keys and the ZOOM and ROTATE keys. These keys and there associated functions are described later in this section.

NOTE

At this time, only 50 parts may be included in the nest. Any attempt to exceed this limit causes the message "LIST FULL" to be displayed and the attempted "PLACE" or "INSERT" operation aborted. If the 50 part limit has been reached, save the nest and use the newly created part as a single part. This way, more than 50 parts can be placed in a nest. The NEST EDITOR keeps track of the nest size in bytes as parts are added to a nest. This NEST SIZE is displayed on the SELECT screen (item 6 on the NESTING menu). When the nest size limit is reached (approx. 100k bytes), the user is warned with an error message ("MEMORY FULL"). In response, the user should connect the parts in the nest, and perform a save to NC PROGRAM MEMORY. If the "save" operation ends with the error message "PGM SIZE EXCEEDS MAX ALLOWED" displayed, the nest is too large and parts must be removed from the nest before it can be saved. This error condition shows that the internal NC PROGRAM MEMORY size limit of 128k bytes has been exceeded while performing the save operation.

A typical NESTING screen is shown below with part number 1 (a simple rectangle) selected as the active part. The starting location is the lower left corner of the plate as selected by the STARTING CORNER on the MAIN MENU.



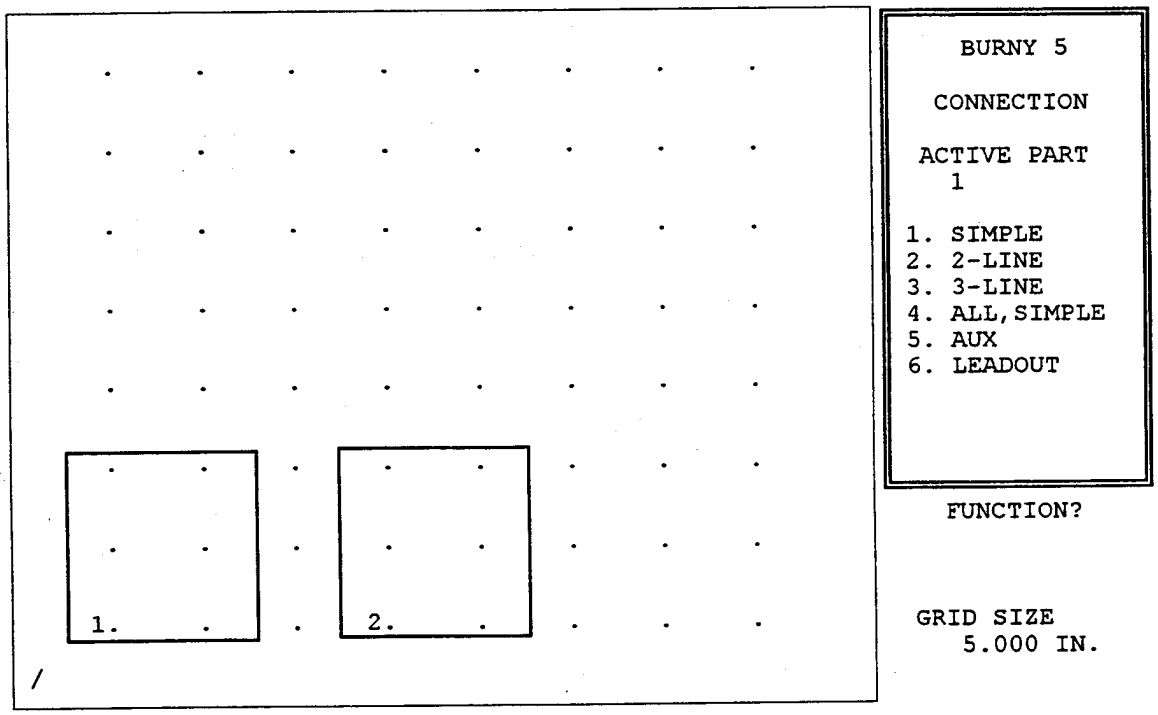
By pressing the <1> key, the PLACE PART function is activated. This function places the ACTIVE PART at its current location in the nest and automatically assigns it a part placement sequence number. This sequence number is used to define the part cutting order. Unlike the INSERT function, the PLACE function always defines the new part as the next in the sequence.

When a part is placed in the nest, it is redrawn in the red/blue combination. A new copy of the ACTIVE PART is then drawn over the previously placed part for movement to the next position. The part can then be moved to a new position on the plate and placed again. This process is repeated until the correct number of pieces are placed on the plate. Then another part can be selected for placement or the parts can be connected and the nest saved to NC PROGRAM MEMORY.

NEST.7 CONNECTING PARTS

By pressing the <2> key while on the NESTING screen, the CONNECT MENU is displayed. This menu allows the user to make connections between parts in the nest in one of several ways. To perform a CONNECT operation, there must be at least two parts placed in the nest. After the connect type has been selected, (except 4. ALL, SIMPLE) the BURNY prompts for a position to connect ("ENTER POS."). The position requested by the BURNY is the part that is to be connected to the previous part. For example, if parts 1 and 2 are to be connected, specify 2 as the part position. If parts 7 and 8 are to be connected, specify 8 as the part position. Parts may only be connected in the order defined by the part placement sequence numbers. Therefore, only sequential parts may be connected and they may not be connected in reverse order.

The part connection screen is shown below.



The "1. SIMPLE" connect function connects two parts with a simple straight line. This is particularly useful when converting a 2 or 3 line connection into a 1 line connection. The same "SIMPLE" connect can be easily done on all parts by using the "4. ALL, SIMPLE" function described in a following section.

The "2. 2-LINE" connect function allows the connection of two parts using two lines to avoid conflicts of fixturing, etc. When selected, a white crosshair appears and the BURNY prompts for the point common to the two connecting lines. The cursor keys can be used to position the crosshair. When the crosshair has been properly positioned, press the <ENTER> key and the BURNY creates the connection between the specified parts.

The "3. 3-LINE" connection is identical to the "2-LINE" connection except three lines are used in the connection and two common points are requested by the BURNY. Again the cursor keys are used to position the crosshair.

By depressing the <4> key, the GRAPHIC NEST EDITOR interconnects all parts in the nest using the SIMPLE one line method. No "ENTER POS." prompt appears since all parts are connected. This is the easiest and fastest way to connect all parts in a nest.

The "5. AUX" function should not be used.

The "6. LEADOUT" function allows a non-cutting move to be added to the end of the nest to allow multiple parts to be cut. When this function is selected, a small white cross-hair appears at the center of the nest screen. This cross-hair can be moved by using the cursor keys. Position the cross-hair to the endpoint of the leadout move, then press <ENTER> to add the leadout move to the nest.

NEST.8 INSERTING PARTS INTO THE NEST

The third item in the NESTING screen menu is the INSERT function. Like the PLACE function, this function inserts the ACTIVE PART at its current position in the nest. However, the INSERT function allows the user to also define the part placement sequence number. This is useful for placing smaller parts within larger parts since smaller parts are usually placed last but cut first.

When the BURNY prompts for the placement sequence number, specify an existing sequence number. This causes the nest to be redrawn and all parts following the inserted part to be renumbered.

NEST.9 DELETING PARTS FROM THE NEST

The DELETE function (item 4 on the NESTING menu) allows any part placed in the current nest to be removed. Pressing the <4> key while on the NESTING screen causes the BURNY to display the prompt "DELETE POS.". Enter the placement sequence number (the small white number next to the part) for the part to be deleted and press <ENTER>. The nest is redrawn and renumbered without the selected part. If the parts in the nest were already connected, the connection chain is broken if a part in the middle of the nest is deleted. The nest must be re-connected before it can be saved.

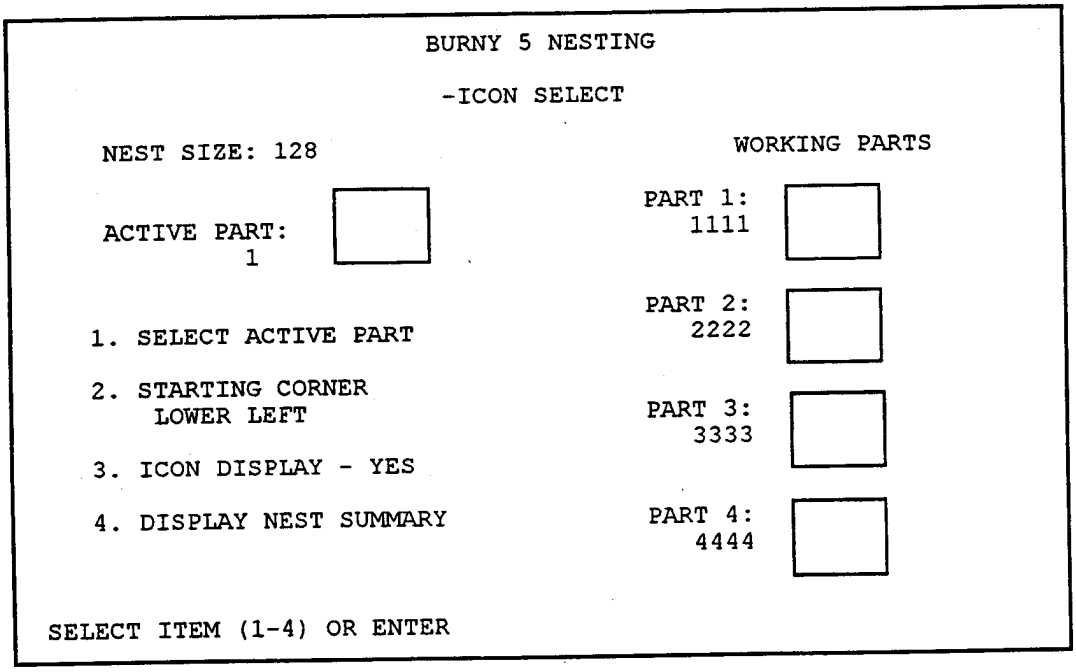
NEST.10 GAUGE

If actual dimensions are required in units of the original part, the GAUGE function is available. When the <5> key is pressed while on the NESTING screen, the BURNY prompts for two points. These points are specified by moving the white crosshair to the correct position and pressing <ENTER>. Once the gauge routine has the two points, it displays the coordinates, on a normal engineering coordinate system, for each point and then calculates and displays the distance between the two points.

NEST.11 ICON SELECT

The ICON SELECT screen is used by pressing the <6> key while on the NESTING screen. If enabled, this screen displays icons for the ACTIVE PART and any WORKING PARTS selected in the main GRAPHIC NEST EDIT menu. The NEST SIZE display shows the current size of the nest in bytes. This size is only an approximation of the program's size when saved to NC PROGRAM MEMORY. Several factors decide the actual program size. One is the number and size of the dimension moves in the nest. Another depends on whether KERF setup operations are to be done on the nest. Sometimes, the internal NC PROGRAM MEMORY size may be as much as 50% greater than the size displayed by the NEST EDITOR. Therefore to prevent problems when nesting parts for later use with KERF, THE RECOMMENDED MAXIMUM NEST SIZE IS 80k BYTES.

The ICON SELECT menu is shown below.



A new part to nest can be selected by pressing the <1> key. This changes the prompt to "SELECT WORKING PART (1-4):". A new ACTIVE PART can be selected from any of the WORKING PARTS displayed. (In order for WORKING PARTS to be displayed on this screen, they must first be selected on the MAIN MENU).

NOTE

The icon boxes shown are displayed only if they are not disabled by NEST SETUP OPTION number 2 or by function 3 in this menu.

A new ACTIVE PART is selected by entering the number (1-4) for the WORKING PART on the right side of the screen. If part 4 is selected as the new ACTIVE PART, it is redrawn in the ACTIVE PART icon box. The old ACTIVE PART is redrawn in the WORKING PART 4 icon box. To return to the NESTING screen with the new active part press the <ENTER> or <CE> key. The new ACTIVE PART is drawn on the NESTING screen in the position selected as the starting corner.

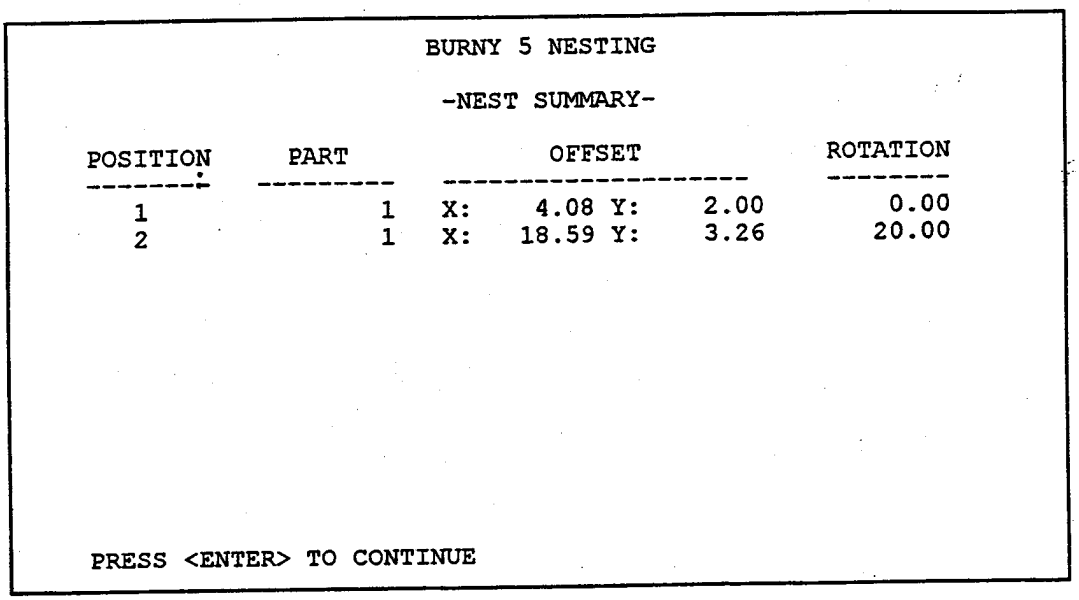
The STARTING CORNER function duplicates item 5 in the MAIN MENU. The starting corner tells the BURNY where to initially position the ACTIVE PART on the NESTING screen. The key definitions are as follows:

1) UPPER LEFT
3) UPPER RIGHT
5) CENTER
7) LOWER LEFT
9) LOWER RIGHT

The ICON DISPLAY function controls the display of the ACTIVE and WORKING PART icons. This function is useful for large part programs (mini-nests for example) that take a long time to graph. The icon display can be turned off to eliminate the graphing delays. The WORKING PARTS can still be selected in the same way when the icon display is disabled. Pressing the <3> key followed by the <ENTER> key displays the prompt "ICON DISPLAY (1-YES 2-NO):". Pressing the <1> key enables icon display and pressing the <2> key disables icon display. This function is duplicated in the SETUP OPTIONS menu.

The DISPLAY NEST SUMMARY function displays a table containing information about the parts added to the current nest. An example is shown below. This example shows that two parts have been placed in the nest (both part number 1). Each part's offset from the origin and rotation are displayed. Offset values are displayed in the selected unit type (inch or millimeters) and represent the part position using a Cartesian coordinate system (+X is to the right, +Y is up). Rotation angles are represented as degrees in the CCW direction. POSITION number is the same placement sequence number given to a part when it is added to the nest.
Pressing any key returns to the ICON SELECT screen.

An example NEST SUMMARY screen is shown below.



```
                        BURNY 5 NESTING

                        -NEST SUMMARY-

POSITION      PART              OFFSET                ROTATION
--------      ----      --------------------          --------
   1             1    X:    4.08 Y:    2.00             0.00
   2             1    X:   18.59 Y:    3.26            20.00




PRESS <ENTER> TO CONTINUE
```

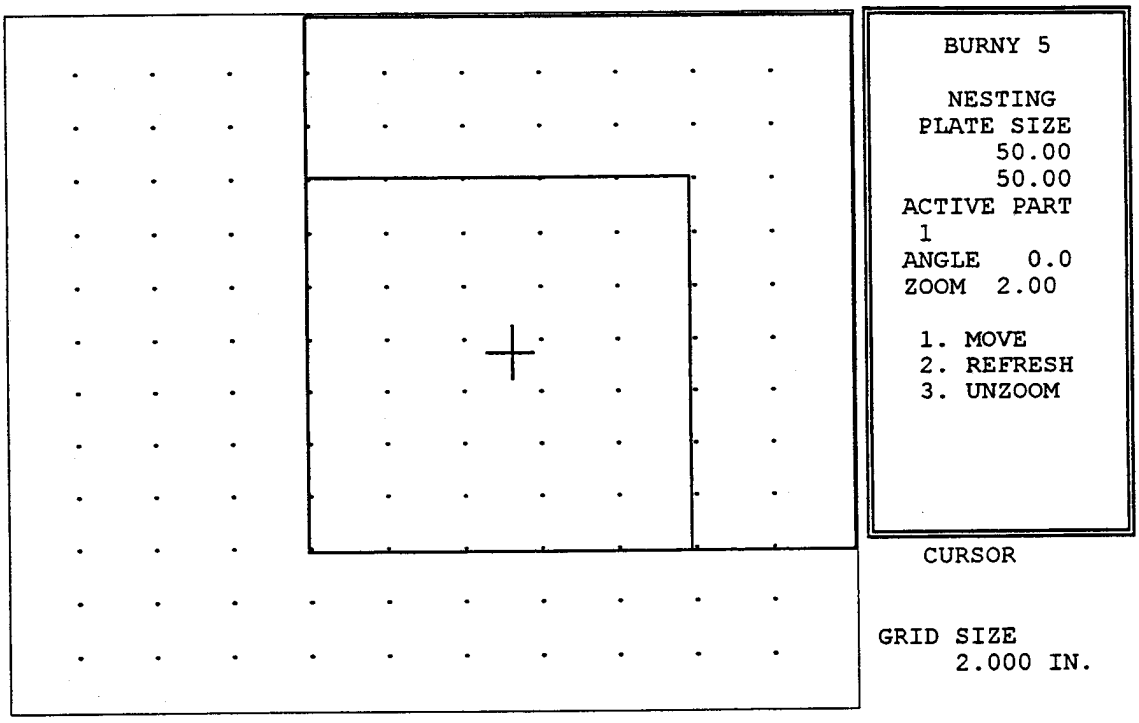
NEST.12 REFRESH

Pressing the <7> key while on the NESTING screen causes the display to be completely redrawn. This can be used any time to clean up the NESTING screen and remove all unnecessary connecting lines.

NEST.13 ZOOM

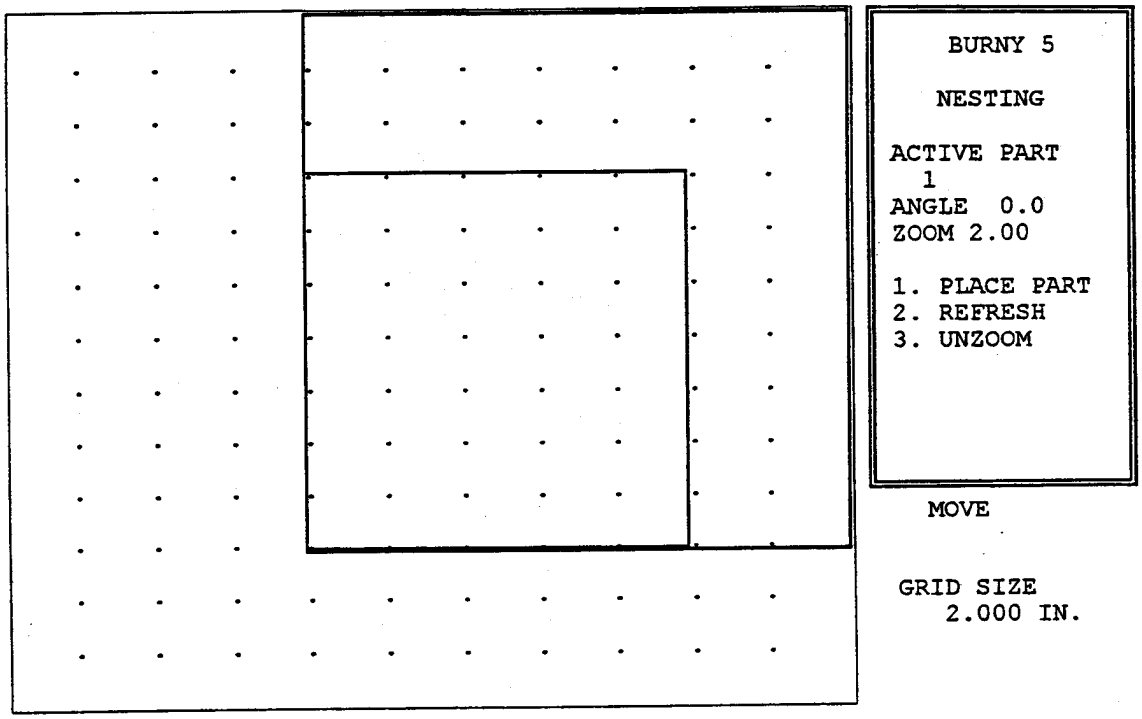
Pressing the <ZOOM> key while in the NESTING screen starts the ZOOM screen. The left <ZOOM> key makes the nest bigger and right <ZOOM> key makes it smaller. The nest is always zoomed about the center of the ACTIVE PART. The CURSOR function is automatically activated when entering the ZOOM screen. A white crosshair is placed in the center of the zoomed screen (the center of the ACTIVE PART).

The ZOOM screen is shown below.



When the <1> key is pressed, the screen is updated and the ZOOM MOVE function is started. This function allows the ACTIVE PART to be moved within the boundaries of the zoomed portion of the plate. To return to the CURSOR function, press <ENTER> or <CE>. To place the part in the nest, Press the <1> key (PLACE PART). To return to the unzoomed condition, press the <3> key (UNZOOM).

The ZOOMED NESTING screen is shown below. Note the magnification next to the word ZOOM. This screen shows times 2 magnification which shows the left <ZOOM> key was pressed once. If the ZOOM value was 4.0, the left <ZOOM> key would have been pressed twice. Each press of the left <ZOOM> key results in twice the magnification. Similarly, each press of the right <ZOOM> key results in a times two decrease in magnification.



The PLACE PART function allows the part to be placed into the nest while in ZOOM mode. This functions the same way as the PLACE PART on the non-zoomed NESTING MENU.

The REFRESH function is used with the CURSOR function to give a PAN capability to the ZOOM screen. When this function redraws the screen, it defines the current cursor position as the new screen center.

The UNZOOM function returns control to the normal NESTING screen with a times one magnification. It does not matter how often the <ZOOM> key was pressed, the UNZOOM function always returns to the unzoomed state.

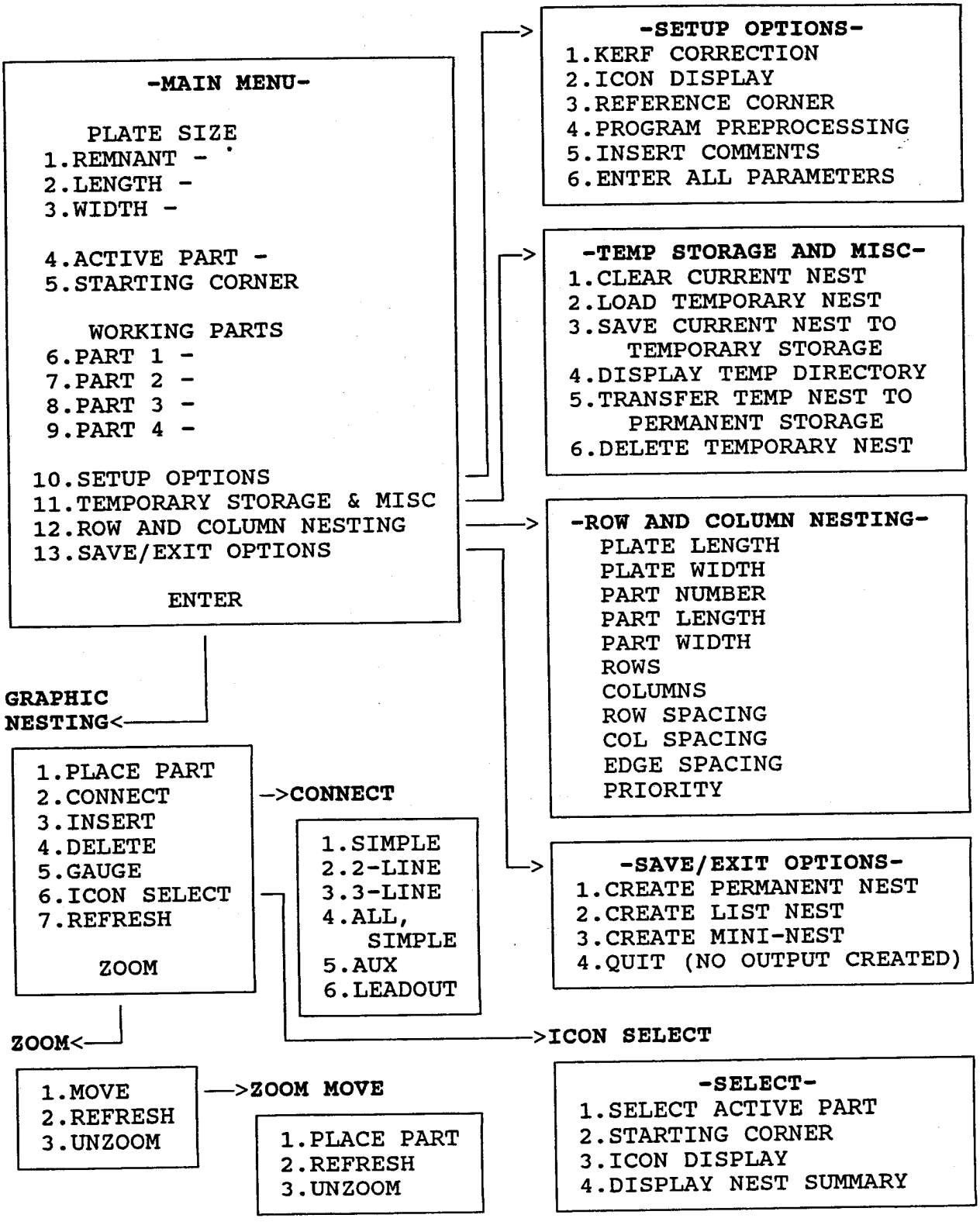
NEST.14 ROTATE

To allow maximum flexibility in utilizing plate area, parts can be inserted in the nest at any rotation angle. The angles are entered in degrees with a resolution of 0.1 degrees. A positive rotation angle is defined as counterclockwise and a negative rotation angle is defined as clockwise. By depressing either <ROTATE> key while on the NESTING screen, the GRAPHIC NEST EDITOR prompts for a rotation angle. The valid range of rotation angles is -360 to +360 degrees. Once the angle has been keyed in and the <ENTER> key pressed, the BURNY redraws the ACTIVE PART with its new rotation. The current active part rotation angle is shown at the top right side of the screen in the NESTING menu box. Once the part is redrawn, it can be moved and placed into the nest in the usual manner.

NEST.15 NEST FLOW DIAGRAM

The following diagram shows all of the prompting menus used by the GRAPHIC NEST EDITOR. It also illustrates the prompting pathways used to move from menu to menu. Usually pressing the <CE> key (or the <ENTER> key without a numeric selection) causes the nest editor to return to the previous menu and/or screen.

BURNY 5 NEST FLOW DIAGRAM



BATCH SETUP/KERF

The BATCH SETUP/KERF utility function allows the user to define a list of one or more LOAD/RUN SETUP operations for processing. Normal LOAD operations and RUN SETUP operations require the user to select only one program for processing and then wait for the operation to complete before the next can be specified. The BATCH LIST allows up to 30 entries to be quickly defined for processing with no additional operator interactions required.

Each BATCH LIST entry allows the program source to be specified as either NC PROGRAM MEMORY, SERIAL DEVICE or INTERNAL FLOPPY. When NC PROGRAM MEMORY is specified, the RUN SETUP operation is performed on a part program already resident in the BURNY. However, when SERIAL DEVICE or INTERNAL FLOPPY is specified, the BATCH utility must first perform a LOAD operation from the selected device before the RUN SETUP operation can be performed. (When selecting SERIAL DEVICE, the device actually used must be selected through SYSTEM SETUP DATA variable 43, BATCH LOAD DEVICE.)

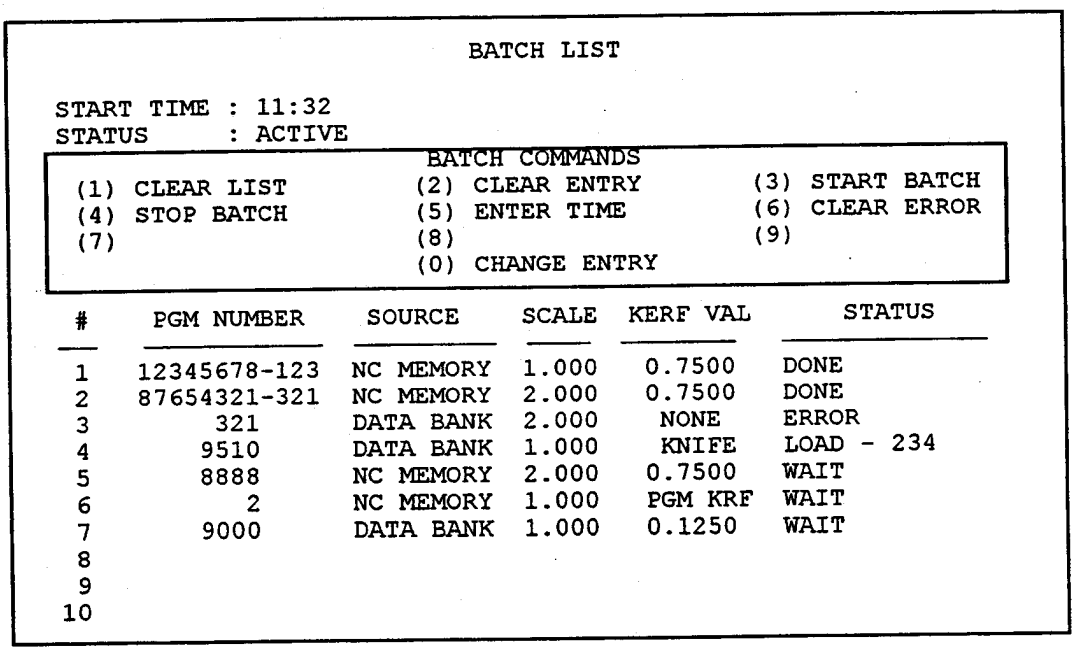
The SETUP operations performed by the BATCH utility are identical to those performed by the RUN process. They include SCALE, KERF, and ACCEL/DECEL processing. As a result, once these operations have been performed on a program, no further processing is normally required before it can be RUN. However, if SCALE, KERF, or any associated SYSTEM SETUP DATA variable, such as SLOW DOWN DISTANCE, is changed, or the program is "re-loaded" from a device or "saved" from the PROGRAM TEXT EDITOR, after BATCH processing has been performed, additional RUN SETUP operations will be required before the program can be RUN.

The BATCH SETUP/KERF utility is particularly useful when loading and processing large NC part programs. These programs typically require a long time to process and the user is normally not present when one completes to start the next. The BATCH utility allows the user to eliminate this "idle time" between operations since all operations defined in the list are performed, in the order specified, with no additional prompting required. With the delayed "START TIME" capability, the BATCH utility can also be used to automatically perform LOAD and RUN SETUP operations during off-hours and between shift changes. BATCH processing is also useful when using PROGRAMMED KERF since the required KERF value can be directly provided in the NC part program.

NOTE

In the standard operating mode, BATCH SETUP/KERF processing can only be performed while the BATCH LIST screen is displayed. If not on this screen, the idle processing time in the BURNY cannot be used by the BATCH process. However, with the BACKGROUND OPTION enabled, BATCH processing can also be performed while at the MAIN MENU and the utility menu screens. See the BACKGROUND OPTION section in this manual for additional information.

The BATCH processing function is accessed by selecting "6. SETUP/LOAD/STORE" from the UTILITIES menu and then selecting "1. SETUP/KERF SUPPORT" from the SUPPORT MENU. This causes the BURNY 5 to display the BATCH LIST using the following screen format.



BATCH LIST

START TIME : 11:32
STATUS : ACTIVE

BATCH COMMANDS

(1) CLEAR LIST (2) CLEAR ENTRY (3) START BATCH
(4) STOP BATCH (5) ENTER TIME (6) CLEAR ERROR
(7) (8) (9)
(0) CHANGE ENTRY

#	PGM NUMBER	SOURCE	SCALE	KERF VAL	STATUS
1	12345678-123	NC MEMORY	1.000	0.7500	DONE
2	87654321-321	NC MEMORY	2.000	0.7500	DONE
3	321	DATA BANK	2.000	NONE	ERROR
4	9510	DATA BANK	1.000	KNIFE	LOAD - 234
5	8888	NC MEMORY	2.000	0.7500	WAIT
6	2	NC MEMORY	1.000	PGM KRF	WAIT
7	9000	DATA BANK	1.000	0.1250	WAIT
8					
9					
10					

Whenever the BATCH SETUP/KERF function is first selected, the BATCH LIST screen is immediately displayed to show the first 10 entries in the processing list. Each entry contains a program number, a program source, a scale value, a kerf value and an operation status value. This screen, which is continuously updated in real time, also displays the status of the BATCH process through various data fields. From this screen, the up and down cursor keys can be used to move the block cursor at the left side of the screen and select an entry for modification. The <I> and <II> keys also affect the position of this block cursor. However, they are used to scroll to the other pages of the BATCH LIST. The list holds a maximum of 30 entries.

The "START TIME:" field at the top of the screen is blank unless the ENTER TIME (<5> key) command has been used or START BATCH (<3> key) command is used. The "STATUS:" field indicates the current state of the BATCH process. An "INACTIVE" status means the BATCH process is not busy. An "ACTIVE" status means the BATCH process is loading or performing RUN SETUP operations on a program. When it is "ACTIVE", further information is displayed in the status field of the currently active entry. The example screen shown above indicates.that the BATCH process has completed entry numbers 1 through 3, is working on entry number 4, and has not started the rest. Entry number 4 (program 9510) is being loaded from the DATA BANK. The number at the far right indicates the number of bytes transferred so far. After the program is loaded, the status display for that entry shows the percent complete for the RUN SETUP process.

The command menu at the top of the BATCH LIST screen identifies the functions that are provided to maintain and control the operation of the BATCH process. They are as follows:

CHANGE ENTRY
CLEAR LIST
CLEAR ENTRY
START BATCH
STOP BATCH
ENTER TIME
CLEAR ERROR

CHANGE ENTRY

The CHANGE ENTRY function (<0> key or just <ENTER>) allows the user to add or modify the setup parameters of an entry in the BATCH LIST. When selected, the BATCH LIST screen is replaced with the BATCH ENTRY screen. The following screen illustrates the format of the BATCH ENTRY screen as it might appear with the last prompt displayed. The actual prompts displayed are dependent on the selections made by the user.

```
                    BATCH ENTRY

LIST ENTRY   : 7
PGM SOURCE   : SERIAL DEVICE
DEFAULT      : DATA BANK
PGM NUMBER   : 9000
PGM NAME     : BUCKET03
SCALE VALUE  : 1.00
KERF ENABLE  : YES
PROGRAM KERF: NO
KERF VALUE   : 0.125
```

The first prompt on the BATCH ENTRY screen appears as "LIST ENTRY : XX" where "XX" is the index of the entry selected by the block cursor on the BATCH LIST screen. Any value between 1 and 30, inclusive, may be entered to select a different entry. Pressing <ENTER> selects the displayed entry number. Pressing <CE> returns to display the BATCH LIST screen.

Each entry in the BATCH LIST allows the location of the desired NC part program to be specified. Three sources are supported as shown in the following HELP menu.

```
PROGRAM SOURCE

1. NC PROGRAM MEMORY
2. SERIAL DEVICE
3. INTERNAL FLOPPY
```

Selecting NC PROGRAM MEMORY causes a resident NC part program to be processed. However, selecting SERIAL DEVICE or INTERNAL FLOPPY causes the NC part program to be first loaded from the selected device. Then, after the program has been successfully loaded, a RUN SETUP operation is immediately performed on the newly loaded program before any other entries in the BATCH LIST are processed. If the load is not successful, the RUN SETUP operation is not performed and the next "waiting" entry, if any, is immediately processed.

NOTE

When SERIAL DEVICE is selected, "DEFAULT : *****" is immediately displayed, where "*****" identifies the serial device selected through SYSTEM SETUP DATA variable 43, BATCH LOAD DEVICE. If the "DEFAULT : NO DEFAULT" message appears, the BATCH serial device is not defined. See the SYSTEM SETUP DATA VARIABLES section for further details.

The next prompt allows the user to select the program for processing. When the "PGM SOURCE:" is NC PROGRAM MEMORY, the number of the desired NC part program can be specified directly through the numeric keypad or by using the scroll keys. Once the correct NC part program number is displayed, pressing <ENTER> completes the selection. When "PGM SOURCE:" is SERIAL DEVICE or INTERNAL FLOPPY, the program number must be directly entered since these devices do not yet support "directory lookup" operations.

NOTE

The "ASCII NAME" capability may be enabled which allows the user to define a name for a program being loaded or to call a program by its ASCII FILENAME from the INTERNAL FLOPPY or an external device supporting the ASCII NAME CALLUP capability. When enabled, the program number prompt is followed by a program name prompt. Otherwise, the prompt for "SCALE" immediately follows the program number prompt. For additional information, see the description of the ASCII NAME feature in PART-1 of this manual.

After identifying the program to be processed, the next prompt allows the user to define the scale factor for the RUN SETUP process. The default is "SCALE : 1.00" which defines a ratio of 1:1 (100 percent). Scale values greater than one increase the size of the part and values less than one reduce the size of the part as follows:

0.25 - Resulting part is 25% of the original.
0.50 - Resulting part is 50% of the original.
1.00 - No scaling required.
1.25 - Resulting part is 125% of the original.
2.00 - Resulting part is 200% of the original.

After the SCALE prompt, several KERF prompts are displayed which allow the operator to enable or disable KERF processing, and if enabled, to accept or override any existing "PROGRAMMED KERF" or "DIAL IN KERF" value that may be already defined in the selected program. Up to three prompts may be displayed to obtain the required values. They are as follows:

KERF ENABLE : YES
PROGRAM KERF : NO
KERF VALUE : 0.0000

The first KERF prompt allows the operator to disable all KERF compensation operations in the selected program, even if it contains a PROGRAMMED KERF value. A response of "YES" is required to perform "DIAL IN KERF" or "PROGRAMMED KERF" operations. The second KERF prompt allows the operator to accept any "PROGRAMMED KERF" value contained in the program or re-use the existing KERF value if the NC program being loaded was previously saved in the special PROCESSED INTERNAL program format. A response of "NO" causes the BURNY to display the third KERF prompt. This prompt allows the operator to directly define the required KERF value. This value will override any existing "PROGRAMMED KERF" OR "DIAL IN KERF" that may already be defined in the program.

After the last prompt has been satisfied, pressing <ENTER> causes the BURNY to display the "LIST ENTRY :" prompt at the top of the screen with the index of the next entry in the processing list. To modify this entry, just press <ENTER>. To modify or define a different BATCH LIST entry, enter a new index number and press <ENTER>. However, to return to the BATCH LIST screen, press the <CE> key.

REMEMBER

After defining one or more operations in the BATCH LIST, the BATCH SETUP process must be "started" in order to perform the desired operations.

CLEAR LIST

The CLEAR LIST function (<1> key) allows the user to clear the entire BATCH processing list. Pressing the <1> key causes the "CLEAR BATCH LIST: NO" prompt to be displayed. Selecting the "YES" response causes all the entries in the BATCH LIST to be cleared.

CLEAR ENTRY

The CLEAR ENTRY function (<2> key) allows the user to clear a single BATCH LIST entry. Pressing the <2> key causes the "CLEAR BATCH ENTRY: NO" prompt to be displayed. Selecting the "YES" response causes the selected BATCH process entry to be removed from the BATCH LIST. The entry cleared depends on the current cursor location.

START BATCH

The START BATCH function (<3> key) causes the BATCH utility to immediately start processing entries on the BATCH list. This in turn causes the status field at the top of the screen to change from "INACTIVE" to "ACTIVE" but only if one or more "waiting" entries are found on the BATCH list. The START TIME field is also updated to reflect the time BATCH processing began.

Processing begins at the first entry in the list with a status of "WAIT". As entries are processed, the "WAIT" status condition in the active entry is updated in real time to show the current operation (LOAD, KERF or ACCEL) and a changing count or percent value. When all of the "WAIT" entries in the BATCH LIST have been processed, the BATCH process automatically returns to the "INACTIVE" state. See the **ENTER TIME** function for "delayed start" operations.

STOP BATCH

The STOP BATCH function (<4> key) causes the BATCH process to immediately terminate the currently active operation. The BATCH process also terminates an active operation if the user leaves the BATCH LIST screen without the BACKGROUND OPTION enabled. If enabled, an operation such as RUN will terminate an active BATCH operation. Whenever a BATCH LOAD/SETUP operation is terminated, the status of the active entry is automatically returned to "WAIT" so that it may later be restarted. For additional information, see the BACKGROUND OPTION section in this manual.

ENTER TIME

The ENTER TIME function (<5> key) allows the user to postpone the start of BATCH process operations until the specified time is reached. Time is defined using "24 hour clock" labeling conventions. It is entered as a single value representing hour, minute and second as HHMMSS, although less than 6 digits may be specified. For example, a value of "1405" represents "2:05 PM".

NOTE

In the standard operating mode, BATCH SETUP/KERF processing is only performed while on the BATCH LIST screen. If not on this screen when the start time has occurred, the BATCH process will remain "INACTIVE". For additional information, see the BACKGROUND OPTION section in this manual.

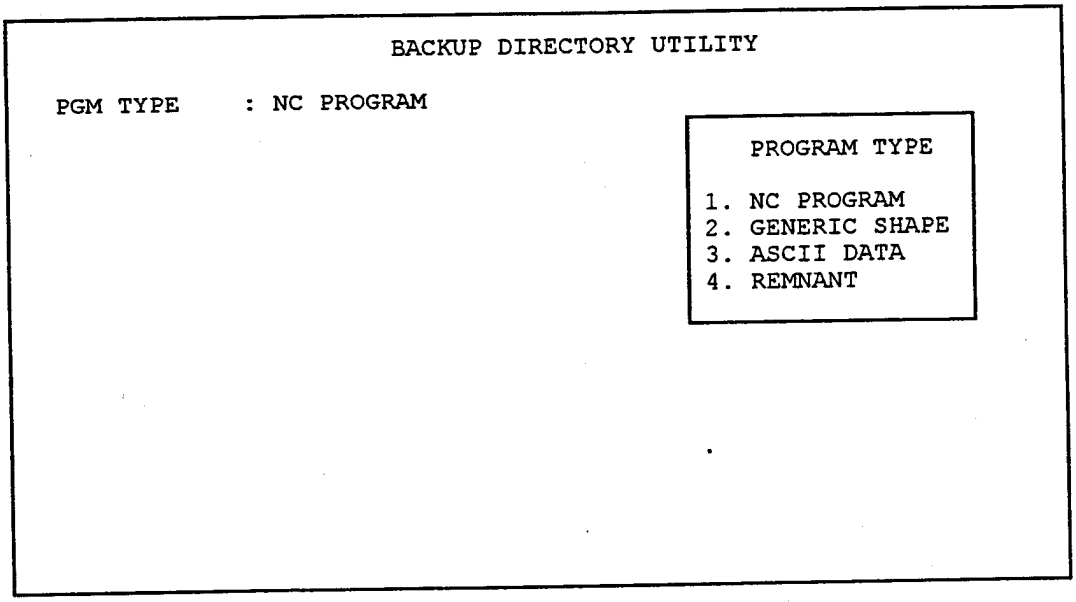
CLEAR ERROR

The CLEAR ERROR function (<6> key) clears any and all error conditions that may have occurred during one or more of the specified LOAD or RUN SETUP operations. These conditions are indicated by the text string "ERROR" in the status field of a BATCH LIST entry. An error condition must be cleared before a BATCH operation can be re-attempted on the failed entry. The full error message can be displayed by pressing the <IV> key after the cursor has been positioned on the line that has an error.

BACKUP DIRECTORY FILES

The BACKUP DIRECTORY utility function allows all of the programs from a selected internal directory, **which do not have program number extensions**, to be saved with a single operator request to the internal or external BURNY FLOPPY or any other external SERIAL DEVICE. Each directory type must be selected and backed up individually. Programs are transferred one at a time to the selected device as separate files so that individual files can later be recalled using the normal LOAD function. Program files are saved in the order in which they appear in the BURNY directory list.

The BACKUP DIRECTORY utility is accessed by first selecting "6. UTILITIES" from the MAIN MENU, then "3. DIRECTORY SUPPORT" and finally "5. BACKUP DIRECTORY" from the DIRECTORY SUPPORT menu. This causes the screen to update as follows, assuming the "NOVICE" prompting mode is enabled. If the "PROGRAM TYPE" menu is not displayed but it is desired, press the <IV> key at the "PGM TYPE" prompt.



The first prompt displayed after entering the BACKUP DIRECTORY utility allows the operator to select the directory type (for example, NC PROGRAM MEMORY or GENERIC SHAPE MEMORY) based on the program data type. In the initial release of this feature, no other prompts were used. The parameters to select the serial device type, program format, baud rate and character type had to be defined through SYSTEM SETUP DATA variable 42 (SERIAL STORE DEVICE) before initiating the BACKUP DIRECTORY operation. If this variable was not properly defined (for example, if it is set to "0"), the message "INVALID DEVICE" would be displayed as each program was selected for transfer and the transfer would terminate. When this error condition occurs, no data is stored.

The following illustrates the format of the BACKUP DIRECTORY prompting screen as it might appear with the last prompt displayed. The actual prompts displayed are dependent on the selections made by the user.

```
                    BACKUP DIRECTORY UTILITY

PGM TYPE      : NC PROGRAM

STORE TO      : SERIAL DEVICE

SERIAL TYPE   : STD CALLUP

BAUD RATE     : 4800

CHAR FORMAT   : EVEN PARITY, 7 DATA BITS

PGM FORMAT    : WORD ADDRESS




PRESS <ENTER> TO BACKUP:
```

As in the STORE operation, each of the digit positions in SYSTEM SETUP DATA variable 42 can predefine one or more serial device prompting values used by the BACKUP DIRECTORY utility. Individual device variables (variables 44 through 50) can also be used to reduce the number of prompting operations performed. Placing a value of "0" in these variables allows all prompt values to be directly defined by the operator with no special keystrokes. To override predefined values, the operator must press <SHF> before pressing <CE> on the "STORE TO: SERIAL DEVICE" prompt line. For additional information, see the SYSTEM SETUP DATA and SERIAL COMMUNICATION sections in this manual.

After satisfying all of the necessary value prompts, the message "PRESS <ENTER> TO BACKUP:" is displayed at the bottom of the screen. Be sure to ready the storage device and/or install the required disk before starting the BACKUP DIRECTORY operation with the <ENTER> key press.

When the BACKUP DIRECTORY operation is performed, only programs without extension numbers are sent. When a duplicate program number exists on the backup device, such as the BURNY FLOPPY or the FILE SERVER, the existing program is automatically replaced with the new backup file.

As programs are transferred, the program number and the transferred byte count of the active operation are displayed at the bottom of the screen. When one transfer completes, the BACKUP DIRECTORY function automatically selects the next allowable program from the directory list and performs another transfer. This process continues until all of the programs without extension numbers in the selected directory are sent or the BACKUP DIRECTORY operation is aborted with the <RST> or <CE> keys.

NOTE

> In the current implementation, only the BURNY FLOPPY device supports a "STORE DEVICE FULL" status condition. However in future versions, the communication protocols for other types of devices will be expanded to allow this type of error condition to be reported back to the BURNY.

When all of the required programs have been stored, the total number of programs transferred is displayed at the bottom of the screen with a "PRESS <ENTER> TO CONTINUE" message. Press <ENTER> to return to the "PROGRAM TYPE" prompt at the top of the screen and select the next directory type to be backed up. To exit the BACKUP DIRECTORY utility, press the <RST> key or the <CE> key.

NOTE

- Remember, only programs WITHOUT extension numbers are saved.
- The BURNY may not know when the backup device is full, so make sure the device can handle all of the programs contained in the selected directory.
- If the same program/file number is located in different directories and both are backed up to the same device (or disk), only the last one with the same number will be retained. The BURNY FLOPPY and FILE SERVER always replace existing programs with the latest backup version.

CONFIGURATION FILES

A directory type was added to the BURNY 5 system software to retain special ASCII DATA files and other miscellaneous program files. Like the GENERIC SHAPE directory, this directory is supported in INTERNAL MEMORY and on RAM CARTRIDGE. Space is only allocated to this directory when it is actually used. The ASCII DATA directory is used to retain SYSTEM SETUP DATA and CUSTOM AUXILIARY CODE data files. These files can be edited, stored to PANEL FLOPPY, RAM CARTRIDGE or a SERIAL DEVICE, or loaded like any other program file.

Loading a program to the ASCII DATA directory from a serial or floppy device is helpful in determining unknown file types or problems with syntax. Once loaded in the ASCII DATA directory, the program can be displayed in the DISPLAY/EDIT utilities. The BURNY 5 loads programs into the ASCII DATA directory just as they are with no modifications or interpretations.

A setup data "SAVE/RESTORE" feature allows the user to convert the internal SYSTEM SETUP DATA and the CUSTOM AUXILIARY CODE data tables into ASCII DATA files for use in EDIT, LOAD and STORE operations. This allows the user to retain this important setup data "off-line" on a SERIAL DEVICE or a RAM CARTRIDGE for later use in the control. This data can also be used to define the exact same configuration in other BURNY 5 controls provided that they have the same software version date. Hard copy of these setup values can be obtained by "storing" these ASCII files to a printer.

OPERATION

SAVE and RESTORE configuration data operations are performed using the <ZOOM> keys when in the "SETUP/CONFIGURATION" utility with the SYSTEM SETUP DATA or the CUSTOM AUXILIARY CODE data table displayed. When the right <ZOOM> key (zoom down) is pressed, an "ENTER SAVE FILE NUMBER:" prompt is displayed allowing the user to define the program number to be used in the ASCII file creation process. Duplicate program numbers are not allowed. Pressing <IV> at this prompt causes the ASCII DATA directory to be displayed. After specifying the program number and pressing <ENTER>, the currently displayed values are immediately converted and saved as a file in the ASCII DATA directory.

Similarly, the left <ZOOM> key (zoom up) causes an "ENTER LOAD FILE NUMBER:" prompt to be displayed so that the user can specify the number of the ASCII DATA directory file to be recalled. After the number has been entered, the ASCII file is immediately converted and the display is automatically updated to show the newly loaded values.

When restoring CUSTOM AUXILIARY CODE data, the newly defined values are automatically retained in battery backed memory and no additional operations are required. However when restoring SYSTEM SETUP DATA values, only the current "RAM resident" values are updated. To permanently update the SYSTEM SETUP DATA values in non-volatile memory, the user must still perform the "SAVE CONFIGURATION DATA" utility function.

WARNING

Since the RESTORE feature can update some or all of the internal SYSTEM SETUP DATA values (including the LOOP GAIN, X/Y DRIVE SENSE and X/Y ENCODER SENSE), the recalled file must contain the correct values for the machine or the machine may run out of control and/or become unstable. Therefore, it is recommended that the SYSTEM SETUP DATA restore feature only be used with the BURNY not in control of the machine and/or CNC RUN mode not active.

SYSTEM SETUP DATA

A system setup data file can be created in the ASCII DATA directory by pressing the right <ZOOM> key while any of the modifiable SYSTEM SETUP screens are displayed. The prompt "ENTER SAVE FILE NUMBER:" is displayed at the bottom of the screen. If the system is in the "NOVICE" mode, the directory of existing ASCII DATA files is displayed. If not, the <IV> key can be pressed to display it. Enter a file number to save the current system setup data values. The saved file can later be displayed and/or modified using the DISPLAY/EDIT utilities. The program name given to the file is "SYSTEM DATA - xx/xx/xx" where "xx/xx/xx" is the date the file was created. This file name is displayed in the directory list to the right of the program number. It can be changed in the text editor to make identification easier to the operator.

It is suggested that some scheme of numbering be used to differentiate between system setup data files and auxiliary code data files. For example, all system data files could start with 1111 and all auxiliary code files with 2222. Saving the system data file as 11110001 for example, could mean a specific setup for OXYGEN cutting and file 11110002 could be a setup for PLASMA. Also the program name can be changed to reflect the use of the data file (perhaps "SD-OXYGEN" or "SD-PLASMA" in the above case).

If separate system setup data parameters are required for each type of cutting operation, the machine can be "tuned" for each type of operation and the system setup data parameters can be saved in separate files. One of these files can then be recalled before each type of cutting operation to optimize the machine performance.

A saved setup data file can be recalled by pressing the left <ZOOM> key while on any of the modifiable system setup data screens. The prompt "ENTER LOAD FILE NUMBER:" is displayed at the bottom of the screen. If not already displayed, the ASCII DATA directory can be brought up by pressing the <IV> key. Select the correct system setup data file by entering its number at the prompt. When the <ENTER> key is pressed, the data file is loaded, the screen is updated and the new parameters take effect. If a non-existent program number is entered, an error message is displayed. Repeat the operation with a valid program number.

An example of an actual system setup data file saved in the ASCII DATA directory is shown below (in four columns to save space).

```
D
P11110001
  1 = 0:ENGLISH
  2 = 1.96
  3 = 150.00
  4 = 1.44
  5 = 0.60
  6 = 10.00
  7 = 0.7475
  8 = 2.00
  9 = 50.00
 10 = 147.60
 11 = 0.00
 12 = 0.00
 13 = 2.00
 14 = 0.50
 15 = 0.50
 16 = 150.00
 17 = 150.00
 18 = 500
 19 = 5.0000
 20 = 5.0000
 21 = 0:NORMAL
 22 = 1:REVERSE
 23 = 1:REVERSE
 24 = 0:NORMAL
 25 = 0.50
 26 = 0.9950
 27 = -0.9950
 28 = -1.9950
 29 = 1.9975
 30 = 50.00
 31 = 1:RIGHT
 32 = 0.2450
 33 = 0:NORMAL
 34 = 0.44
 35 = 45
 36 = 0
 37 = 9620
 38 = 5362
 39 = 0
 40 = 0
 41 = 5163
 42 = 5163
 43 = 5163
 44 = 370000
 45 = 303000
 46 = 300000
 47 = 0
 48 = 0
 49 = 8163
 50 = 0
 51 = 0
 52 = 0
 53 = 0
 54 = 0
 55 = 0.400
 56 = 48
 57 = 400.00
 58 = 0
 59 = 0
 60 = 0
 61 = 0.0000
 62 = 0.0000
 63 = 0.0000
 64 = 0.0000
 65 = 0.0000
 66 = 0.0000
 67 = 0.0000
 68 = 0.0000
 69 = 0.0000
 70 = 0.0000
 71 = 0.0000
 72 = 0.0000
 73 = 0.0000
 74 = 0.0000
 75 = 0.0000
 76 = 0.0000
 77 = 0.0000
 78 = 0.0000
 79 = 0.0000
 80 = 0.0000
/*
```

The **"D"** at the beginning of the file indicates that it is an ASCII DATA file. All ASCII DATA files must start with the letter **"D"** for the BURNY 5 control to read the file. The next line contains a **"P"** followed by a number. The number is the program number that was used when the file was created. The remaining lines contain the actual system data in a special format that can be read by the BURNY 5 control. The last line contains the special ASCII DATA file termination sequence "/*". This special sequence must be at the end of all ASCII DATA files.

Each numbered line in the system data file corresponds to a specific system data entry. See the BURNY 5 OPERATION AND MAINTENANCE MANUAL section SYSTEM SETUP DATA VARIABLES for the meanings of each of the data file entries.

The parameters that are defined by words (ENGLISH/METRIC, LEFT/RIGHT etc.) are defined below.

0:ENGLISH	0:LEFT	0:NORMAL
1:METRIC	1:RIGHT	1:REVERSE

The text after the 0 or 1 in the data file is optional and only put there by the BURNY 5 to make the file more readable.

CUSTOM AUXILIARY CODE DATA

The custom code data save/restore operation is very similar to the system setup data save/restore operation. When on the modify CUSTOM AUXILIARY CODE screen, press the proper <ZOOM> key to load or store the data file. The left <ZOOM> key is used to load custom code tables and the right <ZOOM> key is used to store the custom code table to the ASCII DATA directory. The <IV> can be used to display the directory of available files. When a custom code table is saved, the name given to the file is "CUSTOM AUX - xx/xx/xx" where "xx/xx/xx" is the date the file is saved. The name can be changed in the text editor to make identifying the file easier especially if there is more than one.

The saved custom code table file can be displayed and/or edited with the DISPLAY/EDIT utilities. The file can also be stored to an off-line storage device for future use.

An example AUXILIARY CODE DATA FILE is shown below (in two columns and condensed to save space).

```
D
P22220001
  1. G05 = 5:CUT OFF
  2. M69 = 7:KERF OFF
  3. G21 =77:ABS LINE IN2 MM0
  4. M67 = 8:KERF LEFT
  5. M70 = 6:CUT ON
  6. G22 =78:ABS CW ARC IN2 MM0
  7. G23 =79:ABS CCW ARC IN2 MM0
  8. M66 = 5:CUT OFF
  9. M68 = 9:KERF RIGHT
 10. G31 =80:ABS LINE IN3 MM1
 11. G32 =81:ABS CW ARC IN3 MM1
 12. G33 =82:ABS CCW ARC IN3 MM1
 13. M65 = 6:CUT ON
 14. M71 = 5:CUT OFF
 15. M00 =21:PROGRAM STOP
 16. M73 = 5:CUT OFF
 17. G11 =74:INC LINE IN3 MM1
 18. G12 =75:INC CW ARC IN3 MM1
 19. G13 =76:INC CCW ARC IN3 MM1
 20. BLANK
 21. BLANK
      .
      .
      .
 99. BLANK
100. BLANK
/*
```

The beginning and the end of this file use the same special start and end code sequences as the SYSTEM SETUP DATA FILE. Each of the used auxiliary code table entries has a corresponding entry in the data file. See the BURNY 5 OPERATION AND MAINTENANCE MANUAL section CUSTOM AUXILIARY CODES for the code definitions. The "BLANK" entries filling to the end of the file ensure that all entries past those defined are blanked out. The text after the code definition is optional and added by the BURNY 5 control for documentation purposes only.

ERROR MESSAGES

Both SYSTEM SETUP and CUSTOM CODE file restore operations require decoding of the saved ASCII file. During the decode operation, errors in the syntax of the files are detected and reported to the user. These error messages are not normally seen when the file is created by the BURNY 5 control. However, if the files are created off-line on a PC or the BURNY files are modified by a.user, problems can arise.

SYSTEM SETUP DATA FILE ERROR MESSAGES

A list of error messages for the SYSTEM SETUP DATA file are shown below. It is assumed that the LINE in error is line 1. However, the first line to be found in error is always displayed.

"ERROR-LINE 1,#1:INVALID INDEX" - This error message occurs if the first number in the field exceeds the maximum number of system setup data entries.

EXAMPLE: "**999** = 123.123"

The value 999 exceeds the maximum number of system setup data variables.

"ERROR-LINE 1,#2:INVALID FORMAT" - This error message occurs if the "=" is missing from an entry.

EXAMPLE: 4. 1.44

In this example a "." is used instead of the "=" to separate the index number form the value. This is a format error and is not allowed.

"ERROR-LINE 1,#3:INVALID VALUE" - This error message occurs if a Boolean value is not present.

EXAMPLE: 1 = **9**:ENGLISH"

A Boolean value requires a "0" or a "1" as the value. If a number other than "0" or "1" is in the file ("9" in this example), this error message is displayed.

"ERROR-LINE 1,#4:OUT OF RANGE" - This error message occurs if an integer value is out of range.

EXAMPLE: "18 = **999**"

System setup data variable 18 (ENCODER COUNTS/REVOLUTION) has a range of 0 to 655. Therefore the value of 999 is out of range.

"ERROR-LINE 1,#5:OUT OF RANGE" - This error message occurs if an unsigned integer value is out of range.

EXAMPLE: "56 = **99999**"

System setup data variable 56 (SPEED LOOP RESET TIME) has a range of 0 to 65535. Therefore the value of 99999 is out of range.

"ERROR-LINE 1,#6:OUT OF RANGE" - This error message occurs if a floating point value is out of range.

EXAMPLE: "4 = **9999.9**"

System setup data variable 4 (LOOP GAIN) has a range of 0 to 2621.4. Therefore the value of 9999.9 is out of range.

CUSTOM CODE DATA FILE ERROR MESSAGES

A list of error messages for the CUSTOM CODE DATA file are shown below. It is assumed that the LINE in error is line 1. However, the first line to be found in error is always displayed.

"ERROR-LINE 1, FIELD 1" - This error message is displayed if the custom code index exceeds the maximum value for the number of entries in the table. Currently the table holds 100 entries, so this value has a range of 1 to 100.

EXAMPLE: "**101**. G05 = 5:CUT OFF"

An index value of 101 exceeds the maximum table entry so an error message is displayed.

"ERROR-LINE 1, FIELD 2" - This error message is displayed if an illegal character is placed in the position where a "G", "M" or " " character is expected.

EXAMPLE: "1. H05 = 5:CUT OFF"

An "H" is not an allowable character so an error message is displayed.

"ERROR-LINE 1, FIELD 3" - This error message is displayed if an out of range value is placed in the position following the "G", "M" or " " character.

EXAMPLE: "1.G9999 = 5:CUT OFF"

A value of 9999 exceeds the maximum allowable value for a custom code definition so an error message is displayed.

"ERROR-LINE 1, FIELD 4" - This error message is displayed if the index for the custom code definition exceeds the number of code definitions available.

EXAMPLE: "1. G05 = 99:NON-EXISTENT CODE

A value of 99 exceeds the current maximum index value of 97 so an error message is displayed.

These error messages should help find problems in the SYSTEM SETUP DATA and CUSTOM CODE DATA files.

PART 4 - PART PROGRAMMING

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PART PROGRAMMING

The BURNY 5 supports a wide variety of techniques to directly create programs in NC PROGRAM MEMORY. It also provides many special features that allow it to load programs from numerous types of off-line storage devices using different program formats. These functions can be summarized as follows:

LOAD FROM STANDARD SHAPE MEMORY
LOAD FROM CUSTOM SHAPE CARTRIDGE
LOAD FROM GENERIC SHAPE MEMORY
LOAD FROM PART CONSTRUCT SHAPE
CREATE (OR EDIT) WITH PROGRAM TEXT EDITOR
CREATE WITH TEACH TRACE
CREATE WITH GRAPHIC NEST EDITOR
LOAD FROM SERIAL OR PANEL DEVICE

The "LOAD FROM SHAPE" functions allow the operator to quickly create custom NC part programs from SHAPE programs that reside in BURNY memory or in a cartridge that is inserted into the front panel. SHAPE programs are special programs that define part geometries and characteristics with variable dimensions and other selectable parameters. When performing a "LOAD FROM SHAPE" operation, prompts are displayed on the screen for each value to be specified by the operator. Then, after all of the desired values have been defined, the BURNY automatically generates an NC part program conforming to the operator's specifications. Since this process can be repeated indefinitely, an endless number of unique parts can be created from each shape. For additional information on the "LOAD FROM SHAPE" function and capabilities provided by shapes residing in STANDARD SHAPE MEMORY, CUSTOM SHAPE CARTRIDGE MEMORY, and GENERIC SHAPE MEMORY, see the PROGRAMMING WITH SHAPES section contained in this part of the manual.

PART CONSTRUCT is a special shape that allows the operator, with no knowledge of NC programming languages, to create NC part programs. Unlike other shape programs, PART CONSTRUCT has no predefined geometrical pattern. When creating a part program with the PART CONSTRUCT SHAPE, prompts are displayed to allow the operator to functionally define any required sequence of line, arc, and auxiliary function codes. Two special features, MATH FUNCTION and TRIANGLE UTILITY, are also provided to help the user define the required dimensional movements. For additional information, see the PART CONSTRUCT OPERATIONS section that follows.

For those who prefer programming in a STANDARD or CUSTOM WORD ADDRESS, ESSI or GENERIC program format, a character based PROGRAM TEXT EDITOR is also provided. This editor allows the operator to create and/or edit any existing NC program using any of the supported NC program formats, regardless of the format used when the program was loaded or created. For additional information on the use and operation of the PROGRAM TEXT EDITOR, see PART-3 in this manual.

The TEACH TRACE process allows the BURNY 5 to monitor and convert the movements of the machine into an NC part program as the machine follows a tracing eye around a template. Like other programs in memory, TEACH programs can be immediately run, or they can be edited and/or stored to any supported device in any supported format for later reloading. They may also be included in a nest. For additional information on the operation of the TEACH TEMPLATE function, see PART-2 in this manual.

The GRAPHIC NEST EDITOR allows the operator to graphically position one or more different NC part programs into a single nested program. Like other programs in NC PROGRAM MEMORY, programs created with the NEST EDITOR can also be modified with the TEXT EDITOR in any supported format or stored to a device for later recall. Nested programs, like individual part programs, can also be included with other programs to create even larger nests. For additional information on the use and operation of the GRAPHIC NEST EDITOR, see PART-3 in this manual.

Last, but not least, NC programs can be directly loaded from a variety of panel mounted and remote serial devices. Several different programming formats are support. These formats, which are also used by the STORE function, the PROGRAM TEXT EDITOR and other program display functions, are described in the sections that follow. However, for additional information on the LOAD operation, see the LOAD PROGRAM section in PART-2 of this manual.

One of the major advantages of the BURNY 5 control is its ability to convert and retain all NC programs in a single internal program format, regardless of whether they were created from STANDARD SHAPES, PART CONSTRUCT, TEACH, EDIT, NEST, LOAD or any other function. As a result, all of the BURNY program functions operate equally well on all of the programs in NC PROGRAM MEMORY. For example, every program can be nested with other programs, run, edited, or stored without restrictions. This is particularly useful when using the custom program features to load programs written for other NC controls. Because of this common internal format, every resident NC program can be converted into one of the STANDARD or CUSTOM WORD ADDRESS and ESSI formats for a STORE or EDIT operation. For example, a program loaded in a CUSTOM ESSI format can still be edited using a STANDARD WORD ADDRESS format, if desired.

Two major programming languages, WORD ADDRESS (as per EIA RS-274 specification) and ESSI, are supported in every BURNY 5 control. A third format, called INTERNAL, is also supported to allow NC programs to be edited, stored and displayed in the common internal program format. This format, which is primarily used for debug and testing purposes, can also be used to store internal programs for later recall with all internally calculated KERF and ACCEL/DECEL data still valid. Special checksum, type and size parameters in the program header are provided in this format to insure that all data remains valid and no data is lost while transferring to and from the off-line storage device or remote computer. See the NC PROGRAMMING LANGUAGES section for a description of the WORD ADDRESS and ESSI programming formats and the auxiliary functions supported.

Additional flexibility and compatibility with program formats used on other controls is achieved by a wide variety of special program formatting features. Some of these apply only to the WORD ADDRESS programming formats, while others apply to both WORD ADDRESS and ESSI. These include the following:

AUXILIARY CODE CONVERSION PROCESS
SPECIAL END OF PROGRAM
DECIMAL SHIFT
AXIS SWAP AND MIRROR
FULL (XYIJ) & PARTIAL (XY ONLY) ABSOLUTE
3 DIGIT AUX CODES
AUTOMATIC I/J SIGN FEATURE
XYXY FORMAT SUPPORT
SPECIAL MULTIFUNCTION AUXILIARY CODES

For additional information on these features, see the PROGRAM FORMAT VARIATIONS section that follows.

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PROGRAMMING WITH SHAPES

In order to reduce the amount of programming required to create and/or load a family of NC part programs with similar characteristics, the BURNY 5 provides support for several different types of SHAPE programs. Unlike NC part programs, SHAPE programs are written in a special "generalized" format. This format allows dimensions and other parameters that are "fixed" in NC programs to be defined with variables. Values are assigned to these variables by the operator and then the NC part program is created by the BURNY.

When a shape is selected to "LOAD" , the BURNY prompts the operator for each of the required parameter values and creates the NC part program as specified. Since few numerical range restrictions are placed on the values entered, an infinite number of unique part programs can be generated from each shape. Programs created from shapes can be edited, nested, stored, reloaded or run like any other in NC PROGRAM MEMORY.

The BURNY 5 supports shape operations from three different sources. They are as follows:

STANDARD SHAPE MEMORY
CUSTOM SHAPE CARTRIDGE MEMORY
GENERIC SHAPE MEMORY

STANDARD SHAPE MEMORY is the most commonly used since it is provided as part of the BURNY 5 system software. It contains 50 STANDARD SHAPES and a special PART CONSTRUCT SHAPE (shape number 99). Each of the 50 STANDARD SHAPES defines a basic geometry that can be used to generate a family of NC part programs. This allows a broad range of parts to be created and cut with only a few simple prompts. For additional information on the 50 SHAPES library, see the STANDARD SHAPE OPERATIONS section in this part of the manual.

The PART CONSTRUCT SHAPE does not pre-define a basic geometry. Instead, it allows any part geometry to be defined. With this shape, the order and number of lines and arcs placed in the resulting NC program are completely determined by the operator. Unlike the PROGRAM TEXT EDITOR, the PART CONSTRUCT SHAPE process operates as a "functional" editor which automatically calculates line and arc endpoints and arc center points from the values entered by the operator. Special mathematic and trigonometric function aids are also provided by the PART CONSTRUCT process. For additional information, see the PART CONSTRUCT OPERATIONS section in this part of the manual.

CUSTOM SHAPE CARTRIDGE MEMORY allows the user to expand the number of internal shapes beyond 50. However, in order to use a SHAPE CARTRIDGE, the optional cartridge port must be installed in the front panel. SHAPE CARTRIDGE programs are provided to the customer in a non-erasable ROM cartridge.

CUSTOM SHAPE CARTRIDGE programs use the same format as the 50 internal shapes. This allows SHAPE CARTRIDGE programs to perform many of the same types of prompting operations as the 50 STANDARD SHAPES. However, many of the currently programmed CUSTOM SHAPES do not support the "QUICK INSPECT" and "ALTERNATE LANGUAGE" switch operations like the internal standard shapes. CUSTOM SHAPES are designed at CMC to meet specific user requirements. Consult the factory for additional information on CUSTOM SHAPE development charges.

GENERIC SHAPE MEMORY contains special "user defined" shape programs that can also be used to create an unlimited number of NC part programs. These shapes, however, can be created off-line or with the BURNY 5 PROGRAM TEXT EDITOR and then loaded or saved in battery backed GENERIC SHAPE MEMORY.

GENERIC SHAPE programs are written in a special GENERIC programming language that resembles the WORD ADDRESS programming format. However, this language also supports prompting blocks, mathematical functions and arithmetic operations on values in data registers. Special dimension block formats allow movements to be assigned from calculated values. Thus, once a GENERIC SHAPE program is placed in GENERIC SHAPE MEMORY, any number of "LOAD FROM SHAPE" operations can then be performed to create any number of NC part programs. For additional information, see the GENERIC SHAPE OPERATIONS section in this part of the manual.

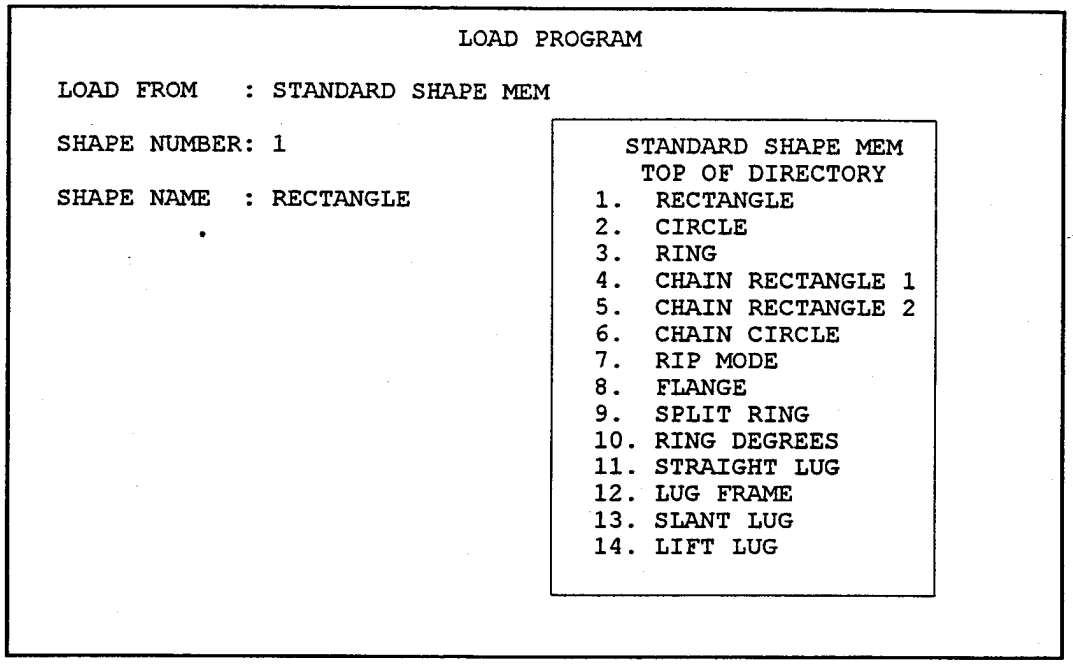
STANDARD SHAPE OPERATIONS

STANDARD SHAPES are special "internally defined" shape programs that can be used to create an unlimited number of custom NC part programs. The BURNY 5 provides 50 STANDARD SHAPES in the STANDARD SHAPE MEMORY directory. Each is designed to create a family of NC part programs with a minimum number of operator prompts. As such, each STANDARD SHAPE pre-defines only a basic geometry. The actual dimension values used during the NC part creation process are directly assigned or mathematically derived from values input by the operator during the shape prompting process.

NOTE

An additional shape program, called PART CONSTRUCT (number 99), also resides in the STANDARD SHAPE MEMORY directory. This shape is provided to expand the capabilities of the shape process and allow any NC part geometry to be created. However, the increased flexibility of the PART CONSTRUCT shape process is achieved through additional prompting operations. For additional information on this special shape, see the PART CONSTRUCT OPERATIONS section.

NC part programs are created from STANDARD SHAPE programs by first selecting LOAD from the MAIN MENU and then, selecting STANDARD SHAPE MEMORY as the program source. This causes the BURNY 5 to display the SHAPE NUMBER / SHAPE NAME prompt and, if in NOVICE prompting mode, a directory list containing the names of the first shapes in STANDARD SHAPE MEMORY. If this list is not automatically displayed, press the <IV> key when at the SHAPE NUMBER prompt to callup the directory list. The <IV> key can also be used during the shape selection process to reposition the display window in STANDARD SHAPE MEMORY since the currently displayed shape number will be positioned at the middle of the list. With the directory list displayed, the <I> and <II> keys can also be used to reposition the display window up and down through the STANDARD SHAPE MEMORY directory one page at a time.



At the SHAPE NUMBER prompt, the up and down arrow keys can be used to step to the desired shape number or the numeric keys, followed by <ENTER>, can be used to directly define the desired shape number.

Once the SHAPE NUMBER has been defined, the <V> key can be used to request a graphic image that illustrates the general characteristics of the shape. This image is only provided as an aid in the shape selection process. The resulting NC part program may be significantly different since it will be created from the values defined by the operator.

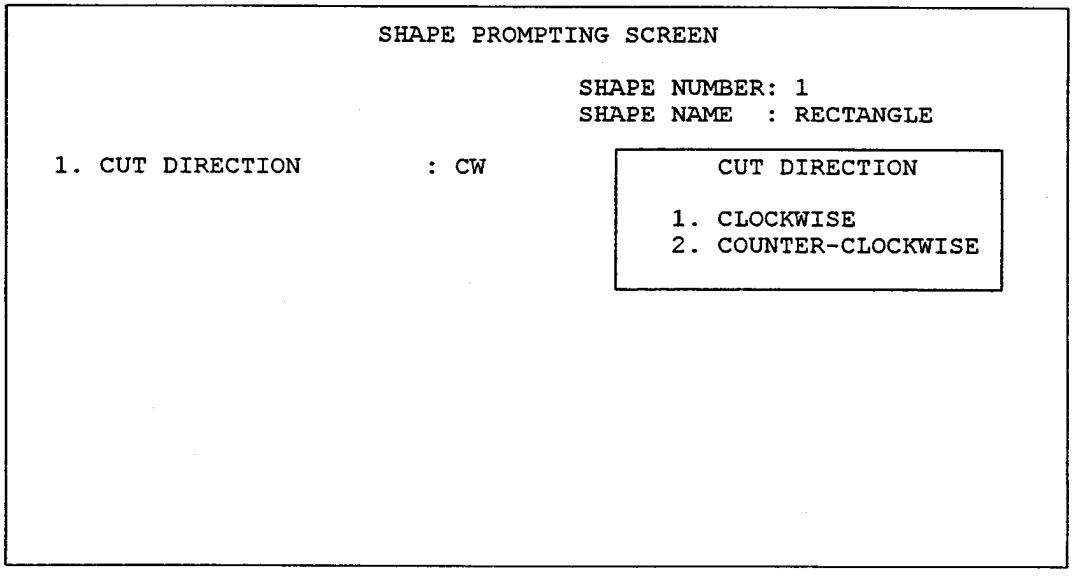
A new feature has been added to the control to graphically scroll through the STANDARD SHAPES. So, instead of selecting a shape by its number, the operator can also select it from its graphical image. The <UP> and <DOWN> cursor keys as well as the <I> and <II> keys can be used to scroll through all the fifty shapes. When the desired shape is displayed on the screen, press the <ENTER> key to return to the prompting screen. The prompting screen now displays the selected shape number and name.

After the SHAPE NUMBER / SHAPE NAME prompt has been satisfied and the <ENTER> key pressed, the BURNY responds with the PROGRAM NUMBER / PROGRAM NAME prompt. At this prompt, type the number for the NC part program that will be created and press <ENTER>. In response, the BURNY will either prompt for the NC PROGRAM NAME or advance directly to the "REPLACE OLD?" prompt.

NOTE

The Burny 5 has the ability to provide a "user defined" PROGRAM NAME. However, to be operational, this feature must be enabled through SYSTEM CONFIGURATION 2. Before that release, the name field of the NC part program name would always be automatically derived from the shape name. For additional information, see variable 38 in the SYSTEM SETUP DATA section.

After a unique NC program number has been defined or "REPLACE OLD? YES" has been selected by the operator, the shape prompting process is started. This causes the screen to update with the first prompt displayed on the left side of the screen. The following screen assumes shape 1, RECTANGLE, is selected and NOVICE prompting mode is enabled.



The HELP menu displayed on the right side of the screen, may or may not appear, depending on the current prompting mode. In NOVICE mode, all HELP menus are automatically displayed. However, in EXPERT mode, HELP menus are only displayed for the current prompt when the <IV> key is pressed.

NOTE

The NOVICE/EXPERT prompting mode is initially defined at power-up through SYSTEM SETUP DATA variable 38. However, this mode can be toggled by pressing <SHF> and then <V> whenever a HELP menu is available for the current prompt. For additional information on the NOVICE/EXPERT prompting mode feature, see PART-1 in this manual.

PROMPTING OPERATIONS

Once the shape selection has been made and the NC program number has been defined, the operator is required to answer a series of prompts which determine the final dimensions of the part. Generalized shape drawings with all associated prompts and prompting notes for each of the 50 STANDARD SHAPES are provided at the end of this section to help illustrate the position of dimensions and the significance of other prompted values.

Another feature has been added to the prompts that require a dimension input. Whenever this type of prompt is displayed on the screen, the message "PRESS V TO DISPLAY SHAPE" appears at the bottom of the screen. When the <V> key is pressed, the shape is displayed on the graphics screen. All the variable dimensions are identified by their prompt numbers. All prompt numbers are displayed in YELLOW, except for the current prompt, which is displayed in WHITE. To aid the operator further, the current prompt text string is also displayed in WHITE. The operator can then press the <ENTER> key to switch to the prompting screen, and provide the requested input to the prompt. This feature was added to give the operator a visual impact of the current prompt in relation to the shape.

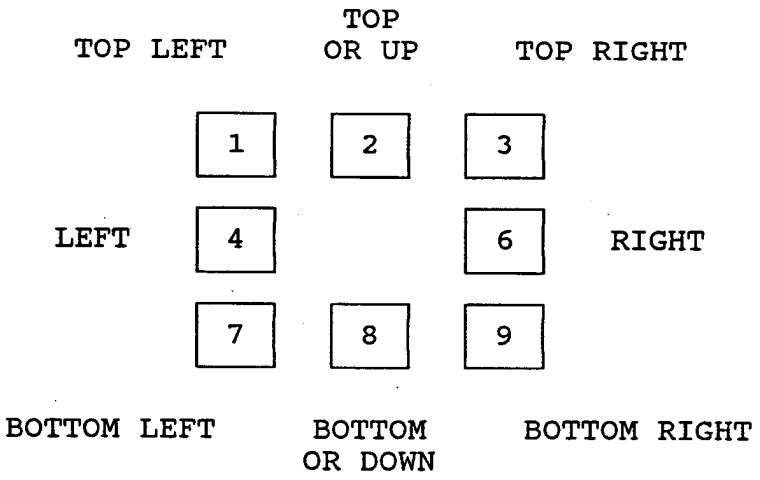
If a dimension is requested, use the numeric keypad along with the decimal point and <CE> keys to enter the desired value. Once it is correct, press <ENTER>. Since the BURNY 5 can operate in either a METRIC or ENGLISH system mode, the default units for the dimensions will be those selected for the operating system during installation by SYSTEM SETUP DATA variable 1, INTERNAL SYSTEM UNIT. However, dimensions can still be entered in either unit by pressing the <SHF> key. This way, an occasional metric part dimension can be entered directly even though the system is set for inch units.

NOTE

To enter a dimension in the opposite unit from the system type, press the <SHF> key first. The displayed value will be converted to the opposite unit (inch/mm) and the number of decimal places will change (2 for inch, 1 for mm). Press the <SHF> key again to change back to the original units. This key only changes the unit for the value being entered. It does not switch the units for the entire system. Each dimension must be converted individually as required.

If a count (such as the NUMBER OF HOLES) or other integer value is requested, use the numeric keypad to enter the desired value. Key press errors can be removed by pressing the <CE> key or the left arrow key before pressing the <ENTER> key.

If a STARTING POSITION or REPEAT DIRECTION is requested, press the <+/-> key or the up and down arrow keys to toggle or step to the desired response and press <ENTER>. Alternately, the outside row of keys on the numeric keypad (1 through 9, excluding 5) can be used to directly select the desired response. Small pointers can be found on these numeric keys as a reminder of the direction they select. The possible sections for the currently displayed prompt are also defined in a special HELP menu, which if not already displayed, can be called up by pressing the <IV> key. The following identifies the directions that are assigned to the numeric keypad.



If a non-numeric selection, such as "CW/CCW" or "YES/NO", is requested, the displayed response may be toggled to the correct response by pressing the <+/-> key or the <UP> and <DOWN> arrow keys before pressing <ENTER>. As an alternative, the <1> and <2> numeric keys may be pressed to directly select the required response. (If not already displayed, the <IV> key may be pressed to call up a help screen that identifies the allowable responses and the assignment of these responses to the numeric keys).

Once all of the parameter and value prompts have been displayed and answered, the following verification prompt appears:

" REPEAT PROMPTING : YES"**

If any of the prompting values have been incorrectly entered, just press the <ENTER> key to return to the top of the screen and redisplay the first shape prompt. Then press <ENTER> to redisplay each prompt in sequence. Corrections can be easily made as needed since all previously entered values will be redisplayed. Note that as an alternative, the operator may use the <CE> to return to the first prompt at any time during the prompting process instead of advancing to the REPEAT PROMPTING request.

If all data is correct when the "REPEAT PROMPTING: YES" prompt appears, press the <+/-> key to change the response to "NO" and press <ENTER>. This causes the BURNY 5 to generate the NC part program from the values specified by the operator. When complete, the following message is displayed:

"WANT TO GRAPH SHAPE: YES"

Pressing <ENTER> with the "YES" response displayed allows the operator to graphically inspect the NC part program that was created from the specified values. After examining the part, press <ENTER> again to display the following prompt:

"DELETE AND RESTART SHAPE: NO"

If any errors were found, change the response to "YES" and press <ENTER>. This causes the BURNY to delete the NC part program just created and restart the prompting process with all previously specified values unchanged. This allows the operator to adjust only the values in error and then create a new NC part program. This process may be repeated indefinitely, provided that "DELETE AND RESTART SHAPE: NO" is not selected. If it is, the newly created part program is saved in battery backed NC PROGRAM MEMORY and the shape process is terminated.

COMMON DIMENSION PROMPTS

In addition to the actual dimensions of the part, most of the 50 SHAPE PROGRAMS also prompt for the following:

KERF DIMENSION
SCRAP DIMENSION
LEADIN DIMENSION
LEADOUT DIMENSION

Most of the STANDARD SHAPES prompt for a KERF value along with the part dimensions. However in most cases, a KERF value of 0.00 should be specified so that the BURNY 5 "DIAL IN KERF" feature can be used when performing RUN SETUP operations. This allows the same NC part program to be cut with different KERF values. When a non-zero KERF value is specified during shape prompting operations, the required KERF offset distance is permanently added to the NC part dimensions, and the "DIAL IN KERF" feature in the RUN SETUP process is no longer operational. Since the KERF can not be adjusted in these part programs, the entire part must be re-programmed in order to change the KERF value.

NOTE

On any of the "Chain Cut" parts, such as CHAIN RECTANGLE 2 (#5) and WEDGE PAIR (#15), the KERF value must be defined through the shape prompting process, along with the part dimensions. This is due to the common side cutting and nesting which is done on these parts. Regardless of the KERF entered, the "DIAL IN KERF" will not function on these parts.

Most of the STANDARD SHAPES also prompt for a SCRAP dimension. This is the space left between successive rows of parts. Since the "DIAL IN KERF" feature does not increase the part-to-part spacing, the value for SCRAP must allow for enough material to accommodate the anticipated KERF plus the desired amount of actual material to be left between the rows of parts.

Often the SCRAP value is also used by the shape process when calculating the traverse move distance from the starting point of the part to the first pierce point. This calculation insures that the X and Y distances from the part to the edge of the plate are the SCRAP distance, assuming that the resulting NC part program is started from the corner of the plate.

NOTE

The accuracy of the SCRAP dimension is equal to the accuracy of the part dimensions. Therefore, the SCRAP value can be set fairly small with good results. A typical SCRAP value for OXYGEN FUEL cutting can be anywhere between .1 to .5 inch (2.5mm to 12mm). Remember that the SCRAP dimension must allow for the anticipated KERF value range if the "DIAL IN KERF" feature is to be used in the RUN SETUP process.

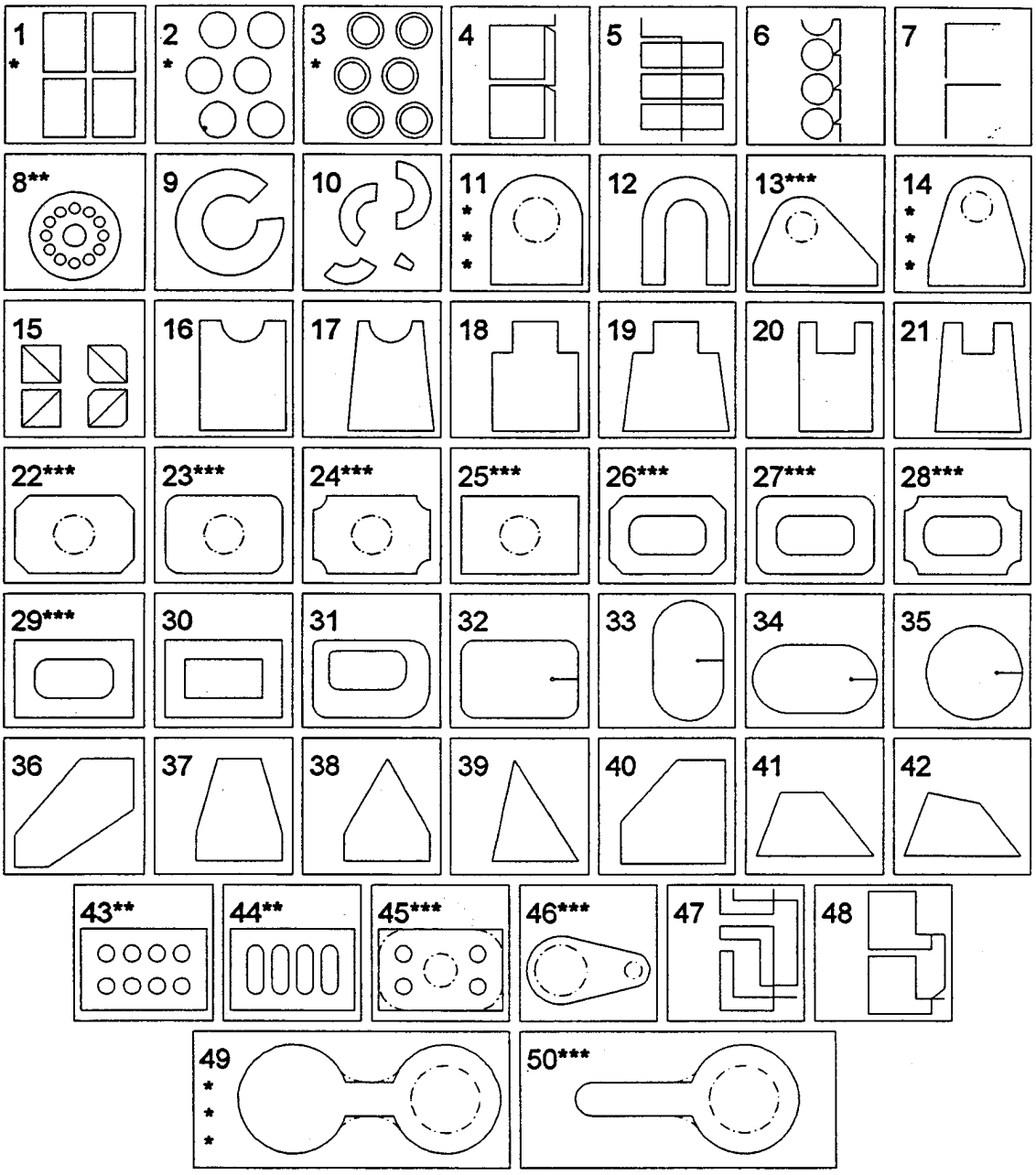
The LEADIN dimension is the distance from the part to the pierce point. Since the piercing operation is sometimes unpredictable, the LEADIN dimension should be set so that the plate is pierced and the cut has stabilized before it reaches the actual part. Normal values range from .25 to 1.00 inch (6mm to 25mm).

The LEADOUT dimension causes the torch to cut away from the part before the cutting oxygen is turned off. This prevents any damage to the cut part due to the bleed-off characteristics of the torch. In addition, on heavy plate cutting, the LEADOUT move guarantees that the bottom of the part has been cut completely before the oxygen is turned off. Normal values are from .5 to 1 inch (12mm to 25mm).

STDSHP.1 SHAPE DESCRIPTIONS

The following pages contain drawings, prompting descriptions and "RUN PROGRAM" notes for each of the 50 STANDARD SHAPES that are currently supported in the BURNY 5. For information on the PART CONSTRUCT SHAPE process, see the PART CONSTRUCT OPERATIONS section.

50 STANDARD SHAPES

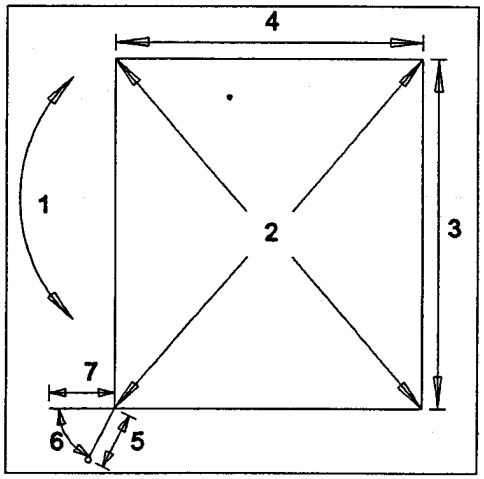


* SELECTABLE START POSITION, CW/CCW CUTTING, AND SELECTABLE REPEAT MODE AND DIRECTION.

** ALLOWS SELECTION OF ANY NUMBER OF HOLES.

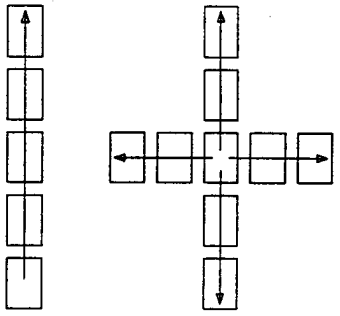
*** DASHED HOLES ARE OPTIONAL. CORNER RADIUS VALUES MAY BE SET TO 0 FOR SHARP CORNERS.

SHAPE 1 : RECTANGLE



REPEAT PATTERNS

AUTO MANUAL



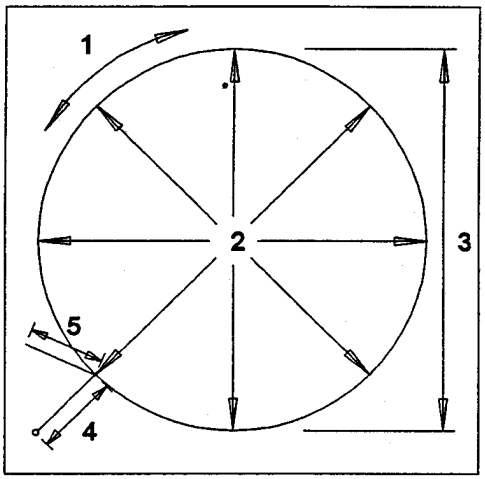
1.CUT DIRECTION	:	(CLOCKWISE OR COUNTERCLOCKWISE)
2.STARTING POSITION	:	(1 OF 4 CORNERS)[1]
3.X DIMENSION	:	(INCHES OR MILLIMETERS)
4.Y DIMENSION	:	(INCHES OR MILLIMETERS)
5.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
6.LEADIN ANGLE (DEGS)	:	(0 TO 90 DEGREES)[2]
7.LEADOUT DIMENSION	:	(INCHES OR MILLIMETERS)[3]
8.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
9.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[4]
10.REPEAT MODE	:	(AUTOMATIC OR MANUAL POSITIONING)[5]

IF AUTO REPEAT MODE:	IF MANUAL REPEAT MODE:
11.**REPEAT PROMPTING	11.REPEAT DIRECTION: (1 OF 4 SIDES)[1]
	12.**REPEAT PROMPTING

NOTES:

1) The STARTING CORNER and REPEAT DIRECTION parameters can be directly entered with the numeric keypad. Direction arrows are provided for quick reference.
2) When defining the LEADIN ANGLE, 0 degrees is parallel to the Y axis and 90 degrees is parallel to the X axis.
3) The LEADOUT position is determined by the direction of the cut. It is either parallel to the last side cut (as shown) or 45 degrees from the last cut direction.
4) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.
5) When running the resulting NC part program, position the torches at the STARTING CORNER of the first part, regardless of the REPEAT MODE selected. From this corner, the program moves out to the actual pierce point.

SHAPE 2 : CIRCLE

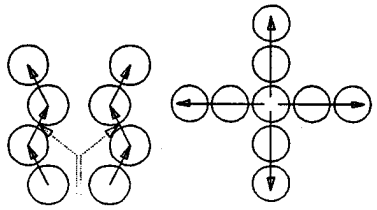


REPEAT PATTERNS

AUTO MANUAL

PLATE SIDE

LEFT RIGHT



60 DEGREE ANGLE TO CENTERS

1.CUT DIRECTION (OD)	:	(CLOCKWISE OR COUNTERCLOCKWISE)
2.STARTING POSITION	:	(1 OF 8 POINTS)[1,3]
3.DIAMETER DIMENSION	:	(INCHES OR MILLIMETERS)
4.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
5.LEADOUT DIMENSION	:	(INCHES OR MILLIMETERS)[2]
6.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
7.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[4]
8.REPEAT MODE	:	(AUTOMATIC OR MANUAL POSITIONING)[5]

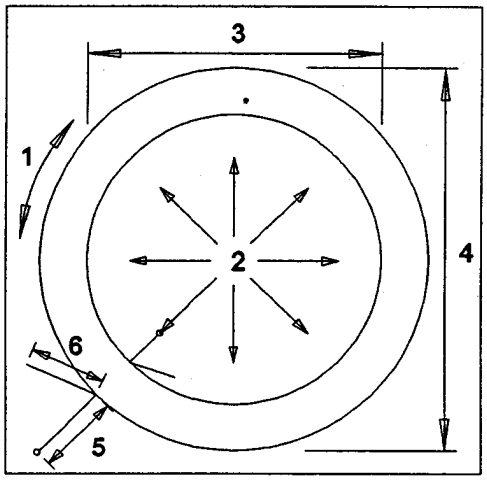
IF AUTO REPEAT MODE:
9.**REPEAT PROMPTING

IF MANUAL REPEAT MODE:
9.REPEAT DIRECTION: (1 OF 4 DIRECTIONS)[1]
10.**REPEAT PROMPTING

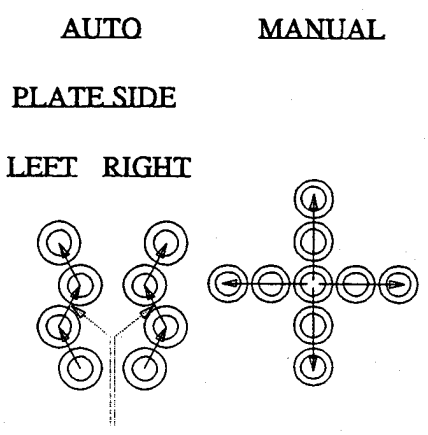
NOTES:

1) The STARTING POSITION and REPEAT DIRECTION parameters can be directly entered with the numeric keypad. Direction arrows are provided for quick reference.
2) The actual LEADOUT position is determined by the direction of the cut. The figure above shows the LEADOUT position assuming a clockwise cutting direction has been selected.
3) When running the resulting NC part program, position the torches at the CENTER of the first part, regardless of the REPEAT MODE selected. From this position, the program moves out to the actual pierce point.
4) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.
5) When performing AUTO REPEAT mode operations, parts are shifted to the left and right at a 60 degree angle to minimize the amount of scrap between parts.

SHAPE 3 : RING



REPEAT PATTERNS



60 DEGREE ANGLE TO CENTERS

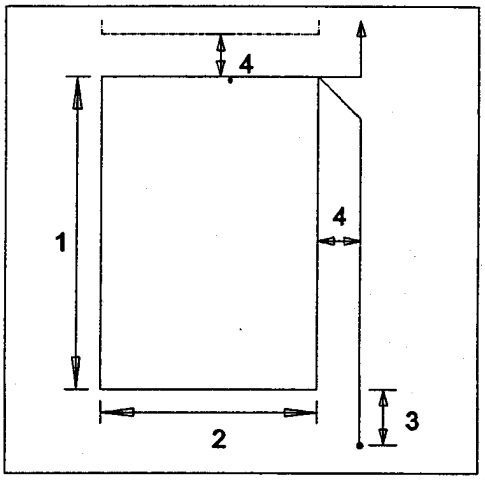
1.CUT DIRECTION (OD)	:	(CLOCKWISE OR COUNTERCLOCKWISE)[1]
2.STARTING POSITION	:	(1 OF 8 POINTS)[2]
3.INNER DIAMETER SIZE	:	(INCHES OR MILLIMETERS)
4.OUTER DIAMETER SIZE	:	(INCHES OR MILLIMETERS)
5.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
6.LEADOUT DIMENSION	:	(INCHES OR MILLIMETERS)[3]
7.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
8.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[5]
9.REPEAT MODE	:	(AUTOMATIC OR MANUAL POSITIONING)[4,6]

IF AUTO REPEAT MODE:	IF MANUAL REPEAT MODE:
10.**REPEAT PROMPTING	10.REPEAT DIRECTION :(1 OF 4 DIRECTIONS)[2]
	11.**REPEAT PROMPTING

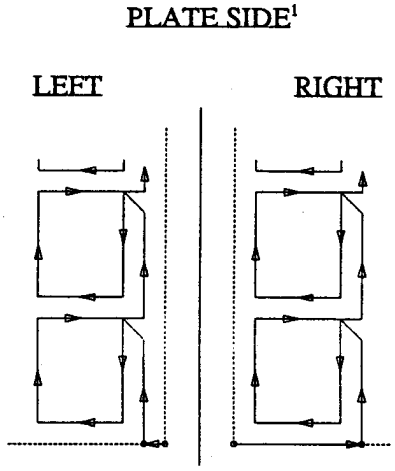
NOTES:

1) The CUT DIRECTION prompt defines the outer diameter cut direction. The inner direction is always opposite so that the same KERF side (LEFT/RIGHT) can be used for both cuts.
2) The STARTING POSITION and REPEAT DIRECTION parameters can be directly entered with the numeric keypad.
3) The actual LEADOUT position is determined by the direction of the cut. The figure above shows the LEADOUT position assuming a clockwise cutting direction has been selected.
4) When running the resulting NC part program, position the torches at the CENTER of the first part, regardless of the REPEAT MODE selected.
5) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.
6) When performing AUTO REPEAT mode operations, parts are shifted to the left and right at a 60 degree angle.

SHAPE 4 : CHAIN RECTANGLE 1



REPEAT PATTERNS

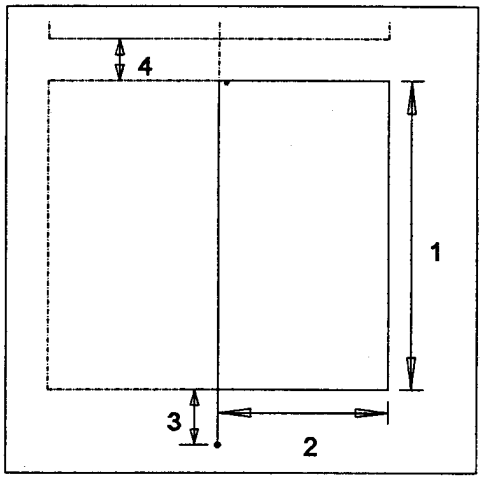


1.X DIMENSION	:	(INCHES OR MILLIMETERS)
2.Y DIMENSION	:	(INCHES OR MILLIMETERS)
3.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
4.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[2]
6.**REPEAT PROMPTING	:	(YES OR NO)

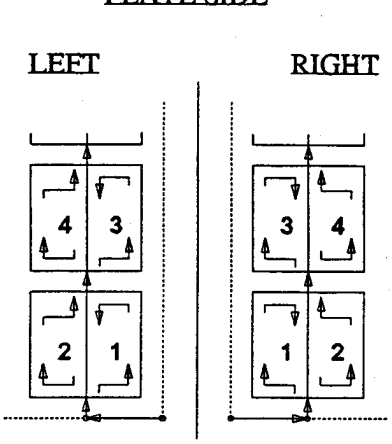
NOTES:

1) All chain cut parts start from the plate corner closest to the operator. The PLATE SIDE is defined through SYSTEM SETUP DATA.
2) A PROGRAM KERF value must be entered here. There is no DIAL-IN-KERF at run-time for this shape.

SHAPE 5 : CHAIN RECTANGLE 2



REPEAT PATTERNS

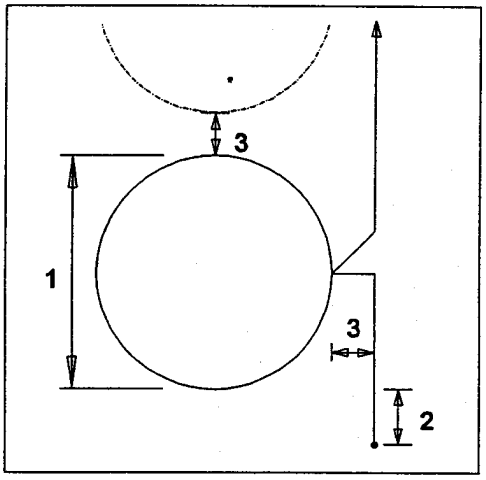


1.X DIMENSION	:	(INCHES OR MILLIMETERS)
2.Y DIMENSION	:	(INCHES OR MILLIMETERS)
3.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
4.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
6.**REPEAT PROMPTING	:	(YES OR NO)

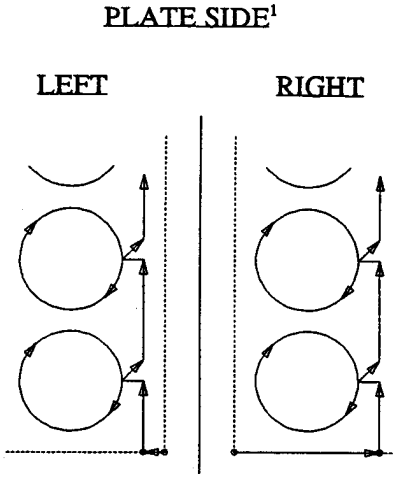
NOTES:

1) All chain cut parts start from the plate corner closest to the operator. The PLATE SIDE is defined through SYSTEM SETUP DATA.
2) The part cutting order also depends on the PLATE SIDE value. The part closest to the corner of the plate is always cut first, as shown under REPEAT PATTERNS.
3) A PROGRAM KERF value must be entered here. There is no DIAL-IN-KERF at run-time for this shape.
4) Although the REPEAT PATTERN creates parts in pairs to minimize scrap and reduce cutting time, each part is individually counted when cut.

SHAPE 6 : CHAIN CIRCLE



REPEAT PATTERNS

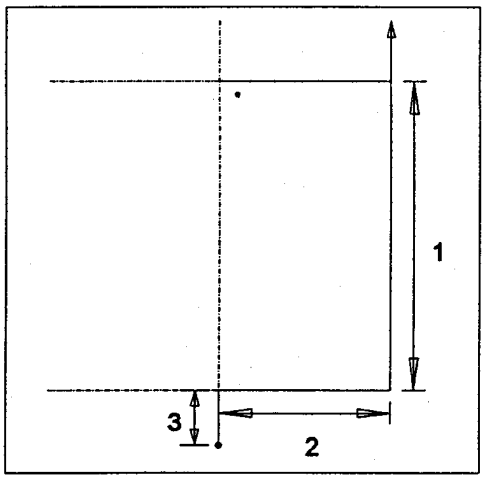


1.DIAMETER DIMENSION	:	(INCHES OR MILLIMETERS)
2.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
3.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
4.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[2]
5.**REPEAT PROMPTING	:	(YES OR NO)

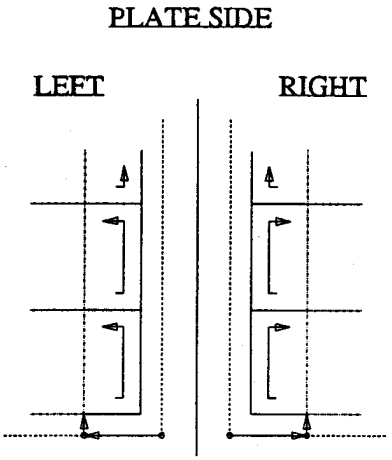
NOTES:

1) All chain cut parts start from the plate corner closest to the operator. The PLATE SIDE is defined through SYSTEM SETUP DATA.
2) A PROGRAM KERF value must be entered here. There is no DIAL-IN-KERF at run-time for this shape.

SHAPE 7 : RIP MODE



REPEAT PATTERNS

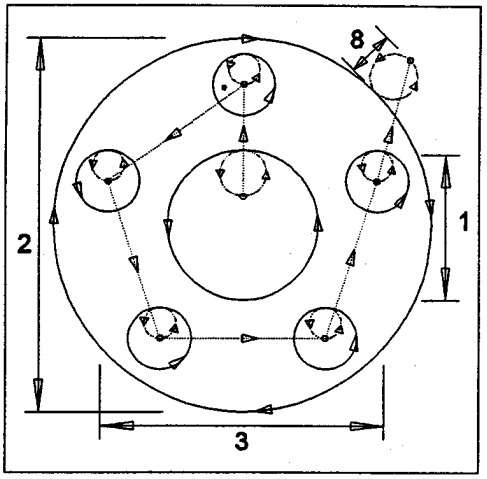


1.X DIMENSION	:	(INCHES OR MILLIMETERS)[1]
2.Y DIMENSION	:	(INCHES OR MILLIMETERS)[1]
3.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
4.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
6.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

1) This part is designed for use with multiple torches.
2) All RIP MODE cuts start at the corner of the plate closest to the operator. The PLATE SIDE is defined through SYSTEM SETUP DATA.
3) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.
4) The cutting sequence also depends on the PLATE SIDE value. After moving away from the corner, a cut is made back towards the corner, as shown under REPEAT PATTERNS.

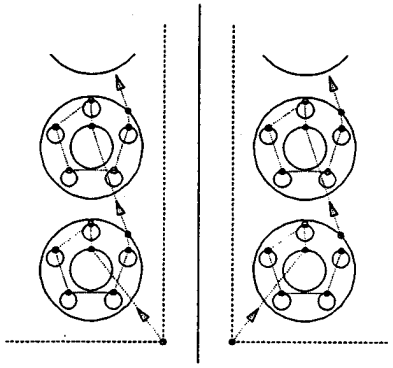
SHAPE 8 : FLANGE



REPEAT PATTERNS

PLATE SIDE

LEFT RIGHT

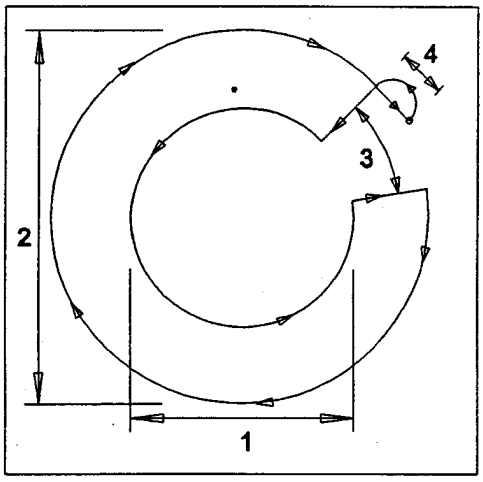


1.INNER DIAMETER SIZE	:	(INCHES OR MILLIMETERS)[1]
2.OUTER DIAMETER SIZE	:	(INCHES OR MILLIMETERS)
3.BOLT CENTER DIAMETER	:	(INCHES OR MILLIMETERS)
4.BOLT HOLE DIAMETER	:	(INCHES OR MILLIMETERS)
5.NUMBER OF BOLTS	:	(COUNT, 0 to 99)[2]
6.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[4]
7.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
8.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)[3]
9.**REPEAT PROMPTING	:	(YES OR NO)

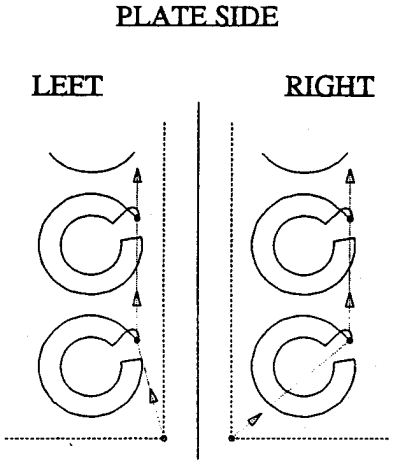
NOTES:

1) If an INNER DIAMETER of 0 is defined, no center hole is cut.
2) If the NUMBER OF BOLTS is defined as 0, no bolt holes are cut.
3) Only the INNER DIAMETER and the OUTER DIAMETER cuts use the LEADIN DIMENSION as the diameter of the circular leadin. The leadin distance for the bolt holes is automatically set to 1/2 of the BOLT HOLE DIAMETER value.
4) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 9 : SPLIT RING



REPEAT PATTERNS

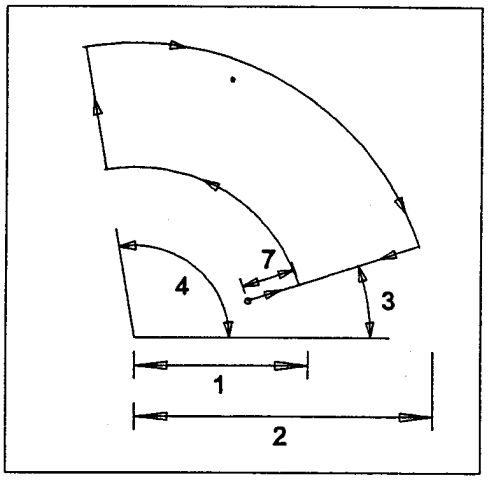


1.INNER DIAMETER SIZE	:	(INCHES OR MILLIMETERS)
2.OUTER DIAMETER SIZE	:	(INCHES OR MILLIMETERS)
3.SPLIT DEGREES	:	(DEGREES)[2,3]
4.LEADIN DIMENSION	:	(INCHES)
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[4]
6.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
7.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

1) The starting position is always at the 45 degree position as shown.
2) The ending position is determined by the SPLIT DEGREES value.
3) The actual spacing between parts is based on the assumption that SPLIT DEGREES is less than 135 degrees. If not, the scrap between parts may be excessive. Therefore smaller arc segments should be cut using shape 10, RING DEGREES.
4) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

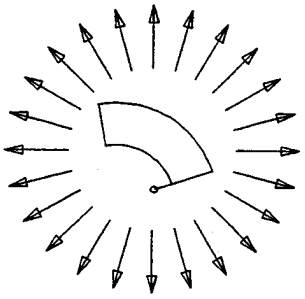
SHAPE 10 : RING DEGREES



REPEAT PATTERNS

MANUAL REPEAT

ALL DIRECTIONS ALLOWED

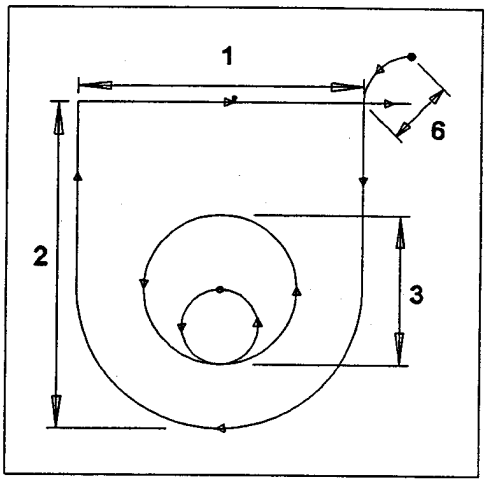


1.INSIDE RADIUS SIZE	:	(INCHES OR MILLIMETERS)
2.OUTSIDE RADIUS SIZE	:	(INCHES OR MILLIMETERS)
3.STARTING DEGREES	:	(DEGREES)[1]
4.ENDING DEGREES	:	(DEGREES)[1]
5.CROSS REPEAT DISTANCE	:	(Y DISTANCE TO NEXT PART)[2]
6.RAIL REPEAT DISTANCE	:	(X DISTANCE TO NEXT PART)[2]
7.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)[3,4]
8.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[5]
9.**REPEAT PROMPTING	:	(YES OR NO)

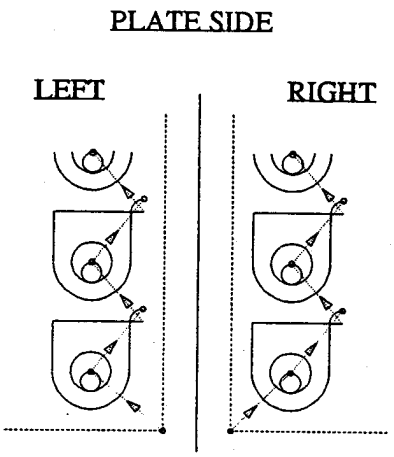
NOTES:

1) The STARTING DEGREES and ENDING DEGREES values represent angular position with respect to the Y axis (0 degrees is parallel to the Y axis and 90 degrees is parallel to the X axis).
2) The REPEAT DISTANCE parameters define the distance from the start of one part to the next. These values must be large enough to provide the necessary SCRAP between parts.
3) When running the resulting NC part program, the machine moves from the starting corner to the pierce point defined by the LEADIN DIMENSION.
4) The leadout distance is automatically set to 1/2 of the LEADIN DIMENSION.
5) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 11 : STRAIGHT LUG



REPEAT PATTERNS

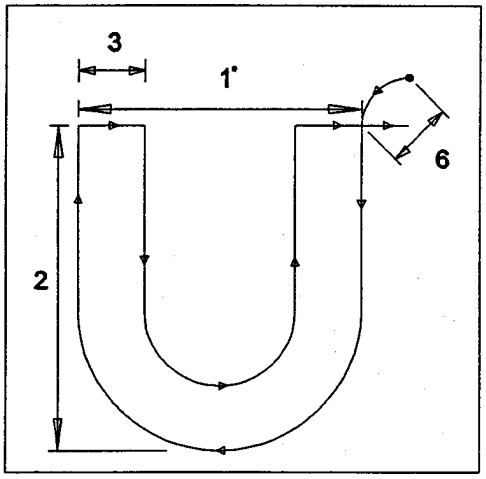


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.HOLE DIAMETER	:	(INCHES OR MILLIMETERS)[1]
4.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
5.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
6.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)[2]
7.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

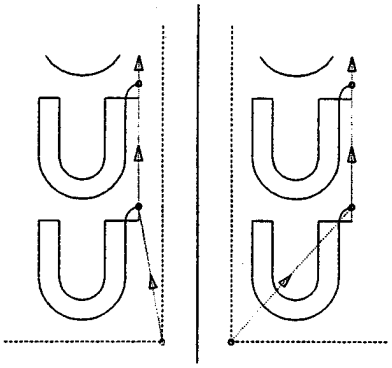
1) If a HOLE DIAMETER of 0 is defined, no center hole is cut.
2) The leadin distance for the center hole is automatically set to 1/2 of the HOLE DIAMETER value.
3) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 12 : LUG FRAME



REPEAT PATTERNS

PLATE SIDE

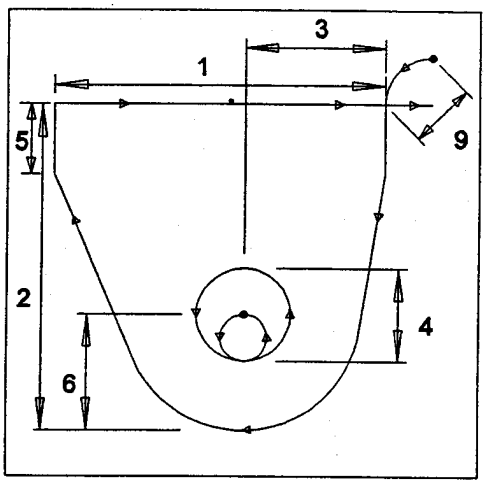


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.THICKNESS DIMENSION	:	(INCHES OR MILLIMETERS)
4.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)^2
5.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
6.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
7.**REPEAT PROMPTING	:	(YES OR NO)

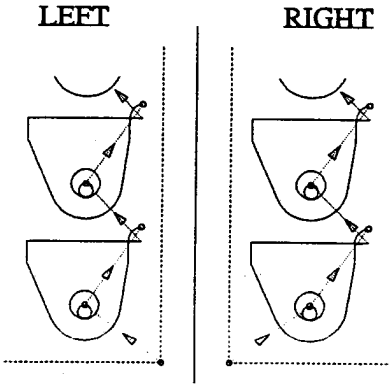
NOTES:

1) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point.
2) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 13 : SLANT LUG



REPEAT PATTERNS



1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.BOLT HOLE CENTER	:	(INCHES OR MILLIMETERS)
4.HOLE DIAMETER	:	(INCHES OR MILLIMETERS)[1]
5.SHOULDER HEIGHT	:	(INCHES OR MILLIMETERS)
6.RADIUS DIMENSION	:	(INCHES OR MILLIMETERS)
7.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[2]
8.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
9.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
10.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

1) If a HOLE DIAMETER of 0 is defined, no center hole is cut.
2) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 14 : LIFT LUG

REPEAT PATTERNS

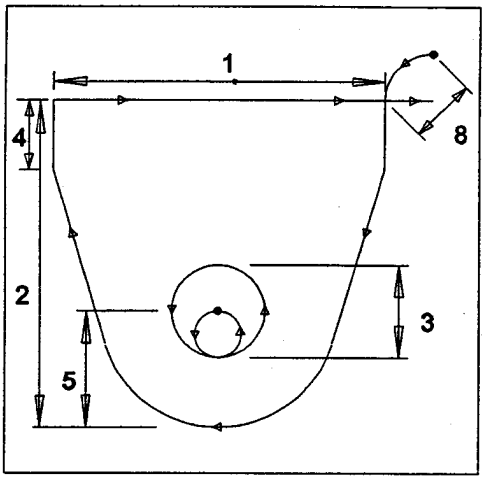
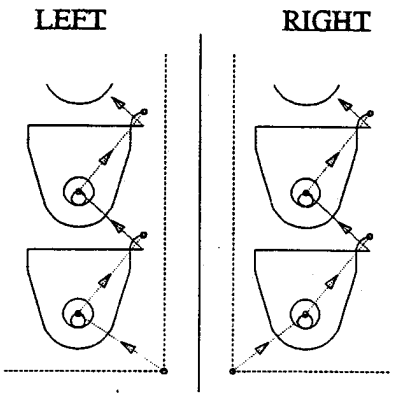


PLATE SIDE

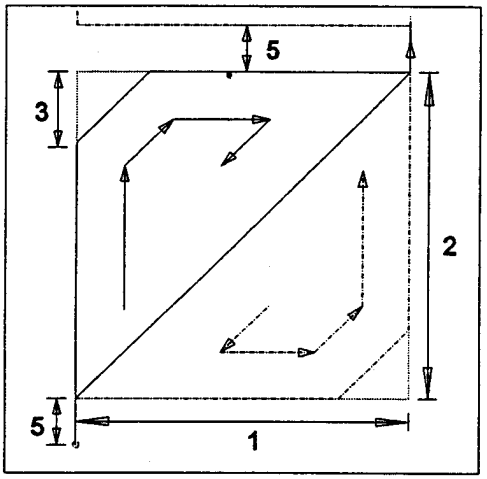


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.HOLE DIAMETER	:	(INCHES OR MILLIMETERS)[1]
4.SHOULDER HEIGHT	:	(INCHES OR MILLIMETERS)
5.RADIUS DIMENSION	:	(INCHES OR MILLIMETERS)
6.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[2]
7.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
8.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
9.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

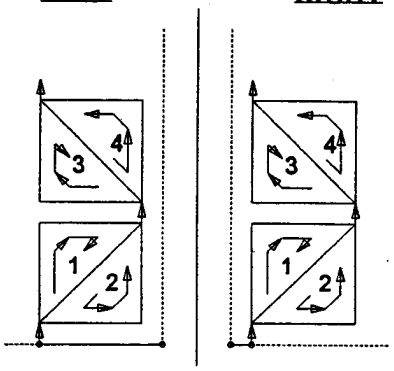
1) If a HOLE DIAMETER of 0 is defined, no center hole is cut.
2) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 15 : WEDGE PAIR



REPEAT PATTERNS

PLATE SIDE

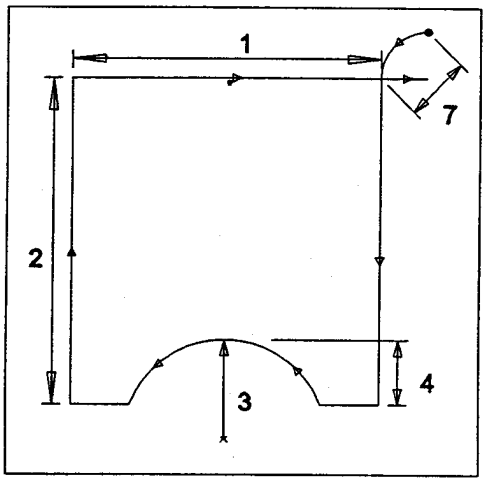


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.BEVEL LENGTH	:	(INCHES OR MILLIMETERS)[1]
4.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
5.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
6.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

1) If a BEVEL LENGTH of 0 is defined, no bevel is cut at the corners. Only sharp, 90degree corners are cut.
2) This shape creates a special 4 part repeat sequence to minimize the amount of scrap. However, any number of parts may be cut since each of the 4 is counted as a separate part.
3) A PROGRAM KERF value must be entered here. There is no DIAL-IN-KERF at run-time for this shape.

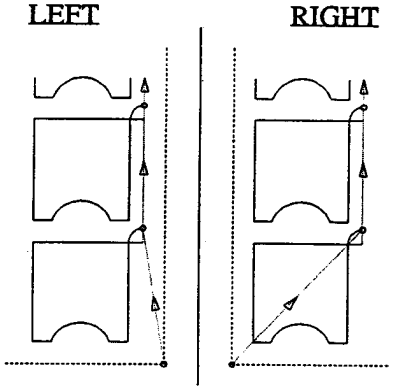
SHAPE 16 : STRAIGHT PIPE SUPPORT



REPEAT PATTERNS

PLATE SIDE

LEFT RIGHT

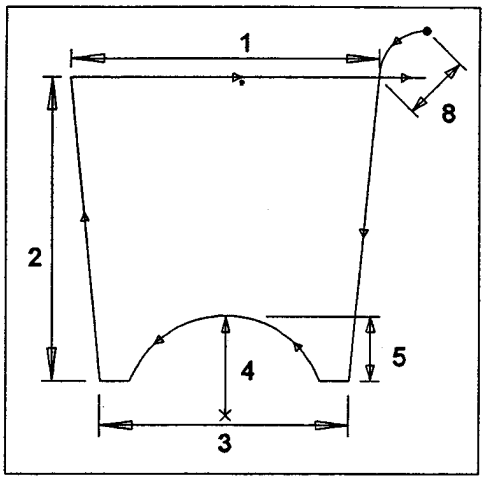


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.RADIUS DIMENSION	:	(INCHES OR MILLIMETERS)
4.ARC DEPTH	:	(INCHES OR MILLIMETERS)
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[1]
6.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
7.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
8.**REPEAT PROMPTING	:	(YES OR NO)

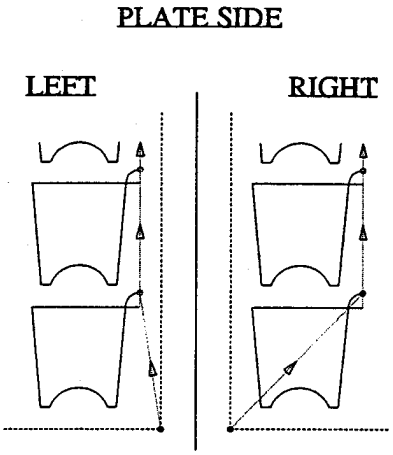
NOTES:

1) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point.
2) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 17 : SLANT PIPE SUPPORT



REPEAT PATTERNS

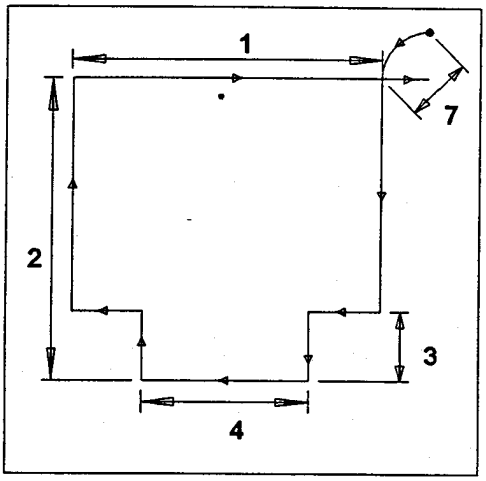


1.BASE WIDTH	:	(INCHES OR MILLIMETERS)[1]
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.TOP WIDTH	:	(INCHES OR MILLIMETERS)
4.RADIUS DIMENSION	:	(INCHES OR MILLIMETERS)
5.ARC DEPTH	:	(INCHES OR MILLIMETERS)
6.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
7.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
8.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
9.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

1) Like others, this part is cut with the BASE at the upper position. As a result, the prompts used to label the top and sides assume the part is rotated 180 degrees.
2) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point.
3) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

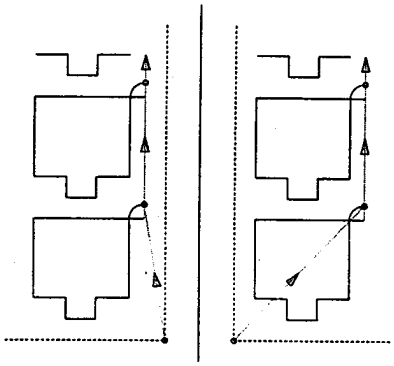
SHAPE 18 : VERTICAL PROJECTION



REPEAT PATTERNS

PLATE SIDE

LEFT RIGHT

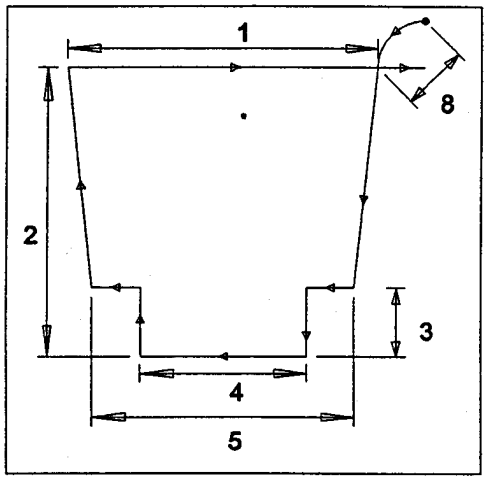


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.COLLAR HEIGHT	:	(INCHES OR MILLIMETERS)
4.COLLAR WIDTH	:	(INCHES OR MILLIMETERS)
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)^2
6.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
7.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
8.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

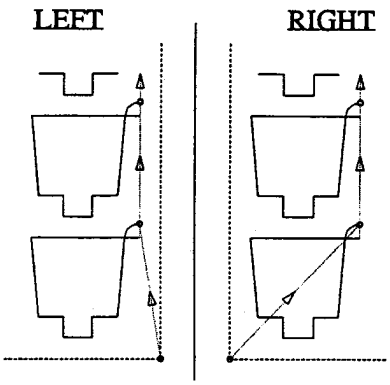
1) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point.
2) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 19 : SLANT PROJECTION



REPEAT PATTERNS

PLATE SIDE

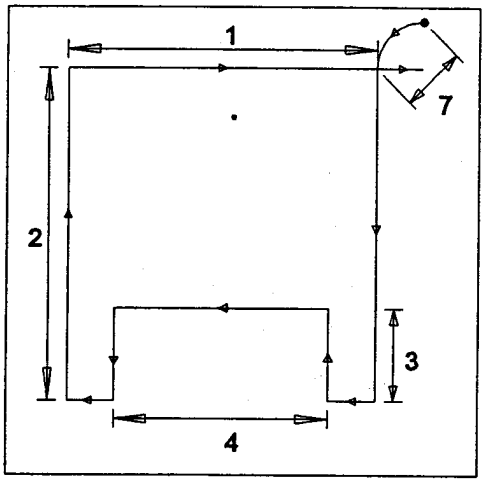


1.BASE WIDTH	:	(INCHES OR MILLIMETERS)[1]
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.COLLAR HEIGHT	:	(INCHES OR MILLIMETERS)
4.COLLAR WIDTH	:	(INCHES OR MILLIMETERS)
5.TOP WIDTH	:	(INCHES OR MILLIMETERS)
6.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
7.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
8.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
9.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

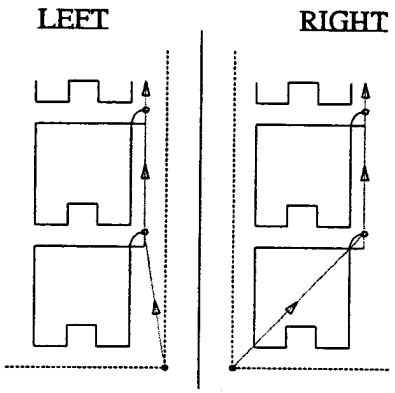
1) Like others, this part is cut with the BASE at the upper position. As a result, the prompts used to label the top and sides assume the part is rotated 180 degrees.
2) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point.
3) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 20 : VERTICAL SLOT



REPEAT PATTERNS

PLATE SIDE

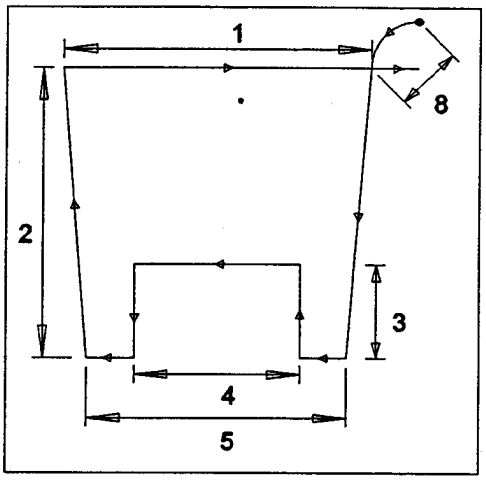


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.COLLAR HEIGHT	:	(INCHES OR MILLIMETERS)
4.COLLAR WIDTH	:	(INCHES OR MILLIMETERS)
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)^2
6.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
7.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
8.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

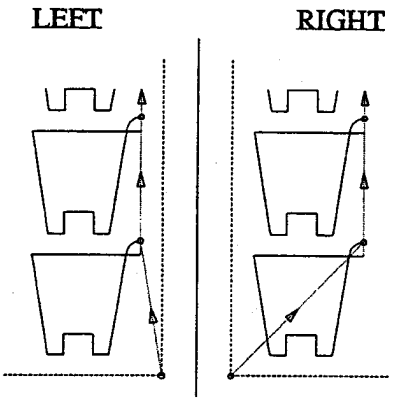
1) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point.
2) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 21 : SLANT SLOT



REPEAT PATTERNS

PLATE SIDE

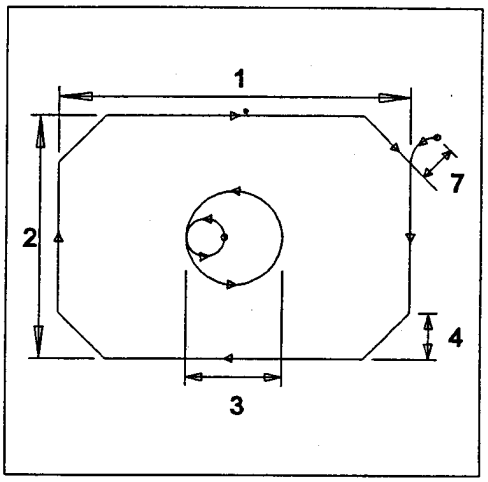


1.BASE WIDTH	:	(INCHES OR MILLIMETERS)[1]
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.COLLAR HEIGHT	:	(INCHES OR MILLIMETERS)
4.COLLAR WIDTH	:	(INCHES OR MILLIMETERS)
5.TOP WIDTH	:	(INCHES OR MILLIMETERS)
6.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
7.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
8.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
9.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

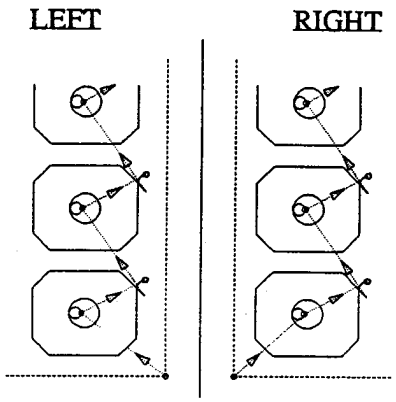
1) Like others, this part is cut with the BASE at the upper position. As a result, the prompts used to label the top and sides assume the part is rotated 180 degrees.
2) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point.
3) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 22 : OCTAGON



REPEAT PATTERNS

PLATE SIDE

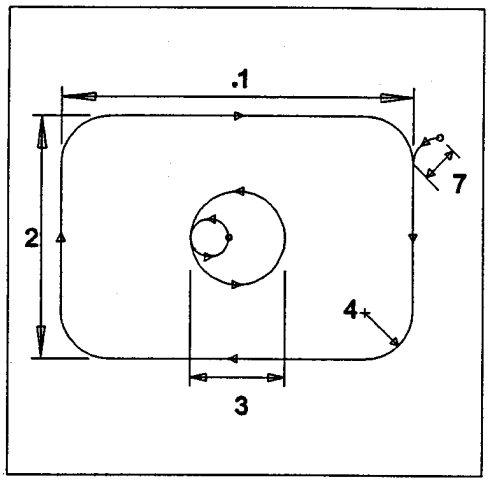


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.HOLE DIAMETER	:	(INCHES OR MILLIMETERS)[1]
4.BEVEL LENGTH	:	(INCHES OR MILLIMETERS)
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[2]
6.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
7.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
8.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

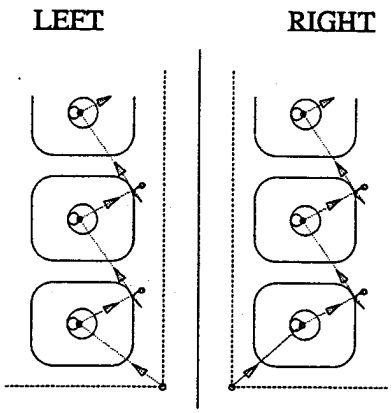
1) If a HOLE DIAMETER of 0 is defined, no center hole is cut.
2) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 23 : SQUARE, CORNER RADIUS IN



REPEAT PATTERNS

PLATE SIDE

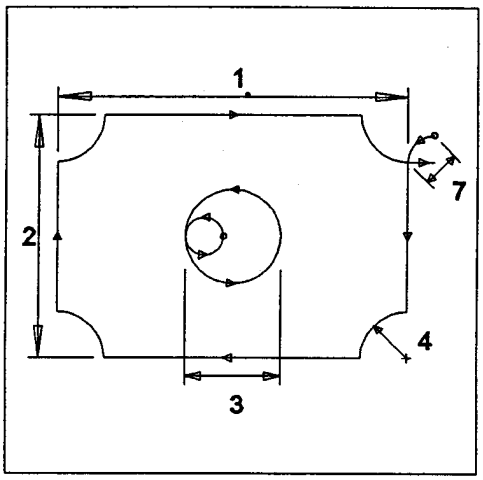


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.HOLE DIAMETER	:	(INCHES OR MILLIMETERS)[1]
4.ARC RADIUS	:	(INCHES OR MILLIMETERS)
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[2]
6.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
7.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
8.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

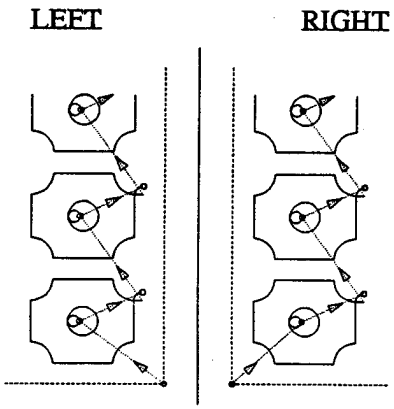
1) If a HOLE DIAMETER of 0 is defined, no center hole is cut.
2) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 24 : SQUARE, CORNER RADIUS OUT



REPEAT PATTERNS

PLATE SIDE

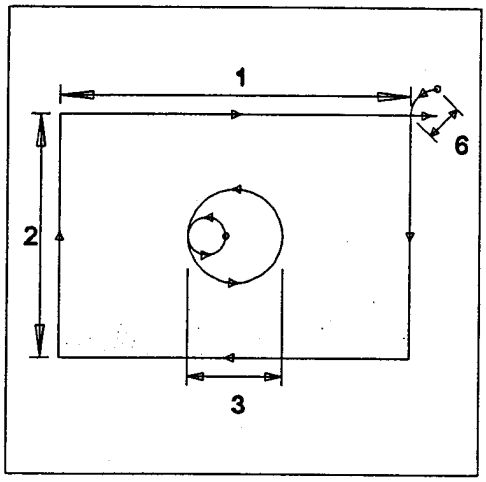


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.HOLE DIAMETER	:	(INCHES OR MILLIMETERS)[1]
4.ARC RADIUS	:	(INCHES OR MILLIMETERS)
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[2]
6.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
7.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
8.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

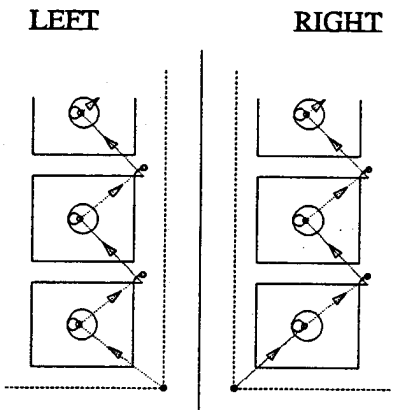
1) If a HOLE DIAMETER of 0 is defined, no center hole is cut.
2) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 25 : SQUARE WITH HOLE



REPEAT PATTERNS

PLATE SIDE

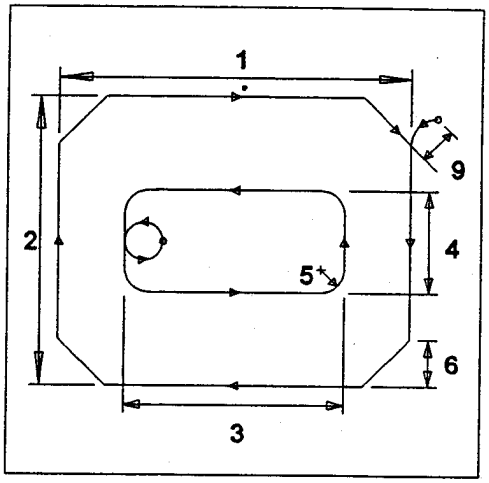


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.HOLE DIAMETER	:	(INCHES OR MILLIMETERS)[1]
4.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[2]
5.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
6.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
7.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

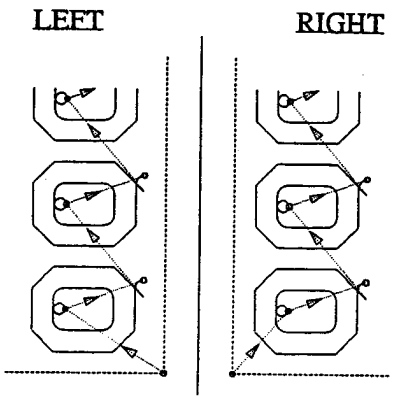
1) If a HOLE DIAMETER of 0 is defined, no center hole is cut.
2) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 26 : OCTAGONAL FRAME



REPEAT PATTERNS

PLATE SIDE

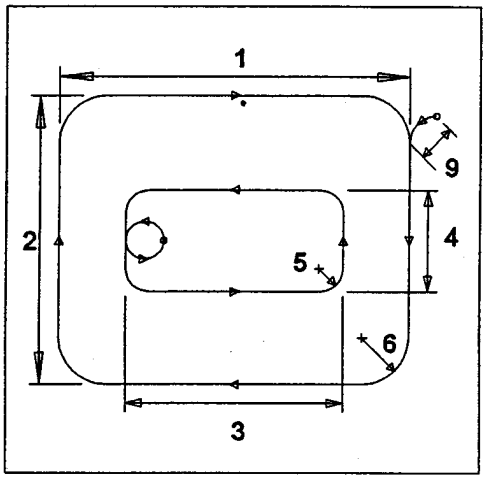


1.OUTSIDE WIDTH	:	(INCHES OR MILLIMETERS)
2.OUTSIDE HEIGHT	:	(INCHES OR MILLIMETERS)
3.INSIDE WIDTH	:	(INCHES OR MILLIMETERS)
4.INSIDE HEIGHT	:	(INCHES OR MILLIMETERS)
5.INSIDE RADIUS	:	(INCHES OR MILLIMETERS)
6.BEVEL LENGTH	:	(INCHES OR MILLIMETERS)
7.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)^2
8.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
9.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
10.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

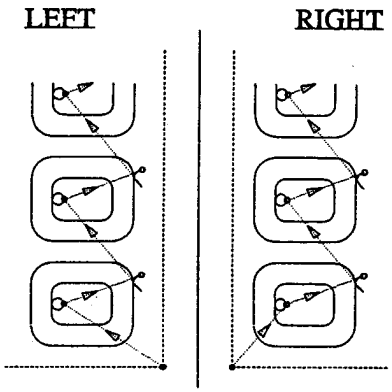
1) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point.
2) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 27 : FRAME, CORNER RADIUS IN



REPEAT PATTERNS

PLATE SIDE

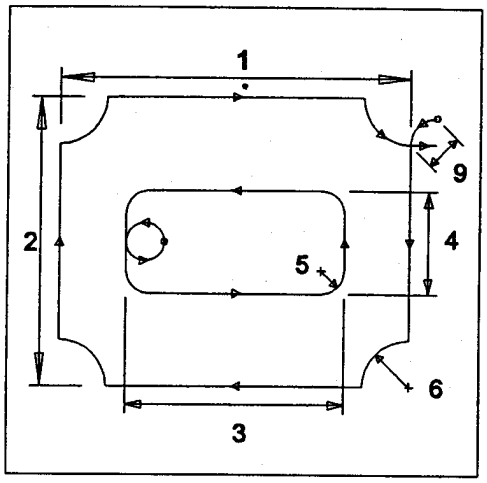


1.OUTSIDE WIDTH	:	(INCHES OR MILLIMETERS)
2.OUTSIDE HEIGHT	:	(INCHES OR MILLIMETERS)
3.INSIDE WIDTH	:	(INCHES OR MILLIMETERS)
4.INSIDE HEIGHT	:	(INCHES OR MILLIMETERS)
5.INSIDE RADIUS	:	(INCHES OR MILLIMETERS)
6.ARC RADIUS	:	(INCHES OR MILLIMETERS)
7.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[2]
8.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
9.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
10.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

1) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point, as shown.
2) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

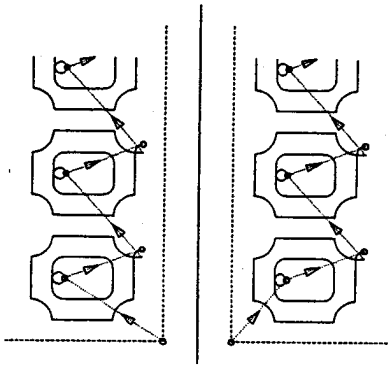
SHAPE 28 : FRAME, CORNER RADIUS OUT



REPEAT PATTERNS

PLATE SIDE

LEFT RIGHT

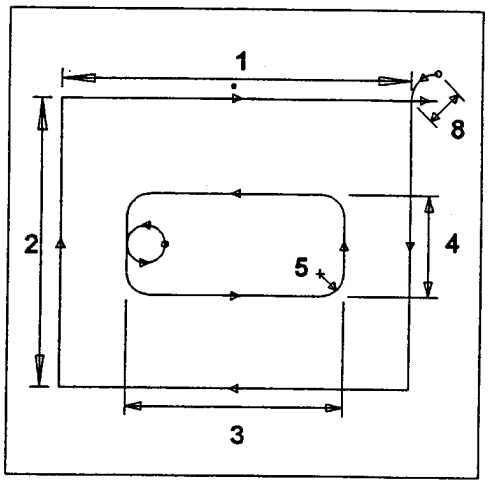


1.OUTSIDE WIDTH	:	(INCHES OR MILLIMETERS)
2.OUTSIDE HEIGHT	:	(INCHES OR MILLIMETERS)
3.INSIDE WIDTH	:	(INCHES OR MILLIMETERS)
4.INSIDE HEIGHT	:	(INCHES OR MILLIMETERS)
5.INSIDE RADIUS	:	(INCHES OR MILLIMETERS)
6.ARC RADIUS	:	(INCHES OR MILLIMETERS)
7.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)^2
8.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
9.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
10.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

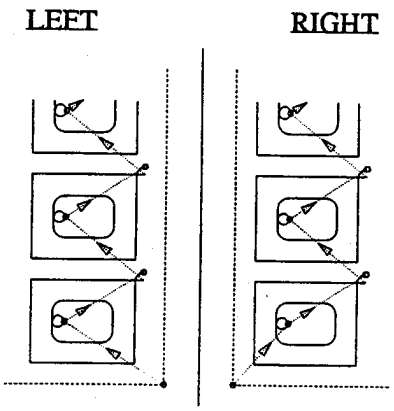
1) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point, as shown.
2) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 29 : SQUARE FRAME



REPEAT PATTERNS

PLATE SIDE

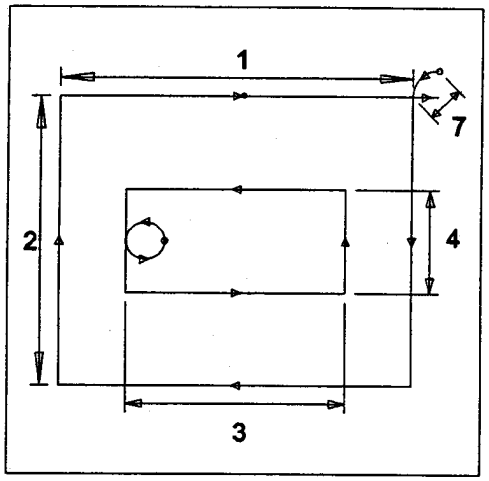


1.OUTSIDE WIDTH	:	(INCHES OR MILLIMETERS)
2.OUTSIDE HEIGHT	:	(INCHES OR MILLIMETERS)
3.INSIDE WIDTH	:	(INCHES OR MILLIMETERS)
4.INSIDE HEIGHT	:	(INCHES OR MILLIMETERS)
5.INSIDE RADIUS	:	(INCHES OR MILLIMETERS)
6.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)^2
7.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
8.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
9.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

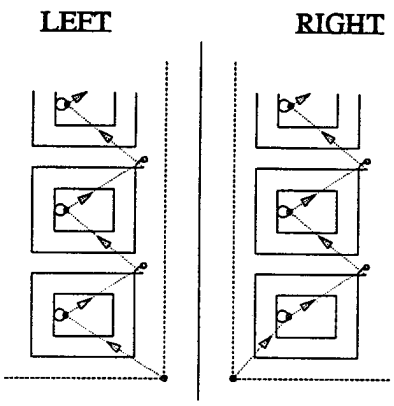
1) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point, as shown.
2) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 30 : RECTANGULAR FRAME



REPEAT PATTERNS

PLATE SIDE

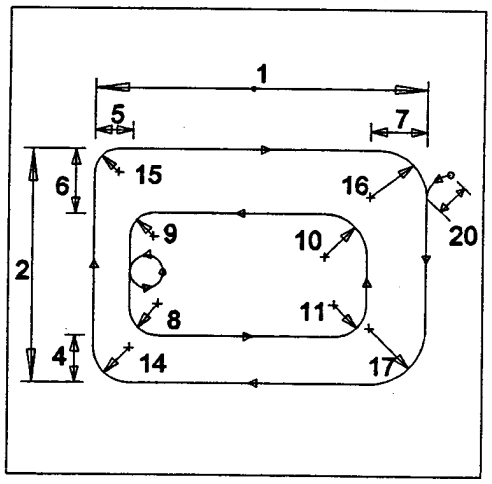


1.OUTSIDE WIDTH	:	(INCHES OR MILLIMETERS)
2.OUTSIDE HEIGHT	:	(INCHES OR MILLIMETERS)
3.INSIDE WIDTH	:	(INCHES OR MILLIMETERS)
4.INSIDE HEIGHT	:	(INCHES OR MILLIMETERS)
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)^2
6.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
7.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
8.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

1) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point, as shown.
2) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

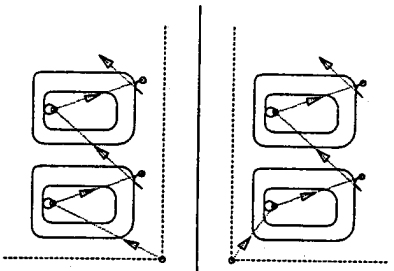
SHAPE 31 : UNIVERSAL FRAME



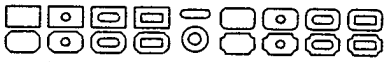
REPEAT PATTERNS

PLATE SIDE

LEFT RIGHT



EXAMPLE SHAPES

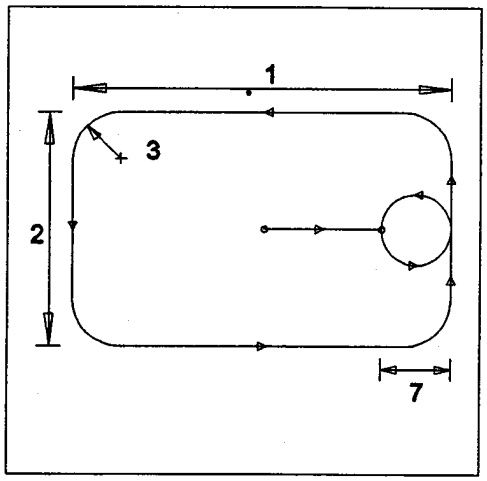


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.SYMMETRY	:	(YES OR NO)[1]
4.BOTTOM THICKNESS	:	(INCHES OR MILLIMETERS)
5.LEFT THICKNESS	:	(INCHES OR MILLIMETERS)
6.TOP THICKNESS	:	(INCHES OR MILLIMETERS)
7.RIGHT THICKNESS	:	(INCHES OR MILLIMETERS)
8.B-LEFT INNER RADIUS	:	(INCHES OR MILLIMETERS)
9.T-LEFT INNER RADIUS	:	(INCHES OR MILLIMETERS)
10.T-RIGHT INNER RADIUS	:	(INCHES OR MILLIMETERS)
11.B-RIGHT INNER RADIUS	:	(INCHES OR MILLIMETERS)
12.BEVEL CORNERS	:	(YES OR NO)
13.CONVEX	:	(YES OR NO)[2]
14.B-LEFT OUTER RADIUS	:	(INCHES OR MILLIMETERS)
15.T-LEFT OUTER RADIUS	:	(INCHES OR MILLIMETERS)
16.T-RIGHT OUTER RADIUS	:	(INCHES OR MILLIMETERS)
17.B-RIGHT OUTER RADIUS	:	(INCHES OR MILLIMETERS)
18.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
19.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
20.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
21.**REPEAT PROMPTING	:	(YES OR NpO)

NOTES:

1) When "SYMMETRY:YES" is selected, values for "THICKNESS", "INNER RADIUS" and "OUTER RADIUS" are automatically preloaded to define a symmetrical part.
2) The CONVEX prompt line only appears when "BEVEL CORNERS:NO" has been selected.
3) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

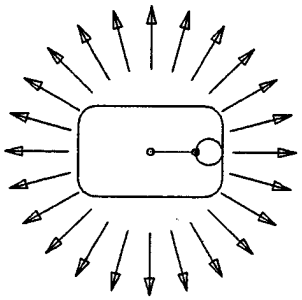
SHAPE 32 : RECTANGULAR HOLE



REPEAT PATTERNS

MANUAL REPEAT

ALL DIRECTIONS ALLOWED

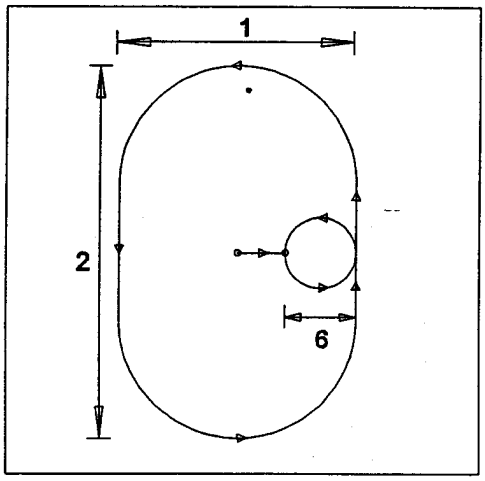


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.CORNER RADIUS	:	(INCHES OR MILLIMETERS)
4.X MOVE DISTANCE	:	(RAIL DISTANCE TO NEXT HOLE)[1]
5.Y MOVE DISTANCE	:	(CROSS DISTANCE TO NEXT HOLE)[1]
6.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[4]
7.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)[2]
8.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

1) The X and Y MOVE DISTANCE values are used to define the "center to center" distance between holes. From this center position, the program moves the machine to the pierce point determined by the LEADIN DIMENSION.
2) LEADIN DIMENSION must be less than the WIDTH DIMENSION.
3) For the first hole, the torch should be positioned to center of the hole by the operator.
4) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

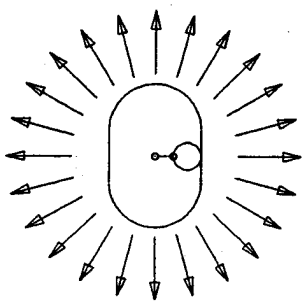
SHAPE 33 : VERTICAL HOLE



REPEAT PATTERNS

MANUAL REPEAT

ALL DIRECTIONS ALLOWED

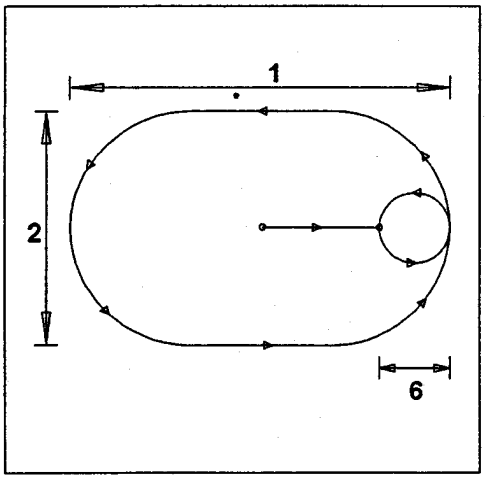


1.SLOT WIDTH	:	(INCHES OR MILLIMETERS)
2.SLOT HEIGHT	:	(INCHES OR MILLIMETERS)
3.X MOVE DISTANCE	:	(RAIL DISTANCE TO NEXT HOLE)[1]
4.Y MOVE DISTANCE	:	(CROSS DISTANCE TO NEXT HOLE)[1]
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[5]
6.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)[2]
7.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

1) The X and Y MOVE DISTANCE values are used to define the "center to center" distance between holes. From this center position, the program moves the machine to the pierce point determined by the LEADIN DIMENSION.
2) LEADIN DIMENSION must be less than SLOT WIDTH.
3) For the first hole, the torch should be positioned to center of the hole by the operator.
4) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

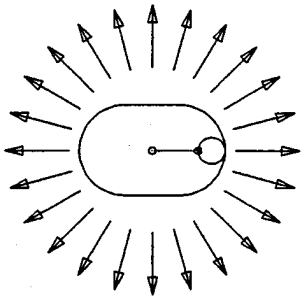
SHAPE 34 : HORIZONAL HOLE



REPEAT PATTERNS

MANUAL REPEAT

ALL DIRECTIONS ALLOWED

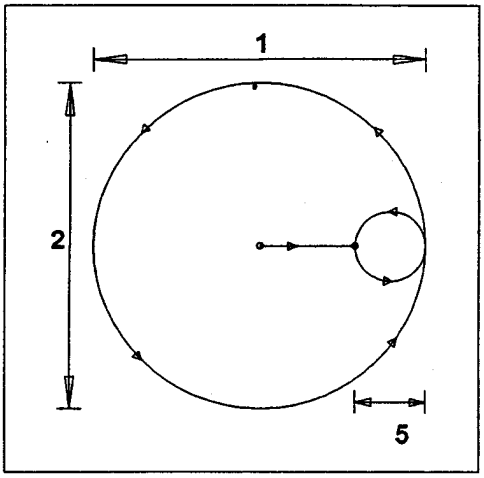


1.SLOT WIDTH	:	(INCHES OR MILLIMETERS)
2.SLOT HEIGHT	:	(INCHES OR MILLIMETERS)
3.X MOVE DISTANCE	:	(RAIL DISTANCE TO NEXT HOLE)[1]
4.Y MOVE DISTANCE	:	(CROSS DISTANCE TO NEXT HOLE)[1]
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[4]
6.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)[2]
7.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

1) The X and Y MOVE DISTANCE values are used to define the "center to center" distance between holes. From this center position, the program moves the machine to the pierce point determined by the LEADIN DIMENSION.
2) LEADIN DIMENSION must be less than the SLOT HEIGHT.
3) For the first hole, the torch should be positioned to center of the hole by the operator.
4) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

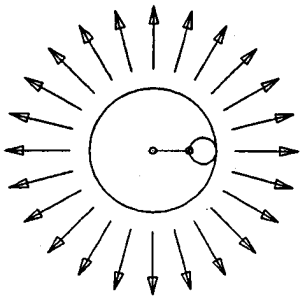
SHAPE 35 : CIRCULAR HOLE



REPEAT PATTERNS

MANUAL REPEAT

ALL DIRECTIONS ALLOWED

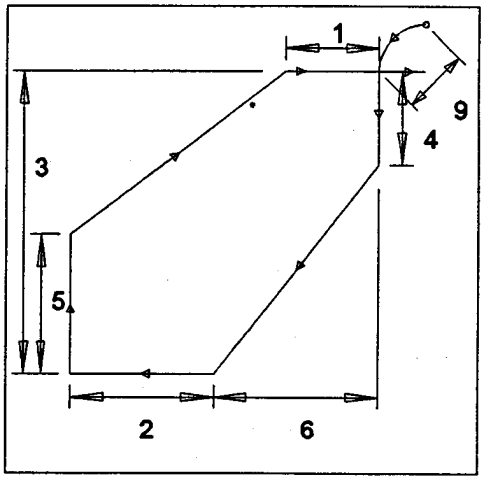


1.DIAMETER DIMENSION	:	(INCHES OR MILLIMETERS)
2.X MOVE DISTANCE	:	(RAIL DISTANCE TO NEXT HOLE)[1]
3.Y MOVE DISTANCE	:	(CROSS DISTANCE TO NEXT HOLE)[1]
4.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[4]
5.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)[2]
6.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

1) The X and Y MOVE DISTANCE values are used to define the "center to center" distance between holes. From this center position, the program moves the machine to the pierce point determined by the LEADIN DIMENSION.
2) LEADIN DIMENSION must be less than the DIAMETER DIMENSION.
3) For the first hole, the torch should be positioned to center of the hole by the operator.
4) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

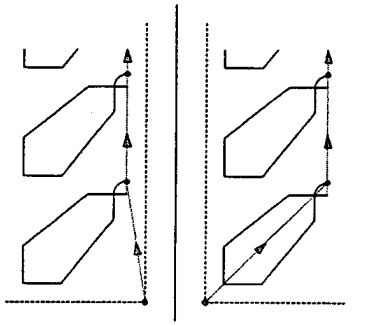
SHAPE 36 : BEAM SUPPORT



REPEAT PATTERNS

PLATE SIDE

LEFT RIGHT

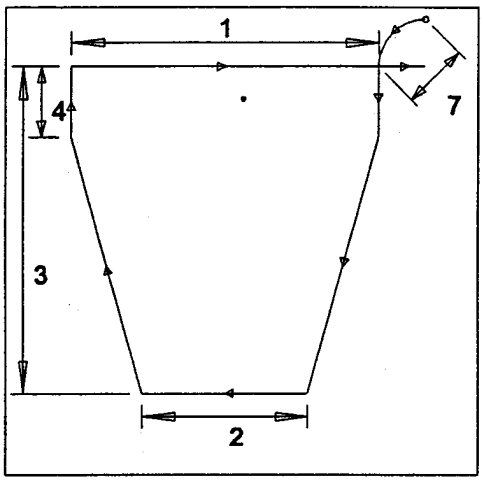


1.BASE WIDTH	:	(INCHES OR MILLIMETERS)[1]
2.TOP WIDTH	:	(INCHES OR MILLIMETERS)
3.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
4.LEFT SHOULDER	:	(INCHES OR MILLIMETERS)
5.RIGHT SHOULDER	:	(INCHES OR MILLIMETERS)
6.LEFT OFFSET	:	(INCHES OR MILLIMETERS)
7.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
8.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
9.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
10.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

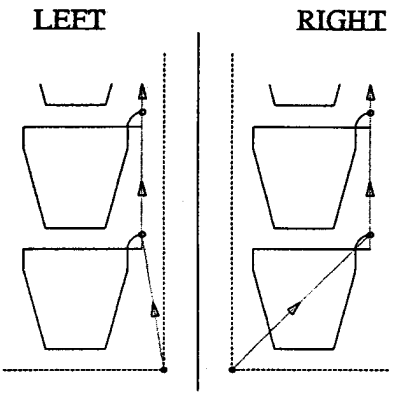
1) Like others, this part is cut with the BASE at the upper position. As a result, the prompts used to label the top and sides assume the part is rotated 180 degrees.
2) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point, as shown.
3) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 37 : TRUSS SUPPORT



REPEAT PATTERNS

PLATE SIDE

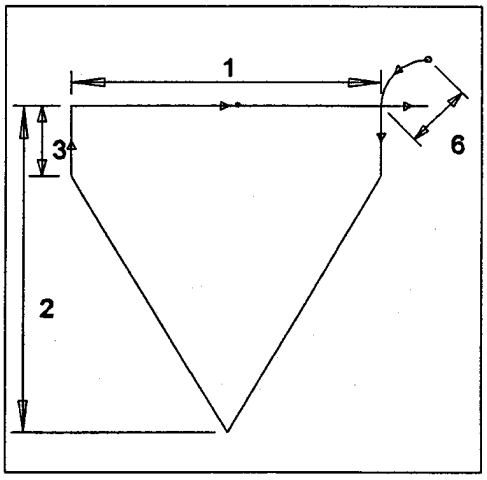


1.BASE WIDTH	:	(INCHES OR MILLIMETERS)[1]
2.TOP WIDTH	:	(INCHES OR MILLIMETERS)
3.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
4.SHOULDER HEIGHT	:	(INCHES OR MILLIMETERS)
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
6.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
7.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
8.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

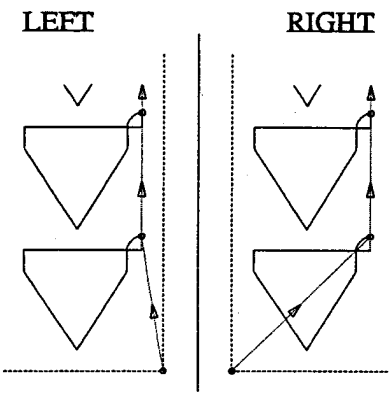
1) Like others, this part is cut with the BASE at the upper position. As a result, the prompts used to label the top and sides assume the part is rotated 180 degrees.
2) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point, as shown.
3) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 38 : ANGULAR TRUSS



REPEAT PATTERNS

PLATE SIDE

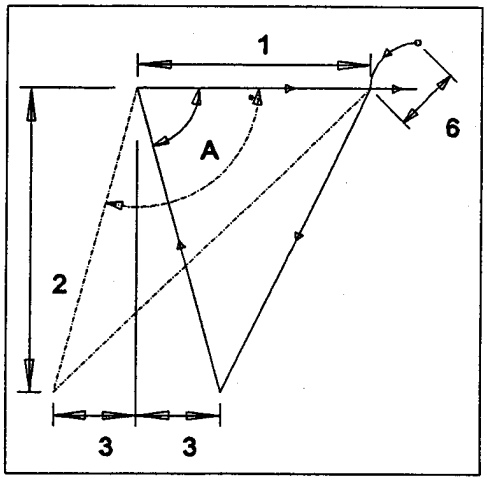


1.BASE WIDTH	:	(INCHES OR MILLIMETERS)[1]
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.SHOULDER HEIGHT	:	(INCHES OR MILLIMETERS)
4.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
5.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
6.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
7.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

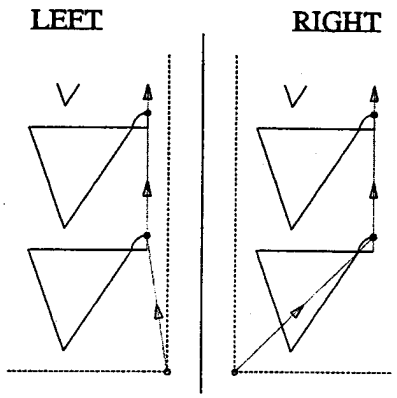
1) Like others, this part is cut with the BASE at the upper position.
2) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point, as shown.
3) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 39 : TRIANGLE



REPEAT PATTERNS

PLATE SIDE

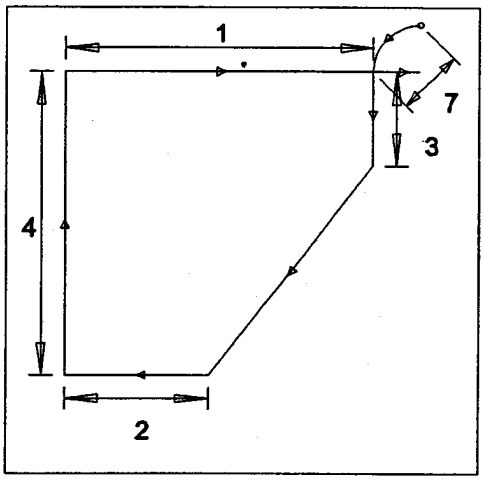


1.BASE WIDTH	:	(INCHES OR MILLIMETERS)[1]
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.LEFT OFFSET	:	(INCHES OR MILLIMETERS)[2]
4.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[4]
5.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
6.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
7.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

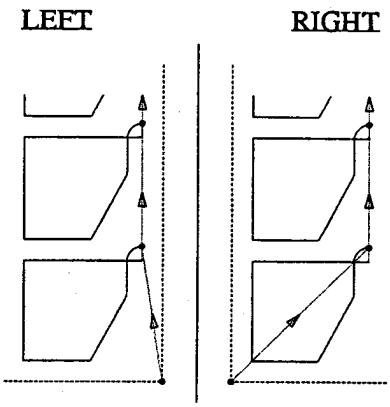
1) Like others, this part is cut with the BASE at the upper position. However the LEFT OFFSET is actually on the left side of the part as shown.
2) When LEFT OFFSET is greater than 0, angle "A" is greater than 90 degrees and when it is less than 0, angle "A" is less than 90 degrees.
3) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point, as shown.
4) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 40 : BEVELED RECTANGLE



REPEAT PATTERNS

PLATE SIDE

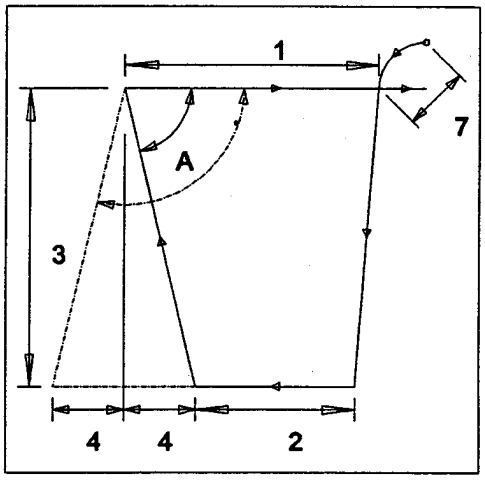


1.BASE WIDTH	:	(INCHES OR MILLIMETERS)[1]
2.TOP WIDTH	:	(INCHES OR MILLIMETERS)
3.LEFT HEIGHT	:	(INCHES OR MILLIMETERS)
4.RIGHT HEIGHT	:	(INCHES OR MILLIMETERS)
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
6.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
7.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
8.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

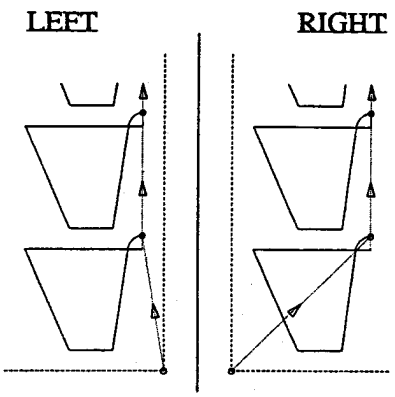
1) Like others, this part is cut with the BASE at the upper position. As a result, the prompts used to label the top and sides assume the part is rotated 180 degrees.
2) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point, as shown.
3) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 41 : TRAPEZOID



REPEAT PATTERNS

PLATE SIDE

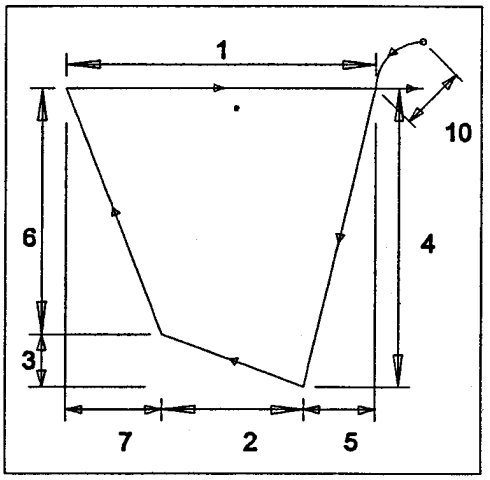


1.BASE WIDTH	:	(INCHES OR MILLIMETERS)[1]
2.TOP WIDTH	:	(INCHES OR MILLIMETERS)[1]
3.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
4.LEFT OFFSET	:	(INCHES OR MILLIMETERS)[2]
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[4]
6.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
7.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
8.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

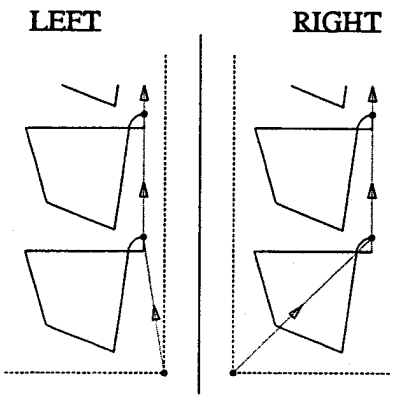
1) Like others, this part is cut with the BASE at the upper position and the TOP at the lower position. However the LEFT OFFSET is actually on the left side of the part as shown.
2) When LEFT OFFSET is greater than 0, angle "A" is greater than 90 degrees and when it is less than 0, angle "A" is less than 90 degrees.
3) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point, as shown.
4) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 42 : QUAD SIDE



REPEAT PATTERNS

PLATE SIDE

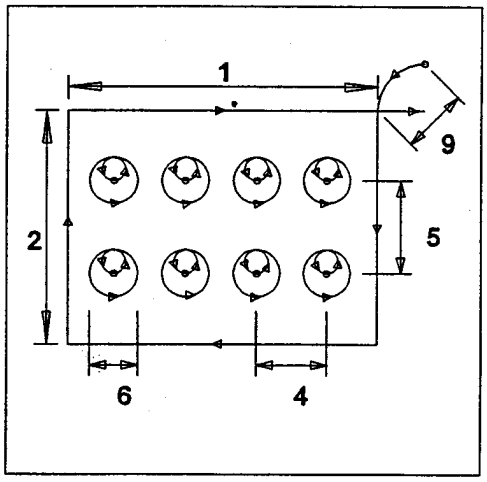


1.BASE WIDTH	:	(INCHES OR MILLIMETERS)[1]
2.TOP WIDTH	:	(INCHES OR MILLIMETERS)[1]
3.TOP OFFSET	:	(INCHES OR MILLIMETERS)
4.LEFT HEIGHT	:	(INCHES OR MILLIMETERS)
5.LEFT OFFSET	:	(INCHES OR MILLIMETERS)
6.RIGHT HEIGHT	:	(INCHES OR MILLIMETERS)
7.RIGHT OFFSET	:	(INCHES OR MILLIMETERS)
8.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
9.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
10.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
11.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

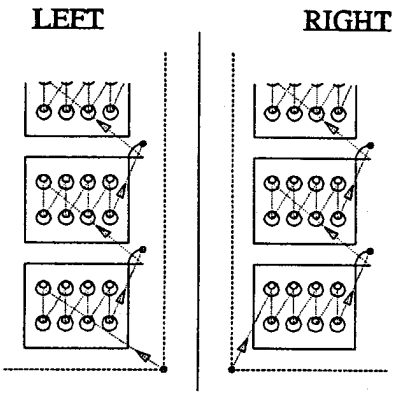
1) Like others, this part is cut with the BASE at the upper position. As a result, the prompts used to label the top and sides assume the part is rotated 180 degrees.
2) The only difference between parts created with LEFT PLATE or RIGHT PLATE enabled occurs in the traverse move to the first pierce point, as shown.
3) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 43 : LAP JOINT



REPEAT PATTERNS

PLATE SIDE

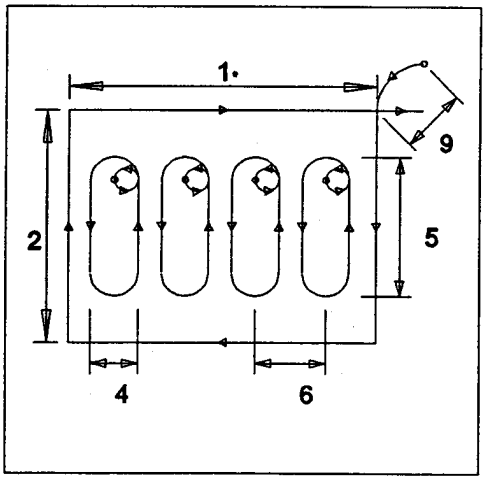


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.NUMBER OF COLUMNS	:	(COUNT, 0 TO 99)
4.COLUMN DISTANCE	:	(INCHES OR MILLIMETERS)
5.BOLT HOLE DISTANCE	:	(INCHES OR MILLIMETERS)[1]
6.BOLT HOLE DIAMETER	:	(INCHES OR MILLIMETERS)[1]
7.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
8.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
9.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
10.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

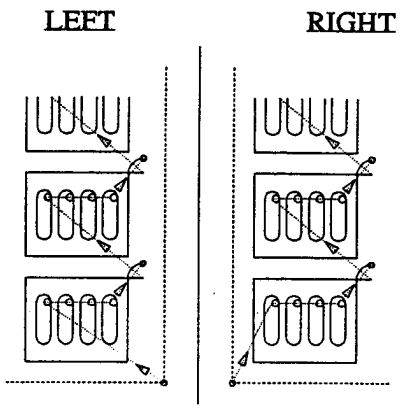
1) The hole pattern defined is automatically centered on the part from top to bottom and left to right.
2) To create a part with a single row of holes, use shape number 44, SLOTTED PLATE, with a SLOT HEIGHT equal to the SLOT WIDTH.
3) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 44 : SLOTTED PLATE



REPEAT PATTERNS

PLATE SIDE

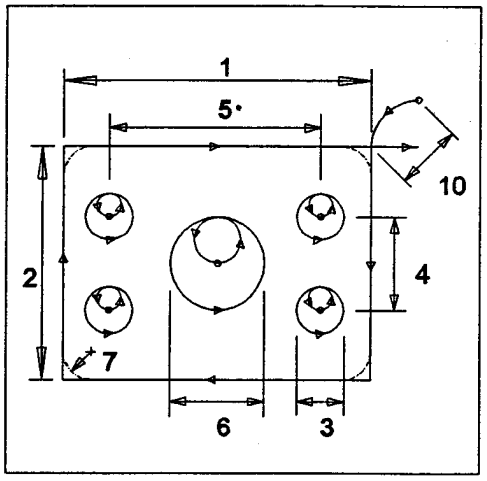


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.NUMBER OF SLOTS	:	(COUNT, 0 TO 99)[1]
4.SLOT WIDTH	:	(INCHES OR MILLIMETERS)[1]
5.SLOT HEIGHT	:	(INCHES OR MILLIMETERS)[1]
6.SLOT DISTANCE	:	(INCHES OR MILLIMETERS)[1]
7.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[2]
8.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
9.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
10.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

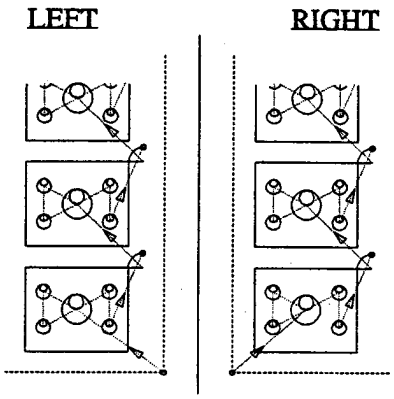
1) The slot pattern defined is automatically centered on the part from top to bottom and left to right.
2) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 45 : LAMP BASE



REPEAT PATTERNS

PLATE SIDE

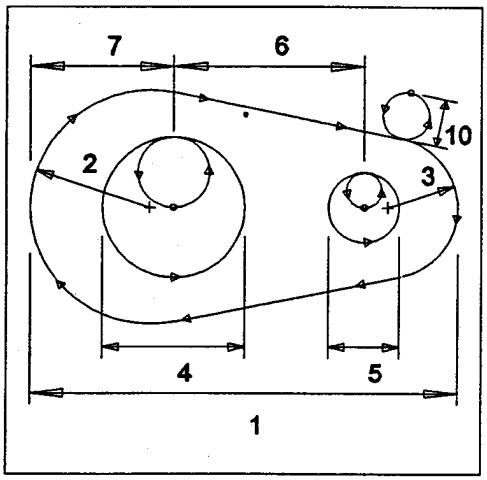


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.BOLT HOLE DIAMETER	:	(INCHES OR MILLIMETERS)
4.X BOLT HOLE CENTER	:	(INCHES OR MILLIMETERS)[1]
5.Y BOLT HOLE CENTER	:	(INCHES OR MILLIMETERS)[1]
6.CENTER HOLE DIAMETER	:	(INCHES OR MILLIMETERS)[2]
7.CORNER RADIUS	:	(INCHES OR MILLIMETERS)[3]
8.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[4]
9.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
10.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
11.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

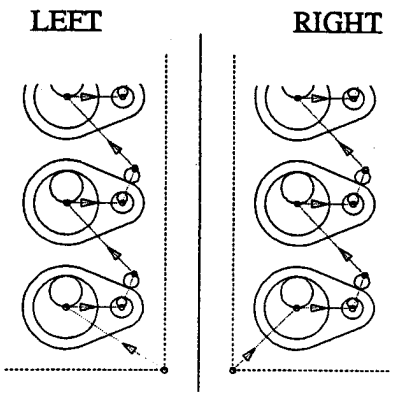
1) The hole pattern defined is automatically centered on the part from top to bottom and left to right.
2) If a CENTER HOLE DIAMETER of 0 is defined, no hole is cut.
3) If a CORNER RADIUS of 0 is defined, sharp corners are cut.
4) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 46 : CAM



REPEAT PATTERNS

PLATE SIDE

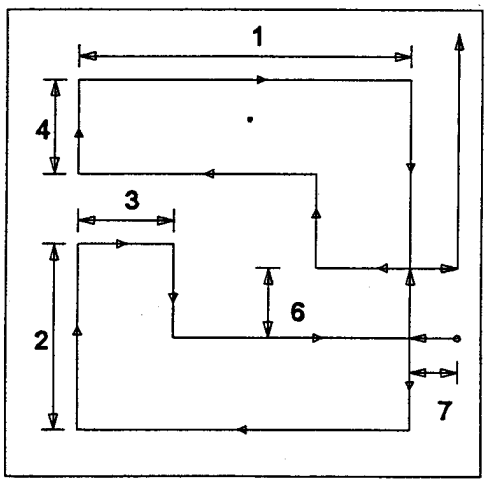


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.LEFT RADIUS	:	(INCHES OR MILLIMETERS)
3.RIGHT RADIUS	:	(INCHES OR MILLIMETERS)
4.LEFT HOLE DIAMETER	:	(INCHES OR MILLIMETERS)[1]
5.RIGHT HOLE DIAMETER	:	(INCHES OR MILLIMETERS)[2]
6.CENTER DISTANCE	:	(INCHES OR MILLIMETERS)
7.LEFT OFFSET	:	(INCHES OR MILLIMETERS)
8.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
9.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
10.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
11.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

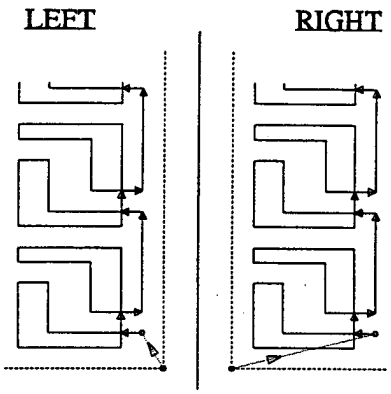
1) If a LEFT HOLE DIAMETER of 0 is defined, no holes are cut in the part.
2) If a RIGHT HOLE DIAMETER of 0 is defined, only the LEFT HOLE is cut.
3) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 47 : "L" BRACKET 1



REPEAT PATTERNS

PLATE SIDE[1]

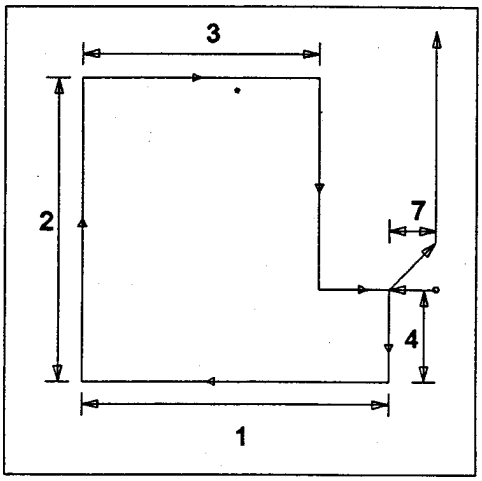


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.VERTICAL THICKNESS	:	(INCHES OR MILLIMETERS)
4.HORIZONAL THICKNESS	:	(INCHES OR MILLIMETERS)
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[4]
6.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
7.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
8.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

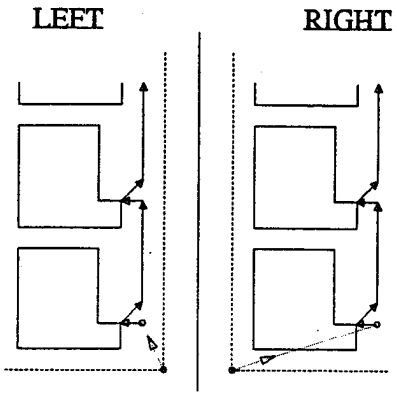
1) All chain cut parts start from the plate corner closest to the operator. The PLATE SIDE is defined through SYSTEM SETUP DATA.
2) Although parts are created in pairs to minimize scrap, each part is individually counted when cut.
3) If part dimensions make it impossible to create part pairs without overlap, use shape 48, "L" BRACKET 2.
4) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 48 : "L" BRACKET 2



REPEAT PATTERNS

PLATE SIDE[1]

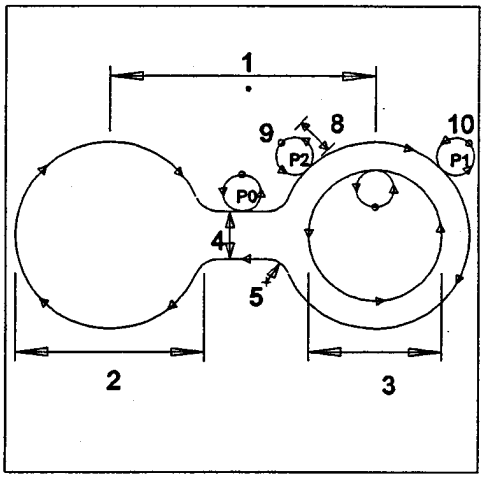


1.WIDTH DIMENSION	:	(INCHES OR MILLIMETERS)
2.HEIGHT DIMENSION	:	(INCHES OR MILLIMETERS)
3.VERTICAL THICKNESS	:	(INCHES OR MILLIMETERS)
4.HORIZONAL THICKNESS	:	(INCHES OR MILLIMETERS)
5.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
6.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
7.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
8.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

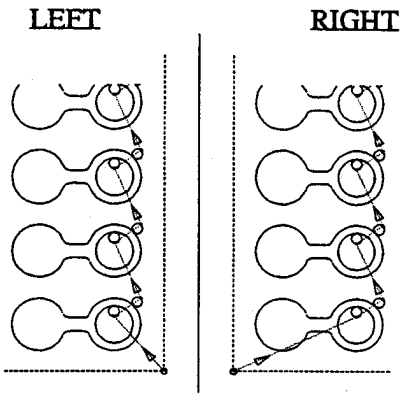
1) All chain cut parts start from the plate corner closest to the operator. The PLATE SIDE is defined through SYSTEM SETUP DATA.
2) If excessive scrap can be eliminated by creating "part pairs", use shape 47, "L" BRACKET 1.
4) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 49 : BI DAMPER



REPEAT PATTERNS

PLATE SIDE

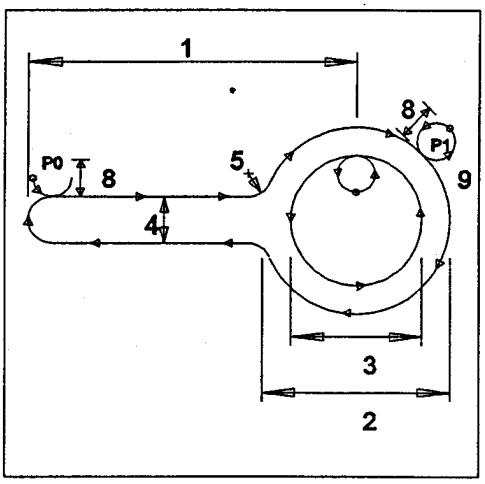


1.CENTER DISTANCE	:	(INCHES OR MILLIMETERS)
2.OUTER DIAMETER	:	(INCHES OR MILLIMETERS)
3.INNER DIAMETER	:	(INCHES OR MILLIMETERS)[1]
4.THICKNESS DIMENSION	:	(INCHES OR MILLIMETERS)
5.RADIUS DIMENSION	:	(INCHES OR MILLIMETERS)
6.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[4]
7.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
8.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
9.LEADIN POINT 1 (P1)	:	(YES OR NO)[2,3]
10.LEADIN POINT 2 (P2)	:	(YES OR NO)[2,3]
11.LEADOUT	:	(YES OR NO)[3]
12.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

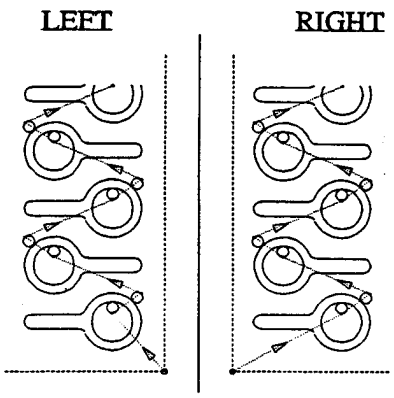
1) If an INNER DIAMETER of 0 is defined, no hole is cut.
2) If LEADIN POINT 1 is selected, the prompt for LEADIN POINT 2 is not displayed.
3) If "NO" is selected for both optional LEADIN POINTS, then the default LEADIN POINT 0 position is used.
4) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

SHAPE 50 : DAMPER



REPEAT PATTERNS

PLATE SIDE



1.HANDLE CENTER DIST.	:	(INCHES OR MILLIMETERS)
2.OUTER DIAMETER	:	(INCHES OR MILLIMETERS)
3.INNER DIAMETER	:	(INCHES OR MILLIMETERS)[1]
4.THICKNESS DIMENSION	:	(INCHES OR MILLIMETERS)
5.RADIUS DIMENSION	:	(INCHES OR MILLIMETERS)
6.KERF DIMENSION	:	(WIDTH OF CUTTING TOOL PATH)[3]
7.SCRAP DIMENSION	:	(DISTANCE BETWEEN PARTS, IN/MM)
8.LEADIN DIMENSION	:	(INCHES OR MILLIMETERS)
9.LEADIN POINT 1 (P1)	:	(YES OR NO)[2]
10.LEADOUT	:	(YES OR NO)
11.**REPEAT PROMPTING	:	(YES OR NO)

NOTES:

1) If an INNER DIAMETER of 0 is defined, no hole is cut.
2) If "NO" is selected for the LEADIN POINT 1 position prompt, the default LEADIN POINT 0 position is used.
3) Setting the PROGRAM KERF value to '0' allows DIAL-IN-KERF to be added at run-time. Entering a KERF value here will not prompt for DIAL-IN-KERF at run-time.

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PART CONSTRUCT OPERATIONS

PART CONSTRUCT is a special shape program that allows virtually any part to be programmed and cut with the BURNY 5. Through a sequence of prompts, the operator can functionally define lines and arcs to create the desired cutting path. Several functions are provided to control "program repeat", "cutting", and other auxiliary functions. Others are provided to perform the special MATH operations and TRIANGLE calculations that are often required when defining the length or angle of a dimensional movement.

NOTE

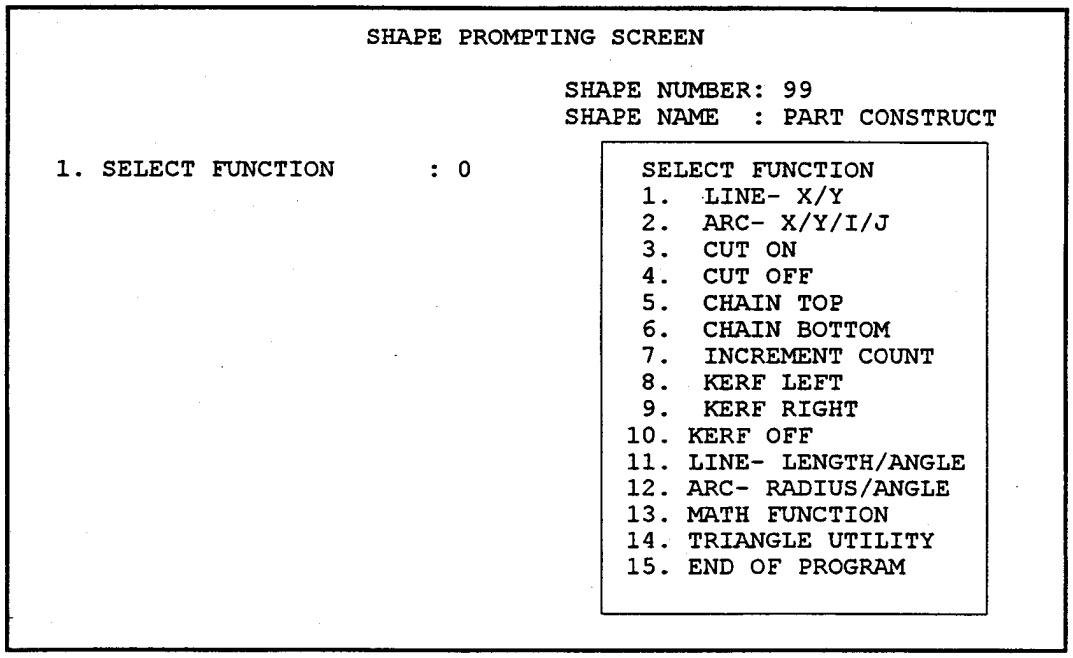
PART CONSTRUCT prompting operates in the same manner as operations on the 50 STANDARD SHAPES. As such, the operator should be experienced with STANDARD SHAPE prompting before using PART CONSTRUCT.

The PART CONSTRUCT process, which is provided as SHAPE 99 in STANDARD SHAPE MEMORY, is selected exactly like any other standard shape. First select LOAD from the MAIN MENU and specify STANDARD SHAPE MEMORY as the source. The BURNY 5 responds with the SHAPE NUMBER / SHAPE NAME prompt. At this prompt type the number 99, or use the up and down arrow keys to step to the desired shape number, and press <ENTER>. The BURNY responds with the PROGRAM NUMBER / PROGRAM NAME prompt. At this prompt, type the number for the NC part program that will be created and press <ENTER>. The BURNY may prompt for the NC PROGRAM NAME or advance directly to the "REPLACE OLD?" prompt.

NOTE

For the PROGRAM NAME feature to be operational, it must be enabled through SYSTEM CONFIGURATION 2. See variable 38 in the SYSTEM SETUP DATA section for additional information.

After a unique NC program number has been defined or "REPLACE OLD? YES" has been selected by the operator, the PART CONSTRUCT process is started. This causes the screen to update with an operator prompt on the left side and the list of available functions on the right as shown. Normally, HELP menus are automatically displayed only in NOVICE mode. However, in PART CONSTRUCT, the main "SELECT FUNCTION" menu is always displayed.

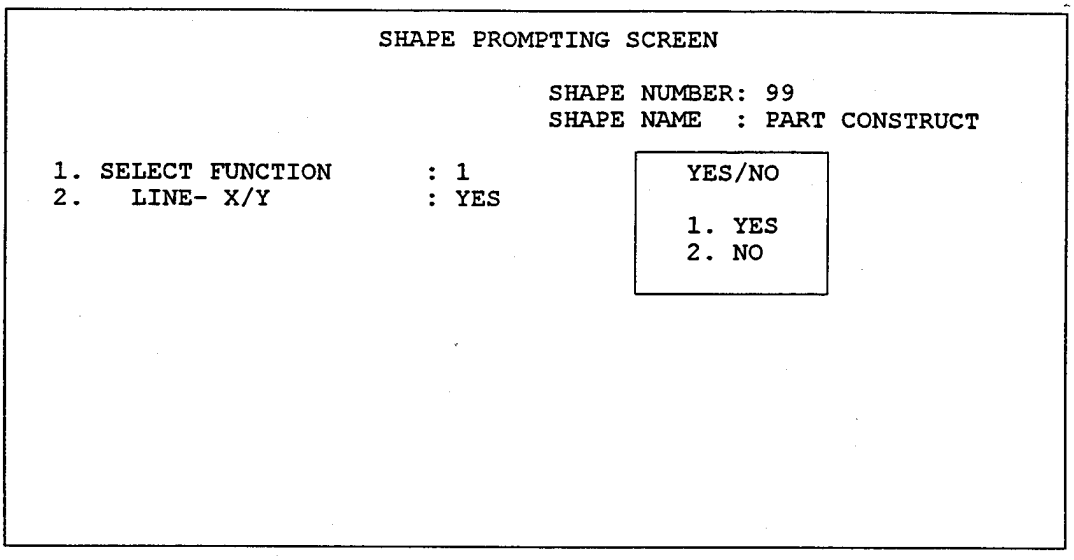


Although the main "SELECT FUNCTION" menu is always displayed in PART CONSTRUCT, other displays are still dependent on the current prompting mode. In NOVICE mode, all HELP menus are automatically displayed. However, in EXPERT mode, HELP menus are only displayed for the current prompt when the <IV> key is pressed.

The NOVICE/EXPERT prompting mode is initially defined at power-up through SYSTEM SETUP DATA variable 38. However, this mode can be toggled by pressing <SHF> and then <V> whenever a HELP menu is available for the current prompt. For additional information on the NOVICE/EXPERT prompting mode feature, see PART-1 in this manual.

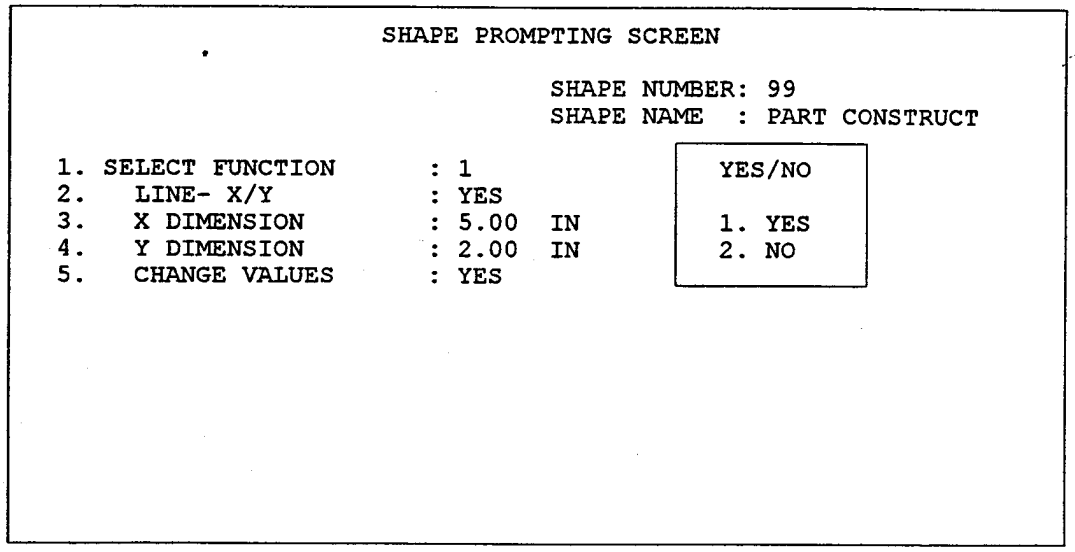
The "SELECT FUNCTION : 0" prompt appears repeatedly when performing PART CONSTRUCT operations. It allows the operator to determine the next function to be performed. Normally it appears on the screen immediately following the last completed function. However by pressing <CE>, the prompt can be returned to the first line of the screen.

Once a function number is selected and the <ENTER> key is pressed, the screen updates to show the selected function name along with a "YES" response next to it. This allows the operator to verify that the correct function was actually selected. For example, if function 1 "LINE- X/Y" was selected, the display would show the following:



If the selected function is correct, press the <ENTER> key to continue. However, if an incorrect function is selected, press the <+/-> key, or the up/down cursor keys, to toggle the response to "NO" and press <ENTER>. Alternately, numeric key <2> can be pressed to directly select the desired response as shown in the HELP menu. Selecting "NO" as the response aborts the function and causes the "SELECT FUNCTION : 0" prompt to reappear.

After selecting the "YES" response, the BURNY prompts for any additional information or dimensions that may be required for the selected function. Then, after all of the necessary data has been entered, a verification prompt is displayed as follows:



To modify any of the values that were input, press the <ENTER> key with the "YES" response displayed. This restarts the prompting associated with the selected function and allows incorrect values to be re-entered. However, if all the data is correct when this prompt is shown, press the <+/-> key to toggle the response to "NO" and press <ENTER>. This causes the BURNY to first perform any calculations that may be necessary and then, add the resulting program block to the NC part being created. When completed, the prompting process automatically redisplays the "SELECT FUNCTION : 0" prompt to allow additional functions to be selected. After the entire part has been programmed, select function 15, "END OF PROGRAM", to add the necessary ending codes to the part and terminate the PART CONSTRUCT prompting operation.

Since parts created with PART CONSTRUCT are in the same internal format as all others in NC PROGRAM MEMORY, the resulting program may be immediately run, edited, added to a nest or stored to any supported device for later recall.

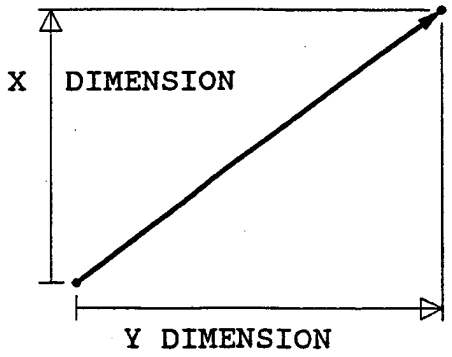
CONSTR.1 FUNCTION DESCRIPTIONS

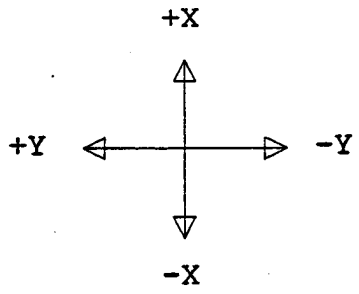
This section contains a detailed description of each of the functions supported by the PART CONSTRUCT SHAPE process. The number identifies the function number that is entered by the operator at the "SELECT FUNCTION : 0" prompt.
The following functions are currently supported:

1	LINE BY X/Y DIMENSIONS
2	ARC BY X/Y/I/J DIMENSIONS
3	CUT ON
4	CUT OFF
5	CHAIN TOP
6	CHAIN BOTTOM
7	PART COUNTER INCREMENT
8	KERF LEFT
9	KERF RIGHT
10	KERF OFF
11	LINE BY LENGTH AND ANGLE
12	ARC BY RADIUS AND ANGLE
13	MATH FUNCTION
14	TRIANGLE UTILITY
15	END OF PROGRAM

1 LINE- BY X/Y DIMENSIONS

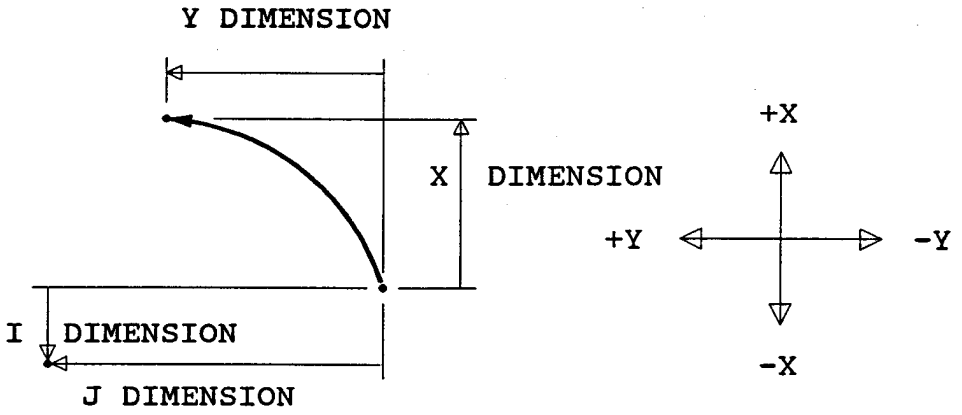
This function creates a straight line move in the NC part program being created. This is the most common method of defining lines. The line is dimensioned by entering the distances on the X axis and Y axis from the START POINT to the END POINT of the line. When the line is cut, it moves the machine in a straight line directly to the end point position.





2 ARC- BY X/Y/I/J DIMENSIONS

This function creates an arc movement in the NC part program being created. The first prompt asks whether the arc should be clockwise (CW) or counter-clockwise (CCW). Then, the prompting continues for the four dimensions needed to define an arc. The "X" and "Y" dimensions define the distance from the START POINT to the END POINT of the arc. The "I" dimension is the distance from the START POINT of the arc to the CENTER of the arc along the X axis while the "J" dimension defines the distance from the START POINT to the CENTER along the Y axis.



3 CUT ON

This function places a "CUT ON" code in the NC part program so that all movements following this block position are performed at the selected cut speed with the cut on. The cut remains "ON" until a "CUT OFF" code is encountered in the part program.

NOTE

Part programs created with the PART CONSTRUCT SHAPE can be used with the "DIAL IN KERF" feature provided that a "KERF LEFT" or "KERF RIGHT" auxiliary function code is also defined in the program. The recommended sequence is to enable the kerf before the "CUT ON" is performed so that the BURNY can adjust the path before the cut is actually turned on.

4 CUT OFF

This function places a "CUT OFF" code in the NC part program. When the part is being cut, this code causes the cut to be turned off and all movements following it to be performed at the high traverse speed.

NOTE

If KERF is enabled on the left or the right, the "CUT OFF" function also automatically cancels the kerf adjustment until the next "CUT ON" code in the program, provided that no "KERF OFF" auxiliary code is encountered before the next "CUT ON".

5 CHAIN TOP

This function places a special pointer in the NC part program to identify the restart position for the "CHAIN BOTTOM" function. When the part is repeated, all program steps before this code are skipped. This allows the special movements that are performed from the corner of the plate for the first part to be skipped on repeat parts. If this code is not used, the part repeats from the very first block of the NC part program.

6 CHAIN BOTTOM

This function places a special code in the NC part program which causes an automatic program repeat when it is encountered. When the "CHAIN BOTTOM" code is found, the program automatically jumps back to the block where the "CHAIN TOP" code was placed and repeats the program from that block position. If this code is not used, the program stops when it detects the end of the NC part program. Each time the <GO> key is pressed, another part program cycle is performed.

7 PART COUNTER INCREMENT

This function places a code in the NC part program which increments the "NUMBER OF PARTS" counter by one each time it is encountered in a running part program. This counter, which is displayed in the status window at the bottom of the screen, is also used when performing AUTO CUT operations for a specific number of parts. If the program being entered actually cuts more than one part (as when they are nested), the "COUNTER INCREMENT" function should be included at the end of each part so that the displayed count will be accurate. If this command is omitted, parts will still be cut but the "NUMBER OF PARTS" value will not count and the AUTO CUT function will be unable to stop at the selected count.

8 KERF LEFT

This function adds the appropriate code in the NC part program so that the "DIAL IN KERF" feature can be used. The "KERF LEFT" function indicates that the kerf should be applied to the LEFT of the cut as the torch is traveling around the part. This is the most common direction since most parts are cut CLOCKWISE on the outside and COUNTER-CLOCKWISE on the inside. If the "DIAL IN KERF" is not to be used but a kerf offset is required, the operator must manually calculate the part dimensions to create the necessary compensated path.

9 KERF RIGHT

Like the "KERF LEFT" function, this function is used with the "DIAL IN KERF" feature to indicate that the kerf should be applied to the RIGHT of the cut as the torch travels around the part.

10 KERF OFF

This function is very rarely used. It only operates with the "DIAL IN KERF" feature and allows the kerf to be disabled while the cut is "ON" or "OFF". In most cases, this function is not needed since the kerf offset is automatically turned off by the "CUT OFF" function and turned back on by the "CUT ON" function, provided that the kerf remains enabled.

11 LINE- LENGTH/ANGLE

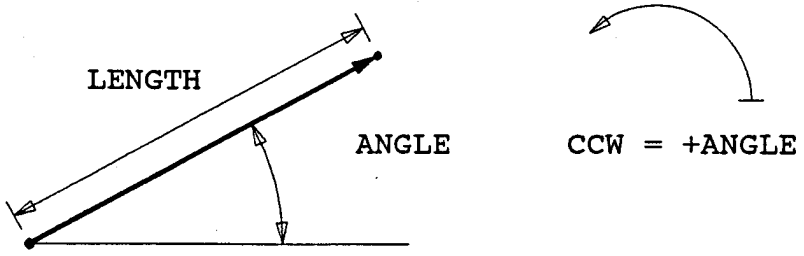
This function provides an alternate method of creating a line movement in the NC part program. With this function, the actual LENGTH and ANGLE of the line, not its X/Y components, are entered to define the line as it travels from the START POINT to the END POINT. Once the values are entered and verified, two additional values are displayed as follows:

"X DIMENSION = xxxx.xx"
"Y DIMENSION = xxxx.xx"

These are the X and Y component values of the line that are calculated from the LENGTH and ANGLE inputs. They are displayed only as an aid in programming the rest of the part. As such, just press <ENTER> to step past these values and automatically add the line to the part being created.

IMPORTANT

The X and Y dimensions displayed are the values that are required to define the line specified by the input values. **DO NOT ENTER ANY NUMBERS OR ALTER THESE VALUES IN ANY WAY.** Just press <ENTER> to accept these values and step through the prompts until the main "SELECT FUNCTION : 0" prompt reappears.



12 ARC- RADIUS/ANGLES

This function provides an alternate method of creating an arc move in the NC part program. With this function, the following four inputs are required:

DIRECTION of the arc (CW/CCW)
RADIUS of the arc
STARTING DEGREES (from horizonal to the start)
ENDING DEGREES (from horizonal to the end)

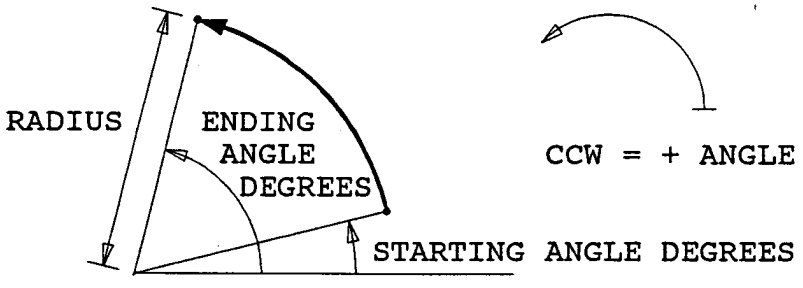
Once these values are entered and verified, four additional values are displayed as follows:

"X END POINT = xxxx.xx"
"Y END POINT = xxxx.xx"
"X CENTER = xxxx.xx"
"Y CENTER = xxxx.xx"

These values are the calculated distances from the START POINT to the END POINT and the START POINT to the CENTER along the X axis and Y axis. They are displayed as an aid in programming the rest of the part. As such, just press <ENTER> to step past these values and add the arc to the NC part program being created.

IMPORTANT

The X and Y dimensions displayed are the values that are required to define the arc specified by the input values. **DO NOT ENTER ANY NUMBERS OR ALTER THESE VALUES IN ANY WAY.** Just press <ENTER> to accept these values and step through the prompts until the main "SELECT FUNCTION : 0" prompt reappears.



13 MATH FUNCTION

This function is provided as an aid in calculating various length, angle and distance values. It is also useful when calculating intermediate dimensions on part drawings and performing trigonometric calculations in general.

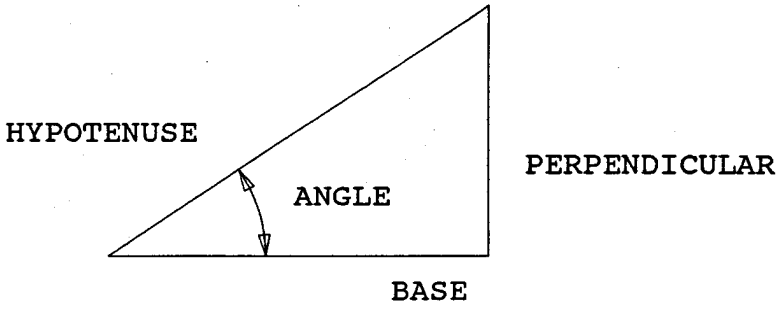
When MATH FUNCTION is selected, the BURNY prompts the operator for two values, "A" and "B". Once these values are entered, the same "YES/NO" verify sequence is performed to allow incorrect values to be re-entered before continuing. After selecting "NO", the first result is displayed from a list of mathematical calculations performed on the two input values. Pressing <ENTER> steps through the list and shows the results of each calculation. When the end of the list is reached, the "SELECT FUNCTION : 0" prompt reappears.
The following calculation results are displayed for input values A and B:

A+B	Add "A" to "B"
A-B	Subtract "B" from "A"
A*B	Multiply "A" times "B"
A/B	Divide "A" by "B"
A*A	"A" squared
B*B	"B" squared
SQUARE ROOT OF A	
SQUARE ROOT OF B	
[A SQR] + [B SQR]	Sum of "A*A" plus "B*B"
SQR RT OF SUM OF SQR	Square root of the sum of squares
SINE OF A	(Assumes "A" is angle in degrees)
COSINE OF A	
TANGENT OF A	
SINE OF B	(Assumes "B" is angle in degrees)
COSINE OF B	
TANGENT OF B	
ARC TANGENT OF A	
ARC TANGENT OF B	
ARC COSINE OF A	
ARC COSINE OF B	
A*SINE OF B	(X component of "A")
A*COSINE OF B	(Y component of "A")
B*SINE OF A	(X component of "B")
B*COSINE OF A	(Y component of "B")
CONVERT A TO MM	(Inches to millimeters)
CONVERT B TO MM	
CONVERT A TO IN	(Millimeters to inches)
CONVERT B TO IN	

14 TRIANGLE UTILITY

This function provides additional calculation aids by solving various RIGHT TRIANGLE equations. Six separate functions are provided. Each requires two of the four relationship values to be input. The function then displays the values for the other two values.

When the TRIANGLE UTILITY is selected, it first issues the verify prompt. After selecting the "YES" response, a menu of seven supported functions is displayed. The first six perform mathematical calculations on the values provided. However, the seventh function exits the TRIANGLE UTILITY and causes "SELECT FUNCTION : 0" to reappear.



FUNCTION	OPERATIONS PERFORMED
1	Inputs BASE and PERPENDICULAR distances and displays ANGLE in degrees and HYPOTENUSE distance.
2	Inputs BASE and HYPOTENUSE distances and displays ANGLE in degrees and PERPENDICULAR distance.
3	Inputs HYPOTENUSE and PERPENDICULAR distances and displays BASE distance and ANGLE in degrees.
4	Inputs BASE distance and ANGLE in degrees and displays PERPENDICULAR and HYPOTENUSE distances.
5	Inputs PERPENDICULAR distance and ANGLE and displays BASE and HYPOTENUSE distances.
6	Inputs HYPOTENUSE distance and ANGLE and displays BASE and PERPENDICULAR distances.
7	This function exits the TRIANGLE UTILITY and returns the PART CONSTRUCT prompting process back to the main "SELECT FUNCTION" prompt.

15 END OF PROGRAM

This function terminates the PART CONSTRUCT process and causes the BURNY 5 to add the necessary "ending" codes to the part program created in NC PROGRAM MEMORY.

IMPORTANT

The BURNY 5 has a "DIAL IN KERF" feature which may be used in NC part programs created by the PART CONSTRUCT SHAPE. However to use this feature, the operator must define a "KERF LEFT" or "KERF RIGHT" function in the part program. If it is not defined, no KERF value prompt will be displayed when the part is selected for a RUN operation. Without a KERF command, the BURNY assumes that the part dimensions are already compensated for the width of the kerf and no "DIAL IN KERF" is required.

CONSTR.2 PROGRAM EXAMPLE

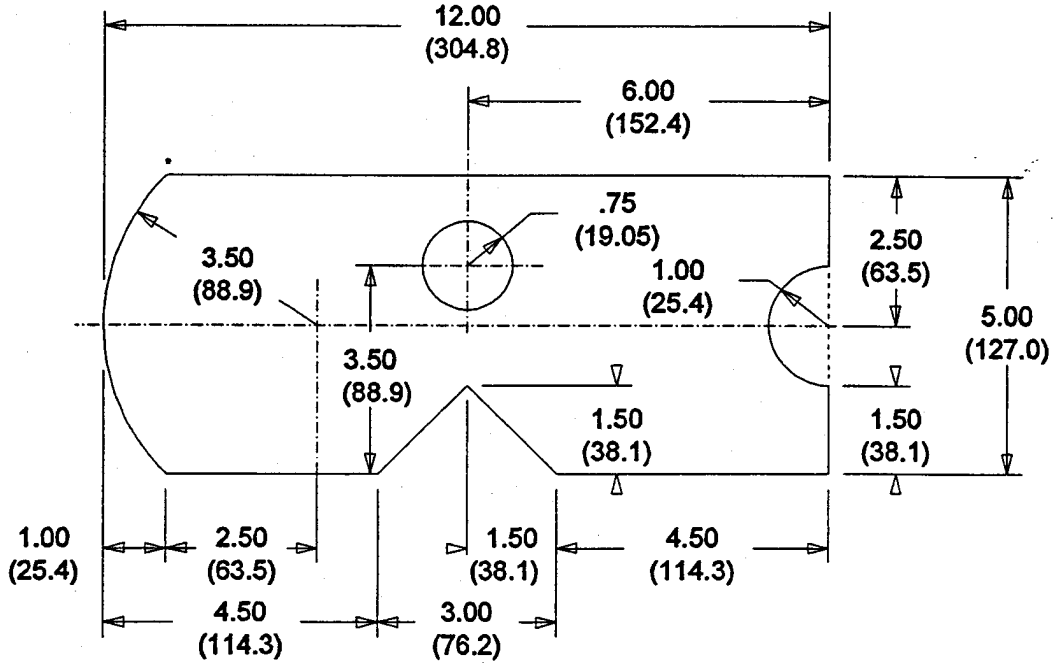
The following sequence illustrates the steps required to create the sample part from the drawing that follows. The NC part program that is created by this example is cut, as shown, with the initial move from the bottom left corner of the plate and the repeat move from the first part to the next. The circled letters on the part drawing reference individual line and arc moves that are defined by the example prompting sequence. Note that dimensional moves are shown in inches with corresponding millimeter values shown in parentheses.

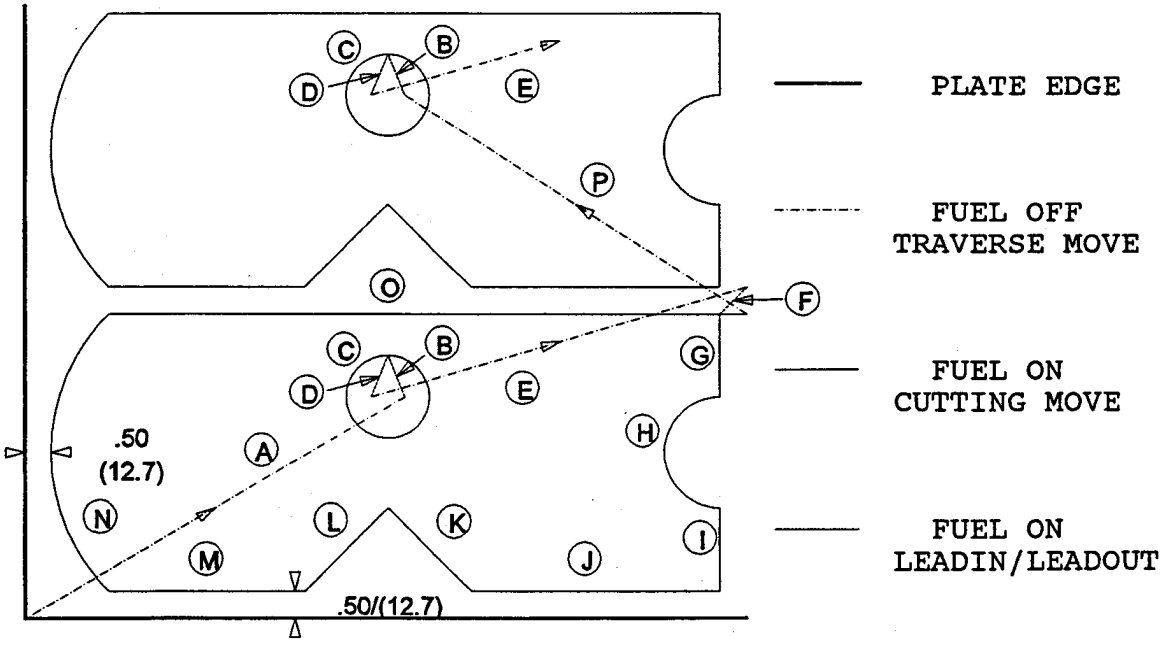
FUNCTION	REF	INPUTS	DESCRIPTION
SEL FNC= 1	A	X= 4.00 (101.6) Y= -6.80(-172.7)	LINE MOVE from corner of plate to pierce point on first part.
SEL FNC= 5			Set CHAIN TOP pointer. When the program repeats, all program blocks following this position will be repeated. This allows the initial move from the corner of the plate to be skipped.
SEL FNC= 8			Set the kerf side on the left so that the "DIAL IN KERF" feature can be used to compensate for the kerf.
SEL FNC= 3			Turn cut on (and kerf offset on, since enabled).
SEL FNC= 1	B	X= .75 (19.1) Y= .30 (7.6)	Cut leadin line for center hole.
SEL FNC= 2	C	ARC DIR- "CCW" X= 0.00 Y= 0.00 I= -.75 (-19.1) J= 0.00	Cut 360 degree arc in the counter-clockwise direction. Since the start and end are the same, both the X and Y values are 0. Since the center is on the X axis, the J value is also 0.

SEL FNC= 1	D	X= -.75 (-19.1) Y= .30 (7.6)	Cut leadout line away from hole.
SEL FNC= 4			Turn cut off at the end of the leadout.
SEL FNC= 1	E	X= 2.00 (50.8) Y= 6.80 (-172.7)	Traverse move to outside corner of part.
SEL FNC= 3	•		Turn cut on to pierce for outside.
SEL FNC= 1	F	X= -.50 (-12.7) Y= .50 (12.7)	Cut leadin to outside of part. NOTE: Kerf is still to the left.
SEL FNC= 1	G	X= -1.50 (-38.1) Y= 0.00	Cut line.
SEL FNC= 2	H	ARC DIR= "CCW" X= -2.00 (-50.8) Y= 0.00 I= -1.00 (-25.4) J= 0.00	Cut 180 degree arc in the counter-clockwise direction.
SEL FNC= 1	I	X= -1.50 (-38.1) Y= 0.00	Cut line down to bottom right corner of part.
SEL FNC= 1	J	X= 0.00 Y= 4.50 (114.3)	Cut line across bottom.
SEL FNC= 1	K	X= 1.50 (38.1) Y= 1.50 (38.1)	Cut diagonal line.
SEL FNC= 1	L	X= -1.50 (-38.1) Y= 1.50 (38.1)	Cut diagonal line back to bottom.
SEL FNC= 1	M	X= 0.00 Y= 3.50 (88.9)	Cut line into radius.
SEL FNC= 2	N	ARC DIR= "CW" X= 5.00 (127) Y= 0.00 I= 2.50 (63.5) J= -2.50 (-63.5)	Cut arc on left end of part in clockwise direction.
SEL FNC= 1	O	X= 0.00 Y=-11.50(-292.1)	Cut top line and leadout from part.
SEL FNC= 4			Turn cut off.

SEL FNC= 7			Increment part counter after part is cut.
SEL FNC= 1	P	X= 4.00 (101.6) Y= 6.20 (157.5)	Move up the plate to the pierce point on the next part.
SEL FNC= 6	.		Set the CHAIN BOTTOM position. This causes the program to step to the position where the CHAIN TOP was defined when repeating the part.
SEL FNC=15			End of program.

Part Drawings - Sample Program 1
INCH / MILLIMETER DIMENSIONS





LETTERS IN CIRCLES DENOTE DATA BLOCK LETTERS IN EXAMPLE.

BLANK

GENERIC SHAPE OPERATIONS

GENERIC SHAPES are special "user defined" shape programs that perform operations similar to STANDARD SHAPE and CUSTOM SHAPE CARTRIDGE programs. However, unlike STANDARD SHAPE programs, which are provided as part of the system software, GENERIC SHAPE programs can be created off-line and loaded into a special directory in battery backed program memory called GENERIC SHAPE MEMORY. Once loaded into this memory, any number of "LOAD FROM SHAPE" operations can then be performed using the shape program. This allows an unlimited number of NC part programs to be created from a single GENERIC SHAPE.

The GENERIC SHAPE capability is supported in the BURNY 5 with a special programming language. This language resembles the EIA standard WORD ADDRESS programming language and allows WORD ADDRESS blocks to be directly used. However, the major advantage of this language over WORD ADDRESS is in its ability to support prompting operations and perform mathematical operations on variables. Special assignment statements allow these variables to be used in place of actual dimension values. This allows GENERIC SHAPE programs to create not one, but a family of NC part programs when used in a "LOAD FROM SHAPE" operation.

When performing a "LOAD FROM GENERIC SHAPE" operation, prompting strings contained in the shape program request dimensions and values from the operator for the required custom part. However, unlike STANDARD SHAPE programs which have the ability to prompt in the currently selected language, GENERIC SHAPE programs do not support an alternate language toggle. These shape programs always use the prompt strings defined in the GENERIC SHAPE program.

Programs written in the GENERIC SHAPE LANGUAGE can be loaded, stored, deleted and edited like any other program in the BURNY 5. The only difference is that GENERIC SHAPE programs are automatically placed in the GENERIC SHAPE MEMORY directory. A special directory is also maintained on RAM CARTRIDGE to insure the NC programs and GENERIC SHAPE programs are not intermixed.

Like STANDARD SHAPE programs, GENERIC SHAPE programs can not be directly "RUN". Instead, they must be used in a "LOAD FROM GENERIC SHAPE" operation to allow the prompting operations to be performed and the desired part program to be created. The resulting NC program is then automatically placed in NC PROGRAM MEMORY. From this memory, it can be run, stored, included in a nest and/or edited like any other NC program.

NOTE

The BURNY 5 GENERIC language supports the decode of the BURNY IV "A, B and C loops". BURNY IV programs with these loops can be loaded into the BURNY 5 as a GENERIC program and then "LOADED" like any other GENERIC program. The resulting program can then be RUN on the BURNY 5.

The following table compares the steps necessary to program and cut two (or more) similar parts using WORD ADDRESS and GENERIC SHAPE programming. It illustrates the benefits of using the GENERIC format.

WORD ADDRESS LANGUAGE	GENERIC SHAPE LANGUAGE
OBTAIN DRAWINGS FOR FIRST PART TO BE PROGRAMMED.	OBTAIN DRAWINGS FOR FAMILY OF SIMILAR PARTS.
ESTABLISH EQUATIONS NECESSARY TO CALCULATE PROGRAM DATA FOR EACH SEGMENT OF THE PART.	ESTABLISH EQUATIONS NECESSARY TO CALCULATE PROGRAM DATA FOR EACH SEGMENT OF THE PART.
USE THESE EQUATIONS TO CALCULATE SPECIFIC X,Y,I,J DATA FOR EACH BLOCK OF THE PROGRAM.	
WRITE PROGRAM IN STANDARD WORD ADDRESS USING SPECIFIC X,Y,I,J DATA FOR EACH BLOCK.	WRITE SHAPE PROGRAM IN GENERIC LANGUAGE USING THE EQUATIONS FOR EACH DATA BLOCK RATHER THAN SPECIFIC DIMENSIONS.
LOAD NC PROGRAM INTO BURNY NC PROGRAM MEMORY.	LOAD SHAPE PROGRAM INTO BURNY GENERIC SHAPE MEMORY.
	USE "LOAD FROM: GENERIC SHAPE" OPERATION TO CREATE DESIRED NC PROGRAM. OPERATOR IS PROMPTED FOR PART DIMENSIONS. BURNY. GENERATES AN NC PROGRAM WITH THE REQUIRED X,Y,I AND J DATA FOR EACH PROGRAM BLOCK.
SETUP AND RUN NC PROGRAM.	SETUP AND RUN NC PROGRAM.

Up to this point, both methods are about equal as far as the steps required and the time spent. However, consider the next part in the family of similar parts to be cut. This is where the GENERIC SHAPE programming language saves time over WORD ADDRESS.

WORD ADDRESS LANGUAGE	GENERIC SHAPE LANGUAGE
USE THE SAME EQUATIONS AS BEFORE AND CALCULATE THE X,Y,I,J DATA FOR EACH DATA BLOCK.	NO RECALCULATING REQUIRED.
WRITE A NEW PROGRAM OR EDIT THE PREVIOUS ONE FOR THE DIMENSIONS OF THE NEW PART.	NO NEED TO WRITE ANOTHER NC PROGRAM.
LOAD NC PROGRAM INTO BURNY 5 NC PROGRAM MEMORY.	NO NEED TO LOAD SHAPE PROGRAM SINCE SHAPE IS ALREADY IN GENERIC SHAPE MEMORY.
	USE "LOAD FROM: GENERIC SHAPE" OPERATION TO CREATE DESIRED NC PROGRAM. OPERATOR IS PROMPTED FOR PART DIMENSIONS. BURNY GENERATES AN NC PROGRAM WITH THE REQUIRED X,Y,I AND J DATA FOR EACH PROGRAM BLOCK.
SETUP AND RUN NC PROGRAM.	SETUP AND RUN NC PROGRAM.

This example illustrates the advantages of using the GENERIC SHAPE programming language. Specific dimensions are directly entered into the BURNY 5 by the operator to create the desired NC part program. Different parts can then be created by simply entering different values. Normal WORD ADDRESS programming requires that a new program be created for each different part to be cut.

GENERIC.1 LANGUAGE DESCRIPTION

The GENERIC SHAPE programming language is a special language supported in the BURNY 5 to perform operations similar to STANDARD SHAPE and CUSTOM SHAPE CARTRIDGE programs. The format and syntax used by this language closely resemble the EIA standard WORD ADDRESS programming language. This allows standard WORD ADDRESS programming blocks to be directly used in a GENERIC SHAPE program.

Several special block formats are supported in the GENERIC SHAPE LANGUAGE. Prompting function blocks allow a shape to request dimensions and values from the operator for the required NC part. Mathematical and trigonometric function blocks are also supported by the GENERIC SHAPE programming language. Other features of the language allow "variables" to define dimension values and auxiliary code values for the resulting NC program.

GENERIC SHAPE programs can be created off-line using standard ASCII codes (ref. ANSI X3.4) and loaded into the BURNY 5 from a serial device or the panel mounted floppy. They can also be created (and modified) using the BURNY 5 TEXT EDITOR. The only difference when using the editor is that the operator must specify "GENERIC SHAPE" instead of "NC PROGRAM" as the program type.

The starting block of a GENERIC SHAPE program typically contains a "G" instead of the "%" code used in the WORD ADDRESS programming language. However, the BURNY 5 will also accept GENERIC SHAPE programs starting with a "%" code. Either starting code (% or G) must be preceded and followed by an "end of block" code. Like in WORD ADDRESS programs, GENERIC SHAPE program numbers are assigned in the BURNY 5 using the "P" command followed by up to 8 digits in the second line of the program. GENERIC SHAPE names and messages are also supported in the BURNY 5 as shown in the following example.

```
<EOB>
G<EOB>
P12345678(NAME OF GENERIC SHAPE)<EOB>
(SHAPE MESSAGE FOR NC PROGRAM)<EOB>
.
.
.
M30<EOB>
```

There are 100 variables that are available for use in defining part equations and for prompting the operator for part dimensions. These variables are specified as D0 through D99. They may be used in any order and may be used more than once within a program.

The GENERIC SHAPE programming language uses 3 types of data blocks. For ease of identification in the following descriptions, these blocks will be referred to as "TYPE 1", "TYPE 2" and "TYPE 3" data blocks.

TYPE 1 DATA BLOCKS: OPERATOR PROMPTS

"TYPE 1" data blocks cause messages to appear on the screen which prompt the operator to enter dimensions or values. These data blocks use the following format:

```
D15 'ENTER [X] DIMENSION' 3,2,A ;999.99
 A          B               C      D
```

where:

|A| is the first field in the block. It contains a variable number (D0 to D99) which is assigned the value entered by the operator.

|B| is the second field in the block which contains a message enclosed by either single or double quote marks ('' or ""). The message between the quote marks is displayed on the screen to prompt the operator for the value to be entered. On the BURNY 5, characters enclosed by brackets [ ] do not flash as on the BURNY 4.

|C| follows the text section and defines the number of digits the operator is allowed to enter for the value. The first number following the quote mark indicates the number of whole digits allowed. The second number (separated by a comma) indicates the number of decimal places allowed. An optional comma and "A" character may also be present in this field. If the ",A" characters are not present, then only an unsigned value can be entered. However if the ",A" characters are present, then both positive and negative values can be entered at the prompt.

The following table summarizes the supported format types:

FORMAT		POSITIONS TO LEFT OF DECIMAL	POSITIONS TO RIGHT OF DECIMAL
(0,1)	.X	0	1
(0,2)	.XX	0	2
(1,0)	X	1	0
(1,1)	X.X	1	1
(1,2)	X.XX	1	2
(2,0)	XX	2	0
(2,1)	XX.X	2	1
(2,2)	XX.XX	2	2
(3,0)	XXX	3	0
(3,1)	XXX.X	3	1
(3,2)	XXX.XX	3	2
(4,0)	XXXX	4	0
(4,1)	XXXX.X	4	1
(4,2)	XXXX.XX	4	2

|D| is an optional field which can be used to define default prompt values for use in BURNY 5 "QUICK INSPECT" operations. The value specified must follow a ";" code. If defined and the operator selects "YES" at the "WANT TO GRAPH SHAPE" prompt which appears on the "LOAD FROM: GRAPHIC SHAPE" screen, the BURNY 5 uses these values to generate and then draw the shape for the operator. This "QUICK INSPECT" feature is only provided to help the operator select the desired GENERIC SHAPE program. Therefore, the use of this field is NOT required for normal operations.

Example: D23'ENTER OFFSET DIMENSION'4,2,A

This GENERIC SHAPE programming block generates the following prompt line:

ENTER OFFSET DIMENSION : 0000.00 IN

The <SHF> key can be used to toggle and convert the currently displayed value from inch to millimeter and vice-versa. <SHF> is also used when entering a new value to select the desired unit type before pressing <ENTER>. Since the ",A" format was specified, negative values can also be entered. Therefore, the maximum value range for this value is -9999.99 to +9999.99, inclusive.

TYPE 2 DATA BLOCKS: ARITHMETIC EQUATIONS

"TYPE 2" data blocks contain the assignments and equations necessary to calculate the specific dimensions for the part program.

The first item in a "TYPE 2" block is the identifier of the variable (D0 to D99) used to store the result of the arithmetic operation. The variable identifier is always followed by an equal sign "=". The equal sign is followed by an equation for the calculation, a variable identifier, or a constant value.

Examples:
D0=3
D1=D0
D14=D1+D7
D25=D1
D26=D25+4
D27=5.678
D10=2*D27

When using constants, the number of digits in the value must be limited to 9 with a maximum of 4 decimal places. Values with more than 4 decimal places will cause an error message to appear when the NC program is created. Values having more than 9 total digits will be truncated to the least significant 9 places.

When using the algebraic operators (+,-,/,and *), the operator must be placed between the variables and constants upon which the function is to be performed.

Example: D2=D3+.25

This equation would add .25 to the value in D3 and place the result in D2.

The same variable may appear on both sides of the mathematical assignment function:

Example: D23=D23+5

If D23 was equal to 10.00 before the operation was performed, D23 would have contain a value of 15.00 after the operation.

Example: D32=D32*D32

The above block will square the value of D32 and place the results back in variable D32.

The following MATH functions are supported in the GENERIC SHAPE programming language.

OPERATOR	DESCRIPTION
+	Addition Operation. Adds two variables, a constant and a variable, or two constants.
-	Subtraction Operation. Subtracts two variables, a constant and a variable, or two constants.
*	Multiplication Operation. Multiplies two variables, a constant and a variable, or two constants.
/	Division Operation. Divides two variables, a constant and a variable, or two constants.
S	Sine Function. Calculates the SIN of a value. Value is assumed to be an angle in degrees.
C	Cosine Function. Calculates the COS of a value. Value is assumed to be an angle in degrees.
T	Tangent Function. Calculates the TAN of a value. Value is assumed to be an angle in degrees.
U	Arc Cosine Function. Calculates the ARCCOS of the value. Result is an angle in degrees.
V	Arc Tangent Function. Calculates the ARCTAN of the value. Result is an angle in degrees.
R	Square Root Function. Calculates the Square Root of a value.
I	Integer Function. Truncates a decimal value to whole digits only. It does not round up or down value before truncation.
F	Fudge Integer Function. Converts a value to the closest integer by rounding up or down and then truncating to the nearest whole number.
A	Absolute Value Function. Forces the value positive.
N	Negate Value Function. Negates the value. (Positive to negative, negative to positive).

When performing algebraic operators (+,-,*,/), operations are ALWAYS performed in a left to right order. Unlike other programming languages that assign a higher operation priority to multiply and divide operations, the GENERIC SHAPE programming language assigns equal priority to all arithmetic operations and always executes them as the appear in the block (left to right order).

Example: . D1=2
D3=5
D9=10
D30=D9+D3-D1*D1

This equation would be evaluated as:

((10+5)-2)*2

and assigns a value of 26 to variable number D30.

The variables to the right of the "=" sign will not have their values altered by any mathematical function. Only the variable to the left of the "=" sign will be altered.

When using the alphabetic MATH function operators (S, C, T, U, etc.) each must precede the variable or constant upon which the function is to be performed.

Example: D2=S35

This block calculates the SIN of 35 degrees and places the resulting value of .5735764 in D2.

When used with algebraic operators (+,-,*,/) in the same equation, the alphabetic operator functions are ALWAYS evaluated first.

Example: D20=2*V20

This block calculates the ARCTAN of 20 (which is 87.137594), multiplies it by 2 and places the resulting value of 174.27519 in D20.

Multiple functions with the alphabetic operators (A,I,R,S, etc.) may be performed by stacking the operators before the variable. In this case, the functions will be evaluated starting with the one closest to the variable.

Example: D28=RASD15

This equation would perform calculations in the following sequence:

1) Calculate the sine of the variable D15.
2) Calculate the absolute value of the results from step 1.
3) Calculate the square root of the results from step 2.
4) Place the final result in variable D28.

In conventional algebraic terms, the above example would appear as:

SQRT(ABS(SIN(D15)))

The GENERIC SHAPE programming language also supports several predefined constants. These constants are values commonly used in calculations and are provided to simplify programming. They are specified using the letter "K" followed by the number of the constant. The following constants are supported.

K0	=	SQRT(2)/2	(.70710)
K1	=	SQRT(2)	(1.41421)
K2	=	SQRT(3)	(1.73205)
K3	=	PI	(3.14159)

Example: D10=D1*K0

This block multiplies the value in D1 with the constant value of .70710 (which equals the square-root of 2 divided by 2) and places the resulting value in D10.

TYPE 3 DATA BLOCKS: WORD ADDRESS ASSIGNMENTS

"TYPE 3" blocks are used to assign values to WORD ADDRESS variables (X,Y,I,J,G,M, etc.) using a format which is similar to standard WORD ADDRESS data blocks. In fact, any WORD ADDRESS variable within a block which has a fixed value may be encoded using standard WORD ADDRESS programming conventions.

Examples:
X5Y-8
G41
(START OF CUT)
M04
G03I3J-8

The GENERIC SHAPE language message text block format allows a GENERIC register number to be defined in message strings for substitution with the actual register value during the NC PROGRAM build process. This allows the GENERIC process to build message strings for display during RUN with values defined by the contents of GENERIC registers.

Example: (CUTTING CIRCLE DIA.=D4)

In this program block, the message generated would depend on the value defined by register D4. If register D4 contained the value 4.5, then the message generated by the GENERIC process would be:

(CUTTING CIRCLE DIA.=4.5)

A WORD ADDRESS variable may also be assigned the value contained in one of the GENERIC variables (D0 to D99). This is accomplished by following the WORD ADDRESS variable (X,Y,G,etc.) with an equal sign "=" and then the identifier of the variable that contains the desired value.

Example: N1G42X=D2Y=D3

In this block, if D2 had a value of 3.5 and D3 had a value of .5, the resulting WORD ADDRESS block would be as follows:

N1G42X3.5Y.5

In "TYPE 3" blocks, a GENERIC variable identifier (D0 to D99) may be preceded by a minus sign. This causes the value from the GENERIC variable to be negated before it is used. However, this operation does not alter the value in the GENERIC variable.

Example: N2X=-D5Y=D5M04

In this block, if D5 had a value of 7.38, the resulting WORD ADDRESS block would be as follows:

N2X-7.38Y7.38M04

GENERIC.2 SHAPE PROGRAM EXAMPLES

The following two programming examples are provided to illustrate the GENERIC SHAPE programming language. Both examples also illustrate the use of program messages in the BURNY 5. Some messages are provided to comment on the GENERIC operations being performed. Others are used to define messages for display on the screen when later performing "cutting" operations.

Program messages are defined between the "(" and ")" characters. Program messages that follow GENERIC SHAPE programming operations in the same block are provided as comments on the GENERIC operations being performed. These messages are not passed to the resulting NC program. However, program blocks that contain only a program message and no other data are passed directly to the NC program being created.

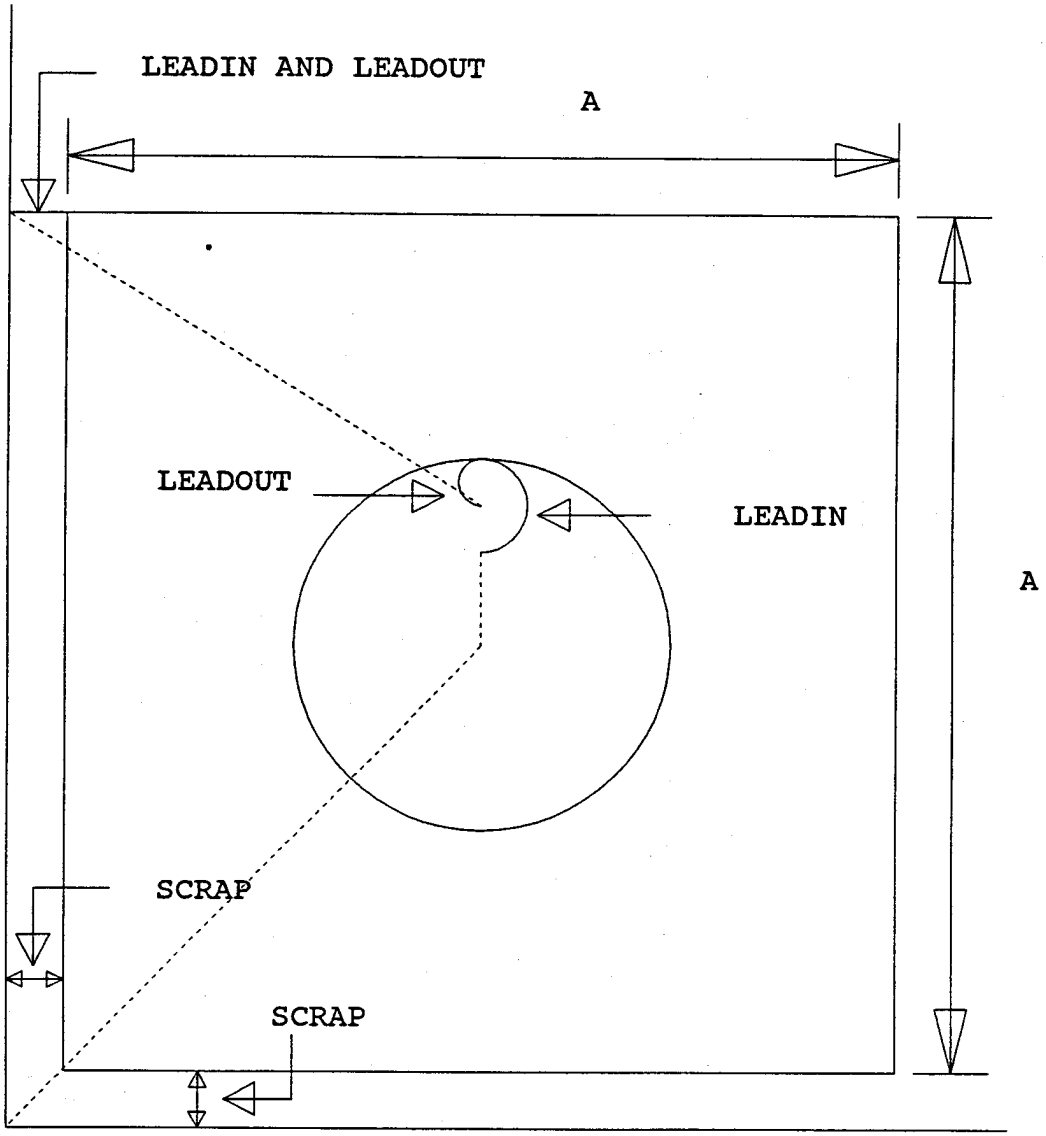
NOTE

The square bracket characters in these GENERIC SHAPE programming examples are only used to highlight the enclosed text. They do not cause flashing operations as in the BURNY 4 GENERIC PROGRAMMING implementation.

SHAPE EXAMPLE 1 (SEE DRAWING G-0682)

The following GENERIC SHAPE program creates an NC program to cut a 10 x 10 inch square part with a variable size hole in the center. The part is referenced from the lower left hand corner of the plate and is a continuous cut part. Lead-in and lead-out moves are circular cuts. Program messages are provided as comments. The number contained in some of these blocks reference one of the three GENERIC SHAPE programming block types. The letter "S" indicates that the block contains a WORD ADDRESS block that is directly transferred to the resulting NC part program.

```
                                (    : EOB CODE REQUIRED BEFORE "G")
G
P0982
D1'ENTER [HOLE] DIAMETER:'3,2   (1   : PROMPT OPERATOR - HOLE DIA)
D2'ENTER [LEADIN] DIM:'1,2      (1   : PROMPT OPERATOR - LEADIN)
D3'ENTER [LEADOUT] DIM:'1,2     (1   : PROMPT OPERATOR - LEADOUT)
D4'ENTER SCRAP DIMENSION:'1,2   (1   : PROMPT OPERATOR - SCRAP DIM)
G70                             (3 S* : SET FOR INCH DIMENSIONS)
G91                             (3 S* : SET FOR INCREMENTAL MODE)
X=D4Y=-D4G03                    (3   : MOVE TO PART REF. SET CCW)
G97                             (3 S* : SET REPEAT POINTER)
X5Y-5                           (3 S* : MOVE TO HOLE CENTER)
D10=D1/2                        (2   : CALCULATE RADIUS  R=1/2 DIA)
D11=D10-D2                      (2   : PIERCE POINT=RADIUS-LEADIN)
X=D11                           (3   : MOVE TO PIERCE POINT)
D12=D2/2                        (2   : CALC. RADIUS FOR LEADIN)
M04G41                          (3 S* : CUT ON - KERF LEFT)
G45X=D2I=D12                    (3   : CUT LEADIN)
I=-D10                          (3   : CUT HOLE)
D14=D3/2                        (2   : CALC. RAD. FOR LEADOUT)
X=-D3I=-D14M03                  (3   : CUT CIRC. LEADOUT-CUTOFF)
D15=5-D10+D3                    (2   : CALC. X DIM TO TOP OF PART)
D16=5+D2                        (2   : CALC. LEADIN POS.)
X=D15Y=D16                      (3   : MOVE TO TOP LEFT CORNER)
M04G42                          (3 S* : CUT ON - KERF RIGHT)
G45Y=-D2                        (3   : CUT LEADIN)
X-10                            (3 S* : CUT LEFT SIDE - 10 inches)
Y-10                            (3 S* : CUT BOTTOM - 10 inches)
X10                             (3 S* : CUT RIGHT SIDE - 10 inches)
Y10                             (3 S* : CUT TOP - 10 inches)
Y=D3M03                         (3   : CUT LEADOUT - CUT OFF)
X=D4Y=-D3                       (3   : MOVE TO CORNER OF NEXT PART)
G98                             (3 S* : REPEAT PART)
M30                             (3 S* : PROGRAM STOP/REWIND TAPE)
```



(DRAWING G-0682)

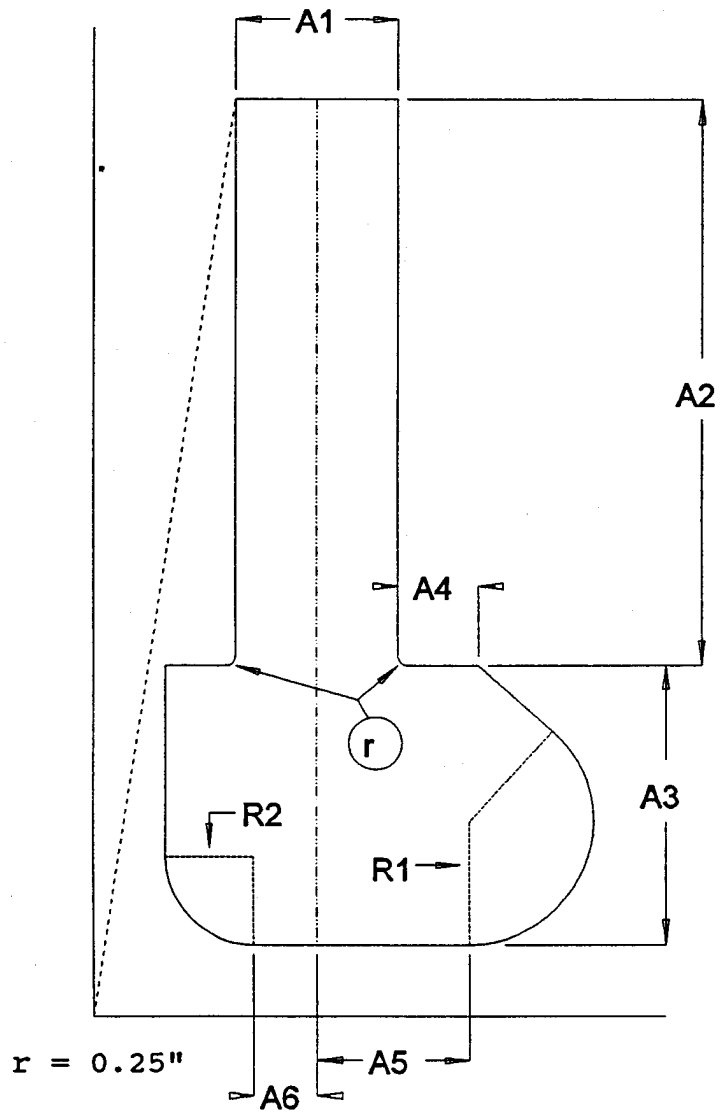
A = 10 INCHES (ENGLISH) 254 MILLIMETERS (METRIC)

SHAPE EXAMPLE 2 (SEE DRAWINGS G-6162 AND DG-6162)

The following BURNY 5 GENERIC SHAPE program creates an NC program that cuts a "Goose neck" part using dimension values specified by the operator. Note that this GENERIC SHAPE program contains a shape name in the second block. This name is also used for the resulting NC program. A program message is also provided in the third block for the resulting NC program.

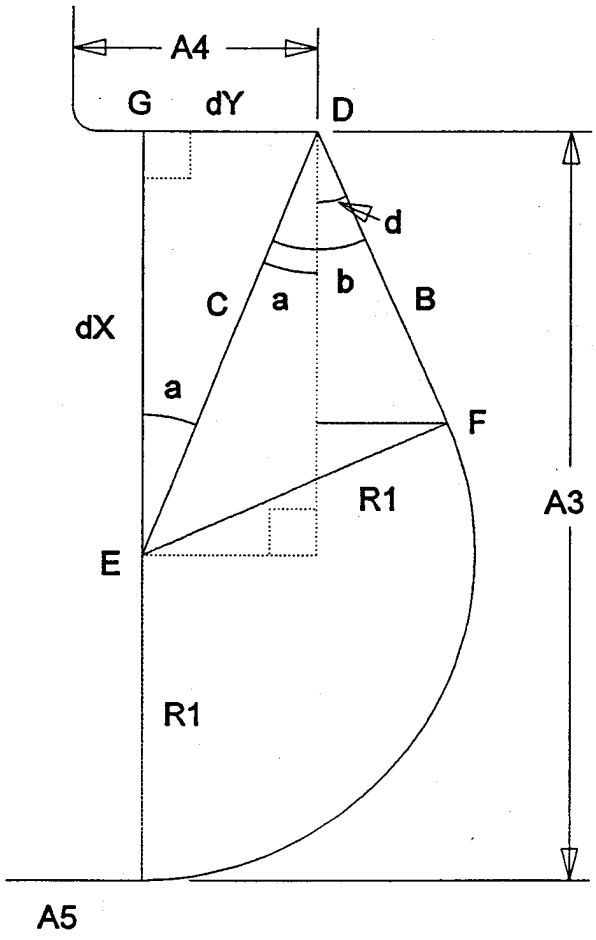
```
G
P6162(GOOSE NECK PART)
(NC PART CREATED FROM GENERIC SHAPE 6162)
D1'ENTER [A1 PIN DIAMETER]:'3,2
D2'ENTER [A2 PIN LENGTH]:'3,2
D3'ENTER [A3] HEAD HEIGHT:'3,2
D4'ENTER [A4] FRONT SHOULDER:'3,2
D5'ENTER [A5] CL TO CL FRONT RAD.:'3,2
D6'ENTER [A6] CL TO CL AFT RADIUS:'3,2
D7'ENTER FRONT RADIUS [R1]:'3,2
D8'ENTER AFT RADIUS [R2]:'3,2
D9'ENTER SCRAP DIMENSION:'3,2
D10'ENTER LEADIN DIMENSION:'3,2
D11'ENTER LEADOUT DIMENSION:'3,2
G70                        (SET FOR INCH DIMENSIONS)
G91                        (SET FOR INCREMENTAL PROGRAMMING MODE)
D0=D6+D8                   (CALCULATE AFT SHOULDER LENGTH: ADD AFT)
D12=.5*D1                  (RADIUS AND A6 DISTANCE TO CL. SUBTRACT)
D0=D0-D12                  (1/2 A1 PIN DIA. RESULTS=AFT LENGTH)
D12=D9+D2+D3+D10           (CALCULATE X START COORDINATE)
D13=D9+D0                  (CALCULATE Y START COORDINATE)
X=D12Y=-D13                (MOVE FROM PLATE CORNER TO START POS.)
G42M04                     (SET KERF RIGHT; CUT ON)
G45X=-D10                  (LEAD IN CUT-SPECIFIED BY G45)
D15=D2-.25                 (SUBTRACT .25in RADIUS TO GET A2 LENGTH)
X=-D15                     (CUT A2-LEFT SIDE OF PART)
G02X-.25Y.25J.25           (SET FOR CW ARC DIRECTION AND .25in ARC)
D14=D0-.25                 (SUBTRACT .25in RADIUS TO GET A7 LENGTH)
Y=D14                      (CUT CALCULATED AFT SHOULDER)
D14=D3-D8                  (SUBTRACT R2 RADIUS FROM A3 - DETERMINE)
X=-D14                     (DISTANCE TO START OF ARC R2-CUT LENGTH)
G03X=-D8Y=-D8J=-D8         (SET CUT DIRECTION CCW AND CUT ARC R2)
D14=D5+D6                  (ADD TO GET TOTAL DISTANCE TO R1 START)
Y=-D14                     (CUT A6 AND A5 LENGTHS)
D15=D4+D1+D0-D8-D6-D5      (FIND CHANGE IN Y FROM R1 TO A4 START)
D16=D3-D7                  (FIND CHANGE IN X FROM R1 TO A4 START)
D17=D15*D15                (Y**2=Y2      -+                          )
D18=D16*D16                (X**2=X2       |                          )
D19=D18+D17                (X2+Y2=C2      |- FIND HYP OF CHANGE       )
D20=D19                    (SAVE C2       |   X AND Y.                )
D19=RD19                   (C=SQRT C2    -+                          )
D21=D7*D7                  (R1**2=R12    -+ FIND SIDE B OF TRIANGLE  )
D22=D20-D21                (C2-R12=B2     |- FDE-ASSUME LINE FD       )
D22=RD22                   (B=SQRT B2    -+ TANGENT TO ARC R1        )
D23=AD15/AD16              (ABS CHANGE IN Y/ABS X)
D23=VD23                   (ARCTAN OF SIDES Y/X RESULTS = ANG a)
D18=D22/D19                (B/C)
```

```
D18=UD18                (ARCCOS OF SIDES B/C RESULTS = ANG b)
D24=D15/AD15            (GET SIGN OF ANGLE-DETERMINES DIRECTION)
D23=D23*D24             (ANGLE a = ANGLE a * SIGN)
D25=90.+D23-D18         (ANGLE d = 90.+ ANGLE a - ANGLE b)
D26=SD25*D22            (SIN ANGLE d *B RESULTS POINT F X COORD.)
D27=CD25*D22            (COS ANGLE d *B RESULTS POINT F Y COORD.)
D28=D3-D26              (CALCULATE IN REF TO ACTUAL X START POS.)
D29=D27+D15             (CALCULATE IN REF TO ACTUAL Y START POS.)
X=D28Y=-D29I=D7         (CUT ARC)
X=D26Y=D27              (CUT LENGTH)
D26=D4-.25              (SUBTRACT .25in RADIUS TO GET A4 LENGTH)
Y=D26                   (CUT A4 LENGTH)
G02X.25Y.25I.25         (CUT ARC .25in RADIUS)
D26=D2-.25              (SUBTRACT .25in RADIUS TO GET A2 LENGTH)
X=D26                   (CUT A2 LENGTH)
D26=D1+D11              (ADD LEADOUT VALUE TO PART)
Y=D26M03                (CUT LEADOUT-CUT OFF)
M30                     (PROGRAM END/REWIND TAPE)
```



(DRAWING G-6162)

	EXAMPLE VALUES
A1 = PIN DIAMETER	4.5
A2 = PIN LENGTH	17.0
A3 = HEAD HEIGHT	8.0
A4 = FRONT SHOULDER LENGTH	2.25
A5 = CL PIN TO CL FRONT RADIUS	4.25
A6 = CL PIN TO CL AFT RADIUS	1.75
R1 = FRONT RADIUS	3.50
R2 = AFT RADIUS	2.50



(DRAWING DG-6162)

```
ASL = AFT SHOULDER LENGTH = (A6+R2) - (.5*A1)

dX = A3 - R1
dY = A4 + A1 + ASL - R2 - A6 - A5

FOR TRIANGLE GDE    C = SQRT((dX*dX) + (dY*dY))
FOR TRIANGLE FDE    B = SQRT((C*C) - (R1*R1))

ANGLE a = ARCTAN(ABS(dY)/ABS(dX)) * (dY/ABS(dY))
ANGLE b = ARCCOS(B/C)
ANGLE d = 90 + (ANGLE a) - (ANGLE b)

FROM POINT D TO POINT F:

     X coordinate = SIN(ANGLE d) * B
     Y coordinate = COS(ANGLE d) * B
```

GENERIC.3 SHAPE ERROR MESSAGES

The following error messages may be displayed when a GENERIC SHAPE program is processed. These errors are typically caused by incorrectly formatted blocks within the GENERIC SHAPE program. Some of these errors are the result of calculation errors that may be caused by the equations used in the program and/or the values specified by the operator through a prompting operation. For example, "DIVIDE BY ZERO" errors can be caused by incorrect values defined by the operator or programming errors.

When an error is detected, the GENERIC SHAPE process is aborted and an error message is displayed. This message identifies the error type and the line number of the GENERIC SHAPE programming block where the error was detected. Often, the error is caused by an incorrectly formatted program block. These block errors, and others, can be easily corrected using the BURNY 5 TEXT EDITOR.

DIGIT FORMAT ERROR: LINE XXXX

This message indicates an error in the numeric format digits in a "TYPE 1" OPERATOR PROMPT block. The following are some examples of this type of error:

D1'ENTER X DIMENSION'2.2	(MUST USE COMMA NOT PERIOD)
D1'ENTER X DIMENSION'2	(SECOND DIGIT MISSING)
D1'ENTER X DIMENSION 2,2	(SECOND QUOTE MISSING)

AUX. FORMAT ERROR: LINE XXXX

This message indicates an error in the auxiliary format digit following the two numeric format digits in a "TYPE 1" OPERATOR PROMPT block. The following are some examples of this type of error:

D1'ENTER X DIMENSION'2,2,B	(A IS THE ONLY VALID CHAR.)
D1'ENTER X DIMENSION'2,2,	(A IS MISSING)

VARIABLE DEFINITION ERROR: LINE XXXX

This message indicates an invalid variable definition has been used in the GENERIC SHAPE programming block. This error can occur in any type of block. The following are some examples of this type of error:

```
D'ENTER.X DIMENSION'2,2     (NO NUMBER FOLLOWING THE D)
DM'ENTER X DIMENSION'2,2    (M IS NOT A VALID NUMBER)
```

VARIABLE TOO LARGE: LINE XXXX

This message indicates that the number of the variable is out of the acceptable range of 0 to 99. This error can occur in any type of block. The following are some examples of this type of error:

```
D108'ENTER X DIMENSION'2,2  (D108 TOO LARGE)
D100'ENTER X DIMENSION'2,2  (100 VARIABLES- 0 TO 99)
```

WADR EQUALITY ERROR: LINE XXXX

This message indicates that the format of an equality statement for a WORD ADDRESS character within the block is invalid. This error can occur in a "TYPE 3" WORD ADDRESS EQUALITY block. The following are some examples of this type of error:

```
N2X=D1+D2       (NO MATH FUNCTIONS ALLOWED)
N2X=3.5         (SHOULD BE N2X3.5)
N2X=Y           (ONLY EQUATE TO GENERIC VARIABLES)
```

CONSTANT DEFINITION ERROR: LINE XXXX

This message indicates that the reference to a GENERIC SHAPE programming constant has been incorrectly defined. This error can only occur in a "TYPE 2" MATH FUNCTION block. The following are some examples of this type of error:

```
D2=D3+K         (NO NUMBER FOLLOWING K)
D2=D3+KA        (DIGIT FOLLOWING K MUST BE A NUMBER)
```

CONSTANT TOO LARGE: LINE XXXX

This message indicates that the number used to access a GENERIC SHAPE programming constant is out of the acceptable range. This error can only occur in a "TYPE 2" MATH FUNCTION block. The following is an example of this type of error:

```
D2=D3+K6        (CONSTANT VALUE MUST BE 0-3)
```

MATH FUNCTION ERROR: LINE XXXX

This message indicates that an invalid MATH function is contained in the identified GENERIC SHAPE programming block. This error can only occur in a "TYPE 2" MATH FUNCTION block. The following is an example of this type of error:

```
D2=D1+QD2       (Q IS NOT A VALID FUNCTION)
D2=D1+(D3+2)    (PARENTHESIS OR BRACKETS ARE NOT
                 ALLOWED WITH MATH FUNCTIONS.)
```

MATH STATEMENT ERROR: LINE XXXX

This message indicates that an invalid combination of MATH functions is present in the GENERIC SHAPE programming block. This error can only occur in a "TYPE 2" MATH FUNCTION block. The following are some examples of this type of error:

```
D2= -D1         (USE NEGATE "N" FUNCTION IN THIS CASE)
D2=D1+2/-4      (NO TWO ALGEBRAIC OPERATORS IN A ROW)
```

DECIMAL NUMBER ERROR: LINE XXXX

This message indicates that a decimal number within the block has too many digits to the right of the decimal point. The maximum is 4 places. This error can only occur in a "TYPE 2" MATH FUNCTION block. The following is an example of this type of error:

```
D2=D1*1.5707963     (MUST TRUNCATE TO 1.5708)
```

DIVIDE BY ZERO: LINE XXXX

This message indicates that the denominator in a GENERIC SHAPE programming divide operation is zero and the divide cannot be correctly performed. This error can only occur in a "TYPE 2" MATH FUNCTION block. A zero value in the GENERIC variable can be the result of a previous prompting operation or calculation.

BLANK

NC PROGRAMMING LANGUAGES AND FORMATS

One of the advantages of the BURNY 5 control is its ability to load and process a wide variety of WORD ADDRESS and ESSI programming formats. This is accomplished through an assortment of conversion routines that can be configured by various parameters in SYSTEM SETUP DATA. These routines translate WORD ADDRESS and ESSI programs saved from the PROGRAM TEXT EDITOR or loaded from a serial device or the panel mounted floppy into a common internal format. This same internal format is also used to save NC programs created with TEACH, the GRAPHIC NEST EDITOR, PART CONSTRUCT or any other shape program. When storing a NC program to a device or using the DISPLAY PROGRAM or PROGRAM TEXT EDITOR, other conversion routines translate the internal format into the WORD ADDRESS or ESSI format selected. This allows all programs, regardless of how they were originally created or loaded, to be stored and edited in any of the supported NC language formats.

NOTE

> During the reconstruction process, every reasonable effort is made to produce the original format. However in some cases, standard BURNY format conventions will be used. For example, WORD ADDRESS dimension blocks using the custom "RXYXY" arc definition format are always rebuilt using the normal "XYIJ" format.

Although three basic NC program formats are provide by the BURNY 5 for LOAD and STORE operations, only two of these are industry standard formats. The third is a special BURNY format that allows the internal program format to be inspected with the DISPLAY PROGRAM utility and transferred to and from serial devices and the panel floppy. This format was originally supported as a diagnostic tool. However it can be used to save and recall NC programs in a more protected manner since it includes checksum and byte count data. It can also be used to minimize the amount of program setup time required since this format retains all ACCEL/DECEL and KERF COMPENSATION data with the NC program data.

When performing NC program LOAD, STORE, TEXT EDIT and other miscellaneous operations, the BURNY 5 normally prompts for the program format. However, in some instances when performing NC program LOAD and STORE operations, this prompt may not appear because of a "predefined" selection that has been made through the associated SYSTEM SETUP DATA variable. For additional information, see the appropriate LOAD PROGRAM or STORE PROGRAM section in PART-2 of this manual.

When at the PROGRAM FORMAT prompt, the following menu may or may not be displayed, depending on the current prompting mode. If not displayed, the <IV> key can be pressed at this prompt to callup the following HELP menu.

```
        PROGRAM FORMAT

1. STANDARD WORD ADDRESS
2. STANDARD ESSI FORMAT
3. PROCESSED INTERNAL FORMAT
4. CUSTOM WORD ADDRESS 1
5. CUSTOM WORD ADDRESS 2
6. CUSTOM WORD ADDRESS 3
7. CUSTOM ESSI FORMAT 1

        SELECT (1-7)
```

Generally, all of the supported NC programming formats, except PROCESSED INTERNAL, can be configured through SYSTEM SETUP DATA to perform one or more of the special conversion features supported by the BURNY 5. Normally, the STANDARD WORD ADDRESS and STANDARD ESSI formats will be configured to support the program format most frequently used. The CUSTOM formats allow an alternate format variation to also be configured.

The STANDARD WORD ADDRESS and STANDARD ESSI formats are configured through SYSTEM SETUP DATA variable 51 (STANDARD PROGRAM FORMAT) and the CUSTOM WORD ADDRESS 3 and CUSTOM ESSI 1 formats are configured through SYSTEM SETUP DATA variable 52 (CUSTOM PROGRAM FORMAT). Both variables allow the same program format variations to be selected. As such, both of these pairs of STANDARD and CUSTOM formats can be configured to perform identical functions, if desired.

The CUSTOM WORD ADDRESS 1 format is provided to always perform conversions based on the recommended BURNY WORD ADDRESS format. Generally, this format performs the same operations as STANDARD WORD ADDRESS and CUSTOM WORD ADDRESS 3 when these formats have NO special features enabled. The only exception is that the default X/Y dimension mode (INCREMENTAL or ABSOLUTE) and, if ABSOLUTE, the I/J dimension mode (INCREMENTAL or ABSOLUTE), can still be defined through SYSTEM SETUP DATA variable 52 for the CUSTOM WORD ADDRESS 1 format.

Like CUSTOM WORD ADDRESS 1, CUSTOM WORD ADDRESS 2 only allows the default dimension mode to be specified through the CUSTOM PROGRAM FORMAT variable. No other special features can be selected through SYSTEM SETUP DATA to alter this format. However, by definition, CUSTOM WORD ADDRESS 2 uses several auxiliary function code definitions that differ from those normally used in the BURNY 5. This format is provided only for compatibility with the "WADR2" format used in other BURNY controls.

Most of the special program format variations supported by the BURNY 5 are selected through the STANDARD PROGRAM FORMAT and CUSTOM PROGRAM FORMAT variables in SYSTEM SETUP DATA. These variables allow the BURNY 5 to customize the conversion routines used when saving programs in NC PROGRAM MEMORY and rebuilding the selected format. As a result, once a program has been placed in memory, changes to these variables will not affect how the part program is run. Therefore, if a program is accidentally loaded from a device with the wrong setup, it must be reloaded after the correct setup has been defined.

The following list of special format features identifies some of the variations that must be defined before loading.

AUX CODE CONVERSION	Allows all of the auxiliary functions to be assigned to M, G or ESSI function values required by the non-standard program format.
X AXIS SIGN INVERT	Inverts the signs of all X and I dimension values in the program while loading and storing.
Y AXIS SIGN INVERT	Inverts the signs of all Y and J dimension values in the program while loading and storing.
AXIS SWAP	Swaps the X and Y, and the I and J dimension values while loading and storing. (X=>Y, Y=>X, I=>J, J=>I)
AUTOMATIC I/J SIGNS	Allows BURNY to determine the signs required for the I/J dimensions when they are not provided by the non-standard program format.
SPECIAL END-OF-PROGRAM	Allows any four character string to be defined as the END-OF-PROGRAM.
ABSOLUTE DIMENSION TYPE	Allows the user to set the default dimension mode to ABSOLUTE for programs that do not contain the necessary auxiliary function code before the first dimension block.
FIXED INCREMENTAL I/J	Allows the I and J dimensions to be incremental when the X and Y are absolute.
DIMENSION DECIMAL SHIFT	Allows all of the dimension values in a WORD ADDRESS program to be scaled while loading and storing.

FEEDRATE DECIMAL SHIFT	Allows the FEEDRATE value defined as an "F-word" field in a WORD ADDRESS program to be scaled.
DWELL DECIMAL SHIFT	Allows the DWELL value defined as an "F-word" field in a WORD ADDRESS program to be scaled.
INVERT ARC DIRECTION	Primarily used for programs written in ESSI format with non-standard arc direction conventions.
AUX CODE BEFORE MOTION	Allows the BURNY to ignore the standard auxiliary code priorities defined by EIA RS-274 and always perform auxiliary function operations before any motions defined by the same WORD ADDRESS block.

For additional information on the WORD ADDRESS and ESSI program formats and the program format variations supported, see the sections that follow.

WORD ADDRESS PROGRAMMING

Although there are 4 choices for WORD ADDRESS program types, they are all basically the same. The major difference is in the assignment of auxiliary function codes. These differences allow the **BURNY 5** to be compatible with other controls and programming systems. Some of the special formats could even be the same as the standard **BURNY 5** program type. In most cases, the standard format for the system should be used. The "WADR3" special format as described above allows complete re-definition of the auxiliary code functions and axis definitions. This section deals with the "STANDARD WADR", "WADR1" and "WADR2" form.

WORD ADDRESS DATA BLOCK SPECIFICATION

The WORD ADDRESS data block is made up of KEY CHARACTERS and VALUES. A KEY CHARACTER is a letter that means something special to the **BURNY 5** control. The KEY CHARACTERS that are supported are:

'%','N','P','G','X','Y','I','J','M','F','K','D','V','T'

All KEY CHARACTERS except for the '%' sign require a numerical value directly after them. These values further describe the KEY CHARACTER to the **BURNY 5** control.

IMPORTANT

ALL PROGRAMS MUST START WITH A DATA BLOCK CONTAINING ONLY A % (PERCENT SIGN). A "LF" (line feed) before the "%" is also required.

SUPPORTED WORD ADDRESS CHARACTER DESCRIPTIONS

(Any word address character not described here is ignored.)

N -LINE NUMBER

The 'N' key character is used for documentation purposes only. It does not affect program execution. The **BURNY 5** does not store these values. When the **BURNY 5** loads a program through serial I/O these values are discarded to conserve memory space.

P -PROGRAM NUMBER

This is an optional KEY CHARACTER that allows up to an 8 digit program number to be included in a program. If a program is loaded containing a program number, it will automatically be loaded in memory as that number.

X -DIMENSION- FOR LINES OR ARCS

Incremental programming- distance from the start point to the end point of a move along the X (rail) axis.

Absolute programming- distance from the zero point to the endpoint of the new move along the X (rail) axis.

The maximum number that can be used for the 'X'value is dependent on what internal system unit is selected in the **BURNY 5** control. This can be set in SYSTEM SETUP DATA VARIABLES, #1 INTERNAL SYSTEM UNIT. See section: SYSTEM SETUP DATA VARIABLES. Setting "INTERNAL SYSTEM UNIT=ENGLISH" allows the following maximum values for 'X','Y','I' and 'J':

For ENGLISH SYSTEMS- +/- 99999.9999 inches
+/- 999999.999 millimeters

If "INTERNAL SYSTEM SETUP=METRIC" for the metric system the following maximum numbers can be used for 'X','Y','I' and 'J' values:

For METRIC SYSTEMS- +/- 999999.999 millimeters
+/- 99999.9999 inches

IMPORTANT

'X','Y','I','J' values that exceed these limits will produce a "PGM SYNTAX ERR".

Y -DIMENSION

For lines or arcs- same as X dimension described above but affecting the Y (cross) axis. The maximum values are the same as the X dimension described above.

I -DIMENSION- FOR ARCS

(Not used on lines)

Incremental programming- distance in the X (rail) axis from the start point to the center of an arc.

Absolute programming- dependent on "PROGRAM FORMAT" SYSTEM SETUP VARIABLE

If 3rd digit of "PRGM FORMAT" is "0", dimension is distance from ZERO (HOME) position to center of arc along the X (RAIL) axis.

If 3rd digit of "PRGM FORMAT" is "1", dimension is incremental distance from start point to center of the arc along the X axis- thus dimension is incremental even though absolute programming is being done.

The maximum values are the same as the X dimension described above.

J -DIMENSION- FOR ARCS

Same as "I" dimension described above but affecting the Y (cross) axis.

"SPECIAL NOTE ON PROGRAMMING ARCS"

The **BURNY 5** will attempt to cut exactly what it is programmed to cut. When programming arc blocks, the distance from the start point of the arc to the center should equal the distance from the end point to the center. If the values are not equal the **BURNY 5** control will use the end point to center distance when cutting the part. The difference is a PATH ERROR. As this PATH ERROR increases a undesirable cut path and machine motion will occur. The machine motion being a factor of setup parameters and machine speed.

If "BACKUP" is used to go in reverse through a cut path with improperly programmed arc blocks, machine motion will be affected. The machine motion being a factor of setup parameters and backup speed.

IMPORTANT

To prevent the possibility of a program containing a improperly programmed arc block from making unwanted cuts, use the "TEST RUN" mode of operation first before cutting the part.

G -PREPARATORY FUNCTION

CODE	FUNCTION RETAINED (NOTE-1	SINGLE BLOCK (NOTE-2)	FUNCTION
G00	A		HIGH SPEED MODE
G01	A •		CUT SPEED MODE
G02	B		CIRCULAR INTERPOLATION CW
G03	B		CIRCULAR INTERPOLATION CCW
G04		X	DWELL
G40	C		KERF COMPENSATION CANCEL
G41	C		KERF COMPENSATION LEFT
G42	C		KERF COMPENSATION RIGHT
G45		X	LEAD IN TO KERF COMPENSATED PART
G46	D		TABLE 0 SELECT
G70	E		INCH PROGRAMMING
G71	E		METRIC PROGRAMMING
G90	F		ABSOLUTE PROGRAMMING
G91	F		INCREMENTAL PROGRAMMING
G92	F		ABSOLUTE REGISTER PRELOAD
G97		X	SETS PROGRAM REPEAT POINTER
G98		X	INITIATES PROGRAM REPEAT AT G97
G201	G		INC LINE IN2 MM0
G201	G		INC CW ARC IN2 MM0
G202	G		INC CCW ARC IN2 MM0
G202	G		INC LINE IN3 MM1
G203	G		INC CW ARC IN3 MM1
G203	G		INC CCW ARC IN3 MM1
G211	G		ABS LINE IN2 MM0
G211	G		ABS CW ARC IN2 MM0
G212	G		ABS CCW ARC IN2 MM0
G212	G		ABS LINE IN3 MM1
G213	G		ABS CW ARC IN3 MM1
G213	G		ABS CCW ARC IN3 MM1
G221			
G222			
G223			
G231			
G232			
G233			
G240	H		PROGRAMMABLE KERF

G24 7 G24 8 G24 9 G25 0	D D D D		TABLE 1 SELECT TABLE 2 SELECT TABLE 3 SELECT TABLE 4 SELECT
G27 6 G27 6	I I		INTERNAL VARIABLE LOAD EXTERNAL VARIABLE LOAD
G78 G27 9 G28 0 G28 1		X X X X	X AXIS HOME Y AXIS HOME X HOME RETURN Y HOME RETURN
NOTE 1: Function is retained until canceled or superseded by another command in the same letter group (A,B,C ETC). NOTE-2: Function affects only the block which it appears in.			

M-MACHINE AUXILIARY FUNCTIONS

The supported "M" function definitions vary depending on the program format specified as illustrated in the following table. In most cases, the first column is the standard auxiliary code definitions for the **BURNY 5.**

STD WADR CODE	SPECIAL WADR1 CODE	SPECIAL WADR2 CODE	WITH BLOCK	AFTER BLOCK	DESCRIPTION
M00 M02	M00 M02	M00 M02		X X	PROGRAM STOP END OF PROGRAM
M03 M20 M04 M21	M03 M20 M04 M21	M05 M21 M03 M20	 X X	X X 	CUTTING PROCESS OFF CUTTING PROCESS OFF CUTTING PROCESS ON CUTTING PROCESS ON
M07 M08 M09 M10	M07 M08 M09 M10	M09 M08 M07 M06	 X X	X X 	PLATE MARKER #1 OFF PLATE MARKER #1 ON PLATE MARKER #2 OFF PLATE MARKER #2 ON
M14 M15	M50 M51	M50 M51	 X	X 	HEIGHT SENSOR DISABLE HEIGHT SENSOR ENABLE
M30	M30	M30		X	END OF PROGRAM(REWIND)
M70 M71	M70 M71	M70 M71	 X	X 	MARKER OFFSET #1 OFF MARKER OFFSET #1 ON

M72 M73	M72 M73	M72 M73	 X	X 	MARKER OFFSET #2 OFF MARKER OFFSET #2 ON
M210 M211 M212	M210 M211 M212	M210 M211 M212	X X X		X SIGN TOGGLE Y SIGN TOGGLE X/Y SWAP TOGGLE
M221 M222 M223 M224 M225 M226 M227 M228	M221 M222 M223 M224 M225 M226 M227 M228	M221 M222 M223 M224 M225 M226 M227 M228	X X X X X X X X		NO MIRROR, NO SWAP MIRROR Y, NO SWAP MIRROR X/Y, NO SWAP MIRROR X, NO SWAP SWAP X/Y, MIRROR X/Y SWAP X/Y, MIRROR X SWAP X/Y, NO MIRROR SWAP X/Y, MIRROR Y
M231 M245 M246 M247 M248 M249 M250 M251 M252	M231 M245 M246 M247 M248 M249 M250 M251 M252	M231 M245 M246 M247 M248 M249 M250 M251 M252	 X X X X 	X X X X X	AUX STATE RESET AUX OUTPUT 1 ON AUX OUTPUT 1 OFF AUX OUTPUT 2 ON AUX OUTPUT 2 OFF AUX OUTPUT 3 ON AUX OUTPUT 3 OFF AUX OUTPUT 4 ON AUX OUTPUT 4 OFF

MACHINE AUXILIARY FUNCTIONS (continued)

STD WADR CODE	SPECIAL WADR1 CODE	SPECIAL WADR2 CODE	WITH BLOCK	AFTER BLOCK	DESCRIPTION
M253	M253	M253	X		AUX INPUT 1 ON
M254	M254	M254		X	AUX INPUT 1 OFF
M255	M255	M255	X		AUX INPUT 2 ON
M256	M256	M256		X	AUX INPUT 2 OFF
M257	M257	M257	X		AUX INPUT 3 ON
M258	M258	M258		X	AUX INPUT 3 OFF
M259	M259	M259	X		AUX INPUT 4 ON
M260	M260	M260		X	AUX INPUT 4 OFF
M261	M261	M261	X		AUX TORCH MASTER ON
M262	M262	M262		X	AUX TORCH MASTER OFF
M274	M274	M274		X	OFFSET 3 OFF
M275	M275	M275	X		OFFSET 3 ON
M276	M276	M276		X	OFFSET 4 OFF
M277	M277	M277	X		OFFSET 4 ON
M278	M278	M278		X	OFFSET 5 OFF
M279	M279	M279	X		OFFSET 5 ON
M280	M280	M280		X	OFFSET 6 OFF
M281	M281	M281	X		OFFSET 6 ON
M282	M282	M282		X	OFFSET 7 OFF
M283	M283	M283	X		OFFSET 7 ON
M284	M284	M284		X	OFFSET 8 OFF
M285	M285	M285	X		OFFSET 8 ON

F- DWELL TIME/FEEDRATE

The "F" variable is use for FEEDRATE and DWELL. The "F" variable with a number after it indicates a programmed speed. However, if it is included in the same data block as the "G04" DWELL command, it sets the DWELL time for that block and all subsequent "G04" blocks until a new "F" DWELL time is included in another "G04" block. The DWELL Time is in seconds.

NOTE

In order for the **BURNY 5** to recognize the "F" variable for feedrate. The PROGRAMMED FEEDRATE enable bit must set. This is enabled through SYSTEM SETUP DATA VARIABLES, #37 SYSTEM CONFIGURATION 1. See section:SYSTEM SETUP DATA VARIABLES.

For example:

N12 G04 F22.5 -BLOCK #12 dwell time for 22.5 seconds

N12 F250.5 -BLOCK #12 Set cut speed to 250.5 inches/min

K- KERF VALUE

THE "K" variable is used to set a programmable kerf value. The "K" variable must be used with a kerf function code such as "G41", KERF LEFT or "G42" KERF RIGHT.

For example:

N12 G41 K.125 -BLOCK #12 KERF LEFT with a value of .125 inches.

IMPORTANT

The programmable kerf value is overridden if the operator enters a different value during the setup for running the part.

D - INDEXED KERF OPERATIONS

"INDEXED KERF" operations are defined using the "D#" field in a WORD ADDRESS program block that also contains a "KERF RIGHT" or "KERF LEFT" auxiliary function code. System defined default values are as follows:

INDEX	KERF VALUE
00	.0000"
01	.0000"
02	.0000"
03	.0600"
04	.0650"
05	.0700"
06	.0750"
07	.0800"
08	.0850"
09	.0900"
10	.0950"
11	.1000"
12	.1250"
13	.1500"
14	.1750"
15	.2000"
16	.2250"

******* NOTES *******

1. In the BURNY 5, all kerf values represent the total kerf width. Therefore, the required kerf offset is actually half this distance.

2. When using index values, no sign or decimal point may be used to define the kerf index number. If it is, a directly programmed kerf value is defined. For example, "G41D3" is a valid selection of indexed value 3 (.0600"). However, "G41D+3" defines a programmed kerf value of 3 inches when in inch dimension mode.

3. User-defined values for index values "1" and "2" may be available at a later date. They are not yet assignable, and have default values of .0000".

V - INTERNAL VARIABLE LOAD REGISTER FIELD

The INTERNAL VARIABLE LOAD function uses an auxiliary function code ("G276"), followed by a register number field ("V1" or "V2"), and a value field. Only positive FIXED DECIMAL formats in the range of 0 to 327.67 may be entered for the value field.

At this time, only two internal registers have been assigned (1: PROGRAMMABLE PREHEAT TIME and 2: PROGRAMMABLE PIERCE TIME). Other internal register values may be defined at a later date.

Examples:

G276V1F12.5	Defines a PREHEAT TIME of 12.50 seconds
G276V2F4	Defines a PIERCE TIME of 4.00 seconds.

Format Conventions:

When using the INTERNAL VARIABLE LOAD auxiliary function, format and numeric value range checks are performed at two levels. The first validations are performed as the program is loaded into NC program memory. Typically, errors found at this level cause a "PROGRAM SYNTAX" error condition to occur. The second level of validation is performed by the RUN process as it decodes and processes the register number and register value. Errors at this level simply cause the running process to ignore the auxiliary function block.

To avoid format and numeric errors, the following INTERNAL VARIABLE LOAD format conventions must be used:

1. For the "register number" field, only values in the range of 0 to 16383 are accepted by the LOAD process. Values not in this range cause a "PROGRAM SYNTAX" error. A register number of 0 or any number beyond the supported internal register number range (which is currently 2) causes the RUN process to ignore the NC program block.

2. For the "value" field, any value beyond the range of 0 to 327.67 will be ignored by the RUN process.

Operational details:

The following related system functions should be considered when using the INTERNAL VARIABLE LOAD function to perform "PROGRAMMABLE PREHEAT TIME" and "PROGRAMMABLE PIERCE TIME" operations:

1. The normal PREHEAT TIME and PIERCE TIME prompting operations on the RUN MODE screen are unaffected by the timer values defined by the INTERNAL VARIABLE LOAD function. That is, these prompts are still used to define the timer values at the start of the program before pressing <GO> and then, after RUN has started and the <STOP> key has been pressed two times, to change the currently defined values regardless of whether or not these values have been redefined by the program.

2. Timer values defined by an executing NC part program do not alter the prompting values displayed on the RUN MODE screen. These "programmable" values only alter the internal timer values used by the RUN process.

3. When using the <RET> key to return to the last pierce or last start of the part program, the preheat and pierce time register values are not changed. They retain their current values. Only a "RETURN TO HOME" (that is, a return to block 1, position (0,0)) causes the internal preheat and pierce time register values to be updated with the last operator defined values.

4. When backing up, no INTERNAL VARIABLE LOAD operations are performed. As such, the currently defined values remain unchanged. However, if the first block of the program is re-encountered, the "PREHEAT TIME" and "PIERCE TIME" register values are updated with the last values defined by the operator from the RUN MODE screen.

T - INDEX FIELD

The T field can be used for OVERLAY TABLE DATA selection. See the UTILITIES section of this manual.

OFFSET ON and OFFSET OFF operations can be performed on the eight tool offsets using a "base function with index" technique. The base function may be the defaults for OFFSET 1 (M70 and M71) or may be user defined through the CUSTOM CODE CONVERSION process. The index is defined by the "T" field.

The following summarizes the operations supported through the standard WORD ADDRESS auxiliary function table:

Internal Function	T Field Value	Base Function with Index	Standard WADR code
OFFSET 1 OFF	T01	M70T01	M70
OFFSET 1 ON	T01	M71T01	M71
OFFSET 2 OFF	T02	M70T02	M72
OFFSET 2 ON	T02	M71T02	M73
OFFSET 3 OFF	T03	M70T03	M274
OFFSET 3 ON	T03	M71T04	M275
OFFSET 4 OFF	T04	M70T04	M276
OFFSET 4 ON	T04	M71T04	M277
OFFSET 5 OFF	T05	M70T05	M278
OFFSET 5 ON	T05	M71T05	M279
OFFSET 6 OFF	T06	M70T06	M280
OFFSET 6 ON	T06	M71T06	M281
OFFSET 7 OFF	T07	M70T07	M282
OFFSET 7 ON	T07	M71T07	M283
OFFSET 8 OFF	T08	M70T08	M284
OFFSET 8 ON	T08	M71T08	M285

To define different base codes for the WORD ADDRESS format, assign the desired codes to the "OFFSET 1 ON" and the "OFFSET 1 OFF" functions through the CUSTOM CODE CONVERSION process.

ADDITIONAL INFORMATION
AUXILIARY "G" CODE DESCRIPTIONS

G02 G03	These two functions are used to define the direction for arc data blocks as either CW or CCW respectively. Once either of these functions is used, all subsequent arcs are in the same direction until the opposite code is used.
G04	This code causes a SYSTEM DWELL to be performed. During this time, the machine is held in position and all control outputs remains in their current condition. The DEFAULT DWELL time is established during the setup and installation procedure. This time is used for all G04 blocks until an "F" variable is included in the same block as the "G04". In this case, the value contained by the "F" variable is used as the dwell time for this and all subsequent "G04" blocks until changed by a new G04 block containing a different "F" time.
G40 G41 G42	These 3 commands are used by the "DIAL IN KERF" routine to compensate the cutting path for the amount of material removed by the cutting process. The kerf directions (LEFT-G41 or RIGHT-G42) are based on which way the centerline of the torch needs to be offset as it travels along the cutting path. G40 is provided to cancel the kerf, however it is not needed in the program since the kerf is automatically turned off when not cutting. Note: When a Part Program contains either KERF LEFT or KERF RIGHT auxiliary codes, the **BURNY 5** assumes that the "DIAL-IN-KERF" feature is used to run the part. When the kerf is added to the part program, it requires approximately 25% more memory to store the kerf data along with the part dimensions. Therefore, when the incoming program is stored, this extra 25% of memory is automatically allocated for each data block. This causes the Kerf processing to run about 20% faster since the space is already available to store the results. If the "DIAL-IN-KERF" feature is not to be used, or if the part program already has the kerf added to the dimensions, the KERF LEFT or KERF RIGHT codes can be removed from the part program before it is loaded. This uses less memory to store the part since no kerf space is being added.
G45	The G45 function may be included along with the arc or line dimensions performing the leadin to the part. Including a G45 in the data block allows the data to be altered to correctly lead into the kerf compensated part.
G70	Indicates that all subsequent part dimensions are in inch units.
G71	Indicates that all subsequent part dimensions are in metric (millimeter) units.

AUXILIARY "G" CODE DESCRIPTIONS (continued)	
G90	Signals that all subsequent dimensions are in absolute programming format. Note although the X/Y are in absolute, the I/J dimension can be either absolute or incremental depending on the setting of "51-PROGRAM FORMAT" or "52-CUSTOM PROGRAM FORMAT".
G91	Signals that all subsequent dimensions are incremental programming format.
G92	Only used in absolute programming mode. When included in a data block containing only X/Y dimensions, it causes the internal absolute registers to be set to the X/Y dim's from the data block. No machine motion occurs. This code is useful for re-setting the absolute zero position at various points in a part program to make the X/Y dimensioning of the subsequent data blocks easier.
G97 G98	These two functions are used as a pair within a part program to perform the PROGRAM REPEAT FUNCTION. The G97 acts as a pointer in the program. When the G98 code is reached, the program jumps back to the point in the program where the G97 occurred. If no G97 is used, the program repeats back to the beginning.

"M" FUNCTION DESCRIPTIONS

M00 - PROGRAM STOP	Causes machine operation to halt and all cutting functions to be turned off. Pressing the GO key resumes program execution.
M02 - PROGRAM END (NO REWIND) M30 - PROGRAM END (W/REWIND)	Either the "M02" or the "M30" must end a WORD ADDRESS PROGRAM. If multiple programs are to be loaded, all but the last one should end with the M02 code since it does not cause a "REWIND". (This is also true if the parts are being loaded through the serial port). The last program to be loaded can use the M30 command to stop the loading process and start the tape rewind.
M04 - CUTTING M21 ON	Initiates CUTTING START SEQUENCE for selected cutting system. While cut is on, machine moves at speed set by operators speed dial.
M03 - CUTTING M20 OFF	Turns OFF CUTTING PROCESS- after performing any cut off sequencing, machine moves at high TRAVERSE SPEED to next pierce location.
M08 - PLATE MARKER #1 ON	Turns on the #1 PLATE MARKING CONTROL relay and starts the marking cycle. Marking speed is selected during "SETUP and INSTALLATION". Normally the "MARKER #1 OFFSET ON" command would appear before the marking process begins to position the marking device at the correct position.
M07 - PLATE MARKER #1 OFF	Turns off the #1 PLATE MARKING DEVICE now moves at high speed to the next marking location. Normally, after the last marking move, the "MARKER #1 OFFSET OFF" command is used to move the cutting torch back to the correct position.
M10 - PLATE MARKER #2 ON	Turns on the #2 PLATE MARKING CONTROL relay and starts the marking cycle. Marking speed is selected during setup and installation. Normally the "MARKER #2 OFFSET ON" command would appear before the marking process begins to position the marking device at the correct position.
M09 - PLATE MARKER #2 OFF	Turns off the #2 PLATE MARKING DEVICE. Machine now moves at high speed to the next marking location. Normally, after the last marking move, the "MARKER #2 OFFSET OFF" command is used to move the cutting torch back to the correct position.

"M" FUNCTION DESCRIPTIONS (continued)	
M71 - PLATE MARKER #1 OFFSET ON	Moves the machine the distance setup as the X/Y MARKER #1 OFFSET dimension (dimensions input during setup and installation). This causes the marker to take the place of the cutting torch so that the part program doesn't have to compensate for the offset between the marker and torch.
M70 - PLATE MARKER #1 OFFSET OFF	CANCELS the MARKER #1 OFFSET and moves the MARKER #1 cutting torch back to the programmed position.
M73 - PLATE MARKER #2 OFFSET ON	Moves the machine the distance setup as the X/Y MARKER #2 OFFSET dimension (dimensions input during setup and installation). This causes the marker to take the place of the cutting torch so that the part program doesn't have to compensate for the offset between the marker and torch.
M72 - PLATE MARKER #2 OFFSET OFF	CANCELS the MARKER #2 OFFSET and moves the cutting torch back to the programmed position.

WORD ADDRESS SAMPLE PROGRAM

The following is a word address program for "SAMPLE PROGRAM #1" -see drawing on the following pages. The "REF" letters on the program listing refer to the circled reference points on the part drawing. Following the program is a detailed description of each program line. The program is shown in both inch and metric units.

SAMPLE PROGRAM #1 (ENGLISH VERSION)

LINE	INCH PROGRAM	REF	COMMENTS
1)	%		START OF PROGRAM CODE
2)	N10 P12345678 (PROGRAM NAME FIELD)		PROGRAM NUMBER
	N20 (THIS IS THE MESSAGE FIELD, 58 CHARACTERS MAXIMUM)		
4)	N30 X4 Y-6.8	A	MOVE FROM CORNER
5)	N40 G97		PRGM REPEAT POINTER
6)	N50 (CUT LEAD IN OF HOLE)		MESSAGE DISPLAYED ON SCREEN
7)	N60 G41 K0.125	B	SET KERF ON LEFT AND USE A VALUE OF .125"
8)	N70 M04		CUT ON
9)	N80 G45 X.75 Y.3		LEAD IN LINE
10)	N90 G03 I-.75	C	CUT CCW ARC HOLE
11)	N100 X-.75 Y.3	D	LEADOUT
12)	N110 M03		TURN OFF CUT
13)	N120 (MOVE TO OUTSIDE OF PART)		MESSAGE DISPLAYED ON SCREEN
14)	N130 X2 Y-6.8	E	MOVE TO OUTSIDE
15)	N140 M04		TURN CUT ON
16)	N150 (CUT OUTSIDE OF PART)		DISPLAYED ON SCREEN
17)	N160 G45 X-.5 Y.5	F	LEAD IN
18)	N170 X-1.5	G	LINE
19)	N180 X-2 I-1	H	ARC (STILL CCW)
20)	N190 X-1.5	I	LINE
21)	N200 Y4.5	J	LINE
22)	N210 X1.5 Y1.5	K	LINE
23)	N220 X-1.5 Y1.5	L	LINE
24)	N230 Y3.5	M	LINE
25)	N240 G02 X5 I2.5 J-2.5	N	ARC -CW
26)	N250 Y-11.5	O	LINE AND LEADOUT
27)	N260 M03		CUT OFF
28)	N270 X6 Y6.2	P	MOVE TO NEXT PART
29)	N280 G98		REPEAT PROGRAM
30)	N290 (PART COMPLETE)		MESSAGE DISPLAYED ON SCREEN
31)	N300 M30		END OF PROGRAM

SAMPLE PROGRAM #1 (METRIC VERSION)

LINE	METRIC (Rounded to nearest .1mm) PROGRAM	REF	COMMENTS
1)	%		START OF PROGRAM CODE
2)	N10 P12345678(PROGRAM NAME FIELD)		PROGRAM NUMBER
3)	N20 (THIS IS THE MESSAGE FIELD, 58 CHARACTERS MAXIMUM)		
4)	N30 X101.6 Y-172.7	A	MOVE FROM CORNER
5)	N40 G97		PRGM REPEAT POINTER
6)	N50 (CUT LEAD IN HOLE)		MESSAGE DISPLAYED ON SCREEN
7)	N60 G41 K3.18	B	SET KERF ON LEFT AND USE A VALUE OF 3.18mm
8)	N70 M04		CUT ON
9)	N80 G45 X19.1 Y7.6		LEAD IN LINE
10)	N90 G03 I-19.1	C	CUT CCW ARC HOLE
11)	N100 X-19.1 Y7.6	D	LEADOUT
12)	N110 M03		TURN OFF CUT
13)	N120 (MOVE TO OUTSIDE OF PART)		MESSAGE DISPLAYED ON SCREEN
14)	N130 X50.8 Y-172.7	E	MOVE TO OUTSIDE
15)	N140 M04		TURN CUT ON
16)	N150 (CUT OUTSIDE OF PART)		DISPLAYED ON SCREEN
17)	N160 G45 X-12.7 Y12.7	F	LEAD IN
18)	N170 X-38.1	G	LINE
19)	N180 X-50.8 I-25.4	H	ARC (STILL CCW)
20)	N190 X-38.1	I	LINE
21)	N200 Y114.3	J	LINE
22)	N210 X38.1 Y38.1	K	LINE
23)	N220 X-38.1 Y38.1	L	LINE
24)	N230 Y88.9	M	LINE
25)	N240 G02 X127 I63.5 J-63.5	N	ARC -CW
26)	N250 Y-292.1	O	LINE AND LEADOUT
27)	N260 M03		CUT OFF
28)	N270 X152.4 Y157.5	P	MOVE TO NEXT PART
29)	N280 G98		REPEAT PROGRAM
30)	N290 (PART COMPLETE)		
31)	N300 M30		END OF PROGRAM

LINE 1 The percent sign indicates the start of a Word Address program.

LINE 2 12345678 is the number assigned to this program. The (PROGRAM NAME FIELD) is for an optional 28 character program name.

LINE 3 This is an optional 60 character MESSAGE FIELD, which may be used to give a short description about the program. The message field may be seen in the second screen of the RUN PROGRAM function.

LINE 4 Initial move from corner of plate to pierce point on first part. Due to the placement of the G97 code, this block is not repeated on each subsequent part.

LINE 5 The G97 code is used to indicate where the program repeat should occur. Any data blocks before the G97 code are not repeated on subsequent parts.

LINE 6 The text "CUT LEAD IN OF HOLE" is displayed on the last line of graphics screen and also in the STATUS DISPLAY "MSG:" FIELD. This message is displayed until the end of program is encountered or until another message is encountered in the program and displayed.

LINE 7 Sets the "Kerf Compensation" to the "Left" of the cut with a value of .125 inches(3.18mm). This command causes the DIAL IN KERF feature to offset the cutting path to the left and produce the correct size part.

LINE 8 Initiate the cutting process. (Cutting process plasma/oxy-fuel selected by operator.) Cutting speed set by operators speed dial.

LINE 9 This line "leads in" from the pierce location to the actual part.

LINE 10 Standard ARC format- a 360 degree circle is cut.

LINE 11 This line "leads out" away from the part before the cutting process is turned off. If any melting occurs when the cutting process is stopped, it occurs in the scrap, away from the part.

LINE 12 Turn off the cutting process.

LINE 13 Display the message "MOVE TO OUTSIDE OF PART".

LINE 14 Move to next pierce point at high traverse speed.

LINE 15 Initiate cutting process for outside cut.

LINE 16 Display the message "CUT OUTSIDE OF PART".

LINE 17 Line "Leads In" from pierce location to part.

LINE 18 Standard line format.

LINE 19 Standard Arc format- Direction is still CCW from previous G03 command.

LINE 20 Standard line format.
LINE 21 " " "
LINE 22 " " "
LINE 23 " " "
LINE 24 " " "

LINE 25 Standard ARC format - Direction changed to CW by G02 command.

LINE 26 Standard line format- Note: Line is .5 inches longer than part. This allows the line to also function as a "Lead-Out" away from the part before turning off the cutting process.

LINE 27 Turn OFF the cutting process.

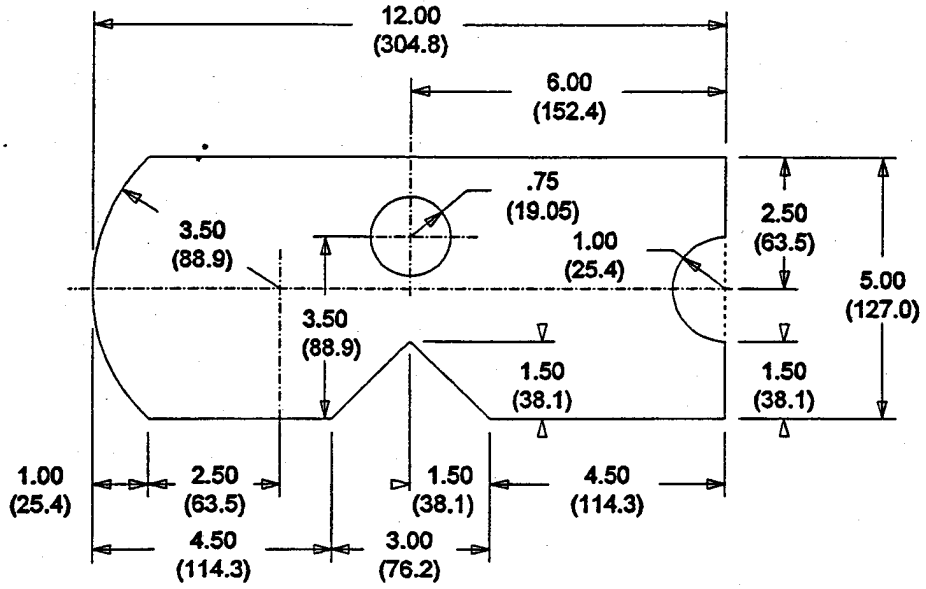
LINE 28 Move to first pierce location on next part.

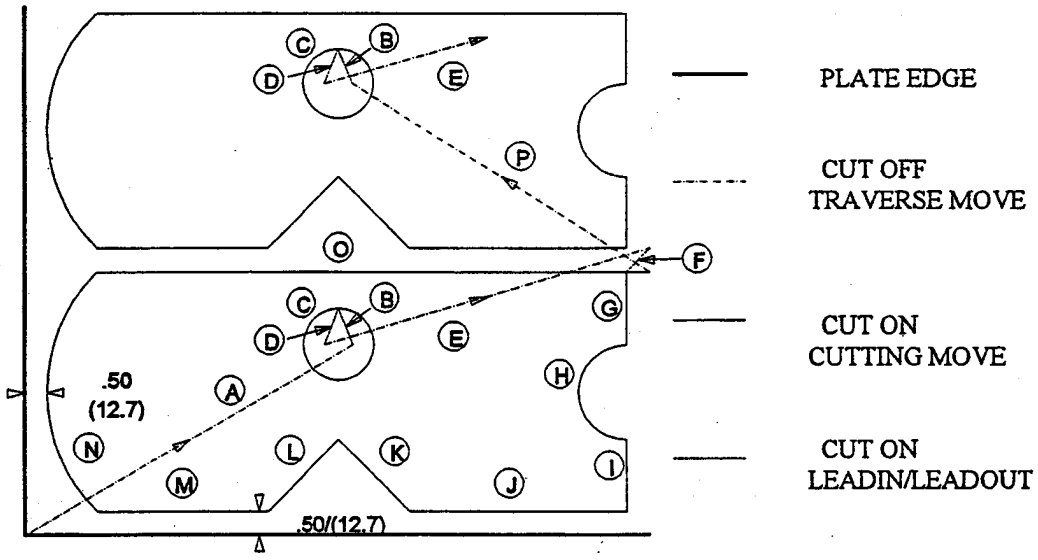
LINE 29 The G98 command causes program to repeat from point where G97 command was used.

LINE 30 The message (PART COMPLETE) is displayed on the screen.

LINE 31 End of Program Command.

Part Drawings - Sample Program 1
INCH / MILLIMETER DIMENSIONS





ESSI PROGRAMMING LANGUAGE

ESSI PROGRAMMING

ESSI part programming uses 3 types of data blocks for the program.

-LINE MOVES
-ARC MOVES
-AUXILIARY FUNCTIONS

LINE AND ARC BLOCK SPECIFICATIONS

Both the LINE and ARC BLOCKS are made up of a series of signed (+/-) dimensions. In ESSI PROGRAMMING, the number of signs in a data block determines whether it is an arc or a line. The dimensions for the block do not contain any decimal points, rather the number of decimal places are defined as follows:

For "INCH" programming, Two decimal places are assumed. The following are examples of INCH dimensions:

+200 equals a dimension of +2.00 inches
+5 equals a dimension of +0.05 inches

For "METRIC" programming, 1 decimal place is assumed with the unit value being .1 millimeters.

Example:

+200 equals a dimension of +20.0 millimeters
+5 equals a dimension of +0.5 millimeters

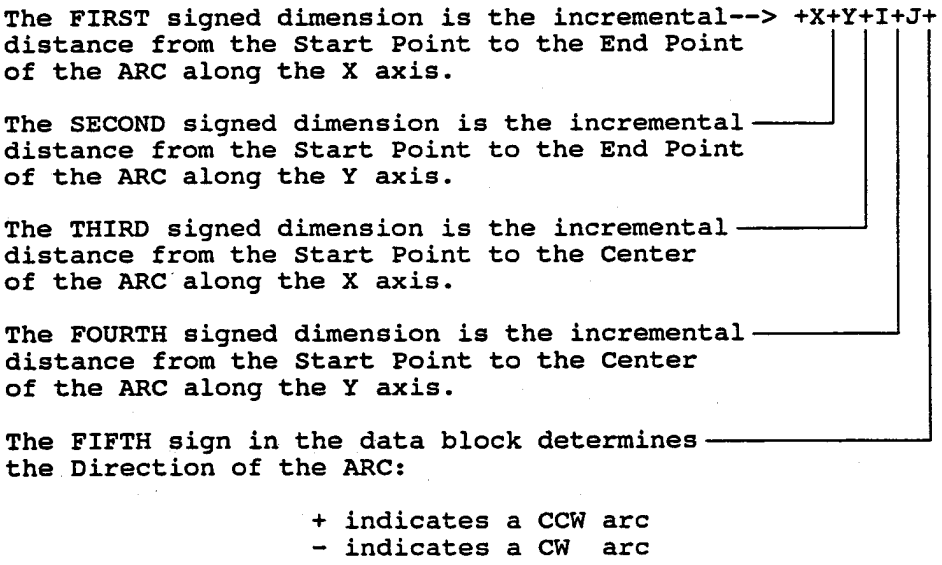
LINE AND ARC BLOCKS ARE DEFINED AS FOLLOWS:

BLOCKS WITH 2 SIGNS, EITHER + OR - ARE "LINE" FUNCTIONS. The first signed value is the X incremental distance and the second signed value is the Y incremental distance. If one of the dimensions is 0, only a + sign need appear in the block.

Examples:

Line of 1 inch in the X axis and -.5 inches in the Y axis would appear as: +100-50	Line of -2.5 inches in the Y axis with no movement in the X axis would appear as: +0-250

BLOCKS WITH 5 SIGNS ARE ARC FUNCTIONS:



SEE THE ESSI SAMPLE PART FOR EXAMPLES OF ARC PROGRAMMING.

NOTE

The maximum number that can be used for the 'X','Y','I','J' value is dependent on what internal system unit is selected in the BURNY 5 control. This can be set in SYSTEM SETUP DATA VARIABLES, #1 INTERNAL SYSTEM UNIT. See section: SYSTEM SETUP DATA VARIABLES. Setting "INTERNAL SYSTEM UNIT=INCH" allows the following maximum values for 'X','Y','I' and 'J':

For INCH SYSTEMS- +/- 99999.99 inches ESSI value +/- 9999999

If "INTERNAL SYSTEM SETUP=MM" for the metric system the following maximum numbers can be used for 'X','Y','I' and 'J' values:

For METRIC SYSTEMS- +/-999999.9 mm ESSI value +/- 9999999

IMPORTANT

'X','Y','I','J' values that exceed these limits will produce a "PGM SYNTAX ERR".

"SPECIAL NOTE ON PROGRAMMING ARCS"

The BURNY 5 will attempt to cut exactly what it is programmed to cut. When programming arc blocks, the distance from the start point of the arc to the center should equal the distance from the end point to the center. If the values are not equal the BURNY 5 control will use the end point to center distance when cutting the part. The difference is a PATH ERROR. As this PATH ERROR increases a undesirable cut path and machine motion will occur. The machine motion being a factor of setup parameters and machine speed. If "BACKUP" is used to go in reverse through a cut path with improperly programmed arc blocks, machine motion will be affected. The machine motion being a factor of setup parameters and backup speed.

IMPORTANT

To prevent the possibility of a program containing a improperly programmed arc block from making unwanted cuts, use the "TEST RUN" mode of operation first before cutting the part.

ESSI FUNCTION CODE DESCRIPTIONS

The third type of ESSI DATA BLOCK is used for the various AUXILIARY FUNCTIONS for the part program. The following is a list of the supported ESSI FUNCTION CODES.

00	PROGRAM STOP - causes machine operation to halt and all cutting functions to be turned off. Pressing the GO key resumes operation.
03 04	SKIP ON, SKIP OFF - the BURNY 5 ignores all data between these two codes. Usually they are used for comments & instructions which only appear on the program printout.
05	RAPID ON - initiates high speed mode.
06	RAPID OFF - initiates cut speed mode.
07	CUTTING ON - initiates the start sequence for selected cutting system. While cut is on, machine moves at the speed set by the operator.
08	CUTTING OFF - turns off cutting process- after performing any cut off sequencing, machine moves at high traverse speed to next pierce location.
09	PLATE MARKER #1 ON - turns on the #1 PLATE MARKER control relay and starts the marking cycle. Machine moves at the marking speed entered during the "SETUP AND INSTALLATION PROCEDURE". Normally, the "11" command for MARKER #1 OFFSET ON would appear before the first marking move.
10	PLATE MARKER #1 OFF - turns off the #1 plate marking device. Now moves at high speed to the next marking location. Normally, after the last marking move, the "MARKER #1 OFFSET OFF" command is used to move the cutting torch back to the correct position.
11	PLATE MARKER #1 OFFSET ON - causes the machine to move by the distances entered for the marker #1 X/Y offset dimension during the "SETUP AND INSTALLATION" procedure. In this way the part program doesn't have to compensate for the physical offset between the marker and torch. See note at end of functions.
12	PLATE MARKER #1 OFFSET OFF - cancels the offset and moves the cutting torch back to the programmed position. See note at end of functions.
13	MARKER #2 ON - See '09' command for MARKER #1.
14	MARKER #2 OFF - See '10' command for MARKER #1.
15	MARKER #2 OFFSET ON - See '11' command for MARKER #1.
16	MARKER #2 OFFSET OFF - See '10' command for MARKER #1.

ESSI FUNCTION CODE DESCRIPTIONS (continued)

21	NO SWAP OR MIRROR (normal coordinates) - Used as reset.
22	NO SWAP, MIRROR Y AXIS - Establish the axis convention by defining the axis mirror bit.
23	NO SWAP, MIRROR X/Y AXIS - See '22'.
24	NO SWAP, MIRROR X AXIS - See '22'.
25	X/Y SWAP, MIRROR X/Y AXIS - Toggle X and Y axes,and mirror bits on the X and Y axes.
26	X/Y SWAP, MIRROR X AXIS - See '25'; mirror only X axis.
27	X/Y SWAP, NO MIRROR - See '25'; no mirror.
28	X/Y SWAP, MIRROR Y AXIS - See '25'; mirror Y axis.
29 30 38	These 3 commands are used by the "DIAL IN KERF" routine to compensate the cutting path for the amount of material removed by the cutting process. The KERF directions (LEFT-29 or RIGHT-30) are based on which way the centerline of the torch needs to be offset as it travels along the cutting path. The 38 code is provided to cancel the kerf, however it is not needed in the program since the KERF IS AUTOMATICALLY TURNED OFF when not cutting. IMPORTANT: See the description for Word Address codes G41 G42 for details of the memory allocation for programs containing Kerf Left or Kerf Right commands.
40	Initialtes programmable kerf mode.
41	This code causes a SYSTEM DWELL to be performed. During this time, the machine is held in position and all control outputs remains in their current condition. The DWELL TIME is set during the "SETUP and INSTALLATION".
63	Aux state reset.
65	This code selects Overlay Table 0.
70	Indicates that all subsequent part dimensions are in inch units.
71	Indicates that all subsequent part dimensions are in metric (millimeter) units.
81	Indicates that all subsequent dimensions are in INCREMENTAL PROGRAM FORMAT.
82	Indicates that all subsequent dimensions are in ABSOLUTE PROGRAM FORMAT. SEE "SD51-PRGM FORMAT" in SYSTEM SETUP DATA for details regarding ABSOLUTE/INCREMENTAL for the X and Y center dimensions in ABSOLUTE MODE.
90	PROGRAM END- NO REWIND -- This code does not cause the tape to rewind at the end of the program. This allows multiple programs to be loaded by stopping the tape at the end of the first program, then after the first program is stored, it starts loading the next one on the tape. If a rewind is desired, the last program in the list should end with the "99" PROGRAM END-REWIND code described below.

ESSI FUNCTION CODE DESCRIPTIONS (continued)

97 98	These two functions are used as a pair within a part program to perform the program repeat function. The 97 acts as a pointer in the program. When the 98 code is reached, the program jumps back to the point in the program where the 97 occurred. The program repeats to the beginning if the 97 code is not used.
64 99	END OF PROGRAM-REWIND (either may be used). When loading from paper tape, this code stops the loading process and then causes the tape to be rewound back to the start. If the program is being downloaded from a remote RS232 source, this code stops the loading process and terminates the link. If multiple programs are to be loaded, the "90" code described above should be used on all but the last one.
237	X AXIS SIGN TOGGLE.
238	Y AXIS SIGN TOGGLE.
239	X/Y SWAP TOGGLE.
245 246	AUX OUTPUT 1 ON. AUX OUTPUT 1 OFF.
247 248	AUX OUTPUT 2 ON. AUX OUTPUT 2 OFF.
249 250	AUX OUTPUT 3 ON. AUX OUTPUT 3 OFF.
251 252	AUX OUTPUT 4 ON. AUX OUTPUT 4 OFF.
253 254	AUX INPUT 1 ON. AUX INPUT 1 OFF.
255 256	AUX INPUT 2 ON. AUX INPUT 2 OFF.
257 258	AUX INPUT 3 ON. AUX INPUT 3 OFF.
259 260	AUX INPUT 4 ON. AUX INPUT 4 OFF.
266 267 268 269	Select Overlay Table 1. Select Overlay Table 2. Select Overlay Table 3. Select Overlay Table 4.
276	INTERNAL VARIABLE LOAD FUNCTION. This function uses a register number field and a value field. Only positive fixed decimal formats can be used with this function. Two variables can be loaded at this time: "Preheat Time" is assigned register 1 and "Pierce Time" is assigned register 2. See the following illustration: 3 PREHEAT TIME: 12.50 SECONDS 4 276+1++1250 3 PIERCE TIME: 4.00 SECONDS 4 276+2++400

ESSI FUNCTION CODE DESCRIPTIONS

278	X HOME.
279	Y HOME.
280	X HOME RETURN.
281	Y HOME RETURN.
282	MARKER #3 OFFSET ON - See '11' command for MARKER #1.
283	MARKER #3 OFFSET OFF - See '12' command for MARKER #1.
284	MARKER #4 OFFSET ON - See '11' command for MARKER #1.
285	MARKER #4 OFFSET OFF - See '12' command for MARKER #1.
286	MARKER #5 OFFSET ON - See '11' command for MARKER #1.
287	MARKER #5 OFFSET OFF - See '12' command for MARKER #1.
288	MARKER #6 OFFSET ON - See '11' command for MARKER #1.
289	MARKER #6 OFFSET OFF - See '12' command for MARKER #1.
290	MARKER #7 OFFSET ON - See '11' command for MARKER #1.
291	MARKER #7 OFFSET OFF - See '12' command for MARKER #1.
292	MARKER #8 OFFSET ON - See '11' command for MARKER #1.
293	MARKER #8 OFFSET OFF - See '12' command for MARKER #1.

NOTE:

Functions 11 and 12 can be used to perform OFFSET ON and OFFSET OFF operations on the eight tool offsets using a "base function with index" technique. The base function may be the defaults of OFFSET 1 (11 and 12) or may be user defined through the CUSTOM CODE CONVERSION process. The index is defined through an extended function (+).

The following summarizes the operations supported through the standard ESSI auxiliary function table:

Internal Function	Index Field Value	Base Function with Index	Standard ESSI code
OFFSET 1 ON	+1	11+1	11
OFFSET 1 OFF	+1	12+1	12
OFFSET 2 ON	+2	11+2	15
OFFSET 2 OFF	+2	12+2	16
OFFSET 3 ON	+3	11+3	282
OFFSET 3 OFF	+3	12+3	283
OFFSET 4 ON	+4	11+4	284
OFFSET 4 OFF	+4	12+4	285
OFFSET 5 ON	+5	11+5	286
OFFSET 5 OFF	+5	12+5	287
OFFSET 6 ON	+6	11+6	288
OFFSET 6 OFF	+6	12+6	289
OFFSET 7 ON	+7	11+7	290
OFFSET 7 OFF	+7	12+7	291
OFFSET 8 ON	+8	11+8	292
OFFSET 8 OFF	+8	12+8	293

To define different base codes for the ESSI format, assign the desired codes to the "OFFSET 1 ON" and the "OFFSET 1 OFF" functions through the CUSTOM CODE CONVERSION process.

ESSI SAMPLE PROGRAM

The following is an "ESSI" program for "SAMPLE PROGRAM #1" (see drawing in this section). The "REF" letters on the program listing refer to the circled reference points on the part drawing. After the program is a detailed description of each program line. The program is done in both inch and metric units.

SAMPLE PROGRAM #1

	INCH PROGRAM	METRIC PROGRAM (Rounded to nearest .1mm)	REF	COMMENTS
1)	+400-680	+1016-1727	A	MOVE FROM CORNER
2)	97	97		PRGM REPEAT POINTER
3)	29	29	B	SET KERF LEFT
4)	07	07		CUT ON
5)	+75+30	+191+76		LEAD IN LINE
6)	++-75++	++-191++	C	CUT CCW ARC HOLE
7)	-75+30	-191+76	D	LEADOUT
8)	08	08		TURN OFF CUT
9)	+200-680	+508-1727	E	MOVE TO OUTSIDE
10)	07	07		TURN CUT ON
11)	-50-50	-127-127	F	LEAD IN
12)	-150+	-381+	G	LINE
13)	-200+0-100+0+	-508+0-254+0+	H	ARC CCW
14)	-150+	-381+	I	LINE
15)	++450	++1143	J	LINE
16)	+150+150	+381+381	K	LINE
17)	-150+150	-381+381	L	LINE
18)	++350	++889	M	LINE
19)	+500+0+250-250-	+1270+0+635-635-	N	ARC -CW
20)	+-1150	+-2921	O	LINE AND LEADOUT
21)	08	08		CUT OFF
22)	+600+620	+1524+1575	P	MOVE TO NEXT PART
23)	98	98		REPEAT PROGRAM
24)	99	99		END OF PROGRAM

LINE 1 Initial move from corner of plate to pierce point on the first part.

LINE 2 The 97 pointer is used to indicate where the program repeat should occur. Any data blocks before the 97 code are not repeated on subsequent parts.

LINE 3 Sets the "Kerf Compensation" to the "Left" of the cut. This command causes the "DIAL IN KERF" option to offset the cutting path to the left and thus produce the correct size part.

LINE 4 Initiate the cutting process. (Cutting process plasma/oxy-fuel selected by operator.) Cutting speed set by operators speed dial.

LINE 5 This line "leads in" from the pierce location to the actual part.

LINE 6 Standard ARC format- Arc direction is CCW since 5th sign is +. Note: zero dimensions (+0) are included for clarity. Only the sign of the dimension is actually needed for the part. This block cuts a 360° arc.

LINE 7 This line "leads out" away from the part before the cutting process is turned off. If any melting occurs when the cutting process is stopped, it occurs in the scrap, away from the part.

LINE 8 Turn off the cutting process.

LINE 9 Move to next pierce point at high traverse speed.

LINE 10 Initiate cutting process for outside cut.

LINE 11 Line "Leads In" from pierce location to part.

LINE 12 Standard line format

LINE 13 Standard Arc format- Direction is CCW since 5th sign is (+). Note: zero dimensions (+0) are included for clarity. Only the sign is actually needed for the part program.

LINE 14 Standard line format
LINE 15 " " "
LINE 16 " " "
LINE 17 " " "
LINE 18 " " "

LINE 19 Standard ARC format - Direction is CW since 5th sign is "-".

LINE 20 Standard line format- Note: Line is .5 inches longer than part. This allows the line to also function as a "Lead-Out" away from the part before turning off the cutting process.

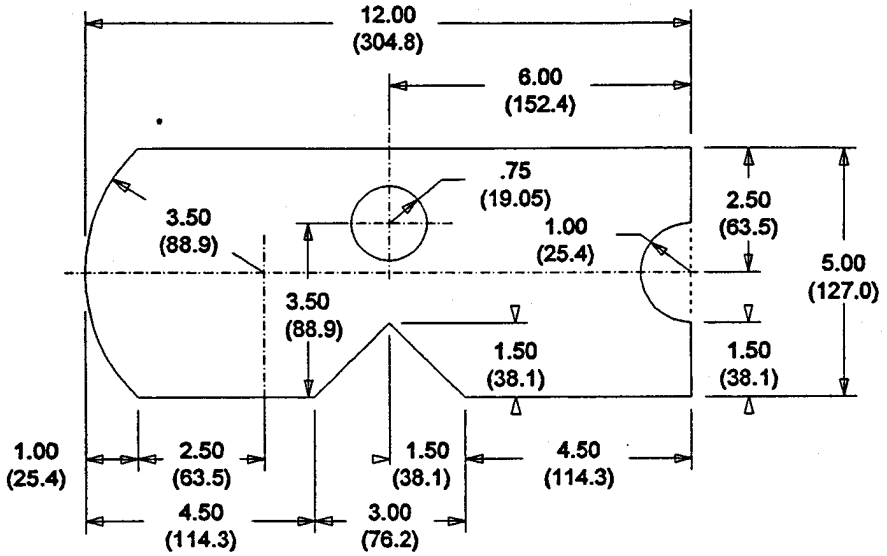
LINE 21 Turn OFF the cutting process.

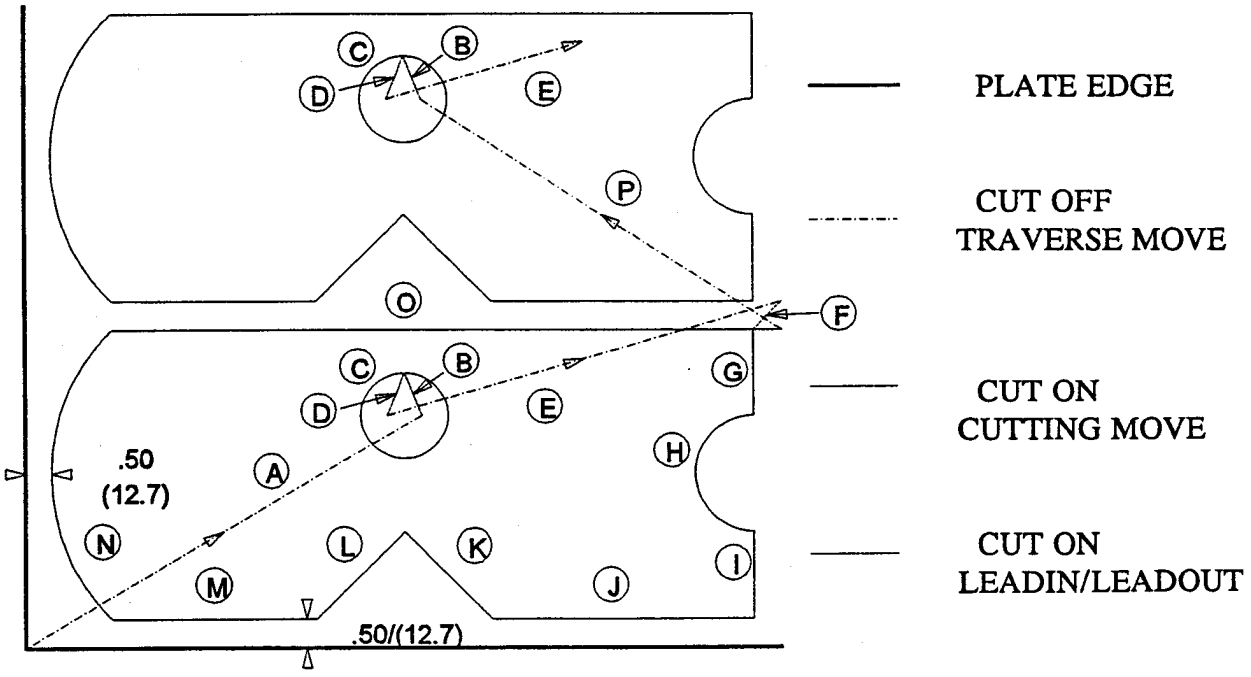
LINE 22 Move to first pierce location on next part.

LINE 23 The 98 command causes program to repeat from point where 97 command was used.

LINE 24 End of Program Command

Part Drawings - Sample Program 1
INCH / MILLIMETER DIMENSIONS





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PART 5 - OPTIONAL SOFTWARE FEATURES

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OPTION ENABLE PROCESS

Since the first release, BURNY 5 has always contained a special "OPTION ENABLE" utility. This utility allows the factory to restrict the use of certain optional features as they are developed and included in new software releases. This is important because no special software versions exist for the BURNY 5. All of the features and options developed for the BURNY 5 are generally included in every software release. Some of these options modify the basic operation of the control when they are enabled, such as KNIFE COMPENSATION. Others have special hardware requirements that must be satisfied for the feature to be fully operational. For example, the COMMAND MESSAGES option requires a second optional RS-422 port. The OPTION ENABLE utility allows the factory to control the access to these features and others that require special hardware or special operator instructions.

The MULTITASKING option allows SERIAL DEVICE LOAD/STORE, PROGRAM TEXT EDIT, and GRAPHIC NEST EDIT operations to be performed while actively running an NC part program. When enabled, these features are accessed through the UTILITIES menu which can be displayed by pressing the <IV> key from the GRAPHIC RUN TRACE screen. Although not actually required, MULTITASKING does allow LOAD/STORE operations from RAM CARTRIDGE while running if the newer BURNY 3.3 processor card is installed in the control.

The BACKGROUND option allows multiple LOAD and STORE operations to be queued and performed while actively running an NC part program or while at the MAIN MENU waiting for the next operator request. It also allows a limited background KERF/SETUP capability when at the MAIN MENU and other selected menus, provided that no other operation was active. It does NOT allow KERF/SETUP operations to be performed while actively running.

The ALTERNATE LANGUAGE option allows text on the screen to be displayed in a language other than ENGLISH.

The FLOPPY SUPPORT option provides for the new panel mounted, internal floppy disk. The floppy option supports an automatic "CALLDOWN" and "CALLUP" mode to LOAD and STORE programs and an "ERASE AND TEST" utility mode to format floppy disks. No "file delete" or "directory lookup" operations are currently supported. This option also allows all of the operations supported on the internal floppy device to be performed with external serial floppy device units using the same command protocol.

The MARKER FONT GENERATOR option allows text strings to be defined as specially formatted program messages for conversion into machine movements. These movements can then be used to draw letters, numbers, and symbols on the plate with zinc markers and other types of marking devices.

The COMMAND MESSAGES option, allows NC programs to define command and text strings in specially formatted program messages for transmission to a remote serial device while running. It can be used to send data to intelligent plate marking devices, axis positioners, and programmable controllers not using the standard communication protocol provided for the BURNY/PLC system. This option also requires a second optional RS-422 serial data port to be installed so that serial LOAD and STORE operations can be performed normally.

The KNIFE COMPENSATION option allows the control to do a special type of KERF compensation process designed for a swivel knife.

The NEST EDITOR, TEMPLATE TEACH and CODE CONVERSION options were added with the introduction of the "monochrome" version of the Burny 5. These three options are standard features on the "color" Burny 5 and are automatically installed at the factory before the unit ships.

The following "OPTION CODE" assignments have been made. Note that some options, such as OPTION 4, share the same option table entry. As a result, several different "KEY CODE" values are available to enable one or all of the options associated with the option table entry.

OPTION	1:	MULTITASKING	
OPTION	2:	BACKGROUND	
OPTION	3:	ALTERNATE LANGUAGE	
OPTION	4.1:	FLOPPY SUPPORT	
	4.2:	FILE SERVER II	(FUTURE)
	4.3:	FLOPPY & FILE SERVER II	(FUTURE)
OPTION	5.1:	FONT GENERATOR	
	5.2:	COMMAND MESSAGES	
	5.3:	FONT GENERATOR & COMMAND MESSAGES	
OPTION	6:	FUTURE	
OPTION	7:	FUTURE	
OPTION	8:	FUTURE	
OPTION	9:	KNIFE COMPENSATION	
OPTION	10.1:	NEST EDITOR	
OPTION	10.2:	TEMPLATE TEACH	
OPTION	10.3:	CODE CONVERSION	
OPTION	10.4:	NEST & TEACH	
OPTION	10.5:	NEST & CODE CONVERSION	
OPTION	10.6:	TEACH & CODE CONVERSION	
OPTION	10.7:	NEST & TEACH & CODE CONVERSION	

Options are "UNLOCKED" by entering special "KEY CODE" values into an option setup table which is accessed through the SETUP/CONFIGURATION utility menu. The actual "KEY CODE" values entered into this table depend on the serial number and software version date codes for the FPC and the MPC as shown on the "SYSTEM BANNER" screen. Thus every BURNY 5 control has a unique set of option "KEY CODE" values. Some option code values allow one or more features to be enabled. For example, OPTION 5 can now be used to enable the FONT GENERATOR option, the COMMAND MESSAGE option or both depending on the "KEY CODE" value entered.

Normally options are enabled in the control before it leaves the factory based on the purchase order. However, if an option must be enabled in the field, contact the factory with the serial number and software version date codes of the system to acquire the necessary "KEY CODE" values.

Once an option is enabled by a "KEY CODE" and the value is stored with the SYSTEM SETUP DATA in non-volatile memory, an enable message will be displayed on the "SYSTEM BANNER" screen to identify the feature as follows:

```
                CLEVELAND MACHINE CONTROLS

                        BURNY 5

COPYRIGHT - CLEVELAND MACHINE CONTROLS - 1985-1992
             SERIAL NUMBER : 12345678
             MPC VERSION   : 11-13-92
             FPC VERSION(1): 11-13-92

OPTIONS:  MULTITASKING
          BACKGROUND
          ALTERNATE LANGUAGE
          FONT GENERATOR
          COMMAND MESSAGES
          KNIFE COMPENSATION
          NEST EDITOR
          FLOPPY SUPPORT
          TEMPLATE TEACH
          CODE CONVERSION
```

To change an option value, select entry 4, "SETUP/CONFIGURATION" from the UTILITY menu and enter the three digit password for the system. Then select 2, "OPTION ENABLE" from the SETUP/CONFIGURATION menu. This causes the system to display the messages "WARNING CHECK MANUAL" and "PRESS <ENTER> TO CONTINUE". (The default password from the factory is the last three digits of the serial number in reverse order.)

NOTE

When changing option code values, it is important to remember that an incorrect value or a value placed in the wrong option number will disable the feature. Therefore, the user should permanently record the option code values for the currently enabled options and retain them in a safe place for future reference.

In response to the <ENTER> key press, the BURNY 5 displays 10 option values and the LOCKOUT CHECK CODE value as follows:

```
                        OPTION CODES

1. LOCKOUT CODE 1: _________     6. LOCKOUT CODE 6 : _________
2. LOCKOUT CODE 2: _________     7. LOCKOUT CODE 7 : _________
3. LOCKOUT CODE 3: _________     8. LOCKOUT CODE 8 : _________
4. LOCKOUT CODE 4: _________     9. LOCKOUT CODE 9 : _________
5. LOCKOUT CODE 5: _________    10. LOCKOUT CODE 10: _________

                    LOCKOUT CHECK CODE: _________

CODE NUMBER TO CHANGE: 1
```

To enter a new value for a specific option number, enter the number of the option at the "CODE NUMBER TO CHANGE" prompt and press the <ENTER> key. This causes the cursor to skip to the selected entry so that the new option value can be entered. After the new value is entered, press <ENTER> again to redisplay the "CODE NUMBER TO CHANGE" prompt. After all of the required option key codes have been defined in the correct table positions, enter "0" at the "CODE NUMBER TO CHANGE" prompt and press <ENTER> to display the "SAVE OPTIONS CODES" prompt. This helps to prevent users that are not authorized from making changes to non-volatile memory. After selecting "YES" at this prompt with the <1> key or the <+/-> key, press <ENTER> to save the option code values in non-volatile memory. This operation will also save any changes that have been made to the SYSTEM SETUP DATA variables since the last non-volatile memory "save" was performed. When the "save" operation completes, the message "CODE NUMBER TO CHANGE" is re-displayed. Press the <RST> or <CE> key to exit the OPTION ENABLE utility.

MULTITASKING OPTION

The MULTITASKING feature allows the operator to take advantage of the "idle" processing time that exists in the BURNY 5 while actively running a part program. With this option enabled, the user can use this time to perform DISPLAY PROGRAM, TEXT EDIT and GRAPHIC NEST EDIT utility operations, SERIAL LOAD/STORE operations, and others while still performing "CUTTING" operations.
To be operational, the MULTITASKING feature must be enabled by defining a special "KEYCODE" value as option number 1 and by saving the value in non-volatile memory. For additional information, see the OPTION ENABLE PROCESS section in this manual.

With the MULTITASKING feature enabled, very few operating differences will be noticed. As in previous software versions, the operator can still call up the UTILITIES menu by pressing the <IV> key when on the "real-time" GRAPHIC RUN TRACE screen. This menu always allowed the operator to perform all of the "DISPLAY SYSTEM DATA" operations and most of the "SETUP/CONFIGURATION" operations to inspect and/or change the system data while running a part program. However other utility entries, such as "DISPLAY/EDIT/NEST" and "DIRECTORY SUPPORT", could not be accessed while running. With the MULTITASKING option enabled, all of the entries in the UTILITY menu, including the new "SETUP/LOAD/STORE" entry, can now be accessed while running.

Generally, the operations performed through the UTILITIES menu operate the same whether running a program or not. The differences that do exist are primarily caused by the high priority given to the running program and the need to keep it supplied with sufficient part program block data. These "running program" block requirements also prevent the operator from deleting and/or replacing programs in memory while running. They do, however, allow programs contained in memory (including the currently running program) to be used in DISPLAY and STORE operations. Any number of new programs can also be loaded or created by the PROGRAM TEXT EDITOR and the GRAPHIC NEST EDITOR, provided that the operator does not specify "REPLACE OLD? YES" in the operation. When saving from either editor, the user must specify a new program number or a new extension number. However when loading, the system will automatically assign a new extension number if the program number already exists in memory. This "no delete during run" restriction also inhibits entry to all of the DIRECTORY SUPPORT utility operations except the INSPECT DIRECTORY function.

Another noticeable difference is the increased time required to DISPLAY, LOAD, STORE and generally access programs from memory while running a program. This increase is caused by the fact that the running program is always given higher priority than the utility operation and the utility process must sometimes wait until the RUN process becomes "IDLE" before it can continue its operation. The display update time is also increased while running a program because the "real-time graphic trace" process always processes the torch position and internally draws the cutter path for later display.

When performing MULTITASKING operations with a program actively running, the user should also be aware of the following BURNY 5 operating characteristics:

1) The "real-time graphic trace" cutter path is internally maintained on the same screen as the "graphic inspect" image. Therefore, if the operator requests a "graphic inspect" of a part program in the DISPLAY PROGRAM, TEXT EDITOR or any other function, or performs GRAPHIC NEST EDITOR operations, the cutter path trace will be lost. After performing a "graphic inspect" and/or GRAPHIC NEST EDITOR operation and returning to the RUN graphic screen, press the <V> key to re-call the running part image and re-enable "real-time graphic trace" operations.

2) As always, the <RST> key immediately terminates the "RUN PROGRAM" process. Therefore when performing utility operations (such as EDIT) while running a part, the operator should not press <RST> to terminate the operation. Instead, press <CE> or the displayed "command menu" key value to terminate the operation.

3) When performing LOAD/STORE operations, the <CE> key can now also be used to abort SERIAL I/O operations instead of pressing <RST>. However as in previous software versions, it may be necessary to press the key twice to abort all levels of the serial communication protocol.

4) The current MULTITASKING implementation does not support UTILITY LOAD operations from STANDARD SHAPE MEMORY or ROM CARTRIDGE while running even though these entries are displayed in the selection menu. Only BURNY FLOPPY (internal or external) and SERIAL DEVICE LOAD operations are currently supported on all hardware versions.

5) BATCH SETUP/KERF operations are only supported in this software version when not running a part. Any operation defined in the BATCH SETUP LIST will remain inhibited until the user returns to the BATCH SETUP screen and re-enables its operation. For additional information, see the BATCH SETUP/KERF and BACKGROUND OPTION sections in this manual.

6) The LOAD and STORE operations that are accessed through the UTILITIES menu can also be enhanced to perform operations from a LOAD QUEUE and STORE QUEUE by enabling the BACKGROUND OPTION. These queues (or lists of programs waiting to be processed) allow the operator to define up to 30 LOAD operations and/or 30 STORE operations for processing, and then return to the GRAPHIC RUN TRACE screen while the programs are being transferred. These queues also allow the operator to define UTILITY LOAD and UTILITY STORE operations before starting the run process so that they can be performed in the "background" while actively cutting. For additional information, see the BACKGROUND OPTION section in this manual.

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BACKGROUND OPTION

The BACKGROUND option has been provided to reduce the amount of "idle" processing time in the control and allow the operator to increase the productivity of the cutting machine. Like the MULTITASKING option, BACKGROUND allows LOAD and STORE operations to be performed while actively performing "cutting" operations. However unlike MULTITASKING, which requires the operator to wait for the LOAD or STORE to complete before the next operation can be commanded, BACKGROUND allows the operator to setup multiple LOAD and/or STORE operations for processing on a queue and then exit to do other operations while the LOAD or STORE is still active. These queues also allow the control to immediately start the next operation when the current operation finishes with no additional operator interaction.

The BACKGROUND option has also expanded the usefulness of the BATCH SETUP utility by allowing KERF and ACCEL/DECEL setup operations to be performed while at the MAIN MENU (and at some UTILITY menus provided the "RUN" process is not active).

After the BACKGROUND option has been enabled, very few operating differences will be observed since all MAIN MENU operations function as in earlier versions. The only difference at the MAIN MENU (and most of the other screens) is the addition of a new status line at the bottom of the screen that shows the state of the BACKGROUND process. Normally, this line appears as "BACKGROUND: INACTIVE" since the BACKGROUND process is normally idle. However when BACKGROUND is performing a LOAD, STORE or SETUP/KERF operation, this line is continuously updated in "real time" to reflect the status of the active BACKGROUND operation. In previous software versions, this line was never used and as a result, was always blank.

BACKGROUND operations are setup through the UTILITY menu that is found by selecting "6. UTILITIES" from the MAIN MENU or by pressing the <IV> key while on the GRAPHIC RUN TRACE screen. From the UTILITY menu, select "6. SETUP/LOAD/STORE" to display the BACKGROUND function menu that appears as follows:

```
        SUPPORT MENU

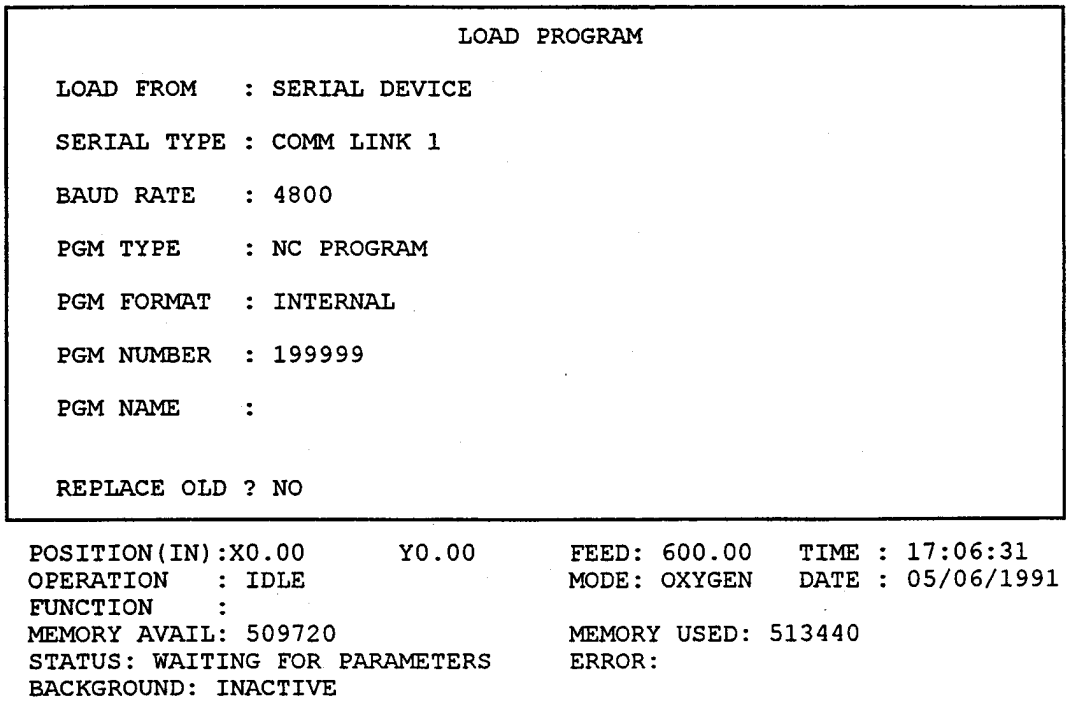
1. SETUP/KERF SUPPORT
2. LOAD SUPPORT
3. STORE SUPPORT

        SELECT (1-3)
```

The SETUP/KERF function allows the operator to select and define, in a list format, NC programs for KERF and ACCEL/DECEL pre-processing. The other two operations, LOAD and STORE, operate similarly to the MAIN MENU LOAD and STORE functions. The BACKGROUND option primarily adds the ability to setup and exit out of these functions without aborting the active operation. For additional information on the prompting operations done by the SETUP/KERF utility function, see the BATCH SETUP/KERF section in this manual.

When the BACKGROUND option is enabled, the LOAD and STORE operations supported through the UTILITY menu are always performed using a "LOAD QUEUE" and a "STORE QUEUE" when using a SERIAL DEVICE or the panel FLOPPY. Both queues are automatically enabled at power-up and both allow up to 30 operations to be defined before exiting.

Although many special operations are provided to manipulate entries on these queues, none are normally required to do UTILITY LOAD and STORE operations. All of the prompting done to setup a queue operation are the same as in the MAIN MENU LOAD and STORE functions. The only difference is that an additional message appears on the UTILITY LOAD and STORE prompting screens to remind the operator that the <III> key can be used to display the contents of the queue. For example, after defining the program number for a UTILITY LOAD, the prompting screen appears as follows:



Like the MAIN MENU LOAD, the UTILITY LOAD prompts the operator to decide if a currently resident program with the same program number should be replaced. However, the "REPLACE OLD" capability is only supported when the "RUN" process is not active.

After satisfying the "REPLACE OLD" prompt, the LOAD operation is initiated. When BACKGROUND is enabled, the LOAD request is placed on a queue and the status line at the bottom of the screen is updated to identify the active LOAD operation as follows:

```
                          LOAD PROGRAM

 LOAD FROM    : SERIAL DEVICE

 SERIAL TYPE  : COMM LINK 1

 BAUD RATE    : 4800

 PGM TYPE     : NC PROGRAM

 PGM FORMAT   : INTERNAL

 PGM NUMBER   : 199999

 PGM NAME     :

 PRESS <III> TO DISPLAY QUEUE
 PRESS <ENTER> TO CONTINUE

POSITION(IN):X0.00      Y0.00      FEED: 700.00   TIME : 17:06:31
OPERATION   : IDLE                 MODE: OXYGEN   DATE : 05/06/1991
FUNCTION    :
MEMORY AVAIL: 509720               MEMORY USED: 513440
STATUS: WAITING FOR PARAMETERS     ERROR:
BACKGROUND: LOADING    199999-999    124 BYTES
```

Note that when BACKGROUND is enabled, the operator can immediately press the <ENTER> key to setup another LOAD operation, press the <III> key to display the LOAD QUEUE, or press the <CE> keys to exit out of the UTILITY LOAD screen without canceling the active LOAD operation. The <RST> key can also be used to exit the UTILITY LOAD and UTILITY STORE screens. However, <RST> will also cancel the running process if it is active.

Once an operation is submitted to the LOAD or STORE queue, it remains on the queue until the operation is completed (with or without an error), or the user modifies the operation of the queue using the commands defined at the top of the QUEUE screen. Other conditions also cause the operations defined on the SETUP/KERF batch list and the LOAD and STORE queues to be temporarily suspended and then automatically restarted. This is required to allow MAIN MENU operations (such as RUN, LOAD and STORE) and some UTILITY MENU operations (such as DISPLAY, EDIT and NEST) to always be done at a higher priority level than the BACKGROUND

operations. In addition, BACKGROUND operations have also been assigned different priorities. Whenever the SETUP/KERF LIST, LOAD QUEUE and STORE QUEUE are all setup at the same time and enabled for operation, STORE operations occur first, then LOAD operations and if not running, SETUP/KERF operations are done last.

Pressing the <III> key on the UTILITY LOAD or UTILITY STORE prompting screen causes the QUEUE screen to be displayed. This screen shows the status of the queue and a table of supported commands. It can also show a history of previous operations and a list of all operations that are waiting to be processed as shown in the following example.

```
                        BACKGROUND LOAD QUEUE
STATUS      : ACTIVE
                          QUEUE COMMANDS
 (1) CLEAR QUEUE      (2) CLEAR ENTRY      (3) CLEAR OLD ENTRIES
 (4) SUSPEND QUEUE    (5) ABORT ENTRY      (6) CLEAR NEW ENTRIES
 (7) RESUME QUEUE     (8) REQUEUE ENTRY    (9) REQUEUE ERRORS
                      (0) EXIT SCREEN

 #     PGM NUMBER      SOURCE        FORMAT      SIZE      STATUS
---   ------------   ----------   ----------   -------   ----------
 -1.     9998-26     COMM LINK    INTERNAL     7344      DONE
  0.   199999        COMM LINK    INTERNAL     5510      ACTIVE
  1.     2222        COMM LINK    WORD ADDR              WAIT
  2.      745        COMM LINK    INTERNAL               WAIT
  3.     9430        COMM LINK    ESSI                   WAIT
  4.    49510        COMM LINK    INTERNAL               WAIT


POSITION(IN):X-1394.01  Y-8.76      FEED: 600.00    TIME : 17:06:31
OPERATION    :IDLE                  MODE: OXYGEN    DATE : 05/06/1991
FUNCTION     :
MEMORY AVAIL: 509720                MEMORY USED: 513440
STATUS: WAITING FOR PARAMETERS      ERROR:
BACKGROUND: LOADING    199999-999     5830 BYTES
```

Whenever the LOAD QUEUE or STORE QUEUE is displayed, the top of the screen shows a table of commands that can be used to control the operation of the displayed queue. These commands allow the operator to stop and start the queue, clear all entries or individual entries, and when necessary, requeue entries that have ended with an error. A description of each of these command functions follows.

(0) EXIT SCREEN

This function returns to the prompt screen. It has the same function as the <CE> key.

(1) CLEAR QUEUE

This function clears all entries on the queue when the queue is IDLE.

(2) CLEAR ENTRY

This function allows the operator to remove a specific entry from the queue. Entries are selected using the UP and DOWN cursor keys.

(3) CLEAR OLD ENTRIES

This function allows the operator to clear all processed entries from the queue (that is, entries with negative index numbers). This operation does not require the queue to be IDLE since it automatically does a "suspend" before and a "resume" after the clear is done.

(4) SUSPEND QUEUE

This function allows an active entry to complete but prevents additional entries from being processed.

(5) ABORT ENTRY

This function allows the operator to abort an active operation. This may be necessary if the selected device is not operating correctly and/or the "TIMEOUT" feature has been disabled. Aborted entries, like other entries can also be later "requeued".

(6) CLEAR NEW ENTRIES

This function allows the operator to clear all entries that are still waiting to be processed from the queue (that is, entries with positive index numbers). This operation does not require the queue to be IDLE since it automatically does a "suspend" before and a "resume" after the clear is done.

(7) RESUME QUEUE

This function enables the index number update and allows the next queue entry to be processed.

(8) REQUEUE ENTRY

This function allows the operator to requeue any entry on the queue. When requeued, the parameters used to define a processed or waiting entry are reused to created a new queue entry. (The original queue entry is left unchanged). Aborted entries and entries ending with an error can also be "requeued". Entries are selected using the UP and DOWN cursor keys.

(9) REQUEUE ERRORS

This function allows the operator to requeue all entries on the queue that ended with an error or were aborted. When requeued, the parameters used to define a processed or waiting entry are reused to created a new queue entry. (The original queue entry is left unchanged).

Besides the operations done by these command functions, others can be performed using the special keys on the keyboard. The <I> and <II> keys are used to page backwards or forwards through the 30 possible entries. The cursor UP and DOWN keys are used to step from entry to entry to select a specific entry to be cleared or requeued. Whenever the selected entry has ended with an error, the <IV> key can be used to display the actual error type at the bottom of the display window. As on other screens, the <CE> key can also be used to exit the QUEUE screen and return to the previous LOAD or STORE prompting screen.

ALTERNATE LANGUAGE OPTION

The ALTERNATE LANGUAGE feature provides the ability to switch the text displayed on the BURNY 5 between two languages. The list of available Languages are ENGLISH, FINNISH, FRENCH, GERMAN, ITALIAN, SPANISH, SWEDISH, DUTCH, and NORWEGIAN.

NOTE

Contact the factory for the most recent list of supported languages.

In order to be operational, two requirements must be satisfied. First, the ALTERNATE LANGUAGE feature must be enabled by defining a special "KEY CODE" value as option number 3 and saving the value in non-volatile memory. For additional information on this procedure, see the OPTION ENABLE PROCESS section in this manual.

Once the ALTERNATE LANGUAGE FEATURE is enabled, the desired primary and secondary languages for the control must be selected. The default primary and secondary language is ENGLISH. The selection of primary and secondary languages is done by setting SYSTEM SETUP DATA variable 40, SYSTEM CONFIGURATION 4 to the appropriate values. For additional information on this procedure, see the SYSTEM DATA SETUP VARIABLES section in this manual.

The displayed language can be easily changed by pressing the two key sequence, <SHF> and then <VI>. This causes an internal "language type" flag to be toggled. This flag is used to define if the primary or the secondary language table should be used for all newly displayed text. Existing text on the screen is not affected by the state of this flag. Therefore, after toggling the "language type" flag, press the <III> key or some other key to change screens. Only newly displayed text strings will be shown in the selected language.

IMPORTANT

If the ALTERNATE LANGUAGE OPTION is not enabled, the ENGLISH LANGUAGE is always displayed.

In addition to the "language toggle" key sequence, another capability also exists in the BURNY 5. It allows for a language to be automatically selected at power-up. When enabled through SYSTEM SETUP DATA variable 38,
SYSTEM CONFIGURATION 2, all of the text strings except the POWER-UP DIAGNOSTICS screen will automatically use the primary language. The <SHF> <VI> key sequence can then be used to toggle the language to secondary language and back, as required. For additional information, see the SYSTEM SETUP DATA section in this manual.

FLOPPY SUPPORT OPTION

The FLOPPY SUPPORT feature provides support for the internal and/or external BURNY FLOPPY· DISK drive. This option allows you to perform LOAD, STORE, and FORMAT operations, as well as FILE DELETE and DIRECTORY LOOKUP operations with the FLOPPY.

When enabled with a special FLOPPY SUPPORT option lockout code and a FLOPPY prompting enable bit, an automatic command mode is used to perform all required operations with the FLOPPY. This eliminates the need for special keypads and/or additional operator training. When properly configured, all operations are performed using the normal BURNY 5 prompting sequences. The only major difference is that "FLOPPY DEVICE" appears as one of the possible device selections.

FLOPPY LOAD and STORE operations can be performed using the MAIN MENU LOAD and STORE functions or the UTILITY LOAD and STORE functions. MULTITASKING and BACKGROUND operations can also be performed when enabled with the necessary option lockout keycodes. FLOPPY FORMAT operations are performed using the ERASE AND TEST utility function. However, this utility also performs a device initialization process, a directory status operation, and after performing the FORMAT, builds a special "EASIDISK.BAT" file on the disk. This file performs two functions. One is to help test the "WRITE/READ VERIFY" file processing logic and verify the formatted floppy directory size. The other is to provide a special start-up configuration file (similar to the "EASIDISK.SYS" file on the start-up disk) which can also be automatically read by the floppy drive at power-up to reset the required communication parameters in the event that the setup data in its non-volatile memory is lost.

The INTERNAL FLOPPY hardware version available for the BURNY 5 allows a single 3.5", high density 1.44mb drive to be mounted behind the protective door on the BURNY panel in place of the optional CARTRIDGE port. The INTERNAL FLOPPY is accessed as a PANEL DEVICE.

The software also supports an external 3.5" or 5.25" floppy unit which can be connected to the serial data port on the back of the BURNY. This EXTERNAL FLOPPY provides the same operational features as the INTERNAL FLOPPY but offers the flexibility of mounting the floppy drive anywhere on the machine or at some distance away from the machine (for example, in the NC programming office). If necessary, this external floppy unit can be moved from BURNY to BURNY as required. However when using the EXTERNAL FLOPPY unit on more than one BURNY, every BURNY will require the FLOPPY DISK option to be enabled. The EXTERNAL FLOPPY is accessed as a SERIAL DEVICE.

Directory operations are supported. Each entry in the directory list contains both a program number and name. The name field contains the DOS filename used to access the file from disk. The number, which is shown in the left most part of the entry, is derived either from the filename or the index position of the file as shown below:

```
DIRECTORY OF: BURNY FLOPPY

      TOP OF DIRECTORY
      2222     2222.CNC
      9510     9510.CNC
  12345678     12345678.CNC
     A0004     FLANGE22.CNC
    900000     900000.CNC

      BOTTOM OF DIRECTORY
```

Files can be selected by number or name, up and down arrow keys, and via an index number (an "A" and the entry's position in the directory). Using this example, entering "A0002" as the program number selects the second entry in the list and updates the program number and name prompt fields with "9510" and "9510.CNC" respectively. An additional capability is that you can LOAD programs from the BURNY FLOPPY that do not use the 8-digit program number convention. As shown in the above example, any DOS filename that cannot be directly converted into an 8-digit program number appears with its special index number. This number becomes the program number used to internally reference the program once it has been loaded.

When performing LOAD operations from the BURNY FLOPPY drive, "file scrolling" and "display directory" operations can be performed. As with other devices used in LOAD operations, the directory of internal NC PROGRAM MEMORY is displayed whenever the <IV> key is pressed. Similarly when performing STORE operations, the software version prompts you with the "REPLACE OLD?" message.

FILE DELETE operations are also supported. As a result, both the MAIN MENU "DELETE" and the SELECTED DELETE functions in the DIRECTORY SUPPORT utility menu can be used to remove individual programs from the floppy. The ERASE AND TEST utility can also be used to delete all of the files from a floppy.

FILE NAMING CONVENTIONS

The floppy disk unit selected for the PANEL DEVICE and the portable SERIAL DEVICE provides limited MS-DOS compatibility. The major restriction is that only root level files can be accessed from the floppy. Files residing in sub-directories created on MS-DOS compatible systems can not be accessed. Therefore, whenever the BURNY performs a FLOPPY LOAD or STORE operation, it always uses the root directory (that is A:*.*) on the diskette.

By default, files written to FLOPPY use program numbers with leading zeroes suppressed and file extensions of ".CNC". However some MS-DOS based application systems use NC program numbers with leading zeroes. To resolve this, a "LEADING 0" feature has been added to the FLOPPY support. When enabled in SYSTEM SETUP DATA variable 49 (FLOPPY DEVICE), this feature allows the operator to access 8 digit program numbers that contain leading zeroes. For example, when this feature is enabled and the operator requests program number "2", the BURNY 5 expands the filename to "00000002.CNC" and performs the required floppy disk operation. Another solution for the "leading 0" problem is also provided through the ASCII FILE PATHNAME feature. Although this feature still requires the operator to specify a unique program number for internal BURNY use, it also allows the operator to specify any valid string of ASCII characters as the desired filename. This allows the operator to access files such as "2.CNC", "002.CNC" or any other string containing one or more leading zeroes, as different files on the floppy.

When used with the BURNY FLOPPY, the ASCII FILE PATHNAME feature allows the operator to specify the filename with or without an extension. When no extension is specified by the operator, the BURNY automatically appends the extension ".CNC". However if no file extension is actually required, the operator must follow the floppy filename with just a period. A trailing period prevents the BURNY from appending the default extension.

Separate internal BURNY directory types are supported with unique file extensions (.CNC, .GNR, .ASC). Additionally, a special user defined NC program file extension allows you to replace the "CNC" extension with any string of up to three characters. This string, defined through SYSTEM SETUP DATA variable 58, may include the single "?" and multiple "*" wildcard characters for maximum flexibility.

The following floppy file naming conventions are recommended:

1). FLOPPY filenames should be defined using up to 8 digits with all leading zeroes suppressed.

2). All FLOPPY filenames should use the default extensions associated with the internal BURNY 5 file type (.CNC, .GNR, or .ASC).

3). If the default ".CNC" NC program file type is replaced with a user defined extension value through SYSTEM SETUP DATA variable 58, all NC program files should consistently use the same extension. The use of wildcard characters in the extension and / or more than one extension type for NC program files is NOT recommended.

By following these simple guidelines, operations with the BURNY FLOPPY can be as easy as those with the RAM CARTRIDGE. All file prompting operations can then be performed using program numbers without the need to enter ASCII text or enable the ASCII NAME CALLUP feature.

Remember, the BURNY 5 is NOT a DOS-based machine. Its ability to read and write DOS compatible files is due to a special floppy controller that is used in both the internal panel mounted and the external serial device. All programs in memory are assigned 8 digit program numbers with an optional 3 digit extension (1-999), which is only used internally to ensure uniqueness. Internally, the program name field, which is also shown in the directory list, is only a description field. As such, two or more programs in a particular internal directory may have the same program name, but they will never have the same program number.

MODES OF OPERATION

While scrolling through or displaying the BURNY FLOPPY directory, the following details should be noted:

1). All of the files displayed will have the extension of the default program type. If it is an NC program type, and the extension has been defined through SYSTEM SETUP DATA variable 58, that extension is displayed. Only extensions matching the selected type will be displayed.

2). Only filenames using valid numeric values will be directly accessible by number. All others will automatically be assigned an "A0000" type program number, which is derived from its position in the directory list. This allows non-numeric filenames and files using one or more leading zeroes to be accessed without the burden of entering ASCII program names.

In order to support a wider variety of filenames, several special index / naming features have been provided. These features, combined with the directory look-up and the up / down scrolling features, allows all files using alphanumeric filenames and non-standard extensions to be accessed with or without the "ASCII FILE PATHNAME" feature enabled. Each feature provides additional flexibility and increased complexity. As a result, both the advantages and disadvantages of each of these capabilities are described in the paragraphs that follow.

The BURNY 5 supports two basic methods of accessing files from the BURNY FLOPPY: NUMERIC mode and ALPHANUMERIC mode. Both support directory look-up, up / down scrolling, special number index, and user defined file extension operations. As a result, both can be used to access files from disk that use non-numeric filenames. The primary difference is in the way you define the request and the amount of prompting input required.

Numeric filename mode:

In NUMERIC mode, only the program number needs to be defined. This number can be directly entered or the up / down cursor keys can be used to step to the desired number (with or without the directory list displayed). A third approach allows the index position of the file in the directory list to be used to advance the cursor to that position.

Alphanumeric filename mode:

When the ASCII FILENAME feature is enabled in the BURNY FLOPPY to enable ALPHANUMERIC mode, an additional prompt line is displayed. This prompt queries for the default pathname to be used (such as "*.CNC"). You can modify it to use any valid DOS filename, with or without single or multiple wildcard characters (such as "RING*.?NC"). This allows you to narrow or widen the search used to build the directory list. From this list, the scrolling and index number operations can be used to select the desired file, but only from the PROGRAM NUMBER prompting line.

The PROGRAM NAME field is used to define the desired filename. In this mode, the PROGRAM NUMBER field is only used to define the number internally used by the BURNY after loading. Through the PROGRAM NAME prompt, you may enter any sequence of ASCII characters to define the filename and file extension (even if it differs from the extension displayed in the "DIRECTORY" prompt line). As in other PROGRAM NAME prompting operations, the HELP key (<IV>) can be pressed to display the codes defined by a two-key sequence. Other character codes are entered by using the up / down cursor keys while on the PROGRAM NAME prompting line. This mode gives you maximum flexibility when loading and storing with the BURNY FLOPPY but adds the burden of entering ASCII filenames and extensions.

INTERNAL FLOPPY HARDWARE

Whenever the panel mounted INTERNAL FLOPPY is installed in the BURNY, a special internal switching card is provided to automatically direct the required logic signals from the external serial port to the internal device, but only when it is selected as a panel device. As a result, operations with an external serial device are still supported when the panel mounted disk drive is properly installed.

A start-up disk (**A38-23125**) is provided with every floppy drive unit. This disk contains a special configuration file,named "EASIDISK.SYS" which can be used to reconfigure the floppy disk controller port for communication with the BURNY. Normally this is not required since the necessary parameters are saved at the factory in the non-volatile memory on the floppy controller. However if communication problems arise with the floppy and attempts to perform an ERASE AND TEST with another disk are not successful, this disk, or any other disk that has been successfully formatted with the ERASE AND TEST utility and still contains the "EASIDISK.BAT" file, should be inserted into the drive. Turn the power to the BURNY off for several seconds. When the power is turned back on, the floppy drive will automatically read the "EASIDISK.SYS" or "EASIDISK.BAT" files, reconfigure the communication port parameters and save the floppy controller parameters in its non-volatile memory.

Several other files are also provided on the start-up disk (**A38-23125**) to help verify the operation of the BURNY serial communication port and floppy drive. "BNYTRM.EXE" is a executable file that can be run on an IBM or IBM compatible computer running MS-DOS. This program provides a terminal emulator mode which can be used to diagnose problems with the BURNY serial port, if they should occur. (Communications with the EXTERNAL FLOPPY are performed at 4800 baud). A text file, named "BNYTRM.DOC" provides information on the use of this program. Two other files, "88765504.CNC" and "88765502.CNC", are sample NC programs in CUSTOM WORD ADDRESS 1 format that can be used to verify LOAD operations from the INTERNAL FLOPPY drive.

SETUP/CONFIGURATION

In order to perform operations with the INTERNAL FLOPPY panel device or the EXTERNAL FLOPPY serial device, a special key code value must be defined and saved as OPTION LOCKOUT CODE number 4. Without this code, the command protocol that is used to perform automatic LOAD, STORE and other operations with the floppy controller will not function. Like other BURNY option codes, the FLOPPY SUPPORT option has a unique value for every control. As such, these keycodes can only be obtained from the factory. For additional information on the entry and definition of option code values, see the OPTION ENABLE section in this manual.

In addition to the FLOPPY SUPPORT option lockout code, several other system configuration bits must be defined to specify whether or not the INTERNAL FLOPPY and/or CARTRIDGE devices are available. By default, the panel device is defined as a CARTRIDGE device and no INTERNAL FLOPPY is available. To disable the CARTRIDGE device and enable the INTERNAL FLOPPY set the "0000 0420" bits in SYSTEM SETUP DATA variable 38 (SYSTEM CONFIGURATION 2) to ones. For additional information, see the SYSTEM SETUP DATA VARIABLES section in this manual.

Other configuration values are defined for the BURNY FLOPPY through a newly created SYSTEM SETUP DATA variable (variable number 49, FLOPPY DEVICE). This variable provides attributes for the INTERNAL FLOPPY and the EXTERNAL FLOPPY devices. Normally this variable will be set to zero to use the system defaults for the internal and external FLOPPY devices which are as follows:

HIGH DENSITY 3.5" DRIVE
WRITE VERIFICATION ENABLED
READ/WRITE TIMEOUTS ENABLED (NOT ALTERABLE)
P####(AAAA) PROGRAM HEADER BLOCKS ENABLED
LEADING ZERO PROGRAM NUMBERS DISABLED
ASCII FILE PATHNAMES DISABLED
4800 BAUD (NOT ALTERABLE)
7 DATA BITS, EVEN PARITY (NOT ALTERABLE)

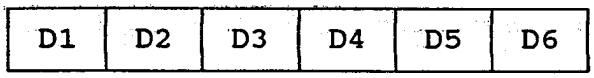
Some of these default values can be modified by setting the appropriate bits in the FLOPPY DEVICE variable. Others can not. To better define these and other supported features, a partial definition of the FLOPPY DEVICE variable has been provided on the pages that follow. For a more complete definition of this variable, see the SYSTEM SETUP DATA VARIABLES section in this manual.

SETUP VARIABLE 49 - FLOPPY DEVICE

This parameter is used to specify special device definition values for the INTERNAL and EXTERNAL FLOPPY device although not all assignments affect both device types. If set to zero, no special assignments are assumed for either device.

Like other device definition values, this parameter value is supported as a 6 digit value. The high three digits (left most) provide feature enable/suppression flag bits. Of these, some are specifically assigned to either the INTERNAL FLOPPY or the EXTERNAL FLOPPY. Others affect the operations performed on both device types. The low three digits (right most) provide definitions for "PROGRAM TYPE", "BAUD RATE" and "CHARACTER FORMAT". These values are used to pre-assign prompting values for use with the EXTERNAL FLOPPY serial device. If necessary, they can also be used to override the "power-up" system defaults for the external serial device or user assigned defaults defined by the SYSTEM SETUP DATA parameters SERIAL LOAD DEVICE, SERIAL STORE DEVICE and BATCH LOAD DEVICE. INTERNAL FLOPPY operations are always performed using the default assignments "7 DATA BITS", "EVEN PARITY", "4800 BAUD" with the PROGRAM TYPE selected by normal prompting operations.

The 6 digit FLOPPY DEVICE parameter value is defined as follows:



where:

"**D1**" defines the following bit flags:

WRITE TIMEOUT DISABLE:
READ TIMEOUT DISABLE:

When set to one, these configuration bits allow the user to disable the timeout operations that are normally enabled on the EXTERNAL FLOPPY. When not disabled, these timeout conditions cause operations to automatically terminate if communications are suspended more than 20 seconds. These bits do not affect the timeout operations that are always enabled for the INTERNAL FLOPPY.

WRITE VERIFICATION DISABLE:

When set to one, this bit inhibits the automatic read that is performed by the INTERNAL and EXTERNAL FLOPPY controllers when writing data. This check is normally performed to verify that the data was correctly written to floppy disk. Although the verification does take time to perform, no additional transfer time is required because of the buffering operations that are used to keep the data transfer active.

These bit flags can be assigned as follows. The "X" indicates the feature is selected when the value above the column is used for the "D1" digit.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
WRITE TIMEOUT DISABLE		X		X		X		X		X		X		X		X
READ TIMEOUT DISABLE			X	X			X	X			X	X			X	X
NOT USED					X	X	X	X					X	X	X	X
WRITE VERIFICATION DISABLE									X	X	X	X	X	X	X	X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

"D2" defines the following bit flags:

EXTERNAL FLOPPY LOW DENSITY:
INTERNAL FLOPPY LOW DENSITY:

When set to one, these configuration bits allow the user to change the default INTERNAL and/or EXTERNAL FLOPPY format type from HIGH DENSITY to LOW DENSITY. Generally, the density type is only significant when performing a FORMAT with the "ERASE AND TEST" utility. The high density drives used for the BURNY FLOPPY are capable of reading and writing files in both high and low density formats regardless of the state of these configuration bits.

EXTERNAL FLOPPY 5.25" DRIVE:

When set to one, this bit changes the default EXTERNAL FLOPPY drive type from 3.5" to 5.25". The type established by this bit is used when performing the initialization and test operations in the ERASE AND TEST utility.

P###(AAA) PROGRAM BLOCK DISABLE:

When this bit is set to one, the program header block that is normally output following the "%" block is suppressed. This feature is provided for use when performing ASCII FILE PATHNAME operations to prevent the program number and program name specified by the operator from being overwritten when reloading files that were stored to the BURNY FLOPPY. This bit affects operations on both the INTERNAL and EXTERNAL FLOPPY devices.

These bit flags can be assigned as follows. The "X" indicates the feature is selected when the value above the column is used for the "D2" digit.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
EXTERNAL FLOPPY LOW DENSITY		X		X		X		X		X		X		X		X
EXTERNAL FLOPPY 5.25" DRIVE			X	X			X	X			X	X			X	X
INTERNAL FLOPPY LOW DENSITY					X	X	X	X					X	X	X	X
SUPPRESS P#(A) BLOCK OUTPUT									X	X	X	X	X	X	X	X

"D3" defines the following bit flags:

LEADING ZERO PROGRAM NUMBERS:

When set to one, this bit causes the BURNY to expand all program numbers to 8 digit values with leading zeroes. Normally, leading zeroes are suppressed. This bit affects operations on both the INTERNAL and EXTERNAL FLOPPY devices.

ASCII FILE PATHNAME ENABLE:

When set to one, this configuration bit causes the BURNY to process the program name as a possible file pathname. Generally, name strings that do not use one of the reserved names, a " - " (space, dash, space) sequence or "/" (slash) can be used as file names. This bit affects the operations performed on both the INTERNAL and EXTERNAL FLOPPY devices. Remember, the FLOPPY does not support sub-directories.

These bit flags can be assigned as follows. The "X" indicates the feature is selected when the value above the column is used for the "D3" digit.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
NOT USED		X		X		X		X		X		X		X		X
NOT USED			X	X			X	X			X	X			X	X
LEADING ZERO·PGM NUMBERS					X	X	X	X					X	X	X	X
ASCII FILE PATHNAME ENABLE									X	X	X	X	X	X	X	X

"**D4**" defines PROGRAM FORMAT for the EXTERNAL FLOPPY as:

0 => No assignment made, perform normal prompting
1 => STANDARD WORD ADDRESS
2 => STANDARD ESSI FORMAT
3 => PROCESSED INTERNAL FORMAT
4 => CUSTOM WORD ADDRESS 1
5 => CUSTOM WORD ADDRESS 2
6 => CUSTOM WORD ADDRESS 3
7 => CUSTOM ESSI FORMAT 1

"**D5**" defines BAUD RATE for the EXTERNAL FLOPPY as:

0 => No assignment made, perform normal prompting
1 => 110
2 => 300
3 => 600
4 => 1200
5 => 2400
6 => 4800 (system default)
7 => 9600 (not recommended for LOAD operations)
8 => 19200 (not recommended for LOAD operations)

"**D6**" defines CHARACTER FORMAT for the EXTERNAL FLOPPY as:

0 => No assignment made, perform normal prompting
1 => 7 DATA BITS, NO PARITY
2 => 8 DATA BITS, NO PARITY
3 => 7 DATA BITS, EVEN PARITY (system default)
4 => 8 DATA BITS, EVEN PARITY
5 => 7 DATA BITS, ODD PARITY
6 => 8 DATA BITS, ODD PARITY
7 => (not applicable)

BLANK

MARKER FONT GENERATOR OPTION

The MARKER FONT GENERATOR feature allows plate marking devices to be used to label and/or identify individual parts before they are cut. When enabled, this feature allows the NC programmer to define a text string of up to 30 characters for marking as a simple ASCII message. Each character of the string is then used to internally call the required FONT program.

MARKER TEXT is defined using a specially formatted program message as a control string. The general format of the MARKER TEXT control string is shown below:

>10<ASCII MARKER TEXT string
>10>scale<ASCII MARKER TEXT string
>10>scale>rotation<ASCII MARKER TEXT string

A BURNY message control string always begins with a ">" symbol and one or more command code digits to indicate that it is not a normal program message. For MARKER TEXT control strings, two digits are used to define the command type and the directory to be used first in the FONT search. (Note that if the first search fails, the system automatically repeats the search in INTERNAL FONT MEMORY). These codes are assigned as follows:

10 => NC PROGRAM MEMORY
11 => RAM CARTRIDGE MEMORY
12 => (NOT YET SUPPORTED)
13 => INTERNAL FONT MEMORY

The characters following the 2 digit command code determine which message format is being used. One form only allows the MARKER TEXT string to follow. A second form allows a "text scale factor" to be defined before the text string. A third allows both a "text scale factor" and a "text rotation angle" to be defined. Note that the ASCII string for marking must follow a "<" character. Both the "scale factor" and "rotation angle" are always defined as fixed decimal values regardless of the NC program format selected. Font scale values can be defined in the range 0.00 to 65.35 and rotation values in the range of -360.0 to +360.0 degrees.

Other MARKER TEXT control string syntax variations are supported to simplify programming. These allow the imbedded ">" character shown in the general format definition to be replaced with ",", "+", "-" or " " characters as shown below. Note that "scale" is an unsigned value that is unaffected by a leading "+" or "-" character and that no spaces are permitted to follow the sign character or decimal point in a numeric value.

>10, 3, 0<GUSSET #1	TRIPLE SIZED IN -Y DIRECTION
>10 +1 +90<FLANGE 2	SINGLE SIZED IN +X DIRECTION
>10 2 -90<JOB: 15-2-674	DOUBLE SIZED IN -X DIRECTION
>10, .25, +45< LEFT FRAME	1/4 SIZED IN +X-Y DIRECTION

As with other ESSI program messages, MARKER TEXT message blocks are preceded with a "SKIP DATA ON" function block "03" and followed by a "SKIP DATA OFF" function block "04". In WORD ADDRESS, MARKER TEXT control strings are enclosed in the characters "(" and ")".

When defining a MARKER FONT operation in an NC program, normal "OFFSET ON/OFF" and "MARKER ON/OFF" operations are specified to perform the necessary marker offset operations and select which of the supported markers should be used. As such, MARKER FONT operations are performed using the following logic sequence.

1) Perform a MARKER OFFSET ON operation (if required)
2) Perform a required MARKER ON operation
3) Define a MARKER TEXT control string as a message
4) Perform a required MARKER OFF operation
5) Perform a MARKER OFFSET OFF operation (if required)

For example, the following sequence is programmed in ESSI format to perform a MARKER TEXT operation.

```
11
09
03
>10>2>90<TEXT FOR MARKING OPERATION
04
10
12
```

and in WORD ADDRESS format:

```
M71
M08
(>10>2>90<TEXT FOR MARKING OPERATION)
M07
M70
```

When a MARKER TEXT control string is encountered in an NC program, the BURNY 5 automatically decodes the text following the "<" character and internally calls the required FONT programs from the specified directory to perform the necessary marker control and movement operations for each character in the string, including spaces. MARKER FONT programs are uniquely identified in memory with the left 4 digits of their 8 digit program number defined as "AAAA". The right 4 digits contain the ASCII character code in hexadecimal. For example, program "AAAA0043" contains the marker movements for the upper case ASCII character "C" (ASCII code >43).

Whenever ">10" is used as the command code, the BURNY first searches NC PROGRAM MEMORY for the desired FONT program number. If it is not found, the system checks if the font character was lower case. If so, the system repeats the search in the same directory using the program number for the font character's upper case equivalent. If the search fails to find the upper case FONT program, the system then searches INTERNAL FONT MEMORY for the required program. INTERNAL FONT MEMORY contains programs for all of the printable codes between space ">20" and underscore ">5F" with the exception of "?", "$", "^" and "@". This includes all of the digits and all of the upper case letters. Note that whenever one of the missing codes is encountered and is undefined in the specified directory, the BURNY 5 automatically marks an underscore code in its place.

Each individual FONT program is a complete NC program containing the necessary operations to generate one character mark on the plate. All FONT programs in INTERNAL FONT MEMORY use a standard height of 1 inch and a width of 0.9 inch which includes 0.3 inch to the right of each character for uniform spacing. Text scaling and rotation values specified in the message control string allow character size and string direction to be adjusted regardless of the scale and rotation values specified for the entire part.

All MARKER FONT character operations are defined using MARKER 1 ON/OFF codes so that an automatic substitution can be made. The marker actually used is defined by the marker operations immediately before and after the MARKER TEXT control string. For example, if a MARKER 2 ON is placed before the message control string, all MARKER 1 ON/OFF codes in the FONT program are automatically replaced with MARKER 2 ON/OFF function codes for execution. The following example FONT program would mark a "C" on the plate.

```
%
PAAAA0043(ASCII "C")
M07
X1Y-.6
M08
Y.6
X-1
Y-.6
M07
Y-.3
M02
```

The following additional items provide information which may prove to be useful in the event that problems are encountered when using the MARKER FONT GENERATOR feature. For additional information on how to setup and enable options in the BURNY 5, see the OPTION ENABLE section in this manual.

NOTES

1) MARKER FONT programs always RUN at the SYSTEM SETUP DATA defined MARKER SPEED, or if zero, the currently defined running speed. Since they are never KERF COMPENSATED or processed for ACCEL/DECEL, all FONT program movements are predefined to RUN at the selected speed with full slowdown at the corners.

2) MARKER FONT movements are never displayed when performing "graphic inspect" operations. They are only shown when actually "running", provided that "real-time" graphic trace operations are active. (Remember that ZOOM operations always clear the previously displayed "real-time" trace images on the GRAPHIC RUN TRACE screen).

3) After the last character of a MARKER FONT string is marked, the MARKER FONT process automatically returns the machine to the text string starting position. Movements down or up the plate for the next text line must be directly defined by the NC program.

4) When running in reverse, MARKER TEXT control strings are ignored when they are encountered. However if the <REV> key is pressed while the MARKER FONT string is actually being processed, the machine will backup through the text movements until the key is released.

5) Although INTERNAL FONT MEMORY does not contain font programs for any of the lower case characters, "@", "$", "^", "?" and any of the symbols with ASCII codes greater than hexadecimal 5F, the user may define and load these fonts as CUSTOM FONT programs in NC PROGRAM MEMORY and/or a RAM CARTRIDGE. However, current FPC software versions do not allow program numbers to be directly entered with leading "AAAA" digits. It only allows these programs to be selected with the up and down cursor keys. Therefore when loading FONT programs through the serial port, the "AAAA00##" type program number can only be defined by the "P" field in the first data block of the file. This value will then override any file number used to identify the program at the remote device.

6) The logic used in the MARKER FONT process allows the programmer to create CUSTOM FONT programs that mark words, phases or images and then call them with a single ASCII character code. No font program size limitation exists since return operations are based on the absolute starting position. The only restriction is that MARKER FONT programs are not permitted to contain MARKER TEXT control string messages. All movements must be directly defined in the FONT program.

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COMMAND MESSAGE OPTION

The COMMAND MESSAGE feature allows the BURNY 5 to send ASCII messages as command strings to an optional RS-422 serial data port as they are encountered in a running NC part program.

This feature requires a second optional RS-422 serial data port to be installed in the control. After this hardware requirement has been satisfied, the COMMAND MESSAGE feature can be enabled by defining and saving the correct keycode value in option number 5. This keycode value, which is based on the serial number of the control and the MPC software version date code, is unique for every control. As such, it can only be obtained from the factory. For additional information, see the OPTION ENABLE section this manual.

The COMMAND MESSAGE feature supports several different data transmission schemes. One allows COMMAND MESSAGE strings to be unconditionally transmitted without any acknowledgement required by the external device. An optional time delay is available in this mode to wait for the device to complete its operation. Another scheme requires COMMAND MESSAGE strings to be acknowledged before the BURNY can continue with the next NC program block. This approach also allows the receiving device to respond with a <NAK> to request a retransmission of the data for verification purposes. A third transmission scheme encloses the NC program COMMAND MESSAGE text in a special "data packet". The format of this packet includes a starting code, an ending code and a checksum value to provide some level of error detection.

COMMAND MESSAGES are defined in an NC program using a program message format that is similar to the format used by the MARKER FONT GENERATOR feature. This allows a COMMAND MESSAGE to be displayed in the normal message field on the last line of the graphics window as it is transmitted to the external device. Generally, only printable ASCII codes can be defined in a NC program message. However, to provide maximum flexibility, the COMMAND MESSAGE feature performs a special substitution on certain character pairs. This allows the programmer to define and send any binary code in the range of 0 to 255 to an external device. See the end of this section for a table of these special character pairs.

The COMMAND MESSAGE option allows the NC programmer to define control strings and messages for transmission out the RS-422 port as special program messages. The following three general string formats are supported:

>20<COMMAND MESSAGE text
>20>format<COMMAND MESSAGE text
>20>format>timeout<COMMAND MESSAGE text

Other control string syntax variations are also supported to simplify programming. These allow the imbedded ">" value delimiter to be replaced with ",","+","-" or " " as shown below. Note that "format" and "timeout" are unsigned values that are not affected by a leading "+" or "-" character.

>20,3,0<COMMAND MESSAGE TEXT
>20+1+5<COMMAND MESSAGE TEXT
>20-2-2<COMMAND MESSAGE TEXT
>20 0 10<COMMAND MESSAGE TEXT

A COMMAND MESSAGE always begins with the ">" character and an operation value in the range of 20 to 29 to indicate that it is not a normal program message. (MARKER FONT TEXT messages begin with >10, >11, >12 or >13). The actual value used defines the type of operation required as follows:

"20" performs the COMMAND MESSAGE transmit while performing a "RUN HOLD" operation. This operation insures that the COMMAND MESSAGE is completely transferred to the external device before the BURNY executes the next program block. Any time delay specified is also allowed to complete before the run process is allowed continue.

"21" causes the BURNY to just setup the COMMAND MESSAGE for transmission and then continue with the execution of the next NC program block. This allows the COMMAND MESSAGE to be transferred while executing additional program blocks. However, only 4 messages can be setup for transfer while continuing to run. If more are attempted, the BURNY automatically performs a "RUN HOLD" operation until all of the messages that were previously setup have been transferred.

"22" performs the same operation as the "20" operation code but also waits for the external device to respond with an acknowledge code (ACK, hexadecimal 06). This operation also allows the external device to request a retransmission of the COMMAND MESSAGE by sending a negative acknowledge code (NAK, hexadecimal 15).

The character code following the ">20" determines which of the general formats is being used. One format allows only the COMMAND text string to follow. Others allow the characteristics of the transfer to be adjusted for each COMMAND MESSAGE defined in the program. The optional "format" value allows the programmer to identify whether or not an automatic carriage return and line feed should be appended to the COMMAND MESSAGE that follows or whether some other supported feature should be used. The optional "timeout" value allows the programmer to specify the delay required before continuing (when no acknowledge is to be performed) or the maximum wait time before terminating with an error (when waiting for the external device to respond).

In the current implementation, the "timeout" value is specified as a 3.2 format value where a value of "10" defines a time of 10.00 seconds. The "format" value field is defined by adding the numeric values for the desired characteristics.

These values are defined as follows:

0=> No special assignments.
1=> Append a carriage return (<CR>, hexadecimal 0D) and a line feed (<LF>, hexadecimal 0A) code to the end of the COMMAND MESSAGE string.
16=> Append an "EXCLUSIVE OR" check byte (<BCC>) to the end of the COMMAND MESSAGE.
32=> Enclose the COMMAND MESSAGE with the characters <STX> (hexadecimal 02) and <ETX> (hexadecimal 03). The <ETX> follows the COMMAND MESSAGE and optional <CR><LF> appended codes but precedes the check byte.

When a value of "49" is placed in the "format" field of the COMMAND MESSAGE program message, all of the currently supported characteristics are selected. Values other than 0, 1, 16, 17, 32, 33, 48 and 49 should not be used since these may enable undesirable features in future software releases.

As an example, assume that the special <SOH> and <EOT> codes are selected by a value of "8000 0000" in SYSTEM CONFIGURATION 3 and the following COMMAND MESSAGE program message is placed in an NC program written in WORD ADDRESS:

(>20,49,5<PART:12345)

The resulting command string sent to the external device will have the following format:

<SOH><STX>PART:12345<CR><LF><ETX><BCC><EOT>

where each of the codes between the < > characters represent a single 8-bit binary code.

As with other ESSI program messages, COMMAND MESSAGE control strings are preceded with a "SKIP DATA ON" function block ("03") and followed by a "SKIP DATA OFF" function block ("04"). In WORD ADDRESS, COMMAND MESSAGE program messages are enclosed within the characters "(" and ")" as follows:

In ESSI:

03
>20<Command message text
>20<More command message text
04

In WORD ADDRESS:

(>20<Command message text)
(>20<More command message text)

Program message fields in the BURNY 5 have a maximum length of 60 characters including the necessary parenthesis or END-OF-BLOCK character codes. Since this character limit must include the text required to identify the message as a special COMMAND MESSAGE and define any special operations and formats required, the number of characters that can be transmitted to the device in a single block is at most 54 characters. This count is further reduced when using two character sequences to define special control codes or 8-bit code values.

When a COMMAND MESSAGE sequence is executed in an NC program, the BURNY displays a status of "RUN-MESSAGE TRANSMIT" as it sends the message out the RS-422 data port. If a time delay is then required or the message must be acknowledged by the external device, the status changes to "WAIT-MESSAGE DELAY" as the BURNY holds position. If the message communication process is successful, the running process continues normally. However if an error is detected and/or the message retry count has been exceeded, the running process displays a status "RUN-**MESSAGE ERROR**", beeps 3 times and retransmits the message to the external device. When performing operations that require an acknowledge from the remote device, a status of "RUN-MESSAGE VERIFY" is displayed until an <ACK> character is received. When in this mode, a <NAK> causes the BURNY to retransmit the COMMAND MESSAGE for verification by the external device.

When backing up, COMMAND MESSAGE strings are currently sent to the remote device. Later, configuration bits may be provided to inhibit message transmission in reverse or enable the transmission of a special control code prefix to indicate the reverse direction, depending on the mode selected by the user through the SYSTEM CONFIGURATION 3 variable.

SETUP/CONFIGURATION:

In the current implementation, COMMAND MESSAGE strings can only be output through the optional RS-422 serial port. With this second serial port, the primary RS-232 serial port remains available for SERIAL DEVICE LOAD and STORE operations while idle or actively running, provided the required MULTITASKING and/or BACKGROUND options have been enabled.

The COMMAND MESSAGE feature can only be used when it has been enabled by a special OPTION 5 code. This code, which is based on the serial number of the BURNY control and the software date code, can only be obtained from the factory. For additional information, see the OPTION ENABLE section in this manual.

Typically only one device will be connected to the RS-422 port. However, special provisions have been made to support more than one device on the RS-422 serial port using a "multi-drop" or "pass-through" configuration. In this configuration, all devices connected to the port "listen" for messages specifically directed to them. When necessary, one and only one targeted device on the port can respond to a given message. Therefore, when multiple devices are connected to the same RS-422 port, all must be intelligent enough to screen only those messages directed to them and ignore all others. If so, the device receiving COMMAND MESSAGES may also reside with the PLC on the same RS-422 link. However, when the programmable controller configuration is not enabled, only COMMAND MESSAGE data is sent out the RS-422 port. When more than one COMMAND MESSAGE device has been connected to the RS-422 link, the COMMAND MESSAGE string defined in the NC program must provide all of the necessary device identification data.

The following default parameter assignments have been made for the COMMAND MESSAGE feature.

9600 BAUD RATE, 8 DATA BITS, ODD PARITY
NO HARDWARE HANDSHAKE
NO AUTOMATIC XON/XOFF HANDSHAKE
NO TIMEOUTS
NO CARRIAGE RETURN/LINE FEED APPEND
NO SPECIAL PACKET FORMATTING CODES

Of these parameters, some can be altered through the high 4 (left most) digits of SYSTEM SETUP DATA variable 39, SYSTEM CONFIGURATION 3. These 4 digits provide format flags in the left 2 digits, a BAUD RATE index in the 3rd digit and a CHARACTER TYPE index in the 4th digit. With the first release, only one flag bit was used. When set, every COMMAND MESSAGE sent out the RS-422 port is preceded by a <SOH> code (hexadecimal 01) and followed by an <EOT> code (hexadecimal 04).. This is provided to automatically enclose the COMMAND MESSAGE and eliminate the possibility of accidentally addressing a PLC on the same serial link. The baud rate and character type index codes allow the user to alter the communication setup that is normally used to communicate with the PLC. However these values will only override the system defaults for BAUD RATE and CHARACTER TYPE when the PLC configuration is NOT enabled by hardware JUMPER B on the I/O card.

NOTE

In order for the BURNY 5 to operate in the normal configuration, without the PLC, JUMPER B must be installed on the I/O card. If it is not, the message "PLC-LINK ERROR" will be displayed repeatedly as it waits for the non-existent PLC to respond to a communication request.

SYSTEM CONFIGURATION 3 (SYSTEM SETUP DATA variable 39) is defined as an 8 digit value. However, only the first 4 digits (D1 to D4) are used by the COMMAND MESSAGE feature. As a result, only a partial description of this parameter follows. For a more complete description, see the SYSTEM SETUP DATA section in this manual.

SYSTEM CONFIGURATION 3 is defined as follows:

D1	D2	D3	D4	D5	D6	D7	D8

where:

"D1" alters the default COMMAND MESSAGE format to include additional characteristics. Currently only one format bit has been assigned. When set with a value of 8, all COMMAND MESSAGES are enclosed in the character codes <SOH> (hexadecimal 01) and <EOT> (hexadecimal 04).

"D2" is currently undefined but should be set to zero to prevent problems in future software releases.

"D3" defines the required BAUD RATE for the optional RS-422 port when NOT operating in the PLC configuration mode as follows:

0=> No assignment made (uses default of 9600 BAUD)
1=> 110 BAUD
2=> 300 BAUD
3=> 600 BAUD
4=> 1200 BAUD
5=> 2400 BAUD
6=> 4800 BAUD
7=> 9600 BAUD
8=> 19200 BAUD

"D4" defines the required CHARACTER TYPE for the optional RS-422 port when NOT operating in the PLC configuration mode as follows:

0=> No assignment (uses default of 8 DATA, ODD PARITY)
1=> 7 DATA BITS, NO PARITY
2=> 8 DATA BITS, NO PARITY
3=> 7 DATA BITS, EVEN PARITY
4=> 8 DATA BITS, EVEN PARITY
5=> 7 DATA BITS, ODD PARITY
6=> 8 DATA BITS, ODD PARITY
7=> EIA CODES (uses ODD PARITY), NOT RECOMMENDED

"D5" is currently undefined but should be set to zero to prevent problems in future software releases.

"D6" is currently undefined but should be set to zero to prevent problems in future software releases.

"D7" is currently undefined but should be set to zero to prevent problems in future software releases.

"D8" is currently undefined but should be set to zero to prevent problems in future software releases.

Later, SYSTEM SETUP DATA variable 39 may be used to enabled and/or select other COMMAND MESSAGE variations such as custom communication protocols, the number of retries required before giving up, and whether or not communication errors and a failure to respond to the message should force a "cycle stop" condition or just display a warning message and continue.

Miscellaneous items:

1) The character format used when sending data out the serial port is independent of the format used when loading the NC program. Programs loaded using ODD PARITY EIA are internally stored in an ASCII character format. During this conversion, any undefined EIA code encountered while loading is automatically deleted from the program. In addition, EIA codes greater than hexadecimal 80 are also deleted from the program. As a result, only valid character codes should be used when using ODD PARITY EIA formats. It is recommended that only ASCII character formats be used when loading programs that contain COMMAND MESSAGE strings and that only ASCII data formats be used in communications with the external device.

2) Since only printable ASCII character codes can be retained in a program message, special two character code sequences are supported to define non-printable control codes and 8-bit code values for transmission to the external device. These two character sequences are retained in the program message for display on the last line of the graphics window but are converted into a single 8-bit code for transmission to the external device. The "&" character is used to signal an ASCII control code sequence which removes the >40 bit from the following character code value. The "!" character is used to perform both a >40 bit clear and a >80 bit set in the following character value. The "$" character is used to signal an 8-bit value sequence which causes the >C0 bits to be set in the following character code value. Since these three codes are used to signal the special code definition, they must be specified twice in order to define a single "&", "!" or "$" code for transmission and override the special character code process. The following tables identify the two character sequences that are supported and the resulting 8-bit code value in hexadecimal. Note that other two character sequences also exist. However these sequences result in a value which can be directly assigned using a single printable ASCII code. For example, the sequence "&k" defines a code value of >2B which is the ASCII code for "+".

For codes that require special definitions in some cases:

"&`" >20=SPACE (DEFINES SPACE AT END OF ESSI MESSAGE)
"&h" >28="(" (DEFINES "(" IN WORD ADDRESS MESSAGE)
"&i" >29=")" (DEFINES ")" IN WORD ADDRESS MESSAGE)
"&?" >7F=DEL (DEFINES NON-PRINTABLE DELETE CODE)

For ASCII control codes (less than hexadecimal 20):

"&@"	>00	"&H"	>08	"&P"	>10	"&X"	>18
"&A"	>01	"&I"	>09	"&Q"	>11	"&Y"	>19
"&B"	>02	"&J"	>0A	"&R"	>12	"&Z"	>1A
"&C"	>03	"&K"	>0B	"&S"	>13	"&["	>1B
"&D"	>04	"&L"	>0C	"&T"	>14	"&\"	>1C
"&E"	>05	"&M"	>0D	"&U"	>15	"&]"	>1D
"&F"	>06	"&N"	>0E	"&V"	>16	"&^"	>1E
"&G"	>07	"&O"	>0F	"&W"	>17	"&_"	>1F

For 8 bit character codes (higher than hexadecimal 80):

"!@"	>80	"!H"	>88	"!P"	>90	"!X"	>98
"!A"	>81	"!I"	>89	"!Q"	>91	"!Y"	>99
"!B"	>82	"!J"	>8A	"!R"	>92	"!Z"	>9A
"!C"	>83	"!K"	>8B	"!S"	>93	"!["	>9B
"!D"	>84	"!L"	>8C	"!T"	>94	"!\"	>9C
"!E"	>85	"!M"	>8D	"!U"	>95	"!]"	>9D
"!F"	>86	"!N"	>8E	"!V"	>96	"!^"	>9E
"!G"	>87	"!O"	>8F	"!W"	>97	"!_"	>9F
"!`"	>A0	"!h"	>A8	"!p"	>B0	"!x"	>B8
"!a"	>A1	"!i"	>A9	"!q"	>B1	"!y"	>B9
"!b"	>A2	"!j"	>AA	"!r"	>B2	"!z"	>BA
"!c"	>A3	"!k"	>AB	"!s"	>B3	"!;"	>BB
"!d"	>A4	"!l"	>AC	"!t"	>B4	"!<"	>BC
"!e"	>A5	"!m"	>AD	"!u"	>B5	"!="	>BD
"!f"	>A6	"!n"	>AE	"!v"	>B6	"!>"	>BE
"!g"	>A7	"!o"	>AF	"!w"	>B7	"!?"	>BF
"$@"	>C0	"$H"	>C8	"$P"	>D0	"$X"	>D8
"$A"	>C1	"$I"	>C9	"$Q"	>D1	"$Y"	>D9
"$B"	>C2	"$J"	>CA	"$R"	>D2	"$Z"	>DA
"$C"	>C3	"$K"	>CB	"$S"	>D3	"$["	>DB
"$D"	>C4	"$L"	>CC	"$T"	>D4	"$\"	>DC
"$E"	>C5	"$M"	>CD	"$U"	>D5	"$]"	>DD
"$F"	>C6	"$N"	>CE	"$V"	>D6	"$^"	>DE
"$G"	>C7	"$O"	>CF	"$W"	>D7	"$_"	>DF
"$`"	>E0	"$h"	>E8	"$p"	>F0	"$x"	>F8
"$a"	>E1	"$i"	>E9	"$q"	>F1	"$y"	>F9
"$b"	>E2	"$j"	>EA	"$r"	>F2	"$z"	>FA
"$c"	>E3	"$k"	>EB	"$s"	>F3	"$;"	>FB
"$d"	>E4	"$l"	>EC	"$t"	>F4	"$<"	>FC
"$e"	>E5	"$m"	>ED	"$u"	>F5	"$="	>FD
"$f"	>E6	"$n"	>EE	"$v"	>F6	"$>"	>FE
"$g"	>E7	"$o"	>EF	"$w"	>F7	"$?"	>FF

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KNIFE OPTION

The KNIFE feature allows the BURNY to perform a special type of KERF compensation process that modifies the cut path to counter act the rounding effects of the swivel knife offset. Generally, this process extends the end points of lines and arcs (and adds the necessary arc fill-in blocks) so that sharp corners can be cut correctly. When this option is enabled, an additional prompt appears on the RUN SETUP and BATCH SETUP screens to allow its selection. If not selected, normal KERF processing can be selected and a "DIAL IN KERF" value may still be entered. However, when KNIFE processing is selected, the normal "DIAL IN KERF" function is bypassed since both cannot be used at the same time in a program.

Two special SYSTEM SETUP DATA variables are used by the KNIFE process. They are the KNIFE COMPENSATION ROTATE DIAMETER (variable number 34) and the KNIFE COMPENSATION BREAKPOINT ANGLE (variable number 35). These variables must be defined before the KNIFE compensation process is actually performed on a program. For additional information on these variables, see the SYSTEM SETUP DATA VARIABLES section in this manual.

To be operational, the KNIFE feature must be enabled by defining a special "KEYCODE" value as option number 9 and saving the value in non-volatile memory. For additional information, see the OPTION ENABLE PROCESS section in this manual.

NOTE

Like NC programs that require KERF compensation, programs requiring KNIFE compensation must also contain a LEFT KERF or RIGHT KERF auxiliary function code. If not, no KERF or KNIFE prompting operations will be performed.

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PART 6 - OPTIONAL CONFIGURATION

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PROGRAMMABLE LOGIC CONTROLLER

This section contains specific setup, programming and interface documentation for use in the **BURNY 5**/PROGRAMMABLE LOGIC CONTROLLER system configuration, hereafter referred to as the "PLC SYSTEM". Much of the information contained in this section duplicates and/or consolidates information that is provided in other places in this manual.

NOTE

This manual section supersedes the information previously contained in the separate **BURNY 5**/PROGRAMMABLE CONTROLLER SYSTEM manual (AO-73109). That manual, which only described operations performed with WORD ADDRESS programs, has been discontinued.

JUMPER REQUIREMENT

Support for PLC SYSTEM operations has been incorporated into the standard software version and can be enabled via a system jumper.

Jumper 5J on the I/O card provides a set of 8 jumpers labeled "A" through "H". Removing jumper 5J-B enables programmable I/O operations for the CPU / Data Communication Unit (CPU / DCU) module pair.

Removing jumper 5J-D (without removing 5J-B) enables programmable I/O operations for the TI 335 PLC, which contains a built-in serial communications port. This CPU provides higher speed, and improves the performance of larger, more time critical logic programs often found in larger applications. Also, you may set and monitor I/O and data registers while executing logic and performing communications with the BURNY 5. (The CPU / DCU module pair disables these operatons when communications are on-line.)

Notes for TI 335 PLC:

1) MPC software version 8/10/94 or above must be installed in the control since older versions do not use jumper D.
2) The four secondary RS-422/RS-232 port jumpers on the BURNY I/O card must be switched to RS-232.
3) New "PLC to BURNY" cabling must be provided. The TI 335 uses a special four-wire modular plug (compatible with the handset cord on a telephone, not the wall plug) instead of the 25-pin D-shell connector used on the DCU module.

Several changes were made in the 8/10/94 software version to help identify the format selected by the "B" and "D" jumpers. Whenever programmable I/O operations are enabled by one of these jumpers, digits 3 and 4 in SYSTEM SETUP DATA variable 39 (SYSTEM CONFIGURATION 3), are forced to the required baud rate and character type index values, for display purposes only. Any attempt to change these parameters through this variable will be ignored by the control. When "B" is removed (for CPU / DCU support), the value is displayed as **7D**** (* indicates a user-defined value). When "D" is removed (with jumper B installed, for TI 335 PLC CPU support), the value is displayed as **79****.

To display the jumper positions, first select "1. DISPLAY SYSTEM DATA" from the UTILITIES menu and then select "2. RUNTIME DATA". SYSTEM SETUP DATA variable 20, MPC SYSTEM JUMPERS, shows these jumpers as an 8 digit value in reverse order with 0 indicating the jumper is "ON" and 1 indicating "OFF".

The following shows the typical jumper setting with programmable I/O enabled. (Note jumper "B" is "1").

H	G	F	E	D	C	B	A
1	0	0	0	0	0	1	1

Nearly every function of the standard **BURNY 5** remains the same in the PLC SYSTEM. Differences in operation are caused by the fact that all cutting and auxiliary function logic operations are performed by a "ladder logic" program executing in the programmable controller. Operations between the PLC and the **BURNY 5** are coordinated by the transmission of status, keyboard and function code data messages which are sent through an RS-422 communication link. This occasionally causes the status message at the bottom of the screen to change while the transfer is in progress.

Whenever one of the drive related keys is pressed (RECYCLE, STOP, GO, JOGS, "A" - "E", etc.), a keyboard data message is sent from the **BURNY** to update the necessary data registers in the PLC. This allows the PLC "ladder logic" program to continuously monitor these keys and perform the appropriate operations when pressed. The **BURNY 5** PLC SYSTEM always keeps the communication link active, even when performing serial I/O LOAD and STORE operations. This allows jog operations and other special operations activated by the "A" through "E" keys to always be performed. The transmission of this message may cause the status message at the bottom of the screen to briefly change to "PLC-LINK BUSY" before restoring the previously displayed status message. However if communications cannot be performed because the PLC is not "on line" or not properly connected to the **BURNY**, the status message will change to "PLC-*** LINK ERROR ***" and the warning beeper will continuously repeat until communications with the PLC are re-established.

Major internal operating differences exist when a program is RUN in the PLC SYSTEM since all cutting logic is performed by the PLC and not the **BURNY 5**. In order for the PLC to perform this logic (and any other logic associated with markers, multiple torches, etc.), the **BURNY** sends auxiliary function code values to the PLC as they are encountered in a running program. The PLC then performs the required logic operations. When necessary, the PLC can force the BURNY to delay before continuing with the NC program.

Although no special programming formats are required when creating part programs for use in the PLC SYSTEM, the PLC SYSTEM must be configured to execute either WORD ADDRESS or ESSI programs. Both program types can not be supported do to differences in the function code values. In the PLC SYSTEM, these code values are sent from the **BURNY** to the PLC for processing in its "ladder logic" program. The duplication of values between WORD ADDRESS "M" codes and ESSI function codes makes it impossible to support both formats. The format type selected is determined by the function code assignments made in the CUSTOM AUXILIARY CODE CONVERSION table. The first 28 entries in this table must all be defined using WORD ADDRESS codes or ESSI codes to satisfy PLC SYSTEM requirements.

In order to support the special auxiliary code processing requirements of the PLC SYSTEM, several special internal function codes have been added to the **BURNY 5**. One allows the user to define an auxiliary code as a "TRANSMIT TO PLC AND CONTINUE TO RUN" operation and another as a "TRANSMIT TO PLC AND WAIT FOR VERIFICATION". To access these special functions, the user must setup the CUSTOM AUXILIARY CODES table and perform all LOAD, STORE and EDIT operations using the required program format type (WORD ADDRESS or ESSI). In a WORD ADDRESS PLC SYSTEM, "STANDARD WORD ADDRESS" or "CUSTOM WORD ADDRESS 3" must be used since only these program types support CUSTOM AUXILIARY CODE CONVERSION operations. In an ESSI PLC SYSTEM, either "STANDARD ESSI" or "CUSTOM ESSI 1" may be used. Other formats should not be used since they do not support the special functions that may be required by the PLC for proper operation.

SYSTEM SETUP DATA REQUIREMENTS

As in the standard **BURNY 5** system, the SYSTEM SETUP DATA parameters must be set to the values supplied by the cutting machine manufacturer for proper machine operation. However when programmable I/O is enabled, four of these values are not applicable since they are associated with the PLASMA ARC, OXYGEN BLEED OFF and MARKER DELAY TIMER operations that are performed by the programmable controller. Values may be defined for these setup variables but they will not be used. The following setup data parameters are not used in the PLC SYSTEM:

11. PLASMA ARC DELAY	: 0
12. PLASMA ARC OFF DELAY	: 0
13. OXYGEN FUEL BLEEDOFF	: 0
25. MARKER DELAY	: 0

The only other difference in the setup data in the PLC SYSTEM is that the CUSTOM AUXILIARY CODES feature is always enabled for use with the "STANDARD WORD ADDRESS", "STANDARD ESSI", "CUSTOM WORD ADDRESS 3" and "CUSTOM ESSI 1" program formats regardless of the values in variable 51, STANDARD PROGRAM FORMAT, or variable 52, CUSTOM PROGRAM FORMAT.

For additional setup information on program feedrate, digital feedrate, auxiliary torch and other special functions supported in the standard **BURNY 5** system, see the SYSTEM SETUP DATA and CUSTOM AUXILIARY I/O sections in this manual.

CUSTOM AUXILIARY CODE TABLE REQUIREMENTS

Along with the setup variables, the CUSTOM AUXILIARY CODE table accessed through the "SETUP/CONFIGURATION" utilities menu must be setup based on the definitions supplied by the cutting machine manufacturer. If not defined before attempting to RUN a program, "STOP-AUX TABLE ERROR" is displayed and program execution is inhibited.

The CUSTOM AUXILIARY CODES table requires every internal function to be assigned at least one auxiliary code value. These values are used by the **BURNY**, when it executes an internally created STANDARD SHAPE program or TAUGHT PART program, to convert the internal operations such as "CUT ON" to the correct external function code value.

NOTE

> Although "M" and "G" function code values can both be specified in the first 28 entries in a WORD ADDRESS PLC SYSTEM, only "M" code values will actually be sent to the PLC when running a part. "G" code values only affect the operation of the **BURNY** and do not involve the PLC. However when the PLC is configured for ESSI formats, all ESSI function codes are sent to the PLC for processing, regardless of the internal function code assignments made.

In the normal **BURNY 5** configuration, the CUSTOM AUXILIARY CODE table is only used to define additional function codes or re-assign standard code values to other functions. Although space exists for up to 100 definitions, only the first few entries are typically used. However when programmable I/O operations are enabled, the function definitions for the first 28 table entries are forced to specific internal function values and the user must assign an auxiliary code type and value for each function.

NOTE

Through these 28 entries the user establishes the PLC SYSTEM type as WORD ADDRESS or ESSI. Therefore, all 28 entries must be of the same program type. If not, a "AUX TABLE SETUP ERROR" message is displayed when the user attempts to RUN a program.

DEFAULT AUXILIARY CODE DEFINITIONS

Whenever the first 28 required function assignments are not defined, the user can force the **BURNY** to automatically assign default WORD ADDRESS or ESSI function values for these entries by defining "G00=00:NO OPERATION" or " 0=00:NO OPERATION" as the first table entry. The system will then define the required table entries, based on the function code type specified, as follows:

	IF WORD ADDRESS:	IF ESSI:
1.	M03 = 5:CUT OFF	8 = 5:CUT OFF
2.	M04 = 6:CUT ON	7 = 6:CUT ON
3.	M70 = 12:OFFSET 1 OFF	12 = 12:OFFSET 1 OFF
4.	M71 = 13:OFFSET 1 ON	11 = 13:OFFSET 1 ON
5.	G40 = 7:KERF OFF	38 = 7:KERF OFF
6.	G41 = 8:KERF LEFT	29 = 8:KERF LEFT
7.	G42 = 9:KERF RIGHT	30 = 9:KERF RIGHT
8.	M00 = 21:PROGRAM STOP	0 = 21:PROGRAM STOP
9.	G70 = 14:INCH DIMENSIONS	70 = 14:INCH DIMENSIONS
10.	G71 = 15:MM DIMENSIONS	71 = 15:MM DIMENSIONS
11.	G97 = 3:CHAIN TOP	97 = 3:CHAIN TOP
12.	G98 = 4:CHAIN BOTTOM	98 = 4:CHAIN BOTTOM
13.	G45 = 20:LEAD-IN DIM. MOVE	89 = 20:LEAD-IN DIM. MOVE
14.	G04 = 19:PROGRAMMABLE DWELL	41 = 19:PROGRAMMABLE DWELL
15.	G90 = 16:ABS. PROGRAM DIM.	82 = 16:ABS. PROGRAM DIM.
16.	G91 = 18:INCR. PROGRAM DIM.	81 = 18:INCR. PROGRAM DIM.
17.	G92 = 17:ABS. POS. REG. LOAD	83 = 17:ABS. POS. REG. LOAD
18.	M72 = 29:OFFSET 2 OFF	16 = 29:OFFSET 2 OFF
19.	M73 = 28:OFFSET 2 ON	15 = 28:OFFSET 2 ON
20.	G00 = 31:HIGH SPEED MODE	5 = 31:HIGH SPEED MODE
21.	G01 = 30:CUT SPEED MODE	6 = 30:CUT SPEED MODE
22.	G77 = 34:EXT. VARIABLE LOAD	84 = 34:EXT. VARIABLE LOAD
23.	G78 = 35:X AXIS HOME	85 = 35:X AXIS HOME
24.	G79 = 36:Y AXIS HOME	86 = 36:Y AXIS HOME
25.	G80 = 37:X HOME DIM. RETURN	87 = 37:X HOME DIM. RETURN
26.	G81 = 38:Y HOME DIM. RETURN	88 = 38:Y HOME DIM. RETURN
27.	M02 = 22:PROGRAM END	90 = 22:PROGRAM END
28.	M30 = 23:PGM. END WITH REWIND	64 = 23:PGM. END WITH REWIND

MACHINE MANUFACTURER AUX CODE DEFINITIONS

Although default values can be provided by the system, the machine manufacturer should provide definitions for all necessary auxiliary functions in the CUSTOM AUXILIARY CODE table so that PLC logic operations can be performed as programmed.

NOTE

The look-up process only scans from the first table entry to the first undefined table entry.

AUXILIARY CODE VALUES DEFINED BY MACHINE MANUFACTURER:

1.	____= 5:CUT OFF	51.	____=___:_____
2.	____= 6:CUT ON	52.	____=___:_____
3.	____= 12:OFFSET 1 OFF	53.	____=___:_____
4.	____= 13:OFFSET 1 ON	54.	____=___:_____
5.	____= 7:KERF OFF	55.	____=___:_____
6.	____= 8:KERF LEFT	56.	____=___:_____
7.	____= 9:KERF RIGHT	57.	____=___:_____
8.	____= 21:PROGRAM STOP	58.	____=___:_____
9.	____= 14:INCH DIMENSIONS	59.	____=___:_____
10.	____= 15:MM DIMENSIONS	60.	____=___:_____
11.	____= 3:CHAIN TOP	61.	____=___:_____
12.	____= 4:CHAIN BOTTOM	62.	____=___:_____
13.	____= 20:LEAD-IN DIM. MOVE	63.	____=___:_____
14.	____= 19:PROGRAMMABLE DWELL	64.	____=___:_____
15.	____= 16:ABS. PROGRAM DIM.	65.	____=___:_____
16.	____= 18:INCR. PROGRAM DIM.	66.	____=___:_____
17.	____= 17:ABS. POS. REG. LOAD	67.	____=___:_____
18.	____= 29:OFFSET 2 OFF	68.	____=___:_____
19.	____= 28:OFFSET 2 ON	69.	____=___:_____
20.	____= 31:HIGH SPEED MODE	70.	____=___:_____
21.	____= 30:CUT SPEED MODE	71.	____=___:_____
22.	____= 34:EXT. VARIABLE LOAD	72.	____=___:_____
23.	____= 35:X AXIS HOME	73.	____=___:_____
24.	____= 36:Y AXIS HOME	74.	____=___:_____
25.	____= 37:X HOME DIM. RETURN	75.	____=___:_____
26.	____= 38:Y HOME DIM. RETURN	76.	____=___:_____
27.	____= 22:PROGRAM END	77.	____=___:_____
28.	____= 23:PGM END WITH REWIND	78.	____=___:_____
29.	____=___:_____	79.	____=___:_____
30.	____=___:_____	80.	____=___:_____
31.	____=___:_____	81.	____=___:_____

32. ____=___:_____
33. ____=___:_____
34. ____=___:_____
35. ____=___:_____
36. ____=___:_____
37. ____=___:_____
38. ____=___:_____
39. ____=___:_____
40. ____=___:_____
41. ____=___:_____
42. ____=___:_____
43. ____=___:_____
44. ____=___:_____
45. ____=___:_____
46. ____=___:_____
47. ____=___:_____
48. ____=___:_____
49. ____=___:_____
50. ____=___:_____

82. ____=___:_____
83. ____=___:_____
84. ____=___:_____
85. ____=___:_____
86. ____=___:_____
87. ____=___:_____
88. ____=___:_____
89. ____=___:_____
90. ____=___:_____
91. ____=___:_____
92. ____=___:_____
93. ____=___:_____
94. ____=___:_____
95. ____=___:_____
96. ____=___:_____
97. ____=___:_____
98. ____=___:_____
99. ____=___:_____
100. ____=___:_____

AUXILIARY CODE TABLE DISPLAY/MODIFY UTILITIES

To display or modify the CUSTOM AUXILIARY CODE table, select "6. UTILITIES" from the MAIN MENU. Then to display the table, select "1. DISPLAY SYSTEM DATA" and then "6. CUSTOM AUXILIARY CODES". The system will then display the first 40 entries of the code table. Additional entries can be displayed by using the I and II keys.

To modify the CUSTOM AUXILIARY CODE table, select "4. SETUP/CONFIGURATION" from the UTILITIES menu and enter the password followed by ENTER. Once the configuration menu is displayed, select "5. CUSTOM AUXILIARY CODES". The system will then display the first table entry using the following:

```
TABLE NUMBER   : 1
CODE TYPE      :
CODE VALUE     :
FUNC. NUMBER   : 5
FUNC. NAME     : CUT OFF
```

Once displayed, a white numeric value will be displayed in the "TABLE NUMBER" field indicating that this value is currently selected. To display a specific table entry, either scroll to the desired entry with the up and down cursor keys or directly specify the entry's number and press ENTER. Once displayed, the entry can be modified by pressing ENTER to select the "CODE TYPE" field. This field, like others, can also be modified using either the up and down cursor keys or directly entering the number of the desired code type (0=BLANK, 1=ESSI, 2="G" and 3="M"). Pressing ENTER again advances to the "CODE VALUE" field where the function code value (0-99) is entered. The "FUNC NUMBER" field is use to enter the index of the desired internal function. When entered numerically or selected by scrolling, the "FUNC NAME" field is automatically updated to identify the selected function. The following function index values are currently supported:

0. NO OPERATION
1. CLOCKWISE ARC
2. COUNTER-CLOCKWISE ARC
3. CHAIN TOP
4. CHAIN BOTTOM
5. CUT OFF
6. CUT ON
7. KERF OFF
8. KERF LEFT
9. KERF RIGHT
10. MARKER 1 OFF
11. MARKER 1 ON

12. OFFSET 1 OFF
13. OFFSET 1 ON
14. INCH DIMENSIONS
15. MILLIMETER DIMENSIONS
16. ABSOLUTE PROGRAM DIMENSIONS
17. ABSOLUTE POSITION REGISTER LOAD
18. INCREMENTAL PROGRAM DIMENSIONS
19. PROGRAMMABLE DWELL
20. LEAD-IN DIMENSION MOVE
21. PROGRAM STOP
22. PROGRAM END
23. PROGRAM END WITH REWIND
24. PROGRAM DATA SKIP ON (IGNORES DATA)
25. PROGRAM DATA SKIP OFF (PROCESSES DATA)
26. MARKER 2 ON
27. MARKER 2 OFF
28. OFFSET 2 ON
29. OFFSET 2 OFF
30. CUT SPEED MODE
31. HIGH SPEED MODE
32. XMIT TO PLC BEFORE MOVE AND RUN
33. XMIT TO PLC AFTER MOVE AND WAIT
34. EXTERNAL VARIABLE LOAD
35. X AXIS HOME
36. Y AXIS HOME
37. X HOME DIMENSION RETURN
38. Y HOME DIMENSION RETURN
39. MULTI SETUP SELECT
40. AUX OUTPUT 1 ON
41. AUX OUTPUT 1 OFF
42. AUX OUTPUT 2 ON
43. AUX OUTPUT 2 OFF
44. AUX OUTPUT 3 ON
45. AUX OUTPUT 3 OFF
46. AUX OUTPUT 4 ON
47. AUX OUTPUT 4 OFF
48. AUX INPUT 1 ON
49. AUX INPUT 1 OFF
50. AUX INPUT 2 ON
51. AUX INPUT 2 OFF
52. AUX INPUT 3 ON
53. AUX INPUT 3 OFF
54. AUX INPUT 4 ON
55. AUX INPUT 4 OFF
56. PART INCREMENT

57. PROGRAMMABLE FEEDRATE
58:HOME OFFSET
59:PROGRAMMED KERF
60:AUX STATE RESET
61:NO MIRROR, NO SWAP (NORMAL)
62:MIRROR Y, NO SWAP
63:MIRROR X/Y, NO SWAP
64:MIRROR X, NO SWAP
65:SWAP X/Y, MIRROR X/Y
66:SWAP X/Y, MIRROR X
67:SWAP X/Y, NO MIRROR
68:SWAP X/Y, MIRROR Y
69:MASTER TORCH ON
70:MASTER TORCH OFF
71:INC LINE IN2 MM0
72:INC CW ARC IN2 MM0
73:INC CCW ARC IN2 MM0
74:INC LINE IN3 MM1
75:INC CW ARC IN3 MM1
76:INC CCW ARC IN3 MM1
77:ABS LINE IN2 MM0
78:ABS CW ARC IN2 MM0
79:ABS CCW ARC IN2 MM0
80:ABS LINE IN3 MM1
81:ABS CW ARC IN3 MM1
82:ABS CCW ARC IN3 MM1
83:X SIGN TOGGLE
84:Y SIGN TOGGLE
85:X/Y SWAP TOGGLE
86:OFFSET 3 ON
87:OFFSET 3 OFF
88:OFFSET 4 ON
89:OFFSET 4 OFF
90:OFFSET 5 ON
91:OFFSET 5 OFF
92:OFFSET 6 ON
93:OFFSET 6 OFF
94:OFFSET 7 ON
95:OFFSET 7 OFF
96:OFFSET 8 ON
97:OFFSET 8 OFF

NOTE

The CUSTOM AUXILIARY CODE definition table is retained in battery-backed program memory. Therefore, whenever the "3. DIRECTORY SUPPORT" utility "4. ERASE AND TEST" is performed on program memory, the custom auxiliary code definitions are also cleared.

SPECIAL INTERNAL FUNCTIONS FOR USE WITH PLC

Several internal functions have been added to the **BURNY 5**. Some of these can be used in both the standard configuration and the PLC configuration. Others are only operable in the PLC configuration.

FUNCTIONS 30/31 - CUT SPEED / HIGH SPEED MODE

These functions allow the executing part program to specify whether cutting speed (operator controlled) or high traverse speed is to be used. They are both operational in the standard and PLC configurations. Programmable feedrate operations can also be enabled for operation. This allows an executing NC program to also specify the desired cutting speed (if properly setup and enabled). The following formats are supported:

In WORD ADDRESS:		In ESSI:	
G00	"HIGH SPEED"	5	"RAPID ON"
G01	"CUT SPEED"	6	"RAPID OFF"
G01F150	"PROGRAMMED SPEED"	39+150	"PROGRAMMED SPEED"

NOTE

Several of the internal codes automatically select cutting or traverse speed. For example, the "CUT ON" function will always run at cutting speed. Therefore if an external "M" code is defined as the internal "CUT ON" function, it will automatically run at cutting speed without an additional cut speed mode code required.

FUNCTION 32 - XMIT TO PLC BEFORE MOVE AND RUN

Normally, all WORD ADDRESS and ESSI function codes cause the machine to stop motion until the **BURNY** has received a verification from the PLC that it was processed. Then, the **BURNY** continues along the programmed path. However, some auxiliary functions are supposed to act "on the run" where they are transmitted but do not require a wait for verification. For example, torch height sensor on/off while cut is in progress. These auxiliary functions must be defined in the table as FUNCTION TYPE 32 so that they do not cause the automatic slowdown.

FUNCTION 33 - XMIT TO PLC AFTER MOVE AND WAIT

The communication link between the **BURNY** and PLC is used to send auxiliary function values to the PLC as they are encountered in a part program. This special PLC function allows the user to define a non-standard execution sequence when function codes are included in the same program block with program dimensions. In ESSI programs, this function is not required because only one function can be defined in each program block.

When using WORD ADDRESS, multiple functions may be defined in the same program block or with a dimension move. "M" codes assigned to one of the internal **BURNY** functions ("CUT ON" for example) can be sent either before or after any X/Y moves in the same block based on the internal function definition ("CUT ON" happens before the move, "CUT OFF" happens after the move). However, undefined "M" codes which are not assigned to internal functions are normally sent before any X/Y moves in the block. This function, FUNCTION TYPE 33, can be used to force internally undefined functions to be sent after the X/Y move.

NOTE

For simplicity, WORD ADDRESS programs should be written so that each data block performs only one function. Dimension blocks should only contain the X/Y dimension data and auxiliary code blocks should contain only 1 "M" or "G" code. This will eliminate any ambiguity as to when the function will actually be sent to the PLC.

FUNCTION 34 - EXTERNAL VARIABLE LOAD

This function allows a part program to directly transfer data to any one of the internal data registers in the programmable controller. Special register allocations may be provided by the machine manufacturer.

Two data formats are supported. One allows the user to specify data in Binary-Coded-Decimal (BCD) format with a value range of 0 to 9999. In this format, each digit is represented as a 4 bit value. Thus, the BCD value of 1234 is encoded as the binary value:

0001 0010 0011 0100 (HEXADECIMAL 1234)

The other allows the user to specify data in a fixed decimal format with a value range of 0 to 655.35 or -327.67 to +327.67, depending on how the PLC logic program chooses to decode the data. In this format, the value is converted from decimal to binary and scaled to a .01 resolution per count. Thus, the fixed decimal value of 12.34 is encoded as the binary value:

0000 0100 1101 0010 (HEXADECIMAL 04D2 or DECIMAL 1234)

and a fixed decimal value of -12.34 is encoded as:

1111 1011 0010 1110 (HEXADECIMAL FB2E or DECIMAL -1234)

In the following examples, the WORD ADDRESS "G77" code and the ESSI "77" auxiliary code values are used for the external variable load function. However any WORD ADDRESS "M" or "G", or ESSI code can be assigned to this function using the CUSTOM AUXILIARY CODE table.

EXAMPLE 1: To load PLC register 15 with the BCD data value 1234, the program block would be:

In WADR: G77 V15 B1234 ("B" INDICATES A BCD VALUE)
In ESSI: 77+15+1234

EXAMPLE 2: To load PLC register 16 with the binary representation of the fixed decimal data value 12.34, the program block would be:

In WADR: G77 V16 F12.34 ("F" INDICATES FIXED DEC.)
In ESSI: 77+16++1234 (Note the double "+" signs)

NOTE

This function is not modal. All the information (aux code, variable number and data value) must appear in the same program block.

FUNCTIONS 35/36 - X/Y AXIS HOME

These two functions cause the machine to begin a search for the respective X/Y home limit switch and then the home index pulse from the axis encoder. (See the interface specifications that follow for the hardware details on the home switch and index pulse). When one of these functions is executed, the machine will move at high traverse speed toward the home limit switch. As soon as the switch is detected, it will decelerate to a 12 IPM creep speed and continue moving in the same direction while searching for the home index pulse from the encoder. At this speed, it can accurately detect the home position to the exact encoder count. As soon as the index pulse is found, the machine will stop at the home coordinates. This is now the current program position so any subsequent moves should be dimensioned from this position. This also applies to absolute programs since the home function will reset the current absolute position to the home position as if an "ABSOLUTE POSITION REGISTER LOAD" had been performed.

FUNCTIONS 37/38 - X/Y HOME DIMENSION RETURN

These two functions affect only their respective axis and are only operable after the home position for that axis has been established by a previously executed "X AXIS HOME" or "Y AXIS HOME" function. After a "home" operation is performed, all dimensions are relative to the new home position so there is no way for the program to "know" how far the machine moved to find its hardware home position. These two functions resolve this problem. Whenever the "HOME DIMENSION RETURN" function is executed, the machine moves away from the hardware home position by the exact incremental distance that the machine moved in order to find the home in the first place. If there are no other X/Y moves between the "AXIS HOME" and "DIMENSION RETURN" functions, the machine will end up at the same position it started. This function is used on machines which provide automatic torch spacing so that the torches can be homed and spaced and then the machine returned to its original position.

STATUS MESSAGES

One observable difference between the operation of the **BURNY** with and without the programmable controller occurs in the status window at the bottom of the screen. Since the **BURNY** no longer controls the cutting process when programmable I/O is enabled, many of the normal status messages are not applicable. Instead, a "RUN-NORMAL CYCLE" status message has been created for display while cutting operations are active. Several status messages have also been added for "home" and other PLC related operations. They are as follows:

"RUN-NORMAL CYCLE"	- A part program is running.
"STOP-** E-STOP INPUT **"	- When E-STOP is pending, the **BURNY** stops program execution and disables its outputs. Once the E-STOP condition is removed, press <GO> to resume operations.
"STOP-AUX TABLE ERROR"	- The custom auxiliary code conversion table does not contain the correct data for the PLC link. Setup the custom auxiliary code table values through the "setup/configuration" utilities menu and re-run the part.
"SEARCH-X HOME SWITCH"	- An X axis home command in the part program has caused the **BURNY** to move toward the X home position switch. Once the switch is found, the status window will briefly display the switch found message and then begin searching for the X home encoder index PULSE.
"SEARCH-X INDEX"	- The X home switch was found and the **BURNY** is now searching for X home index pulse. When found, the **BURNY** will stop at the home position.
"SEARCH-Y HOME SWITCH"	- Same as the function described above for the X axis.

"SEARCH-Y INDEX"	- Same as the function described above for the X axis.
"SEARCH-SWITCH FOUND"	- This switch found message is briefly displayed when either the X or Y home switch has been found.
"PLC-LINK BUSY"	- Communication between **BURNY** and PLC is in progress.
"PLC-VERIFY READBACK"	- THE **BURNY** is waiting for verification that a message previously transmitted has been executed by PLC before continuing.
"PLC-*** LINK ERROR ***"	- An error has occurred in the communication between the **BURNY** and PLC. Communications will be continuously retried until successful.

BURNY 5 / PLC INTERFACE SPECIFICATION

The following sections contain PLC SYSTEM specific information related to both hardware and software requirements. The hardware specific data presented in these sections describes the special hardware required for communications and the optional hardware required for hardware "HOME" operations. PLC data register assignments are also provided..

BURNY AC POWER CONNECTION

32RECP-1	115VAC POWER
32RECP-34	115VAC POWER
32RECP-18,19	EARTH GROUND

HOME SWITCH AND ENCODER INDEX PULSE

Each axis is capable of finding a home limit switch and then searching for an index pulse from the axis encoder. When the **BURNY** starts a home search, it will move at high speed toward the home limit switch. The cross axis will move toward the main beam as specified by the "PLATE SIDE" SYSTEM SETUP DATA variable (LEFT or RIGHT). The rail axis will always move in a -X direction toward the operator to find home. If the home function is not to be used on an axis, the associated jumpers for that axis can be set to prevent any unwanted motion even if the home function for that axis is inadvertently included in a part program. The encoder index signal is connected to pin 6 of the respective encoder input connector on the back of the **BURNY**. A jumper wire has been added inside the **BURNY** to connect this signal to the drive interface card. This card contains circuits which allow either an active high or low index signal to be used. The signal must be TTL compatible and can be either a TOTEM-POLE or OPEN COLLECTOR type.

Each axis which is to be homed should have a home switch which is activated before the index pulse for the actual home position is activated. The switch should provide 24VDC to the indicated pin. Jumpers on the interface card can be used to selected ON or OFF as active. For proper operation, the switch must activate at least 1.5 times the SLOW DOWN DISTANCE (SYSTEM SETUP DATA variable 7) before the index pulse for the actual home position. (The recommended distance is 2 times the SLOW DOWN DISTANCE value). The switch does not have to maintain closure for the entire distance, but the signal must be active for at least 1/4 second at the maximum traverse speed.

30RECP-22 CROSS AXIS HOME SWITCH INPUT
30RECP-21 RAIL AXIS HOME SWITCH INPUT

DRIVE INTERFACE CARD

The interface card is essentially an "HL" type card with an additional circuit for monitoring the home switches and index pulses. There are selection jumpers for each of the home switches and index inputs to select active high or low operation depending on the external circuit.

There are 4 internal function codes which must be assigned external WORD ADDRESS "M"/"G" or ESSI function code values (depending on the PLC SYSTEM type) in the CUSTOM AUXILIARY CODE CONVERSION table. They are as follows:

X AXIS HOME-	Causes movement in -X direction while looking for X home switch/index. Once found, the incremental dimension from the previous position to "HOME" is stored as the X home dimension.
Y AXIS HOME-	Causes movement in Y axis while looking for the Y home switch/index. Direction is determined by setting SYSTEM SETUP DATA variable number "31. PLATE SIDE". If set for "PLATE ON LEFT", home will move to the right and vise-versa. Once found, the incremental dimension from the previous position to "HOME" is stored as the Y home dimension.
X HOME DIM RETURN-	Performs an incremental move using the negative X home dimension. It is used to return to previous plate position after home is found.
Y HOME DIM RETURN-	Performs an incremental move using the negative of stored Y home incremental dimension. It is used to return to previous plate position after home is found.

When an "AXIS HOME" auxiliary code is executed, the machine will move at high speed toward the home switch while displaying "SEARCH-X HOME SWITCH" or "SEARCH-Y HOME SWITCH". When the switch is found, the display will change to "SEARCH-SWITCH FOUND" and the machine will decelerate to a stop at 1.5 times the SLOW DOWN DISTANCE (SYSTEM SETUP DATA variable 7). The machine will then begin a 12 IPM move in the same direction and display "SEARCH-X INDEX" or "SEARCH-Y INDEX". When the index is found, normal program execution will continue.

NOTE

Index search will only run for 5 inches. If not found in that distance, "HOME" is set to the current machine position and program execution continues.

If either the home switch or index is active when its respective search is started, the display does not show the search message and the process immediately goes on to the next step. If both are active, it will appear that the home process was completely skipped. These facts can be used to determine if you have the switches/index jumpers set correctly. If it skips one or both of the searches, change the appropriate jumper.

NOTE

There is a small harness attached to the interface card with two wires on it. These must be soldered to pin 6 of the X/Y encoder connectors on the main back panel board to get the index pulse from the encoder plug to the interface card.

SERIAL COMMUNICATION INTERFACE

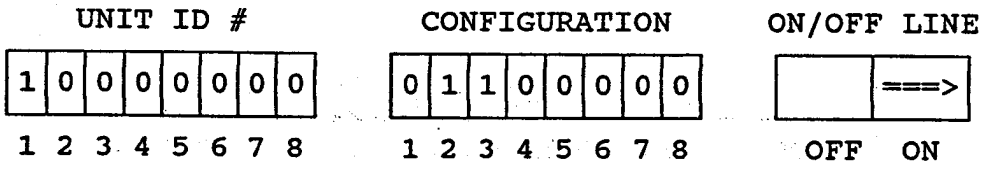
The **BURNY 5** is connected to the PROGRAMMABLE CONTROLLER (PLC) via an RS-422 serial link. A special communication card is added inside the **BURNY** to provide the RS-422 port while still retaining the use of the normal RS-232 port for data communication purposes. The RS-422 port which is the enabled 9 pin port on the bottom right side of the back panel. The connections are:

BURNY	PLC DATA COMM CONNECTOR		
RECP-1 (TX+)	PIN 25 (RX+)	JUMPER	PIN 10-12
RECP-2 (TX-)	PIN 24 (RX-)		PIN 11-13
RECP-3 (RX+)	PIN 22 (TX+)		
RECP-4 (RX-)	PIN 23 (TX-)		
RECP-5 (GND)	PIN 7 (GND)		

A 150 OHM resistor must be connected across the RX+ and RX- terminals at the PLC end of the link. A termination resistor is provided on the RS-422 interface board inside the **BURNY** and does not require an additional resistor.

TI PC CONFIGURATION SWITCHES

Two 8 position DIP switches (and one toggle switch) are located on the side of the PC communication unit. One DIP switch is used to define the "UNIT ID #" and the other, the communication port configuration. As shown below, 1 indicates the "ON" position and 0, the "OFF" position. They should be set as follows:



PARALLEL RELAY I/O INTERFACE

BURNY	PLC PARALLEL 24VDC SINK I/O
31RECP-5,16	+24 DC POWER FROM PLC
32RECP-10,11	+24 DC POWER FROM PLC
32RECP- 4,15,22,37	DC GROUND FROM PLC
32RECP-23	"NOT E-STOP" OUTPUT FROM PLC
32RECP-24	"PROGRAM INHIBIT" OUTPUT FROM PLC
31RECP-29	"COMM REQUEST" OUTPUT FROM PLC
31RECP-18	"PLASMA CUT SELECT" OUTPUT FROM PLC
32RECP-3	"COMM LINK OK" OUTPUT FROM **BURNY**
32RECP-9	FUTURE USE FROM **BURNY** TO PLC
32RECP-21	FUTURE USE FROM **BURNY** TO PLC
32RECP-32	FUTURE USE FROM **BURNY** TO PLC
31RECP-2,3	"**BURNY** OK" contact closes once **BURNY** has powered up and passed diagnostics. Remains closed until **BURNY** power is turned off.
31RECP-36,37	As in the **BURNY 5** system, the PLC system uses this contact as the plasma height sensor enable contact. However with programmable I/O enabled, this output is only active when the running speed is greater than 90% of the current feedrate. The actual state of this output is affected by setup data variable number 33 "plasma height relay" which defines the output as "normally open" or "normally closed". The same logic information is sent via comm link register 61 which is described later. However this information is not affected by variable number 33.

OUTPUTS FROM PLC TO BURNY

The following outputs from the PLC are connected to inputs on the **BURNY 5.**

"E-STOP"

This output from the PLC should "TURN ON" (sink) when the PLC is OK and no E-STOP condition exists. If this wire is broken, or the PLC is turned off, or an E-STOP condition occurs, the **BURNY** will output 0 volts to the X/Y drive signals and not attempt to control machine position (no position hold). When the signal is re-asserted, the **BURNY** will resume control of the servos.

NOTE

Although this input functions independently of the standard E-STOP input, both perform the same internal functions when tripped.

"PROGRAM INHIBIT"

This output from the PLC is used to cause a program hold while a part program is running. The **BURNY** will stop the machine and hold position until the inhibit signal is removed and then resume program execution.

NOTE

This is a program inhibit, not an overall feedrate hold. Therefore, the machine can still be jogged manually even if the inhibit input is active.

"PLASMA SELECT"

This output from the PLC indicates the desired cutting mode to the **BURNY.** The output should be ON when PLASMA cutting is selected and OFF when OXYGEN cutting is selected.

"COMM REQUEST"

This output from the PLC is unused at this time. Later it may be used to signal the **BURNY** that the PLC wants to communicate since the PLC cannot send a request message to the **BURNY**. The programmable controller can only respond as a slave.

OUTPUTS FROM BURNY TO PLC

The following outputs from the **BURNY 5** are connected to inputs on the PLC.

"COMM LINK OK"

This relay output from the **BURNY** will turn on after initial power-up checks are done, and after the **BURNY** has successfully communicated with the PLC. (Initial state of DATA REGISTER 61 is loaded as the check of the comm link). Throughout the operation of the machine, this contact will remain closed unless the **BURNY** detects that the comm link has failed. This will cause the contact to open and remain open until the link is re-established. Then, the contact will close again. A 0.5 second delay should be performed in the PLC ladder before responding to the contact. If the link is re-established in this time, the PLC should ignore the temporary interruption. If it is off longer than 0.5 second, the PLC should set all I/O to a "safe" condition and prevent the servo drives from moving. This contact should not be interpreted as a disastrous failure indication but more as an inhibit to the PLC.

"BURNY OK" CONTACT

This **BURNY** relay contact closes after the **BURNY** has powered up and passed diagnostics. It remains closed until power is turned off.

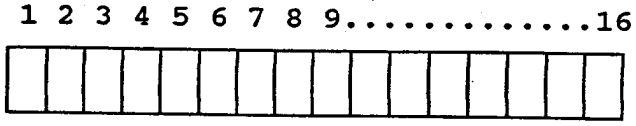
BURNY 5 / PLC REGISTER ALLOCATIONS

The programmable controller supports 64, 16 bit DATA REGISTERS and several different functions to operate on these registers. Through some of these registers the **BURNY** sends data to and reads data from the PLC. Since only "slave type" operations are supported by the TI 335 controller, all data transfers are initiated by the **BURNY**. The PLC only responds with the requested data or status.

REGISTER 1 -	CUSTOMER USE. CAN BE LOADED VIA NC PART
TO -	PROGRAM WITH BCD OR BINARY DATA USING
REGISTER 49-	THE EXTERNAL VARIABLE LOAD FUNCTION.
REGISTER 50-	PLASMA ARC DELAY
REGISTER 51-	PLASMA ARC OFF DELAY
REGISTER 52-	OXYGEN FUEL BLEEDOFF
REGISTER 53-	TABLE #0 MINIMUM OFF TIME
REGISTER 54-	TABLE #0 DEFAULT DWELL
REGISTER 55-	MARKER DELAY TIME
REGISTER 56-	TABLE #0 PLASMA START DELAY
REGISTER 57-	PIERCE RAMP / HOLD TIME
REGISTER 58-	RESERVED
REGISTER 59-	RESERVED
REGISTER 60-	AUXILIARY CODE VALUE
REGISTER 61-	KEY/STATUS DATA BITS
REGISTER 62-	USER DEFINED PREHEAT VALUE
REGISTER 63-	DRIVE RELATED KEYBOARD BITS
REGISTER 64-	LATCHED KEYBOARD/LED BITS

REGISTER 60 - AUXILIARY CODE VALUE

This register is used to transfer auxiliary function code values from the **BURNY** to the PLC. This register is loaded with 16 bits of information each time a function code is sent from **BURNY**. The function code value is represented in a binary format.



The top bit (#1) is set every time a new functions code is sent. This insures that at least one bit in the value will be a 1 since a WORD ADDRESS "M00" and an ESSI "0" would both place 0 in all the other bits.

The second bit (#2) will be set to 1 if the function code was sent while the program is running forward and 0 if the program is running in reverse. This bit should be included in both the decode and use of the function value since a "CUT ON" command in the forward direction should turn on the cut and a "CUT ON" command in reverse should recycle the cutting logic to the "OFF" condition.

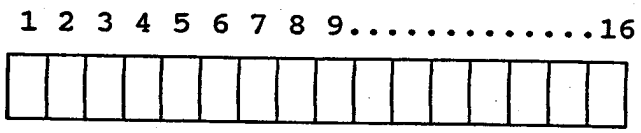
The bottom 12 bits (5-16) contain the numeric value of the auxiliary function code value in binary. This number of bits allows for 4096 codes. Since function values are sent in binary, a forward WORD ADDRESS "M16" or ESSI "16" would set the following bits:

1100000000010000

The PLC must read and decode DATA REGISTER 60 each scan since the value could be loaded at any time. Once it is decoded and has passed through the ladder logic one time, it should be cleared by the PLC. The **BURNY** waits until it reads a value from register 60 with the high bit cleared before continuing with the part program. This insures that the PLC has read and processed the function code and inhibited motion, if necessary, before the **BURNY** continues with the part program.

REGISTER 61 - KEY/STATUS VALUE

This register is used to transfer various keyboard and internal status bits from the **BURNY** to the PLC. Each time one or more of these bits change, the value in this data register will be updated. For each of the following bit assignments, the bit will be "1" for the indicated state.



BIT 1 - >8000 -RST (RECYCLE) KEY PRESSED
BIT 2 - >4000 -STOP (CYCLE STOP) KEY PRESSED
BIT 3 - >2000 -GO (CYCLE START) KEY PRESSED
BIT 4 - >1000 -RET (PIERCE RETURN) KEY PRESSED
(SHOULD RECYCLE CUTTING I/O)
BIT 5 - >0800 -undefined
BIT 6 - >0400 -undefined
BIT 7 - >0200 -SPEED CALIBRATION RUNNING
BIT 8 - >0100 -TEACH MODE RUNNING
BIT 9 - >0080 -undefined
BIT 10- >0040 -PROGRAM RUNNING OVER 90% SPEED
(PLASMA HEIGHT SENSOR)
BIT 11- >0020 -PROGRAM RUNNING (CYCLE START/STOP TOGGLE)
BIT 12- >0010 -PROGRAM RUNNING FORWARD (0 FOR BACKUP)
BIT 13- >0008 -PC MODE (0 FOR NORMAL NC MODE FROM CNC KEY)
BIT 14- >0004 -AUTO CUT MODE SELECTED (0 FOR MANUAL CUT)
BIT 15- >0002 -TEST RUN SELECTED
BIT 16- >0001 -SINGLE STEP SELECTED

No decoding is required on this data. Simply transfer the data to 16 internal coils and use them directly as contacts. The PLC should not alter this value but simply read it each scan to update its internal coil data.

REGISTER 62 - USER ASSIGNED PREHEAT VALUE

This register is used to transfer the operator entered, auto-mode, "oxygen preheat" time to the PLC. The value will be in binary and will be scaled to .1 second resolution.

EXAMPLE: If operator enters a preheat value of "10.00", this register will contain:

0000 0000 0110 0100 (HEXADECIMAL 64 or DECIMAL 100)

Use the BIN/BCD conversion function in the PLC to convert it to 0100 and place it in the preload register for the preheat time. The value in register 62 will be updated any time the **BURNY** is stopped and re-started since the preheat could be changed at this time. By placing the operator entered value in a separate register, it allows the program to change the preheat without losing the operator value. The actual preload register should be selected from one of the customer defined data registers (1-49).

REGISTER 63 - DRIVE KEYBOARD BITS

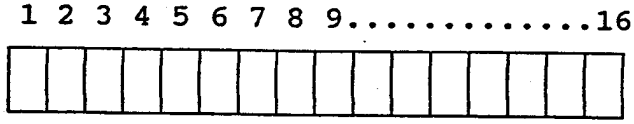
This register is used to transfer 16 bits of drive related keyboard data to the PLC for processing. In addition to the RECYCLE, CYCLE START, CYCLE STOP and PIERCE RETURN key codes (which are still updated in register 61), bit codes for the four jogs, BACKUP, OVERRIDE and "A" - "E" keys are also provided through this register.

NOTE

Most of the keys represented by these key bits operate as maintained keys which allows the PLC to see an active state as long as the key is held down. When the associated bit position is 1, the key is pressed. When 0, it is not pressed. Only two of these keys operate as momentary keys which are only active for 40ms regardless of how long the key is held down. They are the RECYCLE (RST) key and the OVERRIDE (CNC) key.

Related to these key bits are the latched key/LED bits provided through DATA REGISTER 64 which toggle from "ON to OFF" or "OFF to ON" every time the associated key is pressed. See the definition of DATA REGISTER 64 for additional information.

For each of the following bit assignments, the bit will be "1" for the indicated state.



BIT 1- >8000 -undefined
BIT 2- >4000 -POSITIVE X JOG BIT
BIT 3- >2000 -NEGATIVE X JOG BIT
BIT 4- >1000 -POSITIVE Y JOG BIT
BIT 5- >0800 -NEGATIVE Y JOG BIT
BIT 6- >0400 -REV (BACKUP) KEY BIT
BIT 7- >0200 -RET (PIERCE RETURN) KEY BIT
BIT 8- >0100 -RST (RECYCLE) KEY BIT
BIT 9- >0080 -STOP (CYCLE STOP) KEY BIT
BIT 10- >0040 -GO (CYCLE START) KEY BIT
BIT 11- >0020 -CNC (OVERRIDE) KEY BIT
BIT 12- >0010 -DRIVE FUNCTION "A" KEY BIT
BIT 13- >0008 -DRIVE FUNCTION "B" KEY BIT
BIT 14- >0004 -DRIVE FUNCTION "C" KEY BIT
BIT 15- >0002 -DRIVE FUNCTION "D" KEY BIT
BIT 16- >0001 -DRIVE FUNCTION "E" KEY BIT

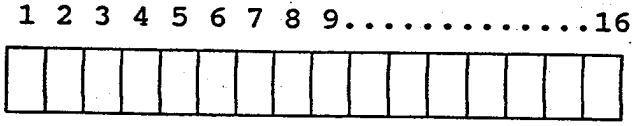
REGISTER 64 - LATCHED KEYBOARD/LED BITS

This register is used to transfer 16 bits of latched keyboard/LED data to the PLC for processing. In addition to the CYCLE START, FORWARD, OVERRIDE mode status bits (which are still updated in DATA REGISTER 61), bit codes for the warning beeper, PLASMA select mode and "A" - "E" key LED's are also provided through this register.

NOTE

The "A" - "E" LED bits like the OVERRIDE (CNC) mode LED are toggled from "ON to OFF" or "OFF to ON" every time the associated key is pressed. This allows the PLC to use these bits as mode indicators for operations performed through the PLC "ladder logic" program.

For each of the following bit assignments, the bit will be "1" for the indicated state.



BIT 1- >8000 -undefined
BIT 2- >4000 -undefined
BIT 3- >2000 -undefined
BIT 4- >1000 -undefined
BIT 5- >0800 -undefined
BIT 6- >0400 -undefined
BIT 7- >0200 -FORWARD RUN BIT
BIT 8- >0100 -PLASMA SELECT BIT
BIT 9- >0080 -WARNING BEEPER BIT
BIT 10- >0040 -GO (CYCLE START) LED BIT
BIT 11- >0020 -CNC (OVERRIDE) LED BIT (LATCHED TOGGLE)
BIT 12- >0010 -DRIVE FUNCTION "A" LED BIT (LATCHED TOGGLE)
BIT 13- >0008 -DRIVE FUNCTION "B" LED BIT (LATCHED TOGGLE)
BIT 14- >0004 -DRIVE FUNCTION "C" LED BIT (LATCHED TOGGLE)
BIT 15- >0002 -DRIVE FUNCTION "D" LED BIT (LATCHED TOGGLE)
BIT 16- >0001 -DRIVE FUNCTION "E" LED BIT (LATCHED TOGGLE)

NOTE

In DATA REGISTER 64, the "GO" LED bit is the same as the "PROGRAM RUNNING" bit in DATA REGISTER 61. Similarly, the "FORWARD RUN" bit is the same as the "PROGRAM RUNNING FORWARD" bit. However, the "CNC" LED bit is the inverted sense of the "PC MODE" bit since it represents the state of the LED on the panel and is "ON" when the **BURNY** is in control of the machine.

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CUSTOM AUXILIARY I/O OPERATIONS

The CUSTOM AUXILIARY I/O feature allows the user to disable one or more standard functions assigned to the **BURNY 5's** digital I/O and use the I/O released for "user defined" auxiliary I/O operations. Through the CUSTOM CODE CONVERSION process, WORD ADDRESS "M" and "G" codes and ESSI function codes are defined as AUX OUTPUT "SET" and AUX INPUT "WAIT" functions for operating on the released I/O. Auxiliary output functions can also be defined as auxiliary torch functions for multiple torch and beveling torch applications.

NOTE

The current implementation only supports CUSTOM AUXILIARY I/O operations on the digital I/O released by a disabled standard function. Later, when more digital I/O becomes available, the CUSTOM AUXILIARY I/O feature will be expanded to support "user defined" I/O operations without disabling these standard functions.

The standard I/O interface used in the **BURNY 5** system provides 8 digital outputs and 4 digital inputs for controlling one OXYGEN torch, one PLASMA torch and two plate markers. By default, these functions are enabled and the digital I/O required for their operation is dedicated to their use.

NOTE

When programmable I/O operations are enabled, the standard I/O interface is not used to support torch and marker operations. Instead, this I/O is used to complement the serial communications performed between the **BURNY 5** and the PLC. The I/O required for torch and marker operations is directly connected to the programmable controller. As auxiliary function codes are encountered (and partially processed in the **BURNY 5**), they are sent to the programmable controller for processing in its ladder diagram. Both the standard I/O functions and CUSTOM AUXILIARY I/O functions are supported through the programmable I/O interface. Therefore, standard BURNY functions should not be disabled when programmable I/O is enabled.

CUSTOM AUXILIARY I/O operations are supported through eight special internal function codes which must be assigned external WORD ADDRESS "M"/"G" or ESSI function code values. Once defined and enabled, these internal function codes allow the executing NC program to "SET" outputs "ON" or "OFF" as they are encountered in the NC program or force the program to "WAIT" for inputs to turn "ON" or "OFF" before continuing. However, if auxiliary I/O operations have not been enabled or the auxiliary codes have not been properly defined in the CUSTOM CODE CONVERSION table, "SET" or "WAIT" operations are performed and these function codes are
ignored. The following special internal functions are defined in the **BURNY 5**:

AUX OUTPUT 1 ON	(sets output "ON")
AUX OUTPUT 1 OFF	(sets output "OFF")
AUX OUTPUT 2 ON	
AUX OUTPUT 2 OFF	
AUX OUTPUT 3 ON	
AUX OUTPUT 3 OFF	
AUX OUTPUT 4 ON	
AUX OUTPUT 4 OFF	

AUX INPUT 1 ON	(waits for "ON")
AUX INPUT 1 OFF	(waits for "OFF")
AUX INPUT 2 ON	
AUX INPUT 2 OFF	
AUX INPUT 3 ON	
AUX INPUT 3 OFF	
AUX INPUT 4 ON	
AUX INPUT 4 OFF	

NOTE

These internal functions are only available for use through the CUSTOM CODE CONVERSION process. Since they have not been assigned default external function code values, they are not defined in the standard WORD ADDRESS and ESSI function code definition tables.

OVERRIDE OF AUXILIARY OUTPUTS

In order for the CUSTOM AUXILIARY output functions to operate in a manner consistent with the standard output functions, the "backup", "pierce return", "cycle stop", and "cycle start" functions perform the following operations on all enabled auxiliary outputs:

1) Whenever the BURNY is not in "RUN" mode, all enabled auxiliary outputs are turn "OFF".

2) When the "REV" key is pressed to perform a "backup" operation, auxiliary outputs that are "ON" remain "ON" until an "AUX OUTPUT ON" is executed for the associated output in the REVERSE direction. Similarly, auxiliary outputs that are "OFF" remain "OFF" until an "AUX OUTPUT OFF" is executed for the associated output in the REVERSE direction. When the "REV" key is released and operations resume in the FORWARD direction, all enabled auxiliary outputs retain their current states until changed by one of their associated "AUX OUTPUT" functions.

3) When the "RET" key is pressed to perform a "pierce return" operation, all enabled auxiliary outputs are internally restored to the states they had when the "pierce" position was saved by the system. However, since the BURNY must be in "CYCLE STOP" mode when a "pierce return" is performed, these states are not physically output until the "GO" key is pressed.

4) Whenever the "STOP" key is pressed to suspend program execution, all enabled auxiliary outputs are turned "OFF". Pressing "GO" then resumes program execution and causes all auxiliary outputs that were "ON" when the "STOP" was pressed to immediately turn "ON".

Additional information on the use of auxiliary I/O and auxiliary torch control operations is provided in the following sections.

ENABLING AUXILIARY I/O OPERATIONS

SYSTEM SETUP DATA variable 37 (SYSTEM CONFIGURATION 1) allows the user to selectively inhibit one or more of the standard BURNY functions and release the associated I/O for a CUSTOM AUXILIARY I/O operation.

NOTE

When programmable I/O is enabled, the standard functions should not be disabled since they may be required for proper operation with the programmable controller. For example, disabling PLASMA forces the BURNY into OXYGEN mode and disabling OXYGEN forces the BURNY into PLASMA mode, regardless of the state of the "PLASMA SELECT" input.

In SYSTEM CONFIGURATION 1, the left most digit of the 8 digit value is used to selectively disable one or more of the standard BURNY OXYGEN, PLASMA or MARKER functions. In the following table, an "X" indicates that the associated standard functions are disabled whenever the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
DISABLE PLASMA									X	X	X	X	X	X	X	X
DISABLE OXYGEN					X	X	X	X					X	X	X	X
DISABLE MARKER 1			X	X			X	X			X	X			X	X
DISABLE MARKER 2		X		X		X		X		X		X		X		X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

AUXILIARY OUTPUT FUNCTION MAPPING

The mapping scheme used to assign CUSTOM AUXILIARY I/O functions to the released **BURNY** I/O is determined by the actual standard functions disabled through the left most digit of the 8 digit SYSTEM CONFIGURATION 1 value.

If a value or C,D,E or F is used:

AUX OUTPUT 1 uses the OXYGEN STOP output	(1CR)
AUX OUTPUT 2 uses the MARKER 1 output	(2CR)
AUX OUTPUT 3 uses the OXYGEN PREHEAT output	(3CR)
AUX OUTPUT 4 uses the OXYGEN START output	(4CR)
(LATER) AUX OUTPUT 5 uses the PLASMA START output	(5CR)
(LATER) AUX OUTPUT 6 uses the PLASMA STOP output	(6CR)
(LATER) AUX OUTPUT 7 uses the MARKER 2 output	(7CR)
(LATER) AUX OUTPUT 8 uses the PLASMA HEIGHT output	(8CR)

AUX INPUT 1 uses the PLASMA ARC ON input
AUX INPUT 2 uses the PLASMA SELECT input
AUX INPUT 3 uses the RUN INHIBIT input
AUX INPUT 4 uses the OXYGEN CUT SWITCH input

If a value of 8,9,A or B is used:

AUX OUTPUT 1 uses the PLASMA START output	(5CR)
AUX OUTPUT 2 uses the PLASMA STOP output	(6CR)
AUX OUTPUT 3 uses the MARKER 2 output	(7CR)
AUX OUTPUT 4 uses the PLASMA HEIGHT output	(8CR)
(LATER) AUX OUTPUT 5 uses the PLASMA START output	(5CR)
(LATER) AUX OUTPUT 6 uses the PLASMA STOP output	(6CR)
(LATER) AUX OUTPUT 7 uses the MARKER 2 output	(7CR)
(LATER) AUX OUTPUT 8 uses the PLASMA HEIGHT output	(8CR)

AUX INPUT 1 uses the PLASMA ARC ON input
AUX INPUT 2 uses the PLASMA SELECT input
AUX INPUT 3 uses the RUN INHIBIT input
AUX INPUT 4 is disabled since OXYGEN I/O is enabled

If a value of 4,5,6 or 7 is used:

AUX OUTPUT 1 uses the OXYGEN STOP output (1CR)
AUX OUTPUT 2 uses the MARKER 1 output (2CR)
AUX OUTPUT 3 uses the OXYGEN PREHEAT output (3CR)
AUX OUTPUT 4 uses the OXYGEN START output (4CR)
(LATER) AUX OUTPUT 5 uses the OXYGEN STOP output (1CR)
(LATER) AUX OUTPUT 6 uses the MARKER 1 output (2CR)
(LATER) AUX OUTPUT 7 uses the OXYGEN PREHEAT output (3CR)
(LATER) AUX OUTPUT 8 uses the OXYGEN START output (4CR)

AUX INPUT 1 is disabled since PLASMA I/O is enabled
AUX INPUT 2 uses the PLASMA SELECT input
AUX INPUT 3 uses the RUN INHIBIT input
AUX INPUT 4 uses the OXYGEN CUT SWITCH input

If a value of 0,1,2 or 3 is used:

AUX OUTPUT 1 is disabled since OXYGEN I/O is enabled
AUX OUTPUT 2 uses the MARKER 1 output (2CR)
AUX OUTPUT 3 uses the MARKER 2 output (7CR)
AUX OUTPUT 4 is disabled since OXYGEN I/O is enabled
(LATER) AUX OUTPUT 5 is disabled since PLASMA I/O is enabled
(LATER) AUX OUTPUT 6 uses the MARKER 1 output (2CR)
(LATER) AUX OUTPUT 7 uses the MARKER 2 output (7CR)
(LATER) AUX OUTPUT 8 is disabled since PLASMA I/O is enabled

AUX INPUT 1 is disabled since PLASMA I/O is enabled
AUX INPUT 2 is disabled since OXY/PLASMA I/O enabled
AUX INPUT 3 uses the RUN INHIBIT input
AUX INPUT 4 is disabled since OXYGEN I/O is enabled

ENABLING AUXILIARY TORCH OPERATIONS

CUSTOM AUXILIARY I/O support also allows AUX OUTPUT ON/OFF functions to be defined as auxiliary torch CUT ON/OFF functions with all appropriate internal cut control logic applied. This feature provides support for multiple torch and beveling torch applications.

When an AUX OUTPUT function is defined as a auxiliary torch, the **BURNY** performs the same "START CUT" and "STOP CUT" logic for the selected mode (OXYGEN or PLASMA) as the standard CUT ON/OFF function whenever the AUX OUTPUT ON or OFF operation is performed. The only difference from the normal CUT ON and CUT OFF functions is that instead of the normal OXYGEN START or PLASMA START output, the output associated with the auxiliary function is used as the OXYGEN START or PLASMA START output. All other functions associated with the selected cut mode (AUTO, MANUAL, STEP or TEST), keyboard function (GO, STOP, REV or RET), timer delay (purge, preheat, etc.) and other associated outputs (OXYGEN STOP, PLASMA STOP, PREHEAT START, etc.) continue to operate normally.

NOTE

KERF compensation operations are also activated whenever KERF is "ON" and one or more of the standard or auxiliary torch functions is "ON".

Auxiliary outputs are identified as torch outputs through the 3rd and 4th digits (numbered as: 12345678) of SYSTEM SETUP DATA variable 37, SYSTEM CONFIGURATION 1. These digits define two hexadecimal codes which allow any or all of the enabled AUX OUTPUT functions to be defined as auxiliary torch functions. However at the present time, only functions for AUX OUTPUT 1,2,3 and 4 are supported by the system. Functions for AUX OUTPUT 5,6,7 and 8 have not yet been defined.

NOTE

In the standard **BURNY 5** configuration, one or more of the standard torch or marker functions must be disabled through SYSTEM CONFIGURATION 1 in order for the AUX OUTPUT internal function codes to be enabled. However when programmable I/O is enabled, the AUX OUTPUT internal function codes are automatically enabled and none of the standard functions need to be disabled to define an auxiliary torch function.

In the following table, an "X" indicates that the associated AUX OUTPUT is defined as a torch whenever the value above the column is used.

DIGIT 3 VALUES:	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
AUX OUTPUT 1 as TORCH CONTROL									X	X	X	X	X	X	X	X
AUX OUTPUT 2 as.TORCH CONTROL					X	X	X	X					X	X	X	X
AUX OUTPUT 3 as TORCH CONTROL			X	X			X	X			X	X			X	X
AUX OUTPUT 4 as TORCH CONTROL		X		X		X		X		X		X		X		X

DIGIT 4 VALUES: (WHEN LATER DEFINED)	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
AUX OUTPUT 5 as TORCH CONTROL									X	X	X	X	X	X	X	X
AUX OUTPUT 6 as TORCH CONTROL					X	X	X	X					X	X	X	X
AUX OUTPUT 7 as TORCH CONTROL			X	X			X	X			X	X			X	X
AUX OUTPUT 8 as TORCH CONTROL		X		X		X		X		X		X		X		X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

For example, when "90C00000" is stored in SYSTEM CONFIGURATION 1, normal PLASMA and MARKER 2 I/O operations are disabled and auxiliary outputs 1,2,3, and 4 are enabled for operation. This value also identifies AUX OUTPUT 1 and 2 as auxiliary torch control functions. Therefore, whenever an AUX OUTPUT 1 ON function is encountered in an NC program, it is processed as a CUT ON function which may initiate a OXYGEN "START CUT" logic operation. "START CUT" logic operations include OXYGEN CUT SWITCH detection, preheat (if necessary), removal of the OXYGEN STOP output and, if in AUTO CUT mode, the activation of 5CR output as an OXYGEN START output for the auxiliary torch. As with the normal CUT ON functions, whenever the cut process is stopped and restarted with the STOP and GO keys or the REV key is pressed to perform a "backup" operation, the "START CUT" logic process is repeated. This setup value also allows the OXYGEN "STOP CUT" logic to be performed when the AUX OUTPUT 1 OFF function is encountered in a program.

MULTIPLE TORCH SEQUENCING LOGIC

CUSTOM AUXILIARY I/O support also allows normal cut functions and auxiliary torch functions to be performed as a sequence of "torch ON" or "torch OFF" commands. Although each "ON" function must be followed by an associated "OFF" function, any torch starting/stopping sequence may be used. For example, the first torch turned "ON" may be the first, middle or last torch turned "OFF".

Whenever a multiple "torch ON" sequence is encountered in a program, only the first "torch ON" function initiates the "START CUT" logic. The "torch ON" functions that follow only turn their associated START outputs ON when executing in AUTO CUT mode. Regardless of the actual "torch ON" function encountered first in OXYGEN mode, the "START CUT" logic process always performs the same ON/OFF output operations on the OXYGEN STOP and OXYGEN PREHEAT START outputs. Additional STOP and PREHEAT outputs for auxiliary torches are not provided. The output associated with the "torch ON" function is only used as a "START" output in AUTO CUT MODE.

If during the cut, a "backup" or "STOP"/"GO" operation is performed, all active torch "START" outputs are turned OFF together and then, turned ON together when the "START CUT" logic process is repeated.

"Pierce return" positions are only saved when the first "torch ON" function in the sequence is encountered.

The following examples use the ESSI program format auxiliary function code values which are frequently used for beveling torch operations (CENTER TORCH, RIGHT TORCH and LEFT TORCH functions). Since the standard ESSI format supported by the **BURNY 5** defines functions 13, 14, 15 and 16 as MARKER function codes and AUXILIARY I/O function codes are not defined in the standard ESSI CODE table, these examples assume the following definitions have been made in the CUSTOM AUXILIARY CODE table. They also assume that the program containing these function codes has been loaded from serial I/O or edited using a program format with the CUSTOM CODE CONVERSION process enabled (ESSI or ESSI 1).

7 = 6:CUT ON
8 = 5:CUT OFF
13 = 40:AUX OUTPUT 1 ON
14 = 41:AUX OUTPUT 1 OFF
15 = 42:AUX OUTPUT 2 ON
16 = 43:AUX OUTPUT 2 OFF

The following examples also assume that the PLASMA function has been disabled, AUX OUTPUT 1 has been defined as the LEFT bevel torch function, and AUX OUTPUT 2 has been defined as the RIGHT bevel torch function. This is accomplished by placing "80C00000" in SYSTEM SETUP DATA variable 37 (SYSTEM CONFIGURATION 1).

NOTE

In the standard **BURNY 5** configuration, one or more of the normal PLASMA, OXYGEN and MARKER operations must be disabled before auxiliary torch operations are allowed. However when programmable I/O is enabled, normal operations do not need to be disabled since the **BURNY**'s digital I/O is not used to perform auxiliary torch operations.

EXAMPLE 1:

```
7          (Normal CUT ON used for CENTER TORCH ON)
+75+0
15         (AUX OUTPUT 2 ON used as RIGHT BEVEL TORCH ON)
+4000+0
8          (Normal CUT OFF used for CENTER TORCH OFF)
+75+0
16         (AUX OUTPUT 2 OFF used as RIGHT BEVEL TORCH OFF)
```

In the first example, the normal CUT ON function would initiate the "START CUT" logic and cause the **BURNY** to perform the appropriate delay and/or pre-heat operations. Then, if in OXYGEN AUTO CUT mode, it would turn ON the normal OXYGEN START output and move the machine the specified distance before turning ON AUX OUTPUT 2 as an auxiliary torch "START". In this example, the normal CUT OFF function would only turn OFF the normal OXYGEN START output since the RIGHT torch is still ON. Only a "torch OFF" function on the last active torch initiates the "STOP CUT" logic. The first "torch OFF" function only turns its associated torch "START" output OFF in AUTO CUT mode.

EXAMPLE 2:

15	(AUX OUTPUT 2 ON as RIGHT BEVEL TORCH ON)
+75+0	
7	(Normal CUT ON used for CENTER TORCH ON)
+75+0	
13	(AUX OUTPUT 1 ON as LEFT BEVEL TORCH ON)
+4000+0	
16	(AUX OUTPUT 2 OFF as RIGHT BEVEL TORCH OFF)
+75+0	
8	(Normal CUT OFF used for CENTER TORCH OFF)
+75+0	
14	(AUX OUTPUT 1 OFF as LEFT BEVEL TORCH OFF)

In the second example, the AUX OUTPUT 2 ON function would initiate the "OXYGEN START CUT" logic and the AUX OUTPUT 1 OFF function would initiate the "OXYGEN STOP CUT" logic. The other "torch ON" and "torch OFF" functions in the sequence only turn their associated torch "START" outputs ON and OFF in AUTO CUT mode.

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PART 7 - SETUP AND MAINTENANCE

BLANK

TYPICAL SETUP EXAMPLE

The following description is provided as an example of the normal sequence used when setting up the control on a cutting machine. It is not the only method, and is not meant to be followed "to the letter". Rather it is a logical order which insures that all necessary parameters are set without unnecessary work.

For this example, the imaginary cutting machine has the following characteristics: (only inch units will be described, however the METRIC setup would be the same.)

-SYSTEM IS TO OPERATE IN INCH UNITS.

-DRIVE SYSTEM CAPABLE OF 150 IPM OPERATION

-500 LINE ENCODERS USED- X AXIS TRAVELS 5.105 INCHES/REV
Y AXIS TRAVELS 4.990 INCHES/REV

-PLATE TO BE CUT IS LOCATED TO THE RIGHT OF THE OPERATOR

-ONLY OXY/FUEL CUTTING

-The BURNY 5 should be set up in the "NOVICE MODE" so that all Help pop-up windows are automatically displayed.

-The BURNY 5 will be communicating with "FILE SERVER" software that has the following characteristics:

SERIAL TYPE: DATA BANK 1 (CLINK PROTOCOL)
BAUD RATE : 4800
CHAR FORMAT: EVEN PARITY 7 DATA BITS
PGM FORMAT : STANDARD WORD ADDRESS
HANDSHAKING: PARTIAL SOFTWARE HANDSHAKING

NOTE

Enable the READ and WRITE timeouts on the BURNY 5. Suppress all NULL characters from being sent before and after the actual program information.

Armed with this information, many of the system parameters can be setup immediately. Before starting, unplug both encoder cables from the back panel, set the machine speed dial to 0 and set SYSTEM SETUP DATA variable 2, MINIMUM POSITION HOLD SPEED, to 0. This should prevent the machine from moving until the parameters are initially set.

NOTE

Setting MINIMUM POSITION HOLD SPEED to '0' is special "TEST MODE" feature that allows the user to inhibit all internal control loop operations and disable all "hold position" logic. When set to zero, normal "RUN MODE" and speed calibration operations are inhibited. In addition, a zero minimum hold value causes the status message in the status window to display "RUN-TEST CYCLE" even when at the main menu and RUN operations are not active.

"JOG SPEED" operations are also affected by a zero MIN HOLD SPEED value. In the BURNY 5, "normal speed" jog operations are defined as a percent of the SYSTEM SETUP DATA variable RUN SPEED LIMIT (or a user defined "digital feedrate" value) and "high speed" jog operations are performed at TRAVERSE SPEED LIMIT. However in this "TEST MODE", jog speed is defined by the speed dial as a percent of MAXIMUM DRIVE SPEED. Since no drive output adjustments are performed in "TEST MODE" for speed or position corrections, jog operations will always ramp from 0 to the percentage output defined by the speed dial. At the full dial position, drive outputs should ramp from 0 to 100%.

FEEDRATE REFERENCE CALIBRATION

From the UTILITIES MENU select "3. AXIS/SPEED CALIBRATION". and press the "ENTER" button. The display will then prompt the operator to "SET FEEDRATE TO ###" "THEN PRESS <ENTER>". DO NOT PRESS "ENTER" as the readout has instructed. Instead, Press the "RST" button. This aborts the Speed Calibration at this time however the speeds have been preset to the full speed. After all the parameters are set, the Speed Calibration will be done correctly.

The next step is to select from the UTILITIES MENU, "4. FEEDRATE REF. CALIBRATION". Set the speed dial to full reference and any "HI/LOW" speed switches to high speed and then press "ENTER".

SYSTEM SETUP DATA VARIABLES (SETV)

The SYSTEM DATA VARIABLES must be set according to the machine characteristics given. Set the following parameters as indicated. NOTE: Some of the values will be preset to an estimated value at this time and then fine tuned later. These Estimated values are typical entries for the parameter but are not to be taken as the only valid inputs.

TYPICAL SETUP EXAMPLE

1. INTERNAL SYSTEM UNIT (ENGLISH/METRIC): ENGLISH

Given information- This parameter should be set first so that any other speed or distance values will appear in the correct units.

2. MINIMUM POSITION HOLD SPEED (IPM/MMPM): 0.00

This value is first set to 0 until the machines jog directions and encoders directions are set correctly. Once the jog and encoders variables are configured properly set this value to 2.00. This is an estimated value. A fine tune adjustment may be done later.

3. MAXIMUM CORRECTION SPEED (IPM/MMPM): 150

Set to maximum speed of drive system on cutting machine- given as 150 ipm.

4. LOOP GAIN : 2.00

This is a estimated starting value. Loop gain to adjusted once actual test part is run.

5. ACCELERATION TIME (SECONDS): 0.60

This is an estimated starting value. Final adjustment to be done once actual test part is run.

6. CORNER SPEED (IPM/MMPM): 10.00

This is a estimated starting value. The final value be determined after actual test part is run.

7. SLOW DOWN DISTANCE (INCH/MM): 0.7500

Nominal SLOWDOWN distance to be adjusted later test part is run.

8. SLOW DOWN RADIUS (INCH/MM): 2.00

Nominal SLOWDOWN RADIUS although this value seems correct for many machines.

9. BACKUP SPEED (IPM/MMPM): 50.00

Nominal BACKUP SPEED. Adjust to operator preference.

10. TRAVERSE SPEED LIMIT (IPM/MMPM): 150.00

Allows machine to traverse at maximum speed of system.

11. PLASMA ARC DELAY (SECONDS): 0.00

This value is set to 0 since example machine is oxy/fuel type only.

12. PLASMA ARC OFF DELAY (SECONDS): 0.00

This value is set to 0 since example machine is oxy/fuel type only.

13. OXYGEN FUEL BLEED OFF DELAY (SECONDS): 2.00

This estimated value represents a typical time oxygen manifold to BLEEDOFF after the cut is turned off. When a part is actually cut, if the time appears too long or short, it can be re-adjusted.

14. MINIMUM OFF TIME (SECONDS): 0.50

This parameter defines the system default dwell any function is turned off. It operates on all functions (plate marker, plasma, oxy/fuel, etc.) and is in addition to any specific "off" delays for a particular operation, such as the OXYGEN FUEL BLEEDOFF DELAY time.

15. DEFAULT DWELL TIME (SECONDS): 0.50

This parameter defines the system default time when a "DWELL" auxiliary code is encountered in a part program without a dwell time assigned in the same program block. However once a dwell time is assigned by the program, it becomes the default time until changed by another dwell function block.

16. MAXIMUM DRIVE SPEED (IPM/MMPM): 150.00

This parameter must be set to the maximum drive speed of the machine at full reference. This value is used in many of the position loop gain and slowdown calculations and if not set correctly, can seriously affect machine performance. This value must be set to the capability of the drive system, not the desired maximum speed.

17. RUN SPEED LIMIT (IPM/MMPM): 150.00

This parameter defines the maximum speed of the machine at full reference with the speed dial used as the "percent" of RUN SPEED required. The RUN SPEED LIMIT value must always be defined less than or equal to the MAXIMUM DRIVE SPEED value. If not, the system automatically replaces the specified value with the MAXIMUM DRIVE SPEED value.

18. ENCODER COUNTS/REVOLUTION (COUNTS): 500.00

Encoders specified as 500 lines/rev.

19. X ENCODER DISTANCE PER REV. (INCH/MM): 5.105

Information given per example.

20. Y ENCODER DISTANCE PER REV. (INCH/MM): 4.990

Information given per example.

21. X ENCODER SENSE (NORMAL/REVERSE): NORMAL
22. Y ENCODER SENSE (NORMAL/REVERSE): NORMAL
23. X DRIVE SENSE (NORMAL/REVERSE): NORMAL
24. Y DRIVE SENSE (NORMAL/REVERSE): NORMAL

These four can not be preset. They must be set by testing, which is described later.

25. MARKER DELAY TIME (SECONDS): 0.00
26. X MARKER 1 OFFSET (INCH/MM): 0.0000
27. Y MARKER 1 OFFSET (INCH/MM): 0.0000
28. X MARKER 2 OFFSET (INCH/MM): 0.0000
29. Y MARKER 2 OFFSET (INCH/MM): 0.0000
30. MARKER SPEED (IPM/MMPM): 0.0000

Since the example machine does not have a plate marker these values may be set to 0.

31. PLATE SIDE (LEFT/RIGHT): RIGHT

Given machine information. This parameter is used to define the location of the plate being cut with respect to the operators console.

32. ERROR WARNING DISTANCE (INCH/MM): 0.1250

The control constantly monitors the "PATH ERROR" when running a part. If the error exceeds the value defined for this parameter, a warning message and beeping will occur.

33. PLASMA HEIGHT RELAY (NORMAL/REVERSE): NORMAL

This is a plasma function only, so the value may be either NORMAL or REVERSE. It does not have no effect on OXY/FUEL cutting.

34. KNIFE COMP. ROTATE DIAMETER (INCH/MM): 0.00
35. KNIFE COMP. BREAKPOINT ANGLE (DEGREES): 0.00

These values only apply to machines that use a swivel knife as a cutting device.

36. SELECT GRAPHICS COLORS : 0

Set to 0 for normal operating colors.

37. SYSTEM CONFIGURATION 1 : 0

This parameter allows the user to alter the "normal" operating characteristics of the BURNY 5 control. When this variable is set to zero, all special features are disabled and only "normal" operations are performed.

38. SYSTEM CONFIGURATION 2 : 1

This parameter allows the user to alter the normal prompting characteristics of the BURNY 5. The BURNY 5 must be set up in the novice mode, a mode where all the HELP screens are displayed. The "NOVICE MODE ENABLE" bit is bit 1.

39. SYSTEM CONFIGURATION 3 : 0
40. SYSTEM CONFIGURATION 4 : 0

These are currently unused and should be set to 0.

41. SERIAL LOAD DEVICE : 5163
42. SERIAL STORE DEVICE : 5163

The given information is :

5 => SERIAL TYPE: DATA BANK 1 (CLINK PROTOCOL)
1 => PGM FORMAT : STANDARD WORD ADDRESS
6 => BAUD RATE : 4800
3 => CHAR FORMAT: EVEN PARITY 7 DATA BITS

The "SERIAL LOAD" device and "SERIAL STORE" device are the same, the "FILE SERVER",(DATA BANK 1) so the values should be the same for both.

43. BATCH LOAD DEVICE : 5163

This parameter is usually set the same as "SERIAL LOAD" which allows special definitions to be assigned for the BATCH LOAD/KERF/SETUP UTILITY which is accessed through the BACKGROUND SUPPORT utility menu. Like the SERIAL LOAD DEVICE parameter, this parameter defines the "LOAD DEVICE" characteristics as a 4 digit value.

44. STANDARD TTY DEVICE : 0
45. STANDARD CALLUP DEVICE : 0
46. BURNY DEVICE : 0
47. COMM LINK DEVICE : 0

Since the BURNY 5 will be communicating with a "FILE SERVER" these parameters should be set to "0".

48. DATA BANK DEVICE : 32163

0 => READ/WRITE timeouts enabled
3 => Suppress 70 nulls from leader and trailer
2 => Use partial software protocol (XON/XOFF only)
1 => BAUD RATE : 4800
6 => CHAR FORMAT: EVEN PARITY 7 DATA BITS
3 => PGM FORMAT : STANDARD WORD ADDRESS

49. UNUSED : 0
50. UNUSED : 0

Set all "UNUSED" parameters to "0".

51. STANDARD PROGRAM FORMAT : 0

This parameter allows the CUSTOM AUXILIARY CODES and other custom program conversion features (such as decimal shift, and axis swap, etc) to be selectively enabled for use with STANDARD WORD ADDRESS and STANDARD ESSI program formats. Since none of these are needed for this example, set the variable to "0".

52. CUSTOM PROGRAM FORMAT : 0

This parameter is similar to standard program format except it effects custom program type, that is, CUSTOM WORD ADDRESS 1, CUSTOM WORD ADDRESS 2, CUSTOM WORD ADDRESS 3 and ESSI FORMAT 1.

53. SPECIAL END OF PROGRAM 1 : 0
54. SPECIAL END OF PROGRAM 2 : 0

These parameters allow a user to define special END OF PROGRAM codes. This example does not call for special codes. These parameters should be set to 0 since they are not used.

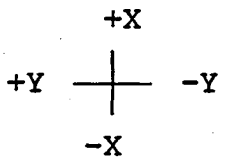
55. SPEED LOOP GAIN : 0
56. SPEED LOOP RESET TIME : 0
57. SPEED LOOP ERROR SUM LIMIT : 0

These parameter may be set to "0" since the "SPEED CONTROL LOOP" is not enabled.

MACHINE SPECIFIC ADJUSTMENTS

After the values are preset, the following procedures can be used to determine the appropriate machine dependent values.

MACHINE DIRECTIONS



1. Turn up the operators speed dial and jog the machine in the +X direction. The machine should move in the rail axis, away from the operator.

   If the machine moves toward the operator in the X (Rail) Axis, reverse the setting of "SETV-23 X DRIVE SENSE" to the opposite "NORMAL" / "REVERSE" setting.

   If the machine moves in the cross axis, the wires to the drives are crossed. Correct the wiring, re-enter the preset values and go on.

2. Jog the machine in the +Y direction. The machine should move in the cross axis, to the left.

   If the machine moves to the Right when the +Y Jog is pressed, reverse the setting of "SETV-21 Y DRIVE SENSE" to the opposite "NORMAL" / "REVERSE" setting.

3. Now that the drives are moving in the right direction, the direction of the encoders must be set. The X/Y position may be viewed at the bottom in the status display or it may be viewed in large character status screen. The X/Y positions may be cleared in the large character status screen.

NOTE

The steps to view the X/Y position in the special large character status screen from "SYSTEM SETUP DATA PAGE 3" are the following:

Press the <CE> key to back up one menu. At this point press the <III> key. The X/Y displays may be cleared by using the <1>,<2>or <3> keys.

To return to "SYSTEM SETUP DATA PAGE 3" simply press the <CE> key and then the <ENTER> key.

Now plug in the X axis encoder cable only- don't plug in the Y yet. Jog the machine in the +X direction to move down the rail. If the X position counts positive (+), the X axis encoder direction is correct.

If the X position counts NEGATIVE (-), reverse the setting of "SETV-21 X ENCODER SENSE" to the opposite "NORMAL" / "REVERSE" value.

If the Y position counts when the X axis is moved, the encoder cables are interchanged.

4. Plug in the Y axis encoder and jog in the +Y direction. If the Y position counts positive (+), the Y encoder direction is correct. If the Y position counts NEGATIVE (-), reverse the setting of "SETV-22 Y ENCODER SENSE" to the opposite "NORMAL"/"REVERSE" value.

5. Select "4. FEEDRATE REF. CALIBRATION" from the UTILITY MENU. Turn the operators speed dial to the "FULL SPEED" maximum position. Also, if there are any speed range switches, set them to the high speed setting so that the speed dial is now set for the maximum drive speed.

   Press the "ENTER" button. The readout will temporarily show the DATA AND CALIBRATION VALUES, and then change to the normal: "FEEDRATE= 150.00".

   At this point, the value displayed in the status display "FEED:" field should be the same as the value entered for the MAXIMUM DRIVE SPEED AS "16. MAXIMUM DRIVE SPEED" or 150 for this example.

   Set SYSTEM SETUP DATA variable 2, MINIMUM POSITION HOLD SPEED from 0 to 2. This enables the control loop operations and all "hold position" logic.

6. Set the control to test run a 5.00 inch diameter "CHAIN CIRCLE" part. Start the test run and turn the speed dial to full speed.

   While the machine is going around the circle, if the path oscillates or is wavy, reduce the setting of "SETV-4 LOOP GAIN" until the oscillation stops. If no oscillation is noted, try raising the "SETV-4 LOOP GAIN" value until the shaking starts and then reduce it till it just stops.

   Now check the performance of the machine as it slows for each corner of the part. If it appears to be banging into the corners rather than smoothly decelerating, either increase the "SETV-7 SLOW DOWN DISTANCE" or decrease the "SETV-6 CORNER SPEED" values. Since this is a trial and error type of adjustment, it is impossible to predict which adjustment will give the best results. Similarly, if the corners appear "Mushy", reduce the "SETV-7 SLOW DOWN DISTANCE" or increase the "SETV-6 CORNER SPEED".

   After the machine slows for a corner, notice the acceleration out of the corner back to full speed. If it appears too long, reduce the "SETV-5 ACCELERATION TIME" value. Similarly if the acceleration appears too fast, increase the accel time.

   The objective of all these adjustments is to provide the smoothest most accurate operation with a minimum of time spent in the corners. Try various combinations of adjustments to get the optimum performance.

7. Setup the control and run a series of "RINGS". After the cut is turned off, watch that the cutting oxygen has completely stopped before the machine begins to move to the pierce point on the outside.

   If the machine begins to move before the cutting oxygen has stopped, increase the "SETV-13. OXYGEN FUEL BLEED OFF DELAY" time value.

   If the Bleedoff time value seems excessive, reduce the setting of BLEEDOFF time". Make sure the new value still provides enough delay to allow the cutting oxygen to stop before moving to the next part.

8. If the machine drives are well balanced, there is no need to do the automatic speed calibration. However, if the speeds are not balanced, the automatic speed calibration routine should be performed (3. AXIS SPEED CALIBRATION).

9. After all parameters are adjusted, and the speed calibration done, select "6. SAVE CONFIGURATION DATA" from the UTILITIES screen and store the new values in the non-volatile memory.

SERIAL COMMUNICATIONS

SERIAL COMMUNICATIONS is the transferring of data between two devices over a communication link. The BURNY 5 serial communications port can be used to load and store from various types of serial communication devices. The actual type of device is not important, only that it comply with the communication and program specifications. Therefore, remote computers, paper tape punches and other serial devices may be connected to the BURNY 5.

For a communications link to operate properly, the characteristics of the transmitting and receiving devices must match. If they do not, the program will either not load at all, or will be interpreted incorrectly. The BURNY 5 can adjust the following characteristics to match the external device.

- PROTOCOL (RTS/CTS, XON/XOFF, AND SPECIAL DEVICES)
- PROGRAM TYPE (WORD ADDRESS, ESSI, AND SPECIALS)
- CHARACTER TYPE (NUMBER OF DATA BITS, PARITY)
- BAUD RATE (110,300,600,1200,4800,9600,19200)

NOTE

The same factors affect both the receiving and transmitting characteristics of the system, therefore, once set, they should function in either direction.

SYSTEM VARIABLES THAT AFFECT COMMUNICATIONS

The BURNY 5, with the following SYSTEM DATA VARIABLES set to "0", prompts the operator for information needed to communicate properly with the other serial device. These variables are:

41. SERIAL LOAD DEVICE
42. SERIAL STORE DEVICE
43. BATCH LOAD DEVICE
44. STANDARD TTY DEVICE
45. STANDARD CALLUP DEVICE
46. BURNY DEVICE
47. COMM LINK 1
48. DATA BANK

PREDEFINED SERIAL DEFINITIONS

Although the BURNY 5 operates with the SYSTEM DATA VARIABLES #41-#48 set to all 0's, it is more convenient to predefine the system variables to match the devices that the BURNY 5 is communicating with. When this is done, all the operator does is select "LOAD FROM:SERIAL DEVICE" or "STORE TO:SERIAL DEVICE", press <ENTER>, select a program number and press <ENTER> a final time. At this time the BURNY 5 begins the loading or storing process. When the process is complete the <RST> key may be pressed to exit to the main menu or the <ENTER> key may be pressed to continue with another "load" or "store" operation.

NOTE

The BURNY 5 allows programs up to 128K bytes of INTERNAL program memory size to be run. This 128K limit includes any KERF compensation that is added to the program at the BURNY 5 control. Programs that exceed this size will produce the error "PGM SIZE EXCEEDS MAX ALLOWED". See section ERROR MESSAGES.

TYPICAL SERIAL LOAD FROM FILE SERVER

In this example, the BURNY 5 will be communicating with a PC compatible computer that is running the "BURNY FILE SERVER" software. The FILE SERVER software is configured to run with the following parameters:

4800 BAUD
7 DATA BITS EVEN PARITY
SOFTWARE HANDSHAKING
CLINK PROTOCOL

CONFIGURING THE BURNY 5

The BURNY 5 must first have the following SYSTEMS DATA VARIABLES predefined:

41. SERIAL LOAD DEVICE
42. SERIAL STORE DEVICE
43. BATCH LOAD DEVICE
48. DATA BANK

"SERIAL LOAD DEVICE", "SERIAL STORE DEVICE" and "BATCH LOAD DEVICE" are all 4 digit values. In this example, they should all be set to "5000". Digit 1 is set to "5" which is "DATA BANK 1". Setting this digit to a '5' lets the control know that the serial device type on "LOAD", "STORE" and "BATCH" operations is a DATA BANK or FILE SERVER. The other digits must be set to '0'.

The "DATA BANK" parameter is a 6 digit number and is set to "**032163**".

Digit 1 is set to "**0**" which is "READ/WRITE timeouts enabled". If the device, the FILE SERVER, does not respond in a short period of time to the commands sent by the BURNY 5, the BURNY 5 aborts the current load process.

Digit 2 is set to "**3**" which suppresses 70 null characters from leader and trailer. Setting this digit to '3' suppresses unneeded characters that are sent out of the serial port.

Digit 3 is set to "**2**" which uses partial software protocol (XON/XOFF only). Setting this digit to a '2' lets the BURNY 5 know that only XON and XOFF characters is used to control the flow of data between the 2 devices.

Digit 4 is set to "**1**" which defines WORD ADDRESS as the program format. Setting this digit to a '1' tells the BURNY 5 that the program to be loaded is in WORD ADDRESS format.

Digit 5 is set to "**6**" which sets the BAUD RATE to 4800. Setting this digit to a '6' causes the BURNY 5 to communicate at 4800 baud, the same rate as the FILE SERVER.

Digit 6 is set to "**3**" which sets the character format to 7 DATA BITS EVEN PARITY.

Once these values are entered, they must be saved in non-volatile memory. To do this, see "SAVE CONFIGURATION DATA" in section "UTILITIES".

CONNECTING TO RS-232C DEVICES

RS-232C is a abbreviation for Recommended Standard 232, Revision C. This standard comes from the engineering department of the Electronic Industries Association (EIA). RS-232C defines the wiring between two serial devices. It also defines the recommended purpose of 25 different wires, which pins they should terminate on and even what voltage levels, current drains and loads are allowed. Of the 25 pins/wires defined by the standard, only 11 wires are used for asynchronous communications. The others are used for synchronous communication or reserved for future use. Although there are 11 wires used for asynchronous communication, the BURNY 5 can communicate with as little 3 (TRANSMIT, RECEIVE AND GROUND) using SOFTWARE HANDSHAKING or as many as 5 (TRANSMIT, RECEIVE, Request-To-Send, Clear-To-Send and Signal Common) using HARDWARE HANDSHAKING. This means that either a 3 wire or 5 wire cable can connect the BURNY 5 to a host storage device. The host storage device may be a computer, tape punch, another BURNY 5 or any other type of serial device.

The following is a list of various specifications which must be followed for the serial communication to function properly. There is only one serial port, a 9 pin connector on the BURNY 5 back panel.

SIGNAL LEVELS ARE RS232C COMPATIBLE- ONLY THE FOLLOWING SIGNALS ARE USED:

SIGNAL NAME	PORT A PIN	DESCRIPTION
SHIELD	PIN 1	PROTECTIVE GROUND (SHIELD)
RIN	PIN 2	RECEIVED DATA INPUT TO BURNY 5
XOUT	PIN 3	TRANSMITTED DATA OUTPUT FROM BURNY 5
GND	PIN 7	SIGNAL GND
CTRL-OUT	PIN 8	CONTROL STATUS LINE -OUTPUT FROM BURNY 5
STAT-IN	PIN 9	INPUT STATUS LINE- INPUT TO BURNY 5
	PINS 5,6	PULLUP TO +5 - MAY BE USED FOR ANY SIGNAL REQUIRING A HIGH LEVEL SIGNAL.

NOTE

The "CTRL-OUT" and "STAT-IN" terminologies are used rather than the more conventional "REQUEST TO SEND" or "CLEAR TO SEND" since these imply specific data-set and data-terminal definitions and do not function identically on all serial devices. By choosing more general names, the correct connection to the remote equipment must be made based on signal function rather than assuming the same named pins are automatically connected.

The signal levels from the BURNY 5 are RS-232 compatible and can be connected directly to a remote computer (up to 50 ft). However, this direct connection could cause serious damage to the computer in the event of an electrical failure or short on the cutting machine. In the case of a plasma torch, if the torch shorts out to the machine, the entire plasma current (1000 amps or more), would flow through the machine chassis and through any parallel path to ground. If a cable were connected between the BURNY 5 and a remote computer, a large current could flow through the cable to the computer's ground connection.

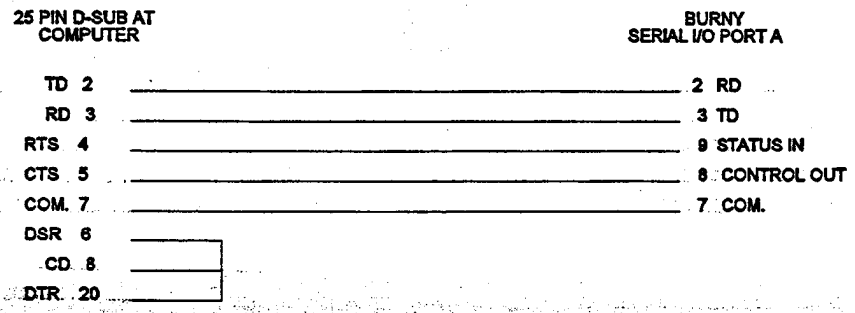
We therefore DO NOT RECOMMEND A DIRECT CONNECTION FROM THE MACHINE TO THE COMPUTER UNDER ANY CIRCUMSTANCES. Instead, a pair of short haul, direct connect modems which provide total optical isolation should be used. These devices are available from several sources and are used to transmit data over longer distances than can be done with standard RS-232. They usually allow transmission over twisted pair cables or fiber optic cables of a mile or more. Also, they should provide total electrical isolation between the transmitting and receiving ends. This protects against a ground loop being developed between the machine and the computer and should prevent any damage in most cases. If the BURNY 5 has a fiber optic modem there is no problem.

These modems should be used any time a device is permanently connected to the cutting machine. If a portable device is used where it is brought to the machine and removed before the cutting actually starts, the modems are not necessary.

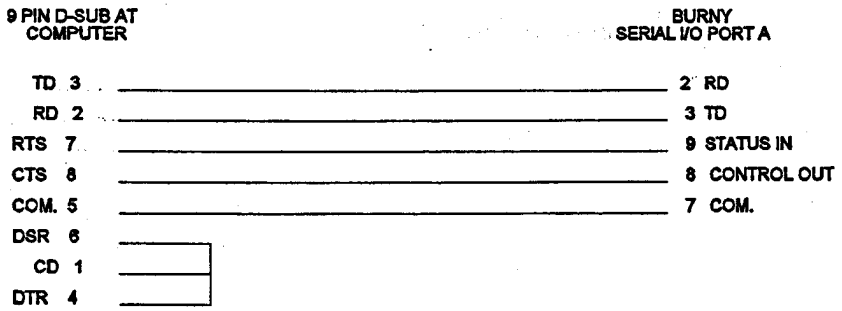
RS-232 CONNECTIONS FOR HARDWARE HANDSHAKING

These drawings show the typical connection from a BURNY 5 control to the standard 25-Pin and 9-Pin RS-232 connectors found on most PC compatible computers and peripherals. For HARDWARE HANDSHAKING, 5 wires are required: TRANSMIT DATA, RECEIVE DATA, REQUEST-TO-SEND, CLEAR-TO-SEND, and SIGNAL COMMON.

RTS/CTS HARDWARE PROTOCOL



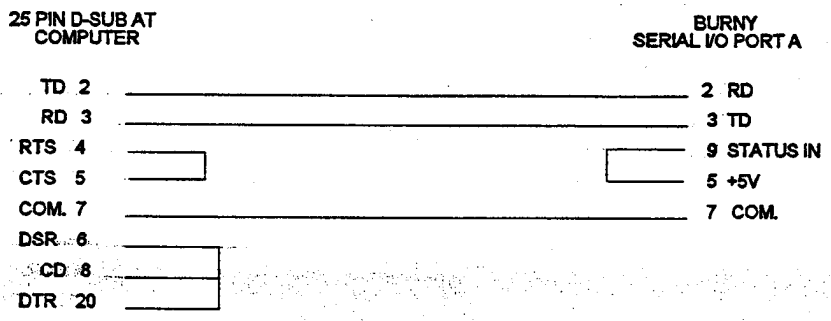
RTS/CTS HARDWARE PROTOCOL



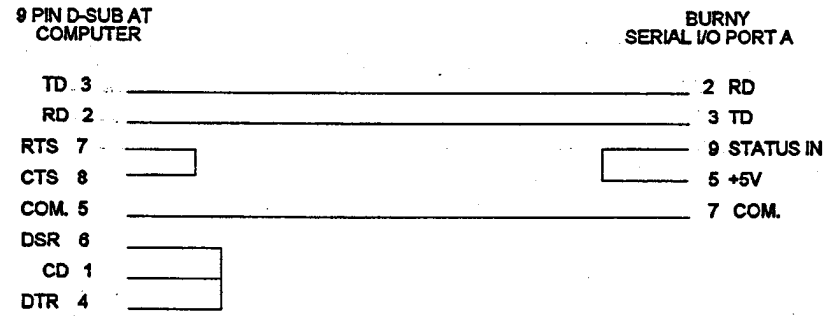
RS-232 CONNECTIONS FOR SOFTWARE HANDSHAKING

These drawings show the typical connection from a BURNY 5 control to the standard 25-Pin and 9-Pin RS-232 connectors found on most PC compatible computers and peripherals. Since SOFTWARE HANDSHAKING uses transmitted characters to control the data flow instead of separate hardware lines, only 3 wires are required: TRANSMITTED DATA, RECEIVED DATA, and SIGNAL COMMON.

XON/XOFF SOFTWARE PROTOCOL



XON/XOFF SOFTWARE PROTOCOL



SHORT HAUL MODEMS

The BURNY 5 may be ordered with an optional direct connect short haul modem installed. This modem, in addition to a host powered modem of the same type, provides the protection needed for the BURNY 5 and the host computer. These modems also increase the maximum distance of the communications link.

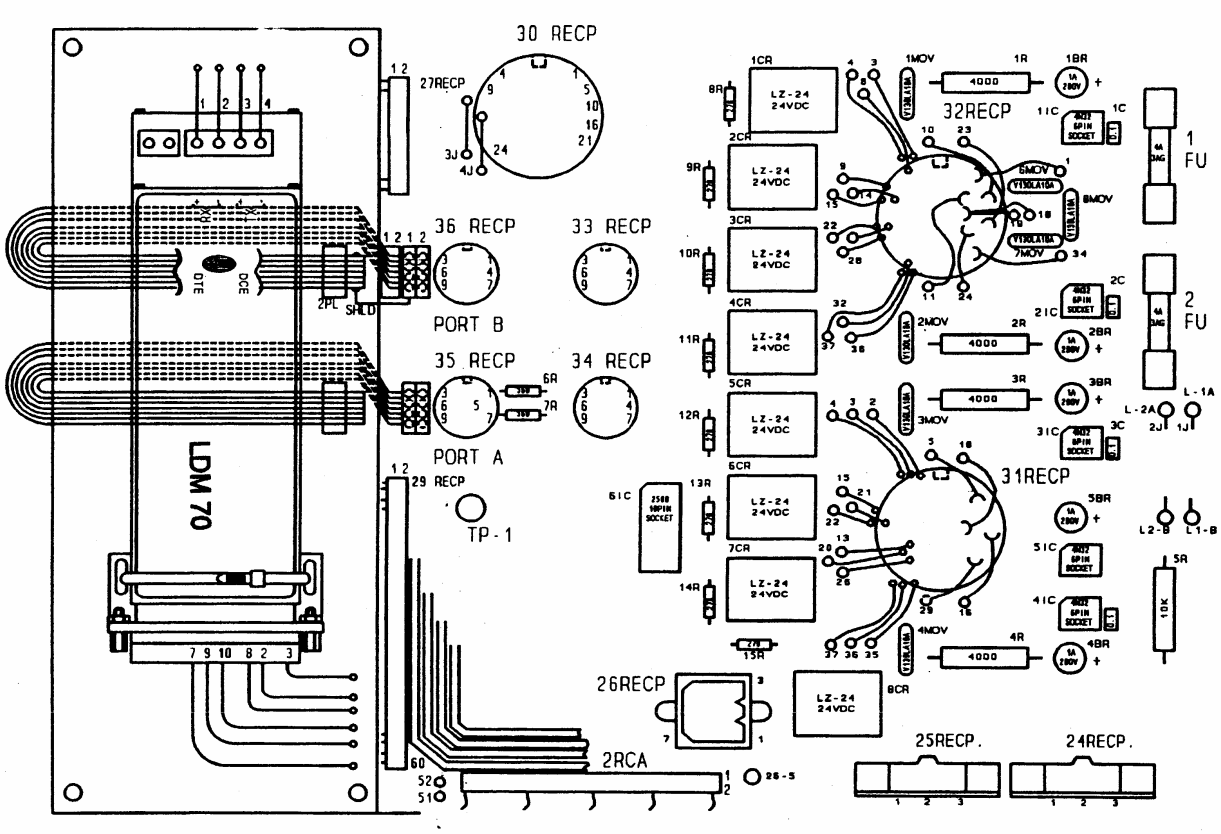
The BURNY 5 internal modem is mounted on a printed circuit card with some additional circuitry that is used for a multiplexer. This card is installed on the inside back panel of the control. It is mounted over the drive interface card.

NOTE

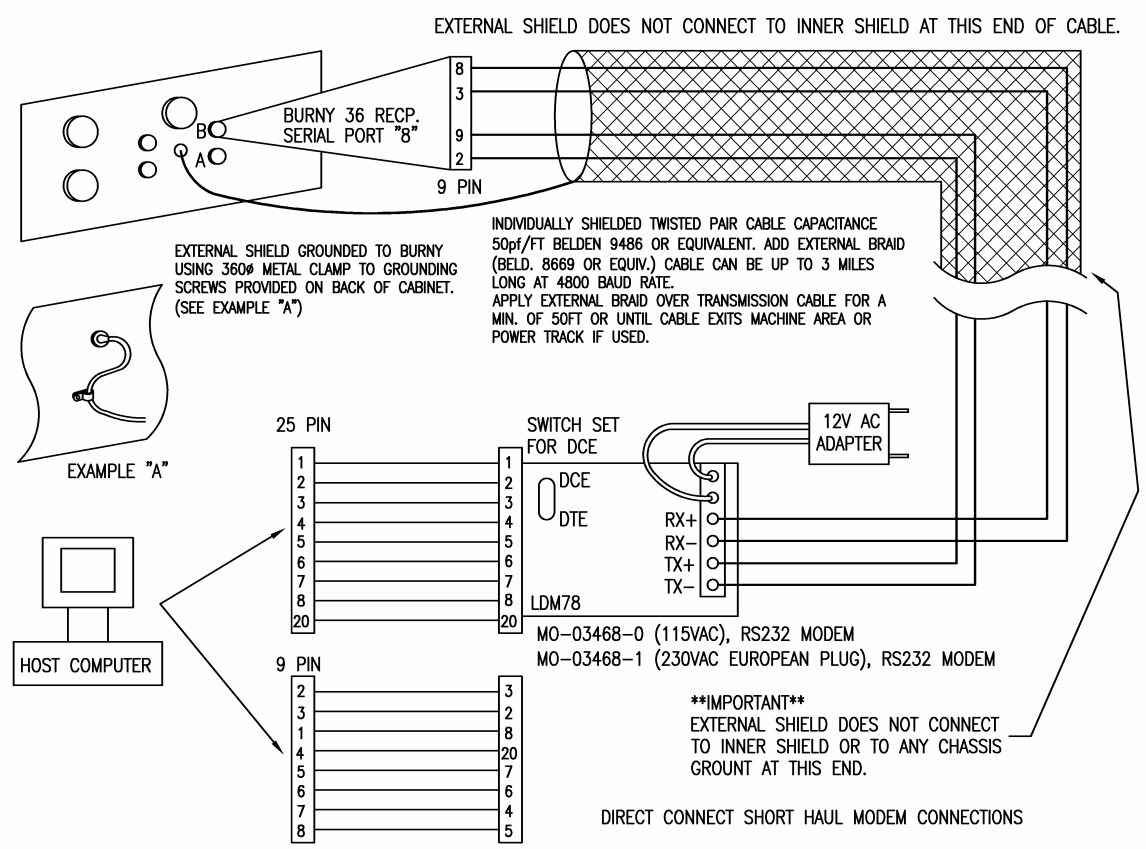
If the modem is not installed by the factory, refer to BURNY MO-4034 MODEM KIT INSTALLATION INSTRUCTIONS part number AO-7440A.

ONCE THE MODEM IS INSTALLED AND CONNECTED, THE NORMAL RS-232 PORT ON THE BACK OF THE BURNY 5 (SERIAL PORT `A') SHOULD NOT BE USED FOR ANY REASON. ALL CONNECTIONS TO THE MODEM CARD OUTPUT ARE MADE THROUGH SERIAL PORT `B'. THE RS-232 OUTPUT AT SERIAL PORT `A' WILL NOT FUNCTION CORRECTLY IF THE MODEM IS INSTALLED.

SIGNAL NAME	PORT B PIN	DESCRIPTION
SHIELD	PIN 1	NO CONNECTION
RX+	PIN 2	MODEM RX+
TX+	PIN 3	MODEM TX+
	PIN 4	** SENSE INPUT #1 (FOR MULTIPLEXER)
	PIN 5	** SENSE INPUT #2 (FOR MULTIPLEXER)
	PIN 6	** CONTACT OUTPUT #1 (FOR MULTIPLEXER)
	PIN 7	** CONTACT OUTPUT #2 (FOR MULTIPLEXER)
TX-	PIN 8	MODEM TX-
RX-	PIN 9	MODEM RX-



TOP VIEW OF INSIDE OF BACK PANEL



CHARACTER FORMATS

The BURNY 5 accepts several different character formats. The most common are:

ASCII (RS-358) - EVEN PARITY, 7 DATA BITS, 1 OR 2 STOP BITS

"EIA" (RS-244) -. ODD PARITY, 8 DATA BITS, 1 OR 2 STOP BITS (FLEXOWRITER) (The EIA RS-244 specification does not define control codes, hence it does not support the XON/OFF software protocol.)

The character format is selected either during installation and setup, or by the operator when the serial I/O operation is selected.

For the remainder of this description, the < > symbols are used to indicate specific characters as follows:

<CR> - HEX 0D - ASCII CARRIAGE RETURN
<EOB> - HEX 0A - ASCII END OF BLOCK (ALSO LINE FEED)
<XON> - HEX 11 - ASCII DC1 (TRANSMITTER ON)
<RON> - HEX 12 - ASCII DC2 (RECEIVER ON)
<XOFF> - HEX 13 - ASCII DC3 (TRANSMITTER OFF)
<ROFF> - HEX 14 - ASCII DC4 (RECEIVER OFF)
<EOF> - HEX 04 - ASCII EOF (END OF FILE)
<NULL> - HEX 00 - BLANK TAPE

HEX CODES SHOWN MUST HAVE APPROPRIATE PARITY BIT ADDED TO THE CODE.

The actual program format can be one of several types, as listed in the programming section of this manual.

HANDSHAKING PROTOCOL SPECIFICATIONS

HANDSHAKING is the way in which the data flow between BURNY 5 and the host storage device is regulated and controlled. There are two types of handshaking used by the BURNY 5. The first type is HARDWARE HANDSHAKING. Hardware handshaking uses the STATUS IN and STATUS OUT control lines (RTS and CTS) to control the data flowing through the transmit and receive lines.

The second type is SOFTWARE HANDSHAKING. Software handshaking does not use the RTS and CTS control lines to control data flow between two serial devices. Software Handshaking uses special characters to control the flow of data between two serial devices. They are <XON> for TRANSMITTER ON and <XOFF> for TRANSMITTER OFF.

RTS/CTS HARDWARE PROTOCOL

The "RTS/CTS" protocol uses electrical control signals defined by the RS-232 standard to regulate the transmission of data. The BURNY 5 has 1 input status line and 1 output control line to perform this handshaking. The status input to the BURNY 5 should be connected to a suitable status output signal from the external device. Similarly, the BURNY 5 control.output should be connected to a status input line on the remote device. Traditionally, these two signals have been called "REQUEST TO SEND" (RTS- STATUS OUTPUT) and "CLEAR TO SEND" (CTS- STATUS INPUT). However, the exact definition may vary, thus they are referred to as only the status input and control output lines. In this way, it implies that they should be connected to give the correct function, not necessarily to the pin bearing the same name. By using this type of handshaking, either the BURNY 5 or the external device can control the data transmission. This compensates for the fact that the data may be transmitted faster than a particular device can process it. If no handshaking is used, data can be lost due to this processing time. With the handshaking, either device can stop the transmission until it is ready to accept more data.

XON/XOFF SOFTWARE PROTOCOL

The "XON/XOFF" protocol uses special ASCII control characters to control the communication process. Since the "EIA" (RS-244) character format does not have equivalent characters for these codes, it cannot be used with software protocol. The following 4 ASCII codes are used:

<XON>	-DC1	-TRANSMITTER ON	HEX 11
<RON>	-DC2	-RECEIVER ON	HEX 12
<XOFF>	-DC3	-TRANSMITTER OFF	HEX 13
<ROFF>	-DC4	-RECEIVER OFF	HEX 14

The <RON> and <ROFF> are used by the transmitter to "Wake Up" the receiving device before the actual data transmission begins. In most cases, these codes are ignored. The "TRANSMITTER ON/OFF" commands are used by the receiving device to turn the "SENDERS" transmitter on or off and thus control the data transmission. In a typical case, the "SENDER" would transmit an <RON> and then begin sending the data. If the receiver cannot process the data fast enough, it sends an <XOFF> back, causing the data to stop. When the receiver is ready for more data, it sends an <XON> and the transmitter starts sending data again.

IMPORTANT

WHEN THE BURNY 5 IS RECEIVING DATA FROM A HOST COMPUTER, IT SENDS AN <XOFF> WHEN IT NEEDS TO STOP THE DATA TRANSMISSION TO PROCESS THE DATA ALREADY RECEIVED. THE REMOTE COMPUTER MUST STOP SENDING DATA WITHIN 3 CHARACTERS AFTER RECEIVING THE <XOFF> CODE. IF IT DOES NOT STOP, IT CAUSES AN "OVERRUN ERROR" AT THE BURNY 5 AND THE DOWNLOAD WILL BE ABORTED.

Since software <XON>/<XOFF> handshaking uses control codes sent over the same wires as the transmitted data, a 3 wire link (RS-232) is possible: Transmit, Receive and Signal Common. Some types of short haul modems only support this type of link since they only provide for one signal to be transmitted in each direction.

NOTE

When software <XON>/<XOFF> handshaking is being used, the Status-input line must be kept at a HIGH level. Tie PIN 5 TO PIN 9 on the 9-pin output connector of the BURNY 5 when software protocol is selected.

STANDARD CALLUP PROTOCOL

This is one of the communication protocols which can be used to provide a more automated link between the host computer and the BURNY 5. When this protocol is selected, the BURNY 5 transmits a request prompt to the host computer when the operator selects a "LOAD FROM SERIAL DEVICE" operation. The remote computer can interpret this header and send back the corresponding file without operator assistance at the computer. This allows for unattended operation of the computer and makes for a more automatic, more efficient link.

For "LOAD" operations, the BURNY 5 sends the following header when a new program is requested: (program number 12345678 used for example)

DOWNLOAD PROGRAM:12345678 <CR><EOB>

TYPICAL STANDARD CALLUP LOAD USING "RTS/CTS" (HARDWARE HANDSHAKING)

The operator selects the "LOAD FROM: SERIAL DEVICE" function, and enters the desired program number. When the <ENTER> key is pressed, any additional communication parameters that are not predefined are prompted for. (as set by SETV45).

NOTE

SYSTEM DATA VARIABLE 45 (SETV45) MUST HAVE THE HIGH 3 DIGITS DEFINED, (LEFT MOST) FOR HARDWARE PROTOCOL. A TYPICAL VALUE WOULD BE '334000'.

Once the parameters are entered, the BURNY 5 turns on its control line, then waits for the remote device to signal it's ready to receive data by sensing the status input line. At this point, the BURNY 5 would send 10 <null> characters, delay for 1 second and then send the following message:

DOWNLOAD PROGRAM:12345678 <CR> <EOB>

The remote device can then begin transmitting the requested program. If the BURNY 5 needs to halt the transmission, it turns off it's control output line, which should cause the remote device to stop sending data. The BURNY 5 turns the control output line back "ON" when data transmission is to resume.

If the program ends with the PROGRAM END/REWIND CODE, the load process stops. However, if the program just loaded ends with the PROGRAM END (no rewind) code, the load process pauses, then turns the control output line back ON and displays the last program number loaded with a "-997" extension. This "extension" is just a temporary number for the program.

"LOADING: 44-997- 0"

When the above message appears at the bottom of the screen, it indicates that the last program loaded was number 44 and it ended with a PROGRAM END code. The BURNY 5 is now waiting for the next program to be sent from the remote computer.

This would allow multiple programs to be loaded by ending the programs with the PROGRAM END (no rewind) code. Each program is loaded based on the program number defined by the "P" word in the program (see individual WORD ADDRESS/ESSI specifications). If a program does not specifically define a program number, the BURNY 5 assigns the number 0.

When the END OF PROGRAM CODE is received, the BURNY 5 then sends a termination message of "<BEL><BEL><BEL>EOF:###<CR><LF>" where ### represents a 3 digit status codes. A complete list of the status codes and their translations are located at the end of this section.

The BURNY 5 then turns off its control output line, finishes loading the program and then either stops the download, or re-enables its port for the next program as described in the section above.

The device sending the program can indicate an "END OF FILE" condition by sending an ASCII "control-D" (Hex '04'). This character indicates that the download link should be aborted. The host computer indicates that the requested program does not exist by sending only the "EOF" code. The BURNY 5 detects that only the "EOF" was sent and indicates a "NO PROGRAM FOUND" condition. The "EOF" character does not have to be used for normal downloading.

TYPICAL STANDARD CALLUP LOAD USING "XON/XOFF" (SOFTWARE HANDSHAKING)

NOTE

A Download to the BURNY 5 using SOFTWARE PROTOCOL requires that the remote device support <XON>/<XOFF> software conventions.

The operator selects the "LOAD FROM: SERIAL DEVICE" function, and enters the desired program number. When the <ENTER> key is pressed, any additional communication parameters that are not predefined are prompted for. (as set by SETV45).

NOTE

SYSTEM DATA VARIABLE 45 (SETV45) MUST HAVE THE HIGH 3 DIGITS DEFINED, (LEFT MOST) FOR SOFTWARE PROTOCOL. A TYPICAL VALUE WOULD BE '333000'.

Once the parameters are entered, the BURNY 5 turns on it's CONTROL LINE and waits for the status input line to go high (which it does immediately because it is tied high). The BURNY 5 indicates that transmission can start by sending:

<XON><RON><10 NULLS><ROFF> waits 1 second, then sends another <XON>

The BURNY 5 then sends the following message to request the specific program:

<RON> DOWNLOAD PROGRAM:12345678 <CR><EOB>

The remote device can begin transmission any time after receiving the <XON> character, or it can wait for the "DOWNLOAD PROGRAM:" message to send the requested program. If the BURNY 5 needs to halt the transmission, it sends an <XOFF> character which should cause the remote device to stop sending data. The BURNY 5 sends an <XON> character when the transmission can resume.

NOTE

The STATUS INPUT LINE on the BURNY 5 must be kept at a high level when software protocol is being used. This may be done by connecting the "STATUS IN" to the pull-up line (pin 9 to pin 5).

When the END OF PROGRAM CODE is received, the BURNY 5 then sends a communication link termination message of "<BEL><BEL><BEL>EOF:###<CR><LF>" where ### represents one of the 3 digit status codes listed at the end of this section. The BURNY 5 then sends an <XOFF> <ROFF> and then turn off it's OUTPUT STATUS LINE.

COMM LINK 1 PROTOCOL

This protocol is also known "DATA BANK 1" and is used with BURNY "FILE SERVER SOFTWARE". COMM LINK 1 is a special communications protocol which allows the BURNY 5 to send and receive part cutting programs from a remote computer via commands sent through the RS-232 port. The host computer can be programmed to use this protocol to provide a totally automatic link, no operator is required at the host computer.

Currently there are four basic commands that are supported.

1. <ESC>!FD (FILE DATA COMMAND)
2. <ESC>!FG (FILE GET COMMAND)
3. <ESC>!FQ (FILE QUE COMMAND)
4. <ESC>!QQ (FILE QUIT COMMAND)

COMM LINK 1 utilizes XON/XOFF software handshaking to control the flow of data between the two devices. A character-by-character check for XON or XOFF(>11 and >13) codes is done. The BURNY 5 does not currently support any block type protocols.

FILE DATA: <ESC>!FD

When the BURNY 5 control sends a program to a remote computer, the program data is proceeded by a "FILE DATA" command string. The message consists of a sequence of characters incorporating the program number being sent.

For example, for the BURNY 5 to send program number 8765 to the remote computer, the following message would be sent first:

<ESC>!FD8765<CR><LF>

where:

<ESC>	is the ASCII escape character
!	is the ASCII exclamation point
FD	is the abbreviated command for "FILE DATA"
8765	is the program number stored in the BURNY 5 control which is sent to the computer. The number is sent as standard ASCII numeric characters.
<CR>	is the ASCII carriage return character
<LF>	is the ASCII line feed character.

The BURNY 5 then PAUSES FOR ONE SECOND and then begins to send program data as follows:

<CR><LF>
%<CR><LF>
P8765<CR><LF>
..
..(PROGRAM DATA)<CR><LF>
..
M30<CR><LF>
^Z<CR><LF> signal for end of program data
<ESC>!QQ###<CR><LF> status code sent by BURNY 5

where:

<ESC>	is the ASCII escape character
!	is the ASCII exclamation point
QQ	is the abbreviated command for "FILE QUIT"
###	is a three digit status code
<CR>	is the ASCII carriage return character
<LF>	is the ASCII line feed character.
^Z	is the ASCII Control-Z character.

FILE GET: <ESC>!FG

The BURNY 5 control requests a program from the storage computer. The BURNY 5 control requests a program by specifying a program number of up to 8 numeric digits. Only numeric file names are used, no alphabetic characters are allowed unless the "ASCII FILE PATHNAME" feature is enabled. The message is a sequence of characters incorporating the desired program number.

For example, to request program number 12345, the BURNY 5 would send the following sequence to the computer.

<ESC>!FG12345<CR><LF>

where:

<ESC>	is the ASCII escape character
!	is the ASCII exclamation point
FG	is the abbreviated command for "FILE GET"
12345	is the program number requested by the BURNY 5 control. The storage computer should send the requested ASCII file preceded by the "FILE DATA" command. The "FILE GET" command is always sent by the requesting device and the "FILE DATA" command always precedes transmission of the actual program.
<CR>	is the ASCII carriage return character
<LF>	is the ASCII line feed character.

NOTE

At this time, the remote computer cannot request a program from the BURNY 5 control. All transfers are initiated at the BURNY 5 control.

If the BURNY 5 issues an "FG" request to the remote computer for a program (12345 for example) which does not exist, the remote computer should send the following response:

<ESC>!FD12345<CR><LF><^Z>

where the <^Z> termination character is sent immediately after the FD header indicating the program does not exist. The BURNY 5 then displays "NO PROGRAM HEADER FOUND" error message.

FILE QUEUE: <ESC>!FQ

The "FILE QUEUE" command allows the BURNY 5 to make a request to the storage computer for the next program in its queue. There is no program number sent with the FILE QUE command. The storage computer must acknowledge the <ESC>!FQ request with <ESC>!FD########<CR><LF>, pause one second then send the program that is next on the queue.

IMPORTANT

An acknowledgment of <ESC>!FD<CR><LF> with no program number also works. However the actual file that is sent to the BURNY 5 MUST CONTAIN A PROGRAM NUMBER BLOCK, such as "P12345678" for WORD ADDRESS. If no program number block is included in the program the BURNY 5 creates a program number of "FFFFFFFF" for that file.

FILE QUIT: <ESC>!QQ

Once a file has been transferred from the storage computer to the BURNY 5, the BURNY 5 sends a <ESC>!QQ### followed by a three digit status code. The status codes are listed at the end of this section.

For example, the BURNY 5 operator requests program number 12345 from the storage computer.

<ESC>!FG12345<CR><LF>	(Request message sent to storage computer by BURNY 5)
<ESC>!FD12345<CR><LF>	(Storage computer sends acknowledgment to BURNY 5)
PAUSES FOR 1 SECOND	
<CR><LF>	(SENDS <CR><LF> BEFORE "%")
%<CR><LF>	(STORAGE COMPUTER BEGINS TO END ASCII FILE)

PROGRAM DATA SENT BY STORAGE COMPUTER TO BURNY 5

.
.
.

PROGRAM DATA SENT BY STORAGE COMPUTER TO BURNY
M30<CR><LF>

^Z<CR><LF>	SIGNAL FOR END OF PROGRAM DATA
<ESC>!QQ0<CR><LF>	PROGRAM COMPLETED NO ERRORS

NOTE

One digit of '0' is returned on a successful completion with no errors.
All other status codes are 3 digits.

THREE DIGIT STATUS CODES

FILE I/O ERROR CODES

500 - INVALID OPERATION CODE ERROR
502 - INVALID DEVICE CODE ERROR
504 - DEVICE NOT OPENED ERROR
506 - DEVICE OPENED FOR WRITE NOT READ ERROR
508 - DEVICE OPENED FOR READ NOT WRITE ERROR
510 - DATA FORMAT ERROR
512 - END-OF-FILE ENCOUNTERED (PGM NOT FOUND)
514 - RECORD NOT FOUND
516 - FILE RECORD CHAINING ERROR
518 - FILE/DEVICE FULL ERROR
520 - DUPLICATE FILE NAME ERROR
522 - FILE/DEVICE ALLOCATION ERROR
524 - FILE/DEVICE PROTECTION ERROR
526 - FILE STRUCTURE FORMAT ERROR
528 - FILE/DEVICE ERASE AND REBUILD COMPLETED
530 - NOT TAPE ERROR
532 - FILE/DEVICE BUSY (ie. NOT ON-LINE)
534 - FILE/DEVICE EMPTY ERROR
536 - NO PROGRAM HEADER FOUND ERROR
538 - PROGRAM SIZE EXCEEDS MAX ALLOWED (ie. 128K)
540 - PROGRAM FILE CHECKSUM ERROR
542 - BUFFER ALLOCATION ERROR

SERIAL I/O ERROR CODES

548 - DEVICE ALLOCATED ERROR CODE
549 - "RECYCLE" ABORT REQUEST TERMINATION
550 - DEVICE OFF-LINE (ie. NO DATA SET READY)
551 - DEVICE NOT-READY(ie. NO CLEAR TO SEND)
552 - READ DATA OPERATION TIMEOUT
553 - WRITE DATA OPERATION TIMEOUT
554 - PARITY ERROR
555 - OVERRUN ERROR
556 - FRAMING ERROR
557 - DATA COMMUNICATION HANDSHAKE ERROR

COMM CHANNEL MESSAGE ERRORS

596 - "ABORT" COMMAND REQUEST TERMINATION CODE
597 - MESSAGE COMMAND ERROR
598 - MESSAGE FORMAT ERROR
599 - BACKGROUND PROCESS ALREADY BUSY ERROR
600 - PROGRAM FORMAT ERROR
601 - PROGRAM SYNTAX ERROR (ie. NO RUN BIT SET)
602 - BUFFER SIZE/ALLOCATION ERROR
603 - DATA SETUP ERROR
604 - COPY/DATA SIZE ERROR
605 - COPY/DATA CHECKSUM ERROR
606 - DATA DEFINITION ERROR
607 - FUNCTION SETUP ERROR

SYSTEM SETUP DATA VARIABLES

The following sections describe the SYSTEM SETUP DATA parameters currently defined in the control. To display their values, select "SYSTEM SETUP DATA" from the "DISPLAY SYSTEM DATA" or "SETUP/CONFIGURATION" utility menus. However, if these parameter values are to be modified and saved in non-volatile memory, the "SETUP/CONFIGURATION" utility must be used. The following SYSTEM SETUP DATA parameters are defined in the control.

NOTE

The "SD" numbers that are used in the BURNY 3 and BURNY 2.5 products have been provided only as a cross reference for those familiar with these products.

1. INTERNAL SYSTEM UNIT	"SD 60"
2. MINIMUM POSITION HOLD SPEED	"SD 08"
3. MAXIMUM CORRECTION SPEED	"SD 09"
4. LOOP GAIN	"SD 16"
5. ACCELERATION TIME	"SD 03"
6. CORNER SPEED	"SD 07"
7. SLOW DOWN DISTANCE	"SD 18"
8. SLOW DOWN RADIUS	"SD 29"
9. BACKUP SPEED	"SD 06"
10. TRAVERSE SPEED LIMIT	"SD 11"
11. PLASMA ARC DELAY	"SD 01"
12. PLASMA ARC OFF DELAY	"SD 17"
13. OXYGEN FUEL BLEED OFF DELAY	"SD 02"
14. MINIMUM OFF TIME	"SD 46"
15. DEFAULT DWELL TIME	"SD 45"
16. MAXIMUM DRIVE SPEED	"SD 04"
17. RUN SPEED LIMIT	"SD 10"
18. ENCODER COUNTS/REVOLUTION	"SD 22"
19. X ENCODER DISTANCE PER REV.	"SD 20"
20. Y ENCODER DISTANCE PER REV.	"SD 21"
21. X ENCODER SENSE	"SD 23"
22. Y ENCODER SENSE	"SD 24"
23. X DRIVE SENSE	"SD 25"
24. Y DRIVE SENSE	"SD 26"
25. MARKER DELAY TIME	"SD 43"
26. X MARKER 1 OFFSET	"SD 40"
27. Y MARKER 1 OFFSET	"SD 41"
28. X MARKER 2 OFFSET	"SD 47"
29. Y MARKER 2 OFFSET	"SD 48"
30. MARKER SPEED	"SD 42"
31. PLATE SIDE	"SD 27"
32. ERROR WARNING DISTANCE	"SD 15"
33. PLASMA HEIGHT RELAY	"SD 28"
34. KNIFE COMP. ROTATE DIAMETER	"SD 70"
35. KNIFE COMP. BREAKPOINT ANGLE	"SD 71"

36. SELECT GRAPHICS COLORS
37. SYSTEM CONFIGURATION 1
38. SYSTEM CONFIGURATION 2
39. SYSTEM CONFIGURATION 3
40. SYSTEM CONFIGURATION 4
41. SERIAL LOAD DEVICE
42. SERIAL STORE DEVICE
43. BATCH LOAD DEVICE
44. STANDARD TTY DEVICE
45. STANDARD CALLUP DEVICE
46. BURNY DEVICE
47. COMM LINK DEVICE
48. DATA BANK DEVICE
49. FLOPPY DEVICE
50. UNUSED
51. STANDARD PROGRAM FORMAT
52. CUSTOM PROGRAM FORMAT
53. SPECIAL END OF PROGRAM 1
54. SPECIAL END OF PROGRAM 2
55. SPEED LOOP GAIN
56. SPEED LOOP RESET TIME
57. SPEED LOOP ERROR SUM LIMIT
58. SPECIAL NC PROGRAM EXTENSION
59. UNUSED
60. UNUSED
61. X MARKER 3 OFFSET
62. Y MARKER 3 OFFSET
63. X MARKER 4 OFFSET
64. Y MARKER 4 OFFSET
65. X MARKER 5 OFFSET
66. Y MARKER 5 OFFSET
67. X MARKER 6 OFFSET
68. Y MARKER 6 OFFSET
69. X MARKER 7 OFFSET
70. Y MARKER 7 OFFSET
71. X MARKER 8 OFFSET
72. Y MARKER 8 OFFSET
73. X HOME 1 OFFSET (FUTURE)
74. Y HOME 1 OFFSET (FUTURE)
75. X HOME 2 OFFSET (FUTURE)
76. Y HOME 2 OFFSET (FUTURE)
77. X HOME 3 OFFSET (FUTURE)
78. Y HOME 3 OFFSET (FUTURE)
79. X HOME 4 OFFSET (FUTURE)
80. Y HOME 4 OFFSET (FUTURE)
81. HEIGHT SENSOR DISABLE LOOKAHEAD DISTANCE
82. MINIMUM RADIUS SPEED
83. MINIMUM SLOWDOWN ANGLE
84. MAXIMUM SLOWDOWN ANGLE
85. START DELAY TIME

1. INTERNAL SYSTEM UNIT (ENGLISH/METRIC)

This parameter allows the user to define the internal system type as ENGLISH or METRIC. From this parameter, the system defines the default dimension type as INCH or MILLIMETER for use in various position, speed and prompting displays. However, the primary purpose of this parameter is to define the internal program unit size and internal encoder count size.

The program unit size defines the resolution that is maintained by internally stored NC programs. When ENGLISH and NORMAL RESOLUTION are selected, the internal program unit size is set to .0025 inches. When METRIC and NORMAL RESOLUTION are selected, it is set to .05 millimeters. These program unit values provide a convenient programming increment when using inch dimensions in an ENGLISH system and millimeter dimensions in a METRIC system. Although dimension unit types can still be mixed within an NC program by using the appropriate auxiliary function codes, dimensional values will be rounded to the nearest program unit for the selected system type.

EXAMPLE

When a program defines a dimension of 4.1250 inches in a METRIC based system, it is internally saved as 104.80 millimeters (which is an error of .025 millimeters). Later, when the DISPLAY PROGRAM utility is used to display the program, the dimension is displayed as 4.1260 inches. These changes are caused by rounding errors when converting from inch to millimeter and back to inch. However, the amount of error displayed will never be more than .0025 inches (or .05 millimeters in a METRIC system) from the programmed position. Special operations are also performed in the control to eliminate the accumulation of incremental errors and to maintain position accuracy.

This difference in the size of the internal program unit prevents programs loaded into a METRIC based system from correctly running on an ENGLISH based system and vice-versa. Thus, any NC program residing in memory should not be directly RUN after changing the system unit type. However, these programs can be re-converted to the new internal type with the EDIT PROGRAM utility provided a WORD ADDRESS or ESSI program format is used. The EDIT process converts internal programs into the selected format and then re-converts them into current internal type when they are "saved" in memory. This difference in the internal program unit also prevents programs transferred from one system type to another via a RAM cartridge (or through the serial port using the PROCESSED INTERNAL program format) from running correctly. These programs should be transferred using one of the WORD ADDRESS or ESSI program formats so that the correct internal format can be created.

This parameter also defines the internal encoder count size which is selected to eliminate internal rounding errors when converting encoder counts into inch or millimeter dimensions. When ENGLISH is selected, the internal count size is set to .0025 inches and when METRIC is selected, it is set to .0625 millimeters.

The following summarizes the effects of selecting ENGLISH or METRIC as the system unit type.

When **ENGLISH** is selected:

- The internal programming increment is defined as 0.0025 INCHES.

- All dimensions and distances for displayed and entered values will be in INCHES.

- All speed displays and entries will be in INCHES PER MINUTE (IPM).

- All STANDARD SHAPE programs will prompt for INCH part dimensions unless the prompt type is altered with the SHF key.

- All GENERIC SHAPE programs will prompt for INCH part dimensions unless the prompt type is altered with the SHF key. However, internal values retained in the GENERIC data registers will always represent INCH values.

- All programs loaded through the SERIAL PORT or saved from the EDIT PROGRAM utility will be assumed to be in INCHES unless these programs contain a METRIC PROGRAMMING auxiliary function code.

When **METRIC** is selected:

- The internal programming increment is defined as 0.05 MILLIMETERS.

- All dimensions and distances for displayed and entered values will be in MILLIMETERS.

- All speed displays and entries will be in MILLIMETERS PER MINUTE (MMPM).

- All STANDARD SHAPE programs will prompt for MILLIMETER part dimensions unless the prompt type is altered with the SHF key.

- All GENERIC SHAPE programs will prompt for MILLIMETER part dimensions unless the prompt type is altered with the SHF key. However, internal values retained in the GENERIC data registers always represent MILLIMETER values.

- All programs loaded through the SERIAL PORT or saved from the EDIT PROGRAM utility will be assumed to be in MILLIMETERS unless these programs contain an INCH PROGRAMMING auxiliary function code.

If this parameter is incorrectly defined, first select the "value" field with the ENTER key and then use the up and down cursor keys to toggle the value between ENGLISH and METRIC before pressing the ENTER again.

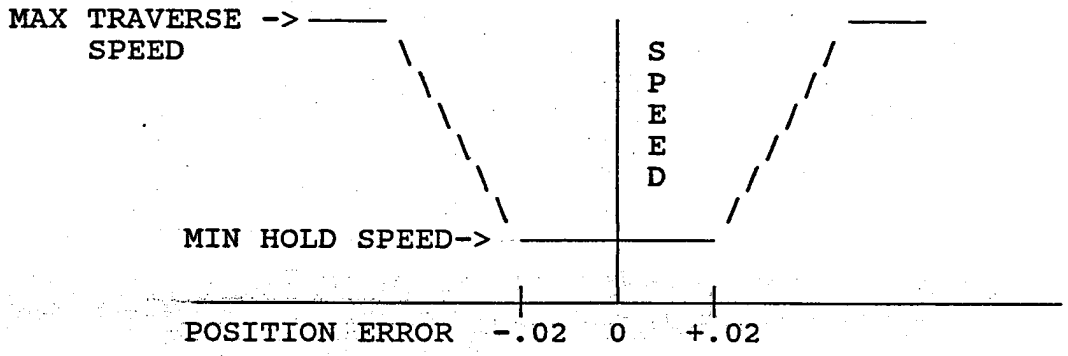
NOTE

Whenever this value is changed, the entire screen is updated with values scaled by the newly defined internal count type. Since a count size of .0025 inches does not equal .0625 millimeters, the newly displayed values are not equivalent to the old values. Therefore, whenever the system type is changed, all setup data values relating to distance and speed must be re-entered for the new system type.

2. MINIMUM POSITION HOLD SPEED (IPM/MMPM)

This speed value is used when the control is holding the machine in position. The speed entered for this parameter is used as a fixed "GAIN" value during the time the machine is within .02in (.5 mm) of the correct position. Within this distance the machine moves at the MINIMUM HOLD SPEED toward the correct position. If the distance is greater than .02in, a normal linear proportional gain is used to move the machine back until it is again within the "HOLD" boundary. This fixed gain method actually provides a higher gain and therefore better position hold than could be achieved with a normal "proportional gain" loop.

The following graph illustrates position hold loop:



At zero error, the speed is also zero.

IMPORTANT

The MINIMUM HOLD SPEED should never have a operating value of 0. A value 0 disables the machine from holding position. Setting the MINIMUM HOLD SPEED to 0 allows for easier set up of drive direction parameters and encoder direction parameters during the installation of the control.

3. MAXIMUM CORRECTION SPEED (IPM/MMPM)

This parameter is used to limit the maximum error speed which can be developed due to large position errors. This helps to prevent oscillation by limiting the "violence" of the shaking that occurs in unstable systems. (Minimum 20 ipm, 500 mmpm).

4. LOOP GAIN

This parameter is the most critical of all the setup parameters in affecting the machine's performance while cutting a part. The position loop constantly compares the position of the machine to the correct programmed path. Any difference (or "PATH ERROR") is multiplied by the LOOP GAIN value. This result is then output to the drives which causes the machine to move back toward the correct path. This value should be set to as large a value as possible to give the most accurate part. However if it is set too high, the machine will become unstable and oscillate while moving around the part. Thus adjusting this value is a trial and error procedure. Too low a value causes some loss of accuracy in the part while too high a value causes unstable operation.

NOTE

A speed control loop may be enabled to more accurately maintain the speed of the machine. Although this speed loop has minimal effect on the position loop process, it is recommended that the speed loop be disabled (or variable 55, SPEED LOOP GAIN, be set to 0.001) when first defining this position LOOP GAIN value and performing initial performance tests. Later adjustments, however, can be made while both the position and speed loops are active.

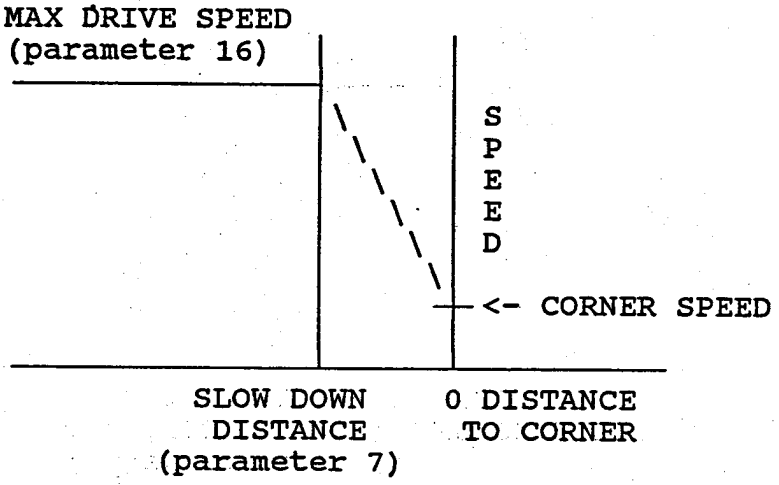
The units for LOOP GAIN are the same as those used for any of the other speed inputs, either INCHES PER MINUTE (IPM) or MILLIMETERS PER MINUTE (MMPM). However, the value entered is the correction speed for a "PATH ERROR" of one encoder count. (Approximately .0025in, .0625 mm). If the "PATH ERROR" is more than one count, the correction speed is the number of encoder counts of error multiplied by the LOOP GAIN value defined. For example, in an ENGLISH system if LOOP GAIN = 2.00 and the "PATH ERROR" is 5 encoder counts (.0125in), the correction speed output to the drive will be 2.00 x 5 = 10 ipm.

5. ACCELERATION TIME (SECONDS)

This parameter sets the acceleration time for the machine to ramp from zero to full speed. This parameter is also used to define the rate that is used when performing ACCEL/DECEL operations for changes in feedrate commanded by the operator or by an executing NC program. This value should be set as low as possible to minimize ramping delays when changing speeds and slowing to negotiate a corner. However, it should not be set so low that an abrupt "jump" occurs after each corner. (Normally .2 to 1.0 seconds).

6. CORNER SPEED (SECONDS)

This parameter, along with SLOW DOWN DISTANCE (parameter 7), controls the deceleration ramp used to slow down before a corner. The slope of this ramp is constant regardless of the travel speed as illustrated:



As can be seen from the graph, both the SLOW DOWN DISTANCE and the CORNER SPEED parameters affect the deceleration ramp. CORNER SPEED defines the speed at which the machine runs after performing a "full slowdown" operation. It should be set as high as possible to minimize the amount of speed change required, but not high enough to overshoot the corner or cause excessive stress (bumping) in the gearbox or drive system. This minimizes the time required to perform the corner and therefore, reduces the variation in the cut quality due to changes in cutting speed. (Typically set to 10 ipm, 250 mmpm).

7. SLOW DOWN DISTANCE (INCH/MM)

This parameter sets the deceleration distance used when slowing for a corner in a part program. It should be set to the minimum distance required to slow down from MAXIMUM DRIVE SPEED to CORNER SPEED. This minimizes the time required to perform the corner and therefore, reduces the variation in the cut quality due to changes in cutting speed. See the description for CORNER SPEED (parameter 6) for further details.

8. SLOW DOWN RADIUS (INCH/MM)

This parameter is used by the "ACCEL/DECEL" routine to determine if a certain radius arc can be run at the current machine speed or if the speed needs to be reduced due to a small radius. When an arc is run, its radius is compared to this value and will cause a slow down proportional to the ratio of the two radii. (Typically set to 2-3 in, 50-80 mm).

The numerical range of this feature is 0 to 81.9 inches (0 - 2047.9 mm). The resolution of this value saved in non-volatile memory is .0025 inch (.0625 mm).

9. BACKUP SPEED (IPM/MMPM)

In earlier software versions, this parameter set the maximum speed of the machine when the "REV" button was pressed. However, if the speed dial was set to a slower speed, the slower speed was used. Since there was no "ACCEL/DECEL" when backing up, this speed was set to a low speed so that the machine could back up around a corner without excessive stress (bumping) in the gearbox or drive system.

"ACCEL/DECEL" operations are performed when running in reverse. This allows "backup" speeds to match or exceed the running speed of the NC program. To take better advantage of this feature, the BACKUP SPEED definition has been changed to allow a non-zero value to define a "fixed" backup speed which is unaffected by the speed dial position. If a zero value is defined, backup speed is defined by the current RUN speed, which can be modified by a "digital feedrate" value specified by the operator or a feedrate commanded by the executing NC program. In either case, the selected RUN speed is always affected by the speed dial position.

10. TRAVERSE SPEED LIMIT (IPM/MMPM)

This parameter is used to limit the speed of the machine during non-cutting, fast traverse moves. It is always set less than or equal to the MAXIMUM DRIVE SPEED value. If the user attempts to set it higher, the value is automatically forced to the MAXIMUM DRIVE SPEED value. See the description for RUN SPEED LIMIT (parameter 17) for additional details.

11. PLASMA ARC ON DELAY (SECONDS)

This parameter is used with PLASMA cutting only and is used to delay the start of motion on a PLASMA cut after the "ARC ON" input has been received.

For PLASMA systems with CURRENT SENSING RELAY outputs, this value is normally set to zero, causing the machine to begin moving as soon as the arc transfers to the plate.

For PLASMA systems without a CURRENT SENSING RELAY output, this value can be used to delay machine motion approximately the same amount of time as the PLASMA system takes between the cycle start and the actual arc firing.

12. PLASMA ARC OFF DELAY (SECONDS)

This parameter defines the timer value used during PLASMA cutting. During a PLASMA cut, if the "ARC ON" input is removed, the control will stop the machine and automatically perform a "STOP CYCLE" function. The operator must then press the green "GO" button on the control before the operation can continue. The "ARC OFF" timer provides a delay before the "ARC OFF" condition is actually recognized. This permits cutting perforated materials and allows the machine to continue running if a previous cutting kerf is crossed. Also, if a part falls out before the entire program is done, the arc will go out. If no PLASMA ARC OFF DELAY time is used, the control will stop and not complete the part since there is no material to cut. (Typically set to 1-2 seconds).

13. OXYGEN FUEL BLEED OFF DELAY (SECONDS)

This parameter defines the timer value used with OXYGEN FUEL cutting. When the cutting OXYGEN is turned off at the end of a cut, the machine will hold position for the specified time to allow the OXYGEN to "bleed off" before moving to the next cut.

14. MINIMUM OFF TIME (SECONDS)

This parameter defines the timer used to cause a dwell after any function is turned off. It operates on all functions (plate marking, plasma, oxygen/fuel, etc.) and is in addition to any specific "off" delays for a particular operation, such as the OXYGEN/FUEL BLEED OFF DELAY time. (Typically 0 to 1 second).

15. DEFAULT DWELL TIME (SECONDS)

This parameter defines the system default time used when a "DWELL" auxiliary code is encountered in a part program without a dwell time assigned in the same block. However once a dwell time is assigned by the program, it becomes the default time until changed by another dwell function block.

16. MAXIMUM DRIVE SPEED (IPM/MMPM)

This parameter must be set to the maximum drive speed of the machine at full reference. This value is used in many of the position loop gain and slow down calculations and if not set correctly, can seriously affect machine performance. This value must be set to the capability of the drive system, not the desired maximum speed. To limit the speed, see TRAVERSE SPEED LIMIT (parameter 10) and RUN SPEED LIMIT (parameter 17).

EXAMPLE

If a machine has a 250 ipm drive system installed, this value must be set to 250 ipm.

17. RUN SPEED LIMIT (IPM/MMPM)

This parameter and TRAVERSE SPEED LIMIT (parameter 10) are used to limit the speed of the machine to something less than the maximum drive capability. Normally, it is not necessary to limit the speed since the machine was designed to work with the drive system. However, some older machines cannot travel as fast as the drive capacity without literally shaking themselves apart. In these cases, the RUN SPEED LIMIT limits the maximum speed while actually running the part.

NOTE

If no limiting is required, set both the RUN SPEED LIMIT and TRAVERSE SPEED LIMIT to the same value as MAXIMUM DRIVE SPEED (parameter 16).

RUN SPEED LIMIT defines the maximum speed of the machine at full reference with the speed dial used to define the "percent" of RUN SPEED required. In previous versions, the RUN SPEED LIMIT parameter was only used to limit the speed while cutting. Only speed dial positions selecting speeds less than the RUN SPEED LIMIT affected the actual running speed.

Since this parameter still defines the maximum running speed of the machine, it is also used to define the default digital feedrate and programmed feedrate values, both of which are always affected by the speed dial position.

The RUN SPEED LIMIT value must always be defined less than or equal to the MAXIMUM DRIVE SPEED value. If not, the system automatically replaces the specified value with the MAXIMUM DRIVE SPEED value.

18. ENCODER COUNTS/REVOLUTION (COUNTS)

This parameter allows different line count encoders to be used for the position feedback, although both the X and Y axes must use the same type of encoder. Quadrature encoders are normally rated by the number of "lines" per revolution. For this parameter, enter the number of "lines" per revolution for the feedback encoders being used. The maximum value of this parameter is 65535.

See the description of X ENCODER DISTANCE PER REV (parameter 19) for further details.

19. X ENCODER DISTANCE PER REV. (INCH/MM)

This parameter and ENCODER COUNTS/REVOLUTION (parameter 18) allows various encoder, rack, and pinion combinations to be used for the encoder position feedback in the control. The encoder must be a "quadrature" type encoder. If a 500 line encoder is used, it actually provides 2000 feedback counts per revolution. The feedback combination must provide between 360 and 440 encoder counts per inch of travel (25 mm). This gives feedback pulses between .00225 to .00275 inches per count when in an ENGLISH based system and .057 to .069 millimeters per count when in a METRIC based system. The value entered for the X and Y encoder distance per revolution is the number of inches (mm) covered by 1 revolution of the feedback encoder. This number divided by 4 times the value entered for the X DISTANCE PER REV gives the distance for each encoder count.

EXAMPLE 1: In an ENGLISH based system, if a 500 line encoder is used and covers 5in/rev, the setup values should be defined as:

X ENCODER DISTANCE PER REV = 5.000
ENCODER COUNTS/REVOLUTION = 500

$$\text{The distance per count} = \frac{5.000}{500*4} = .0025\text{in}$$

EXAMPLE 2: In a METRIC based system, if a 500 line encoder is used and covers 125 mm/rev, the setup values should be defined as:

X ENCODER DISTANCE PER REV = 125.0
ENCODER COUNTS/REVOLUTION = 500

$$\text{The distance per count} = \frac{125.0}{500*4} = .0625 \text{ mm}$$

NOTE

In a METRIC based system, the internal program unit is defined as 0.05 mm but the internal encoder size is defined as 0.0625 mm. This provides a consistent increment for programming (.05 millimeter increments) while still maintaining a positioning resolution of approximately .0025 inches (.0625 millimeters equals .0024606 inches).

20. Y ENCODER DISTANCE PER REV. (INCH/MM)

This parameter is used to define the distance traveled along the Y axis with one revolution of the encoder. See the definition of X ENCODER DISTANCE PER REVOLUTION (parameter 19) for further details.

21. X ENCODER SENSE (NORMAL/REVERSE)

The quadrature encoders used for position feedback provide both direction and position information. Depending on the mounting of the X axis encoder, the direction information may or may not be correct. This parameter allows the control to internally reverse the direction sense of the encoder feedback. If incorrect, first select the "value" field with the ENTER key and then use the up and down cursor keys to toggle the value between NORMAL and REVERSE before pressing ENTER again. The X and Y position values (displayed in the status window at the bottom of the screen) can be used to check that the correct positive and negative directions are established.

22. Y ENCODER SENSE (NORMAL/REVERSE)

This parameter is used to internally reverse the sense of the Y axis encoder. See X ENCODER SENSE (parameter 21) for further details.

23. X DRIVE SENSE (NORMAL/REVERSE)

This parameter is used to internally reverse the polarity of the X axis drive output signal. Depending on the machines drive electronics and the interface card in the control, the drive output signal for the X axis sometimes needs to be inverted so that the motion of the machine is correct. If incorrect, first select the "value" field with the ENTER key and then use the up and down cursor keys to toggle the value between NORMAL and REVERSE before pressing ENTER again. Use the JOG keys to check that the machine moves in the correct direction.

24. Y DRIVE SENSE (NORMAL/REVERSE)

This parameter is used to internally reverse the polarity of the Y axis drive output signal. See X DRIVE SENSE (parameter 23) for further details.

25. MARKER DELAY TIME (SECONDS)

This parameter defines the timer value used to delay the start of motion when the plate marking device is turned on. This delay can be used to allow the marking head to be lowered into position. It can also be used to hold the machine in position for center punching operations. Both MARKER 1 and MARKER 2 operations are affected by this timer.

26. X MARKER 1 OFFSET (INCH/MM)

This parameter is used with Y MARKER 1 OFFSET (parameter 27) to define the offset distance between the cutting torch and plate marker 1. When a program requires plate marking, a "MARKER OFFSET ON" command is first used to shift the marking device to the cutting torches X/Y position. This parameter defines the offset distance along the X axis. This offset allows the part to be programmed without concern for the physical arrangement of the cutting and marking devices. When all the marking is done, a "MARKER OFFSET OFF" command is used by the program to move the cutting torch back to the correct position.

27. Y MARKER 1 OFFSET (INCH/MM)

This parameter is used to define the plate marker 1 offset distance along the Y axis. See the definition for X MARKER 1 OFFSET (parameter 26) for further details.

28. X MARKER 2 OFFSET (INCH/MM)

This parameter is used to define the plate marker 2 offset distance along the X axis. See the definition for X MARKER 1 OFFSET (parameter 26) for further details.

29. Y MARKER 2 OFFSET (INCH/MM)

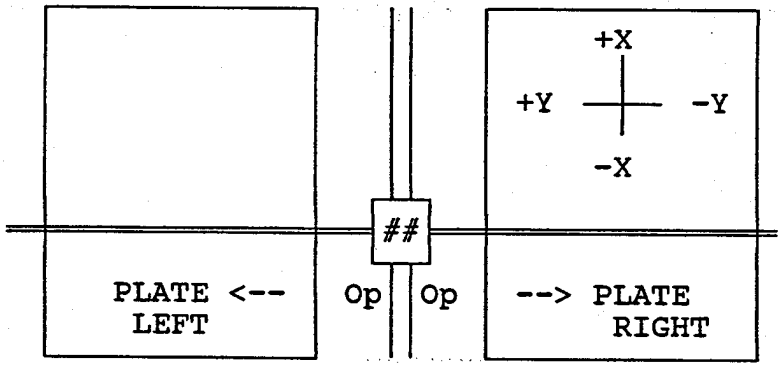
This parameter is used to define the plate marker 2 offset distance along the Y axis. See the definition for X MARKER 2 OFFSET (parameter 28) for further details.

30. MARKER SPEED (IPM/MMPM)

This parameter defines the speed used when in plate "MARKER ON" mode. A non-zero value defines a "fixed" marker speed that is not affected by the speed dial position. If a zero value is defined, the speed used during marker operations is defined by the selected RUN speed, which can be modified by a "digital feedrate" value specified by the operator or a feedrate commanded by the executing NC program. In either case, the selected RUN speed is always affected by the speed dial position. If MARKER SPEED is not set to zero, all feedrate commands encountered in "MARKER ON" mode are ignored and marker movements are performed at the "fixed" speed. Both MARKER 1 and MARKER 2 operations are affected by this parameter.

31. PLATE SIDE (LEFT/RIGHT)

This parameter is used to define the location of the plate being cut with respect to the operator console. It is used by the STANDARD SHAPE routines and others to determine the direction of repeat movements and initial moves from the corner of the plate. All programs should start at the corner of the plate nearest to the operator's console since this gives the best view of the plate for aligning the torches. If incorrectly defined, first select the "value" field with ENTER key and then use the up and down cursor keys to toggle the value between LEFT and RIGHT before pressing ENTER again.



32. ERROR WARNING DISTANCE (INCH/MM)

The control constantly monitors the "PATH ERROR" when running a part. If the error exceeds the value defined for this parameter, a warning message and beeping will occur. This indicates that the machine is not responding to positioning commands and that the part being produced is out of tolerance. This value should be large enough so that the "normal" bumps and shakes associated with a cutting machine in a production shop do not cause a nuisance tripping of the warning. Its main purpose is to issue a warning when something breaks or is jammed on the machine and causes a large offset from the correct path. (Typically set around .05in, 1.25 mm).

33. PLASMA HEIGHT RELAY (NORMAL/REVERSE)

This parameter affects the operation of the PLASMA height sensor relay. This relay's contacts are normally connected to the PLASMA system's height controller. When the control slows for a corner, this relay will energize and should cause the PLASMA height sensor to "freeze" at the current height. Once the machine has re-accelerated, this relay will turn off and allow the height sensor to function normally. Depending on the PLASMA system used, the contact must either "close" or "open" in order to perform the disable function. If this parameter is set to NORMAL, the output contact will be normally "open" and "close" only to disable the height sensor. However if set to REVERSE, the output contact will be normally "closed" and "open" only to disable the sensor. If incorrectly defined, first select the "value" field with ENTER key and then use the up and down cursor keys to toggle the value between NORMAL and REVERSE before pressing ENTER again.

34. KNIFE COMP. ROTATE DIAMETER (INCH/MM)

This parameter is used with the special "swivel knife" compensation routine which modifies the cut path to produce sharp corners rather than rounded corners caused by the knife's offset from center. If the KNIFE option is installed in the control, this value should be set to twice the offset distance from the center of rotation to the knife point.

35. KNIFE COMP. BREAKPOINT ANGLE

This parameter is also used with the special "swivel knife" compensation routine. This value defines the minimum change in direction which will cause the special knife processing to take effect. Thus for small changes in direction, the path will not be affected. However, if a shape corner (greater than this value) is found, the path will be modified so that a sharp corner is actually cut.

36. SELECT GRAPHICS COLORS

This parameter is used to modify some of the color codes used by the graphics process when displaying part images for inspect and nest operations, and when tracing machine position during RUN, TEACH and JOG operations. When set to zero, all colors are reset to their original system default values. This parameter can be used to define eight color code values..

The 8 digit SELECT GRAPHICS COLORS parameter value is defined as follows:

D1	D2	D3	D4	D5	D6	D7	D8

where:

	default color
"D1" defines the "scale bar" color.	(WHITE)
"D2" defines the "cursor" color.	(YELLOW)
"D3" defines the "jog mode" color.	(WHITE)
"D4" defines the "plate" color.	(MAGENTA)
"D5" defines the "trace cut off" color.	(GREEN)
"D6" defines the "trace cut on" color.	(YELLOW)
"D7" defines the "cut off" color.	(BLUE)
"D8" defines the "cut on" color.	(RED)

Colors are assigned by placing a non-zero digit representing the desired color in the appropriate digit position. A digit value of 0 is used to restore the associated color to the original system default color. The following color assignment codes are used:

0 selects the default color for associated type.
1 selects BLUE.
2 selects GREEN.
3 selects CYAN.
4 selects RED.
5 selects MAGENTA.
6 selects YELLOW.
7 selects WHITE.
8 selects BLACK.

37. SYSTEM CONFIGURATION 1

This parameter allows the user to alter the "normal" operating characteristics of the control. When this variable is set to zero, all special features are disabled and only "normal" operations are performed.

SYSTEM CONFIGURATION 1 is supported as an 8 digit value. The high 4 digits (left most digits) are used to selectively disable the normal input and output functions performed for PLASMA, OXYGEN and MARKER operations so that the I/O can be used for user defined auxiliary I/O operations. The low 4 digits (right most) are used to enable (or disable) other special features that have been added to the control such as "digital feedrate", "programmed feedrate" and "speed loop" operations.

The 8 digit SYSTEM CONFIGURATION 1 parameter value is defined as follows:

D1	D2	D3	D4	D5	D6	D7	D8

where:

"D1" and **"D2"** are used to selectively disable one or more of the normal control I/O operations so that the associated digital I/O can be used for custom auxiliary I/O operations. For additional information, see the AUXILIARY I/O OPERATIONS section in this manual.

"D3" and **"D4"** are used to selectively enable outputs that have been enabled for auxiliary output operations as auxiliary torch control outputs. For additional information, see the AUXILIARY I/O OPERATIONS section in this manual.

SYSTEM CONFIGURATION 1 continued.

D1	D2	D3	D4	D5	D6	D7	D8

"D5" defines the following bit flags:

PROGRAMMED FEEDRATE enable:

When set to "1", this bit enables the control to process the feedrate values that are contained in an NC program when it is RUN. When not enabled, the feedrate values are still retained in the program but are ignored by the RUN process.

120% SPEED DIAL RANGE enable:

When set to "1", this bit causes the operating range of the speed dial to be processed and displayed as a "0 to 120%" scale. When used with programmed feedrate or digital feedrate, the full dial position causes a feedrate of 120% to be used. However, the adjusted feedrate value may never exceed the defined RUN SPEED LIMIT value.

FEED PERCENTAGE enable:

When set to "1", this bit causes the FEED value displayed in the status window at the bottom of the screen to display a percentage value instead of the normal Inch/min or MM/min feedrate value. Note that both the speed dial percentage and selected feedrate values are always displayed on the AXIS SPEED utility screen.

SPEED LOOP enable:

When set to "1", this bit enables the speed control loop to detect and correct for errors in axis speed. If not enabled, axis speed adjustments are made using the calibration tables created by the BURNY SPEED CALIBRATION process.

These bit flags can be assigned as follows. The "X" indicates the flag bit is set to "1" if the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
PROGRAM FEEDRATE ENABLE		X		X		X		X		X		X		X		X
120% SPEED DIAL ENABLE			X	X			X	X			X	X			X	X
FEED PERCENTAGE ENABLE					X	X	X	X					X	X	X	X
SPEED LOOP ENABLE									X	X	X	X	X	X	X	X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

SYSTEM CONFIGURATION 1 continued.

D1	D2	D3	D4	D5	D6	D7	D8

"D6" defines the following bit flags:

REVERSED Y HOME SEARCH enable:

When this bit is set to a "1", the Y HOME search is performed away from the main rail, not towards the main rail.

HIGH SPEED JOG enable:

When set to "1", this bit enables the control to use the "DRIVE A" key (to the left of the JOG keys) as a HIGH SPEED jog select. When enabled and the "DRIVE A" key is pressed to toggle the associated LED "ON", jog operations are performed at the TRAVERSE SPEED LIMIT. The currently selected digital feedrate value and speed dial position have no effect on HIGH SPEED jog. When HIGH SPEED jog is not enabled, jog operations are performed at the selected feedrate scaled by the current speed dial position.

NOTE

In earlier software versions, the "A" through "E" drive keys were not used in the standard BURNY 5 system. However in the BURNY 5 / PROGRAMMABLE LOGIC CONTROLLER system, the logic sense of these key bits and their associated LED bits were sent to the PLC for use in the ladder diagram. Therefore, the HIGH SPEED jog feature should not be enabled if the use of "DRIVE A" as a HIGH SPEED jog enable conflicts with its defined use in the user's PLC ladder diagram logic.

DIGITAL FEEDRATE enable:

When set to "1", this bit enables the control to accept digital feedrate changes by the operator through the AXIS SPEED/POSITION display screen. This screen can be accessed by pressing the <I> key from the MAIN MENU or any utility menu, or from the "graphic trace" RUN screen. From the AXIS SPEED/POSITION screen, the operator can increase and decrease the current feedrate value by pressing the up and down cursor keys. Each press changes the feedrate by a value scaled by the speed dial position so that a feedrate change of 1 inch per minute occurs. Pressing the <SHF> key before the <UP> or <DOWN> cursor key alters the "step size" for a 10 ipm change. Pressing the numeric <6> key, allows the operator to enter a new digital feedrate value directly. However, the specified value is internally scaled by the current speed dial position so that the entered value will be displayed.

NOTE

A scaling operation is always performed to compensate for the current speed dial position. Values defined by the operator are not accepted when the equivalent "full scale" value exceeds the defined RUN SPEED LIMIT value. If this occurs, the "full scale" feedrate is clamped at the RUN SPEED LIMIT value.

SPEED LOOP FILTER disable:

When set to "1", this bit disables the speed value filtering process which is automatically enabled when the SPEED LOOP feature is enabled. Normally, this bit will remain cleared to allow for more stable SPEED LOOP operations.

These bit flags can be assigned as follows. The "X" indicates the flag bit is set to "1" if the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
REVERSED Y HOME SEARCH		X		X		X		X		X		X		X		X
HIGH SPEED JOG ENABLE			X	X			X	X			X	X			X	X
DIGITAL FEEDRATE ENABLE					X	X	X	X					X	X	X	X
SPEED FILTER DISABLED									X	X	X	X	X	X	X	X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

SYSTEM CONFIGURATION 1 continued.

D1	D2	D3	D4	D5	D6	D7	D8

"D7" defines the following features:

PATH ERROR CYCLE STOP enable:

When this bit is set to a "1", the normal "RUN - PATH ERROR" warning message and "beeping" is still performed but only until the path error exceeds 4 times the "ERROR WARNING DISTANCE" value defined in SYSTEM SETUP DATA variable 32. When the error exceeds this "4 times" value, the status message is changed to "STOP - PATH ERROR" and a CYCLE STOP condition is forced. To continue from this condition, the operator must press the <GO> key. Note that if the path error does not reach the "4 times" value, the cutting process is allowed to continue without stopping.

LATCHED BACKUP enable:

When this bit is set to a "1", toggle "ON/OFF" backup operations are enabled. When this bit is set to a "0" , the normal "hold-down" backup operation is performed.

INCREMENTAL HOME RETURN enable:

When this bit is set to a "0", the newly added ABSOLUTE RETURN operation is performed. When set to a "1", the old INCREMENTAL HOME RETURN operation is performed.

The operation of the "AXIS HOME RETURN" auxiliary functions have been expanded to perform the return either as an incremental movement defined by the distance travelled when the "AXIS HOME" was last performed, or as a direct return to the absolute coordinate where the "AXIS HOME" was actually initiated. This functional difference is not apparent when the "AXIS HOME" and "AXIS HOME RETURN" are always performed in pairs and no dimensional moves are programmed between the "HOME" and the "HOME RETURN" operations. However, significant differences in machine position and the graphic image do occur when movements are programmed between these two operations and/or multiple "HOME RETURN" operations are performed. As a result, the default "HOME RETURN" mode has been changed to use the newly implemented direct return.

TRANSMIT AFTER AUX PROCESS enable:

The auxiliary code value transfer process used in the BURNY 5 / PLC SYSTEM configuration was changed to send WORD ADDRESS "M" code and ESSI function code values to the PLC before the operation is performed. This allows the PLC to delay the execution of internal BURNY operations until the required PLC operations have been completed. For example, when a "MARKER OFFSET ON" function value is sent to the PLC, the PLC may require a delay or an operator acknowledge before the machine is permitted to move to the offset position. This delay in internal BURNY execution can now be performed using the same "FUNCTION ACKNOWLEDGE" logic that has always been supported. The control still waits for all but the special XMIT and RUN functions to be acknowledged by the PLC before it continues. The PLC performs this acknowledgment by clearing the auxiliary code value register in the PLC, which is constantly tested by the BURNY until the "cleared" value is read. This process now allows the PLC to extend this delay, without limit, until the necessary PLC operations have been completed.

The auxiliary function value was always sent after the BURNY had completed its internal function operation. Since this change in logic may cause problems in existing PLC logic programs, this configuration bit has been added. When this bit is set to "0", "M" code and ESSI function values are always sent "before" the internal BURNY operation is performed. However, if this bit is set to a "1", function code values are always sent "after" the operation is performed.

These bit flags can be assigned as follows. The "X" indicates the flag bit is set to "1" if the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
UNUSED		X		X		X		X		X		X		X		X
LATCHED BACKUP ENABLE			X	X			X	X			X	X			X	X
INCREMENTAL HOME RETURN					X	X	X	X					X	X	X	X
TRANSMIT AFTER AUX									X	X	X	X	X	X	X	X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

SYSTEM CONFIGURATION 1 continued.

D1	D2	D3	D4	D5	D6	D7	D8

"D8" defines the following features:

GRID ZERO enable:

When enabled, the X and Y axes in the status window are shown in absolute position. If not enabled, the X and Y axes in the status window are shown in incremental position. See the D8 Features Enable table below.

CONSTANT RATE ACCELERATION RAMP enable:

The normal operating mode is CONSTANT TIME ACCELERATION, which causes the BURNY to accelerate from the cornering speed to the running speed at a rate defined by the time interval. The greater the required speed change, the steeper the acceleration ramp. The time interval used is defined by the ACCELERATION TIME parameter.

When enabled by the CONSTANT RATE ACCELERATION RAMP, the ACCELERATION TIME parameter defines the time required to accelerate from zero to the MAXIMUM DRIVE SPEED parameter value. This acceleration rate is then used for all speed changes, regardless of the amount of change required. Smaller changes in speed require less time to complete in this mode.

See the D8 Features Enable table below.

DISABLE DOUBLE AXIS RETURNS:

When enabled, this feature corrects the graphical image displayed on the CRT when Plate Alignment is used in conjunction with single axis Home Returns.

See the D8 Features Enable table below.

SYSTEM CONFIGURATION 1 continued.

D1	D2	D3	D4	D5	D6	D7	D8

D8 features can be enabled as follows. The "X" indicates the feature is enabled if the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
GRID ZERO		X		X						X		X				
CONSTANT RATE ACCEL			X	X							X	X				
UNUSED																
DISABLE DOUBLE AXIS									X	X	X	X				

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc. "0" means no features are enabled. "4" through "7", and "C" through "F" are not valid entries.

38. SYSTEM CONFIGURATION 2

This parameter allows you to alter the normal prompting characteristics of the control. It is supported as a 8-digit value and is defined below.

D1	D2	D3	D4	D5	D6	D7	D8

where:

"D1" enables the ZERO key to be used as the password when set to "1".

"D2" is currently unused and should be set to 0 to prevent problems in future software releases.

"D3" enables the CUSTOM BANNER SCREEN when set to "1." See DISPLAY SYSTEM DATA for more information.

"D4" defines the following features:

GRAPHIC CURSOR TYPE definition:

"0" defines the graphic cursor as a star during the RUN trace;
"1" defines the graphic cursor as an X cursor;
"2" defines the graphic cursor as a box; and
"3" defines no cursor

See the D4 Features Enable table below.

OVERLAY TABLE PROMPT on second RUN screen enable:

When enabled, this feature adds a prompt on the second RUN screen for the OVERLAY TABLE DATA. See UTILITIES, SETUP/CONFIGURATION, screen 7: OVERLAY TABLE DATA for more information.

See the D4 Features Enable table below.

SYSTEM CONFIGURATION 2 continued.

D1	D2	D3	D4	D5	D6	D7	D8

"D4" features can be enabled as follows. The "X" indicates the feature is enabled if the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
STAR CURSOR		X				X				X						
X CURSOR			X				X				X					
BOX CURSOR				X				X				X				
NO CURSOR									X	X	X	X				
OVERLAY TABLE PROMPT																

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc. "0" means enable a star cursor, but no overlay table prompt. "4" and "C" through "F" are not valid entries.

"D5" defines the following features:

MONOCHROME DISPLAY PROMPTING enable:

When set to "1", this feature is enabled, and reverse video prompting is used with the monochrome version of this control.

ALL WHITE DISPLAY enable:

When set to "2", this feature is enabled, and causes all character and graphics to be displayed in white. This should be set to "0" for normal operations.

UNDERLINE PROMPTING enable:

When set to a "4" AND the MONOCHROME DISPLAY PROMPTING is enabled, the UNDERLINE prompting mode is enabled. This is the normal prompting set up for the monochrome version of this control. This feature can also be use on color controls to enhance the prompting operations.

SYSTEM CONFIGURATION 2 continued.

D1	D2	D3	D4	D5	D6	D7	D8

"D5" features can be enabled as follows. The "X" indicates the feature is enabled if the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
MONOCHROME DISPLAY		X		X		X		X								
ALL WHITE DISPLAY			X	X			X	X								
UNDERLINE PROMPTING					X	X	X	X								
UNUSED (SET TO ZERO)																

"0" means no features enabled. "8" through "F" are not valid entries.

"D6" is used to enable the following features:

ASCII NAME PROMPTING enable:
Set this bit to enable the alphanumeric prompting feature of the control. After the program number is entered on the STANDARD SHAPE LOAD screen (and others), a small white "^" cursor appears below the program name field. As in the TEXT EDITOR, this cursor identifies the position where the next string character will be placed. From this position the operator can use the left and right arrow keys to change the cursor position, or the up and down arrow keys to step through the supported ASCII character set. See the D6 Features Enable table below.

SYSTEM CONFIGURATION 2 continued.

D1	D2	D3	D4	D5	D6	D7	D8

(D6 continued)

CARTRIDGE PORT disable:

This bit must be set to disable the prompting for the CARTRIDGE PORT, if the control does not have a CARTRIDGE PORT. See the D6 Features Enable table below.

WHITE TRACE CURSOR enable:

Set this bit to display the cursor following the cut path in white while running. If not set, the cursor is displayed in the same color as the cut path. See the D6 Features Enable table below.

D6 features can be enabled as follows. The "X" indicates the feature is enabled if the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
UNUSED (DO NOT SET)																
ASCII NAME PROMPTING			X				X				X				X	
DISABLE CARTRIDGE PORT					X		X						X		X	
WHITE TRACE CURSOR									X		X		X		X	

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc. "0" means no features enabled. "1", "3", "5", "7", "9", "B", "D" and "F" are not valid entries.

"D7" is used to enable the following feature:

GRAPHICS HOME OFFSET enable:

When enabled, AXIS HOME auxiliary functions contained in programs cause the "logical" home program position to be reset to zero during an inspect operation. Normal operations should set this bit to a "0" so no position reset operations are done. See the D7 Features Enable table below.

SYSTEM CONFIGURATION 2 continued.

D1	D2	D3	D4	D5	D6	D7	D8

(D7 continued)

INTERNAL FLOPPY DRIVE INSTALLED:

When set, this bit causes prompting for the internal FLOPPY DRIVE to be enabled. If a floppy drive is installed in the control, this bit must be set. See the D7 Features Enable table below.

SCALE BAR ON TRACE SCREEN enable:

When set, this bit causes the SCALE BAR seen on most graphics screens to also be displayed on the RUN TRACE screen. If this bit is not set, then there is no SCALE BAR displayed on the RUN TRACE SCREEN. See the D7 Features Enable table below.

D7 features can be enabled as follows. The "X" indicates the feature is enabled if the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
GRAPHICS HOME OFFSET		X		X		X		X								
INTERNAL FLOPPY ENABLE			X	X			X	X								
TRACE SCALE BAR ENABLE					X	X	X	X								
UNUSED (DO NOT SET)																

"0" means no features enabled. "8" through "F" are not valid entries.

SYSTEM CONFIGURATION 2 continued.

D1	D2	D3	D4	D5	D6	D7	D8

"D8" is used to enable the following features:

NOVICE MODE enable:

When set, this bit causes the control to initialize the NOVICE/EXPERT mode flag at power-up to the NOVICE state. In NOVICE mode, all HELP pop-up menus are automatically displayed when performing prompting operations. Once the control is up and running, the NOVICE/EXPERT mode flag can be toggled using the "V" key. When this bit flag is set to "0", the control powers up in EXPERT mode and the user must press the "IV" key to display a HELP menu or program directory list. (Pressing the "V" key causes the control to enter NOVICE mode but does not cause the HELP menu to be displayed until the next prompt operation is performed.)

See the D8 Features Enable table below.

ALTERNATE LANGUAGE enable:

When set, this bit causes the control to replace the normal English prompt and status strings with text strings from an alternate language table.

This flag is only used at system power-up to select the default language type. Therefore, after defining the desired state, the SYSTEM SETUP DATA variables must be saved in non-volatile memory (using the "SAVE CONFIGURATION DATA" utility) and the power to the control must be cycled "off" and "on" to verify the definition.

Once the control is up and running, the "SHF" "VI" key combination can be used to internally toggle the language selection flag so that all newly displayed messages will be displayed in the "other" language. This key combination, however, has no effect on the default state defined by this setup data bit.

See the D8 Features Enable table below.

SYSTEM CONFIGURATION 2 continued.

D1	D2	D3	D4	D5	D6	D7	D8

(D8 continued)

EDIT/NEST PASSWORD enable:

When set, this bit causes the control to prompt for the "SETUP / CONFIGURATION" password before entering the requested EDIT PROGRAM or NEST EDIT utility. If the password is not entered, the operation is not allowed. See the D8 Features Enable table below.

CLEAR DIRECTORY PASSWORD enable:

When set, this bit causes the control to prompt for the "SETUP / CONFIGURATION" password before performing the CLEAR DIRECTORY function in the DIRECTORY SUPPORT utility menu. If the password is not entered, the operation is not allowed. This feature has no effect on the "ERASE AND TEST" function which appears in the same utility menu. See the D8 Features Enable table below.

D8 features can be enabled as follows. The "X" indicates the feature is enabled if the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
NOVICE MODE ENABLE		X		X		X		X		X		X		X		X
ALTERNATE LANGUAGE			X	X			X	X			X	X			X	X
EDIT/NEST PASSWORD					X	X	X	X					X	X	X	X
CLEAR DIR PASSWORD									X	X	X	X	X	X	X	X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

39. SYSTEM CONFIGURATION 3

SYSTEM CONFIGURATION 3 (variable 39) is an 8 digit value defined as follows:

D1	D2	D3	D4	D5	D6	D7	D8

where:

"D1" alters the default COMMAND MESSAGE format to include additional characters. Currently only one format bit has been assigned:

8 => All COMMAND MESSAGES are enclosed in the character codes <SOH> (hexadecimal 01) and <EOT> (hexadecimal 04).

"D2" is currently undefined and should be set to zero.

"D3" defines the required BAUD RATE for the optional RS-422 port when not operating in the PLC configuration mode as follows:

0=> No assignment made (uses default of 9600 BAUD)
1=> 110 Baud
2=> 300 baud
3=> 600 baud
4=> 1200 baud
5=> 2400 baud
6=> 4800 baud
7=> 9600 baud
8=> 19200 baud

"D4" defines the required CHARACTER TYPE for the optional RS-422 port when not operating in the PLC configuration mode as follows:

0=> No assignment (uses default of 8 data, odd parity)
1=> 7 data bits, no parity, 2 stop bits
2=> 8 data bits, no parity, 2 stop bits
3=> 7 data bits, even parity, 2 stop bits
4=> 8 data bits, even parity, 2 stop bits
5=> 7 data bits, odd parity, 2 stop bits
6=> 8 data bits, odd parity, 2 stop bits
8=> 7 data bits, no parity, 1 stop bit
9=> 8 data bits, no parity, 1 stop bit
A=> 7 data bits, even parity, 1 stop bit
B=> 8 data bits, even parity, 1 stop bit
C=> 7 data bits, odd parity, 1 stop bit
D=> 8 data bits, odd parity, 1 stop bit

SYSTEM CONFIGURATION 3 continued.

D1	D2	D3	D4	D5	D6	D7	D8

"D5" enables a "hold loop" feature, allowing the BURNY 5 to scale the MINIMUM HOLD SPEED as the machine nears the HOLD position and attempts to maintain the position within one external encoder count. This prevents the machine from oscillating when trying to hold position, especially when using higher MINIMUM HOLD SPEED values to compensate for machine drift.

Set this digit to "1" to enable MINIMUM HOLD SPEED SCALING operations.

"D6" defines the following features:

EXTENDED 8-BIT RUN DECEL SPEED VALUE enable:

When enabled, the EXTENDED 8-BIT RUN DECEL SPEED VALUE lengthens the RUN DECEL SPEED value from five digits to eight digits, allowing the arc and line RUN and END speed values to be defined with greater resolutions. This feature provides smoother speed transitions between program blocks, especially when processing short line and arc segments.

This feature must be enabled before the program is loaded or created in NC program memory, so that the appropriate internal block format can be used. If necessary, the PROGRAM TEXT EDITOR can be used to convert from one internal block format to another by defining the required mode and then recalling and saving the program in one of the WORD ADDRESS programming formats.

See the D6 Features Enable table below.

***** NOTE *****

Programs loaded with this feature enabled may require more space in NC program memory, depending on the program resolution. When using SUPER program resolution, the increase in program size may not be significant. When using HIGH and NORMAL program resolution, the increase in program size is more significant. Also, you may need to reduce the CORNER SPEED or increase the SLOWDOWN DISTANCE values when updating existing controls.

SYSTEM CONFIGURATION 3 continued.

D1	D2	D3	D4	D5	D6	D7	D8

(D6 continued)

PLASMA PIERCE TIMER HOLD enable:

When enabled, the PLASMA PIERCE TIMER HOLD works with the PIERCE TIMER on the RUN MODE screen, and allows you to substitute a reduced acceleration rate function with a hold function. That is, when the PIERCE HOLD is enabled, the machine holds the position where the cut is started until the PIERCE TIMER expires. It then accelerates using the normal acceleration rate.

Pressing <GO> will then cancel the PIERCE HOLD or freeze the timer at its current state if the PIERCE TIMER FREEZE is enabled. See "D8" below.

Note that you can have PLASMA PIERCE HOLD enabled without OXYGEN PIERCE HOLD enabled.

See the D6 Features Enable table below.

OXYGEN PIERCE TIMER HOLD enable:

When enabled, the OXYGEN PIERCE TIMER HOLD works with the PIERCE TIMER on the RUN MODE screen, and allows you to substitute a reduced acceleration rate function with a hold function. That is, when the PIERCE HOLD is enabled, the machine holds the position where the cut is started until the PIERCE TIMER expires. It then accelerates using the normal acceleration rate.

Pressing <GO> will then cancel the PIERCE HOLD or freeze the timer at its current state if the PIERCE TIMER FREEZE is enabled. See "D8" below.

Note that you can have OXYGEN PIERCE HOLD enabled without PLASMA PIERCE HOLD enabled.

See the D6 Features Enable table below.

SYSTEM CONFIGURATION 3 continued.

D1	D2	D3	D4	D5	D6	D7	D8

(D6 continued)

MISSED ARC ENDPOINT CORRECTION disable:

The MISSED ARC ENDPOINT CORRECTION is normally enabled, which detects the endpoint over a wide range of NC programming error conditions and reduces the potential for continuous circling in forward and reverse directions.

You can disable this feature. See the D6 Features Enable table below.

D6 features can be enabled as follows. The "X" indicates the feature is enabled if the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
EXT RUN DECEL SPEED		X		X		X		X		X		X		X		X
PLA PIERCE TIMER HOLD			X	X			X	X			X	X			X	X
OXY PIERCE TIMER HOLD					X	X	X	X					X	X	X	X
DISABLE MISSED ARC									X	X	X	X	X	X	X	X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

"D7" defines PROGRAM RESOLUTION MODE mode as "normal," "high," or "super." This allows the control to use an internal encoder count unit size that differs from the program unit size. PROGRAM RESOLUTION is used with ENCODER COUNTS PER REVOLUTION and the X and Y ENCODER DISTANCE PER REV to internally define the scale factor required to convert external counts to the internal count unit size.

The resolution used by a program is determined when it is first created and / or loaded into NC program memory. Consequently, the required program resolution must be defined **before** loading into NC program memory. Once a program has been loaded or created by the TEACH, EDIT, NEST, or STANDARD SHAPE process, its resolution remains fixed until it is stored and reloaded or called to the TEXT EDITOR and saved using one of the WORD ADDRESS program formats.

SYSTEM CONFIGURATION 3 continued.

D1	D2	D3	D4	D5	D6	D7	D8

(D7 PROGRAM RESOLUTION continued)

Selecting the "best" PROGRAM RESOLUTION depends the programming accuracy required. For machines using external encoder sizes of .0025" per count, the NORMAL RESOLUTION size of .0025" (.05mm) provides the best operating mode. Using program resolutions greater than the external encoder unit size provide no real advantage since they force the BURNY to save more precision than the machine can actually achieve.

HIGH and SUPER RESOLUTION modes have the advantage of allowing programs created with resolutions of .001" or .0001" to be displayed by the DISPLAY PROGRAM and TEXT EDITOR utilities with exact resolution. NORMAL resolutions round program dimensions to the nearest .0025" (.05mm) unit as they are loaded so that cutting accuracy remains within +/- .00125" (.025mm) of the programmed position. Consequently, HIGH and SUPER RESOLUTION modes should only be used when external count sizes are small enough to take advantage of the increased program resolution.

Notes:

1) Take care to ensure that the incoming encoder count rate (when traveling at maximum speed) does not exceed the limits of the I/O hardware installed in the machine. This limit, which is about 15875 counts per second, can severely restrict the maximum allowable speed as follows:

EXTERNAL COUNT SIZE	MAXIMUM SPEED:
.0005 in / .0125mm (HIGH)	475 IPM (11905 MMPM)
.0001 in / .0025mm (SUPER)	95 IPM (2380 MMPM)

These speed limitations, which only exist when using HIGH or SUPER RESOLUTION encoders, are eliminated with the **Type 14** processor card and the **Type 2** I/O card are both installed.

2) NC programs created from STANDARD SHAPES, PART CONSTRUCT, or SHAPE CARTRIDGES are always created using NORMAL resolutions, regardless of the resolution selected through this variable.

SYSTEM CONFIGURATION 3 continued.

D1	D2	D3	D4	D5	D6	D7	D8

(D7 PROGRAM RESOLUTION continued)

3) NC programs generated by the TEACH process use the program resolution defined by this variable.

4) The GRAPHIC NEST EDITOR allows programs loaded with different program resolutions to be used to create a single nested program. When the NEST is saved in NC program memory, the resolution for the NEST is determined by this variable.

5) NC programs saved to RAM CARTRIDGE or stored off-line using INTERNAL format can be loaded into the BURNY 5 control without modification. These programs, by definition, use the NORMAL program resolution mode.

Set D7 to "0" for NORMAL RESOLUTION:
ENGLISH system program unit size: .0025 inch
METRIC system program unit size: .0500 mm

Set D7 to "1" for HIGH RESOLUTION:
ENGLISH system program unit size: .0005 inch
METRIC system program unit size: .0100 mm

Set D7 to "2" for SUPER RESOLUTION:
ENGLISH system program unit size: .0001 inch
METRIC system program unit size: .0020 mm

SYSTEM CONFIGURATION 3 continued.

D1	D2	D3	D4	D5	D6	D7	D8

"D8" defines the following features:

SPECIAL E-STOP STATUS MESSAGE enable:

When enabled, this feature provides more detailed E-STOP status information when using the BURNY "drop-through" back panel. The BURNY 5 latches the status inputs to their current states whenever an E-STOP is pending and reuses three of the normal inputs as E-STOP STATUS input bits.

See the D8 Features Enable Table below.

AUTO SELECT OVERLAY TABLE 1 with PLASMA enable:

When enabled, the AUTO SELECT OVERLAY TABLE 1 WITH PLASMA feature allows the control to automatically use the T3 parameters from OVERLAY TABLE 1 DATA for all existing program and programs created by LOAD SHAPE or TEACH for PLASMA operations, without any additional prompting. See UTILITIES, SETUP / CONFIGURATION, OVERLAY TABLE DATA for more information.

See the D8 Features Enable Table below.

PIERCE TIMER FREEZE enable:

When enabled, the PIERCE TIMER FREEZE feature allows the <GO> key to freeze the current PIERCE TIMER value and hold the PIERCE RAMP speed at a constant level as long as the key is pressed on the RUN MODE screen. Releasing the <GO> key then allows the PIERCE RAMP to continue at its reduced acceleration rate until the timer expires. If not enabled, pressing the <GO> key while the PIERCE TIMER is still active immediately cancels the timer and allows the normal acceleration to be performed.

SYSTEM CONFIGURATION 3 continued.

D1	D2	D3	D4	D5	D6	D7	D8

(D8 continued)

See PLASMA PIERCE TIMER HOLD and OXYGEN PIERCE TIMER HOLD variables defined in "D6."

See the D8 Features Enable Table below.

PLC TIMER DATA enable:

When enabled, the BURNY 5 automatically transfers additional timer reset values whenever the <RST>, <GO>, or <STOP> key is pressed. That is, immediately following the key status message transfer, the BURNY 5 sends an additional message to update PLC data registers 50 through 59 with the currently defined values. See OPTIONAL CONFIGURATION, PROGRAMMABLE LOGIC CONTROLLER, for more information.

See the D8 Features Enable Table below.

"D8" features can be enabled as follows. The "X" indicates the feature is enabled if the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
SPECIAL E-STOP MSGS		X		X		X		X		X		X		X		X
AUTO SELECT TABLE 1			X	X			X	X			X	X			X	X
PIERCE TIMER FREEZE					X	X	X	X					X	X	X	X
PLC TIMER DATA									X	X	X	X	X	X	X	X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

40. SYSTEM CONFIGURATION 4

SYSTEM CONFIGURATION 4 (variable 40) is an 8 digit value defined as follows:

D1	D2	D3	D4	D5	D6	D7	D8

where:

"D1" and **"D2"** define the MAIN and ALTERNATE LANGUAGE of the control. When these digits contain one of the following numbers, they define the languages used when the control powers up and the alternate language switched to with the <SHF> <VI> key sequence. The languages are defined below.

"0" - ENGLISH	"3" - FINNISH	"6" - SWEDISH
"1" - GERMAN	"4" - ITALIAN	"7" - DUTCH
"2" - FRENCH	"5" - SPANISH	"8" - NORWEGIAN

NOTE

SYSTEM CONFIGURATION 2 also contains an alternate language select bit (second bit position from the left). If this bit is set to a "1", the language selected at power up is the "alternate" language. If this bit is set to a "0", the "main" language will be selected as the power up default.

EXAMPLES:

MAIN LANGUAGE : ENGLISH
ALTERNATE LANGUAGE : FRENCH

40. SYSTEM CONFIGURATION 4 : 2000000
(note the left most digit is blank because leading 0's are not displayed)

MAIN LANGUAGE : FRENCH
ALTERNATE LANGUAGE : GERMAN

40. SYSTEM CONFIGURATION 4 : 21000000

If an unsupported "main" language is selected, English will be displayed. If an unsupported "alternate" language is selected, only the "main" language will be displayed. For an alternate language to be displayed, it must be selected in one of the two configuration digits.

SYSTEM CONFIGURATION 4 continued.

D1	D2	D3	D4	D5	D6	D7	D8

"D3", "D4", "D5", "D6", "D7" and **"D8"** are currently unused and should be set to zero.

41. SERIAL LOAD DEVICE

This parameter is used to define default prompt values for serial device LOAD operations. Default prompt values for STORE operations are defined by the parameter SERIAL STORE DEVICE.

SERIAL LOAD DEVICE is entered as a 4 digit value and is used to define prompt value defaults for all serial LOAD devices. If set to zero, no assignments are assumed and normal LOAD prompting operations are performed.

NOTE

The control also provides special device definition parameters for some devices (for example, STANDARD TTY, STANDARD CALLUP, COMM LINK 1, DATA BANK 1, etc.). These values are designed to override any assignments that may have been made through the SERIAL LOAD DEVICE parameter.

SERIAL LOAD DEVICE is a 4 digit value defined as follows:

D1	D2	D3	D4

where:

"D1" defines the selected serial LOAD device as:

0 => No assignment made, perform normal prompting
1 => STANDARD TTY
2 => STANDARD CALLUP
3 => BURNY DEVICE (future)
4 => COMM LINK 1
5 => DATA BANK 1
6 => TAPE READER
7 => MINI FILE (future)

SERIAL LOAD DEVICE continued.

D1	D2	D3	D4

"**D2**" defines the selected PROGRAM FORMAT as:

0 => No assignment made, perform normal prompting
1 => STANDARD WORD ADDRESS
2 => STANDARD ESSI FORMAT
3 => PROCESSED INTERNAL FORMAT
4 => CUSTOM WORD ADDRESS 1
5 => CUSTOM WORD ADDRESS 2
6 => CUSTOM WORD ADDRESS 3
7 => CUSTOM ESSI FORMAT 1

"**D3**" defines the required BAUD RATE as:

0 => No assignment made, perform normal prompting
1 => 110
2 => 300
3 => 600
4 => 1200
5 => 2400
6 => 4800
7 => 9600 (not recommended for LOAD operations)
8 => 19200 (not recommended for LOAD operations)

"**D4**" defines the required CHARACTER FORMAT as:

0 => No assignment made, perform normal prompting
1 => 7 DATA BITS, NO PARITY
2 => 8 DATA BITS, NO PARITY
3 => 7 DATA BITS, EVEN PARITY
4 => 8 DATA BITS, EVEN PARITY
5 => 7 DATA BITS, ODD PARITY
6 => 8 DATA BITS, ODD PARITY
7 => EIA CODES (uses ODD PARITY)

42. SERIAL STORE DEVICE

This parameter is used to define default prompt values for serial device STORE operations. Default prompt values for the LOAD operation are defined by the parameter SERIAL LOAD DEVICE or BATCH LOAD DEVICE.

SERIAL STORE DEVICE is entered as a 4 digit value and is used to define prompt value defaults for all serial STORE devices. If set to zero, no assignments are assumed and normal STORE prompting operations are performed.

NOTE

The control also provides special device definition parameters for some devices (for example, STANDARD TTY, STANDARD CALLUP, COMM LINK 1, DATA BANK 1, etc.). These values are designed to override any assignments that may have been made through the SERIAL STORE DEVICE parameter.

For additional information on the format and definition of this parameter, see the SERIAL LOAD DEVICE parameter definition.

43. BATCH LOAD DEVICE

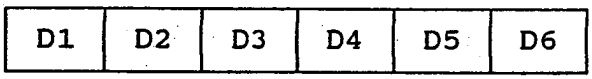
This parameter allows special definitions to be assigned for the BATCH LOAD/KERF/SETUP utility which is accessed through the BACKGROUND SUPPORT utility menu. Like the SERIAL LOAD DEVICE parameter, this parameter defines "LOAD DEVICE" characteristics as a 4 digit value. This parameter, however, defines "prompt type" defaults for the serial device used in BATCH LOAD operations. If set to zero, no assignments are assumed and BATCH LOAD operations cannot be performed. If only the "selected device" digit is defined, BATCH LOAD operations will be performed using the "power-up" default values or, if provided, the special device definition parameter values for the selected device.

For additional information on the format and definition of this parameter, see the SERIAL LOAD DEVICE parameter definition.

44. STANDARD TTY DEVICE

This parameter is used to specify special device definition values for the STANDARD TTY device. It is supported as a 6 digit value. The high three digits (left most) provide feature enable/suppression flag values. The low three digits (right most) provide definitions for "PROGRAM TYPE", "BAUD RATE" and "CHARACTER FORMAT". If the low three digits are defined, these values override the "power-up" defaults and prompt values that may be defined by the SERIAL LOAD DEVICE, SERIAL STORE DEVICE and BATCH LOAD DEVICE parameters. If set to zero, no special assignments are assumed for the device.

The 6 digit STANDARD TTY DEVICE parameter value is defined as follows:



where:

"D1" defines the timeout suppression values as:

0 => READ/WRITE timeouts enabled
1 => Disable WRITE timeouts, READ timeouts enabled
2 => Disable READ timeouts, WRITE timeouts enabled
3 => Disable READ and WRITE timeouts

"D2" defines the leader/trailer suppression values as:

0 => All special leaders and trailers enabled
1 => Suppress 70 null characters from trailer
2 => Suppress 70 null characters from leader
3 => Suppress 70 null chars from leader and trailer
4 => Suppress "man-readable" leader
5 => Suppress "man-readable" & 70 nulls from trailer
6 => Suppress "man-readable" & 70 nulls from leader
7 => Suppress "man-readable" & 70 nulls from both

"D3" defines the protocol definition values as:

0 => Use default protocol (RTS/CTS for this device)
1 => Use default protocol (RTS/CTS for this device)
2 => Use partial software protocol (XON/XOFF only)
3 => Use full software protocol (XON/XOFF/RON/ROFF)
4 => Use hardware protocol only (RTS/CTS)

STANDARD TTY DEVICE continued.

D1	D2	D3	D4	D5	D6

"**D4**" defines the selected PROGRAM FORMAT as:

0 => No assignment made, perform normal prompting
1 => STANDARD WORD ADDRESS
2 => STANDARD ESSI FORMAT
3 => PROCESSED INTERNAL FORMAT
4 => CUSTOM WORD ADDRESS 1
5 => CUSTOM WORD ADDRESS 2
6 => CUSTOM WORD ADDRESS 3
7 => CUSTOM ESSI FORMAT 1

"**D5**" defines the required BAUD RATE as:

0 => No assignment made, perform normal prompting
1 => 110
2 => 300
3 => 600
4 => 1200
5 => 2400
6 => 4800
7 => 9600 (not recommended for LOAD operations)
8 => 19200 (not recommended for LOAD operations)

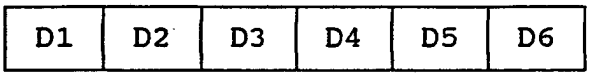
"**D6**" defines the required CHARACTER FORMAT as:

0 => No assignment made, perform normal prompting
1 => 7 DATA BITS, NO PARITY
2 => 8 DATA BITS, NO PARITY
3 => 7 DATA BITS, EVEN PARITY
4 => 8 DATA BITS, EVEN PARITY
5 => 7 DATA BITS, ODD PARITY
6 => 8 DATA BITS, ODD PARITY
7 => EIA CODES (uses ODD PARITY)

45. STANDARD CALLUP DEVICE

This parameter is used to specify special device definition values for the STANDARD CALLUP device. It is supported as a 6 digit value. The high three digits (left most) provide feature enable/suppression flag values. The low three digits (right most) providing definitions for "PROGRAM TYPE", "BAUD RATE" and "CHARACTER FORMAT". If the low three digits are defined, these values override the "power-up" defaults and prompt values that may be defined by the SERIAL LOAD DEVICE, SERIAL STORE DEVICE and BATCH LOAD DEVICE parameters. If set to zero, no special assignments are assumed for the device.

The 6 digit STANDARD CALLUP DEVICE parameter value is defined as follows:



where:

"D1" defines the timeout suppression values as:

0 => READ/WRITE timeouts enabled
1 => Disable WRITE timeouts, READ timeouts enabled
2 => Disable READ timeouts, WRITE timeouts enabled
3 => Disable READ and WRITE timeouts

"D2" defines the leader/trailer suppression values as:

0 => All special leaders and trailers enabled
1 => Suppress 70 null characters from trailer
2 => Suppress 70 null characters from leader
3 => Suppress 70 null chars from leader and trailer
4 => Suppress termination "status" output
5 => Suppress "status" and 70 nulls from trailer
6 => Suppress "status" and 70 nulls from leader
7 => Suppress "status" and 70 nulls from leader/trailer

STANDARD CALLUP DEVICE continued.

D1	D2	D3	D4	D5	D6

"D3" defines the protocol definition values as:

0 => Use default protocol (XON/RON for this device)
1 => Use default protocol (XON/RON for this device)
2 => Use partial software protocol (XON/XOFF only)
3 => Use full software protocol (XON/XOFF/RON/ROFF)
4 => Use hardware protocol only (RTS/CTS)
5 => undefined
6 => undefined
7 => undefined
8 => Use alphanumeric program header name request
9 => Use alphanumeric & default protocol (XON/RON for this device)
A => Use alphanumeric & partial software protocol (XON/XOFF only)
B => Use alphanumeric & full software protocol (XON/XOFF/RON/ROFF)
C => Use alphanumeric & hardware protocol only (RTS/CTS)

"D4" defines the selected PROGRAM FORMAT using the same value definitions as in the STANDARD TTY parameter.

"D5" defines the required BAUD RATE using the same value definitions as in the STANDARD TTY parameter.

"D6" defines the required CHARACTER FORMAT using the same value definitions as in the STANDARD TTY parameter.

46. BURNY DEVICE

This parameter is used to specify special device definition values for the BURNY DEVICE. This device handler performs the same "CLINK1" type protocol as the COMM LINK 1 and DATA BANK 1 devices.This parameter value uses the same 6 digit format as other device definition values.

For additional information on the format and definition of this parameter, see the STANDARD CALLUP DEVICE parameter definition.

47. COMM LINK

This parameter is used to specify special device definition values for the COMM LINK 1 device. This device handler performs the "CLINK1" type protocol allowing programs to be automatically transferred from any serial device supporting the appropriate "HOST" protocol. This parameter value uses the same 6 digit format as other device definition values.

For additional information on the format and definition of this parameter, see the STANDARD CALLUP DEVICE parameter definition.

48. DATA BANK

This parameter is used to specify special device definition values for the DATA BANK 1 device. Like the COMM LINK 1 handler, this handler also performs the "CLINK1" type protocol. This parameter value uses the same 6 digit format as other device definition values.

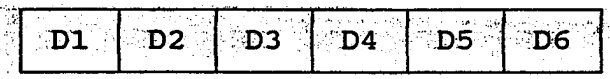
For additional information on the format and definition of this parameter, see the STANDARD CALLUP DEVICE parameter definition.

49. FLOPPY DEVICE

This parameter is used to specify special device definition values for the INTERNAL and EXTERNAL FLOPPY device although not all assignments affect both device types. If set to zero, no special assignments are assumed for either device.

Like other device definition values, this parameter value is supported as a 6 digit value. The high three digits (left most) provide feature enable/suppression flag bits. Of these, some are specifically assigned to either the INTERNAL FLOPPY or the EXTERNAL FLOPPY. Others affect the operations performed on both device types. The low three digits (right most) provide definitions for "PROGRAM TYPE", "BAUD RATE" and "CHARACTER FORMAT". These values are used to pre-assign prompting values for use with the EXTERNAL FLOPPY serial device. If necessary, they can also be used to override the "power-up" system defaults for the external serial device or user assigned defaults defined by the SYSTEM SETUP DATA parameters SERIAL LOAD DEVICE, SERIAL STORE DEVICE and BATCH LOAD DEVICE. INTERNAL FLOPPY operations are always performed using the default assignments "7 DATA BITS", "EVEN PARITY", "4800 BAUD" with the PROGRAM TYPE selected by normal prompting operations.

The 6 digit FLOPPY DEVICE parameter value is defined as follows:



where:

"D1" defines the following bit flags:

WRITE TIMEOUT DISABLE:
READ TIMEOUT DISABLE:

When set to one, these configuration bits allow the user to disable the timeout operations that are normally enabled on the EXTERNAL FLOPPY. When not disabled, these timeout conditions cause operations to automatically terminate if communications are suspended more than 20 seconds. These bits do not affect the timeout operations that are always enabled for the INTERNAL FLOPPY.

WRITE VERIFICATION DISABLE:

When set to one, this bit inhibits the automatic read that is performed by the INTERNAL and EXTERNAL FLOPPY controllers when writing data. This check is normally performed to verify that the data was correctly written to floppy disk. Although the verification does take time to perform, no additional transfer time is required because of the buffering operations that are use to keep the data transfer active.

FLOPPY DEVICE continued.

D1	D2	D3	D4	D5	D6

The D1 bit flags can be assigned as follows. The "X" indicates the feature is selected the value above the column is used for the "D1" digit.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
WRITE TIMEOUT DISABLE		X		X						X		X				
READ TIMEOUT DISABLE			X	X							X	X				
UNUSED																
WRITE VERIFY DIISABLE									X	X	X	X				

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc. "4" through "7" and "C" through "F" are not valid entries.

FLOPPY DEVICE continued.

D1	D2	D3	D4	D5	D6

"D2" defines the following bit flags:

EXTERNAL FLOPPY LOW DENSITY:
INTERNAL FLOPPY LOW DENSITY:

When set to one, these configuration bits allow the user to change the default INTERNAL and/or EXTERNAL FLOPPY format type from HIGH DENSITY to LOW DENSITY. Generally, the density type is only significant when performing a FORMAT with the "ERASE AND TEST" utility. The high density drives used for the BURNY FLOPPY are capable of reading and writing files in both high and low density formats regardless of the state of these configuration bits.

EXTERNAL FLOPPY 5.25" DRIVE:

When set to one, this bit changes the default EXTERNAL FLOPPY drive type from 3.5" to 5.25". The type established by this bit is used when performing the initialization and test operations in the ERASE AND TEST utility.

P###(AAA) PROGRAM BLOCK DISABLE:

When this bit is set to one, the program header block that is normally output following the "%" block is suppressed. This feature is provided for use when performing ASCII FILE PATHNAME operations to prevent the program number and program name specified by the operator from being overwritten when reloading files that were stored to the BURNY FLOPPY. This bit affects operations on both the INTERNAL and EXTERNAL FLOPPY devices.

These bit flags can be assigned as follows. The "X" indicates the feature is selected when the value above the column is used for the "D2" digit.

EXTERNAL FLOPPY LOW DENSTIY		X		X		X		X		X		X		X	
EXTERNAL FLOPPY 5.25" DRIVE			X	X			X	X			X	X			X
INTERNAL FLOPPY LOW DENSITY					X	X	X	X					X	X	X
SUPPRESS P#(A) BLOCK OUTPUT									X	X	X	X	X	X	X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

FLOPPY DEVICE continued.

D1	D2	D3	D4	D5	D6

"**D3**" defines the following bit flags:

LEADING ZERO PROGRAM NUMBERS:

When set to one, this bit causes the control to expand all program numbers to 8 digit values with leading zeroes. Normally, leading zeroes are suppressed. This bit affects operations on both the INTERNAL and EXTERNAL FLOPPY devices.

ASCII FILE PATHNAME enable:

When set to one, this configuration bit causes the control to process the program name as a possible file pathname. Generally, name strings that do not use one of the reserved names, a " - " (space, dash, space) sequence or "/" (slash) can be used as file names. This bit affects the operations performed on both the INTERNAL and EXTERNAL FLOPPY devices.

These bit flags can be assigned as follows. The "X" indicates the feature is selected when the value above the column is used for the "D3" digit.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
NOT USED		X		X		X		X		X		X		X		X
NOT USED			X	X			X	X			X	X			X	X
LEADING ZERO					X	X	X	X					X	X	X	X
ASCII FILE PATHNAME									X	X	X	X	X	X	X	X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

"**D4**" defines the PROGRAM FORMAT for the EXTERNAL FLOPPY as:

0 => No assignment made, perform normal prompting
1 => STANDARD WORD ADDRESS
2 => STANDARD ESSI FORMAT
3 => PROCESSED INTERNAL FORMAT
4 => CUSTOM WORD ADDRESS 1
5 => CUSTOM WORD ADDRESS 2
6 => CUSTOM WORD ADDRESS 3
7 => CUSTOM ESSI FORMAT 1

FLOPPY DEVICE continued.

D1	D2	D3	D4	D5	D6

"**D5**" defines the BAUD RATE for the EXTERNAL FLOPPY as:

0 => No assignment made, perform normal prompting
1 => 110
2 => 300
3 => 600
4 => 1200
5 => 2400
6 => 4800 (system default)
7 => 9600 (not recommended for LOAD operations)
8 => 19200 (not recommended for LOAD operations)

"**D6**" defines the CHARACTER FORMAT for the EXTERNAL FLOPPY as:

0 => No assignment made, perform normal prompting
1 => 7 DATA BITS, NO PARITY
2 => 8 DATA BITS, NO PARITY
3 => 7 DATA BITS, EVEN PARITY (system default)
4 => 8 DATA BITS, EVEN PARITY
5 => 7 DATA BITS, ODD PARITY
6 => 8 DATA BITS, ODD PARITY
7 => (not applicable)

50. UNUSED

Although this parameter is unused at this time, it is supported as an 8 digit value. Its value should be set to zero.

51. STANDARD PROGRAM FORMAT

This parameter allows the CUSTOM AUXILIARY CODES and other custom program conversion features (such as decimal shift, axis swap, etc.) to be selectively enabled for use with the STANDARD WORD ADDRESS and STANDARD ESSI program formats. Previously, these features could only be enabled for use with CUSTOM WORD ADDRESS 3 and CUSTOM ESSI FORMAT 1. This parameter also allows several new features that have been added to the control to be selectively enabled or suppressed.

The 8-digit STANDARD PROGRAM FORMAT parameter is defined as follows:

D1	D2	D3	D4	D5	D6	D7	D8

where:

"D1" is currently undefined. Set this position to "0."

"D2" enables the SINGLE QUADRANT LOAD CONVERSION.

When set to "1", the single quadrant arc signing conversion process allows you to load programs written for old "SINGLE QUADRANT ONLY" controls from other manufacturers, which contain programming errors and endpoint errors caused by insufficient accuracy.

This processes defines I and J dimension signs using logic that assumes all arcs must be less than or equal to 90 degrees. As such, any arc violating this 90 degree limit is automatically converted into a line. This conversion is performed while loading, so that the resulting program in NC memory can be directly run and or inspected using the TEXT EDITOR or DISPLAY PROGRAM utility functions.

"D3" defines the following features:

SPECIAL END OF PROGRAM SEQUENCE #1 enable:

When this bit is set and the SPECIAL END OF PROGRAM #1 parameter value is defined, this special code sequence is enabled for use in the STANDARD WORD ADDRESS and STANDARD ESSI program formats. See the D3 Features Enable table below.

STANDARD PROGRAM FORMAT continued:

D1	D2	D3	D4	D5	D6	D7	D8

(D3 Features continued)

SPECIAL END OF PROGRAM SEQUENCE #2 enable:
When this bit is set and the SPECIAL END OF PROGRAM #2 parameter value is defined, this special code sequence is enabled for use in the STANDARD WORD ADDRESS and STANDARD ESSI program formats. See the D3 Features Enable table below.

WORD ADDRESS BLOCK CHAINING disable:
When set, this bit prevents the WORD ADDRESS process from building ASCII program blocks with multiple auxiliary function codes. Program blocks are then built with one function per ASCII block (as they are stored in internal memory). See the D3 Features Enable table below.

PROGRAM COMPRESSION enable:
When set, this bit causes a program compression feature to be enabled that removes data that is not logically necessary in an NC program as it is loaded from the serial port or saved from the program editor. When enabled, this feature removes all "G00", "G01", "G02" and "G03" function codes from the program which do not effect the operating mode already defined. Additional "G00" and "G01" function codes can also be removed since the normal BURNY "CUT ON" and "CUT OFF" function codes automatically establish "cutting speed" and "high speed" modes as required.

This feature also removes all absolute dimension values which, when internally converted to an increment movement, result in a value of zero. Unlike older NC controls which required the programmer to define an X and Y value for every dimension block when in absolute programming mode, the BURNY only requires the program to define the changing field. Undefined field values are not interpreted as zero, but rather the same position as previously defined.

See the D3 Features Enable table below.

STANDARD PROGRAM FORMAT continued:

D1	D2	D3	D4	D5	D6	D7	D8

D3 features can be enabled as follows. The "X" indicates the flag bit is set if the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
SPECIAL END OF PGM #1		X		X		X		X		X		X		X		X
SPECIAL END OF PGM #2			X	X			X	X			X	X			X	X
WORD ADR CHAIN DISABLE					X	X	X	X					X	X	X	X
PROGRAM COMPRESSION									X	X	X	X	X	X	X	X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

"D4" defines the features:

WORD ADDRESS LINE NUMBER AND ESSI NULL disable:

When set, this bit prevents the WORD ADDRESS process from including line numbers in each ASCII block. This allows programs to be stored to serial devices faster and reduces the size of the ASCII program file. With ESSI, this bit causes the 60 null codes that are normally placed between the non-standard program number/name block and the first program data block, to be suppressed. See the D4 Features Enable table below.

PROGRAM MESSAGE disable:

When set, this bit causes the LOAD process to discard all program message data and reduce the amount of internal memory required. It prevents the STORE process from formatting ASCII program message blocks for output, and prevents the TEXT EDITOR from reading and writing message blocks in a program. See the D4 Features Enable table below.

PROGRAM NAME disable:

When set, this bit prevents the STORE process from sending program names to serial devices and prevents the TEXT EDITOR from reading program names. See the D4 Features Enable table below.

STANDARD PROGRAM FORMAT continued:

D1	D2	D3	D4	D5	D6	D7	D8

(D4 Features continued)

ESSI PROGRAM NUMBER/NAME disable:

When set, this bit prevents the non-standard ESSI program number and name block from being sent to a serial device or read by the TEXT EDITOR when the STANDARD ESSI program format is selected. See the D4 Features Enable table below.

D4 features can be enabled as follows. The "X" indicates the feature is enabled if the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
LINE#/NULL DISABLE		X		X		X		X		X		X		X		X
PGM MESSAGE DISABLE			X	X			X	X			X	X			X	X
PGM NAME DISABLE					X	X	X	X					X	X	X	X
ESSI PGM#/NAME DISABLE									X	X	X	X	X	X	X	X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

"D5" enables the following features:

CUSTOM AUXILIARY CODE CONVERSION enable:

This CUSTOM AUXILIARY CODES table enabled by this bit is defined though the SETUP/CONFIGURATION utility mode. This table allows the user to re-define any external "M", "G" or ESSI function code as an internally supported operation code.

See the "D5" Features Enable table below.

STANDARD PROGRAM FORMAT continued:

D1	D2	D3	D4	D5	D6	D7	D8

(D5 Features continued)

DIMENSION DECIMAL SHIFT enable:

This value allows the dimension values in a WORD ADDRESS program to be scaled as they are read during a serial device LOAD operation. Each shift count represents a divide by "10" when converting to internal format. For example, if a shift count of "2" is defined for the specified program type, "X+5000" defines an incremental move of "+50" (inches or millimeters depending on the selected dimension type). This value is defined in the high three bits of the "D5" value. Therefore, a count of "3" is defined by placing a "6" in the "D5" value. See the following table for additional information.

D5 features can be assigned as follows. The "X" indicates the feature is enabled when the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
CUSTOM CODE ENABLE		X		X		X		X		X		X		X		X
DIMENSION SHIFT OF 1			X	X												
DIMENSION SHIFT OF 2					X	X										
DIMENSION SHIFT OF 3							X	X								
DIMENSION SHIFT OF 4									X	X						
DIMENSION SHIFT OF 5											X	X				
DIMENSION SHIFT OF 6													X	X		
DIMENSION SHIFT OF 7															X	X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

STANDARD PROGRAM FORMAT continued:

D1	D2	D3	D4	D5	D6	D7	D8

"D6" enables the following features:

AXIS SWAP enable:

This feature causes the axis definitions during serial device LOAD/STORE operations and PROGRAM EDIT operations to be swapped so that the internal program matches the standard X and Y axis conventions used by the control. When enabled, the following conversions are performed:

```
+X  -->  +Y
-X  -->  -Y
+Y  -->  +X
-Y  -->  -X
```

When performing LOAD operations and both AXIS SWAP and AXIS SIGN INVERT are enabled, AXIS SWAP is performed before the AXIS SIGN INVERT operation is performed. When performing STORE operations, SIGN INVERT is performed first so that the external convention remains unchanged.

For example, when performing a LOAD operation with AXIS SWAP and X AXIS SIGN INVERT enabled but not Y AXIS SIGN INVERT enabled, the following conversions are performed:

```
+X  -->  +Y  -->  +Y
-X  -->  -Y  -->  -Y
+Y  -->  +X  -->  -X
-Y  -->  -X  -->  +X
```

STANDARD PROGRAM FORMAT continued:

D1	D2	D3	D4	D5	D6	D7	D8

(D6 Features continued)

AXIS SIGN INVERT enable:

This feature causes the sign of the dimension data on the specified axis to be inverted during serial device LOAD/STORE operations and PROGRAM EDIT operations so that the internal program matches the standard X and Y axis direction used by the control.

When enabled for the X axis but not the Y axis:

```
+X  -->  -X   and   -X  -->  +X
+Y  -->  +Y   and   -Y  -->  -Y
```

When enabled for the Y axis but not the X axis:

```
+X  -->  +X   and   -X  -->  -X
+Y  -->  -Y   and   -Y  -->  +Y
```

AUXILIARY CODE BEFORE MOTION enable:

This feature causes all auxiliary function codes that are contained in a WORD ADDRESS program block with a dimensional move (X,Y,I, or J value) to be processed BEFORE the dimensional move. If not enabled, the auxiliary functions for "CUT OFF", "MARKER OFF" and others are processed AFTER any dimensional move that may be defined in the same program block. This feature is performed during the "LOAD" operation and has no effect on programs already residing in memory.

The following table can be used to define the required value. The "X" indicates the feature is enabled when the digit value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Y AXIS SIGN INVERT		X		X		X		X		X		X		X		X
X AXIS SIGN INVERT			X	X			X	X			X	X			X	X
AXIS SWAP					X	X	X	X					X	X	X	X
AUX FUNC BEFORE MOVE									X	X	X	X	X	X	X	X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

STANDARD PROGRAM FORMAT continued:

D1	D2	D3	D4	D5	D6	D7	D8

"D7" enables the following features:

FIXED INCREMENTAL I/J enable:

This feature allows you to define the I and J dimension value format as "INCREMENTAL" even when the X and Y dimension values are programmed in "ABSOLUTE." When this feature is not enabled, the I and J dimensions are assumed to be in the same format as the X and Y dimensions. When this feature is enabled with a value of "1", I and J dimensions are always processed as incremental values. See the D7 Features Enable table below.

DWELL DECIMAL SHIFT enable:

This feature allows the dwell value defined as an "F-word" field in a WORD ADDRESS program to be scaled during LOAD, STORE, EDIT and DISPLAY operations. Each shift count represents a divide by "10" when converting to internal format. For example, if a shift count of "3" is defined for the specified program type, "G04F1500" defines a programmed dwell of 1.5 seconds. You can define a DWELL DECIMAL SHIFT of 1, 2, or 3. See the D7 Features Enable table below.

INVERT ARC DIRECTION enable:

This feature allows the internal arc direction support to perform inverted arc processing operations when performing LOAD, STORE and EDIT operations. It is provided primarily to allow programs written in the ESSI format with non-standard arc direction conventions (+/-) to be used with the control. However, all program formats are affected by this feature. See the D7 Features Enable table below.

STANDARD PROGRAM FORMAT continued:

D1	D2	D3	D4	D5	D6	D7	D8

(D7 Features continued)

D7 features can be enabled as follows. The "X" indicates the feature is enabled if the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
FIXED INCREMENTAL I/J		X		X		X		X		X		X		X		X
DWELL SHIFT OF 1			X	X							X	X				
DWELL SHIFT OF 2					X	X							X	X		
DWELL SHIFT OF 3							X	X							X	X
INVERT ARC DIRECTION									X	X	X	X	X	X	X	X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

"**D8**" enables the following features:

ABSOLUTE DIMENSION TYPE enable:

This feature allows you to change the system default for program dimension type from "INCREMENTAL" to "ABSOLUTE." If this feature is enabled, all program dimensions are assumed to be in "ABSOLUTE" unless changed by the appropriate auxiliary function code. The dimension type selected by this bit is also used to define the required format when storing an internally created TEACH or SHAPE program to a serial device.

See the D8 Features Enable table below.

STANDARD PROGRAM FORMAT continued:

D1	D2	D3	D4	D5	D6	D7	D8

(D8 Features continued)

FEEDRATE DECIMAL SHIFT enable:

This feature allows the feedrate value defined as an "F-word" field in a WORD ADDRESS program to be scaled during LOAD, STORE, EDIT and DISPLAY operations. Each shift count represents a divide by "10" when converting to internal format. For example, if a shift count of "2" is defined for the specified program type, "F1500" defines a programmed feedrate of 15 (ipm or mmpm depending on the selected dimension type). You can define a FEEDRATE DECIMAL SHIFT of 1, 2, or 3. See the D8 Features Enable table below.

MULTIQUADRANT AUTO I/J SIGN CALCULATIONS enable:

This feature allows Word Address programs written for other NC controls to be properly loaded into this NC control. This feature allows arc dimension blocks that define movements in a single quadrant (ie. arcs less than 90 degrees) and multiple quadrants (arcs up to 360 degrees) to be defined without signs on the I and J values. The only restrictions are that both the X and Y dimension fields in the block must be provided and must be non-zero, and no signs must exist on either of the I or J dimension values. When these conditions are met the NC control can calculate which of the four possible points is the correct center point for the arc. However if these conditions are not satisfied, two or more possible solutions exist so the NC control uses positive I/J dimension values.

See the D8 Features Enable table below.

STANDARD PROGRAM FORMAT continued:

D1	D2	D3	D4	D5	D6	D7	D8

(D8 Features continued)

D8 features can be enabled as follows. The "X" indicates the feature is enabled when the value above the column is used.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
ABSOLUTE DIMENSION		X		X		X		X		X		X		X		X
FEEDRATE SHIFT OF 1			X	X							X	X				
FEEDRATE SHIFT OF 2					X	X							X	X		
FEEDRATE SHIFT OF 3							X	X							X	X
MULTIQUAD AUTO I/J									X	X	X	X	X	X	X	X

Hexadecimal values for "A" through "F" are entered as a two key sequence where "SHIFT 0" creates an "A", "SHIFT 1" creates a "B", etc.

52. CUSTOM PROGRAM FORMAT

This parameter uses the same 8-digit format and value definitions as the STANDARD PROGRAM FORMAT parameter. However, this parameter is used when performing custom program format operations (that is, CUSTOM WORD ADDRESS 1, CUSTOM WORD ADDRESS 2, CUSTOM WORD ADDRESS 3 and CUSTOM ESSI FORMAT 1 operations). The only other difference is that the "FIXED INCREMENTAL I/J" and "ABSOLUTE DIMENSION" features are supported in the CUSTOM WORD ADDRESS 1 and CUSTOM WORD ADDRESS 2 formats. All features, however, are supported in the CUSTOM WORD ADDRESS 3 and CUSTOM ESSI FORMAT 1 program formats.

53. SPECIAL END OF PROGRAM 1

This parameter allows a user defined ASCII code sequence to be used as an additional "END OF PROGRAM WITH REWIND" code termination sequence in WORD ADDRESS and ESSI programs. When enabled, this sequence does not inhibit the use of the standard "M02" and "M30" function codes, the ESSI termination codes or any other auxiliary codes defined through the CUSTOM AUXILIARY CODES table as "END OF PROGRAM" or "END OF PROGRAM WITH REWIND" codes.

NOTE

When encountered in a program during a LOAD operation, the control stores an "END OF PROGRAM WITH REWIND" code at the end of the program file in place of the special termination sequence. It then performs the "END OF PROGRAM WITH REWIND" operation. This prevents multiple programs from being loaded and causes a rewind operation to be initiated when using the CMC SPOOLER TAPE READER. To terminate the rewind, the operator must press the "RST" key before the rewind begins or within 3 seconds from the start of the rewind.

The special termination code sequence is specified as 4 ASCII codes entered as 8 hexadecimal digits. A zero code is used to represent the end of a sequence that is less than 4 characters long. Once defined, this sequence must be enabled for use through the STANDARD PROGRAM FORMAT and/or CUSTOM PROGRAM FORMAT parameters.

EXAMPLE 1: To define a 3 character sequence as "/*%", enter "2F2A2500" as the sequence value.

EXAMPLE 2: To define a 2 character sequence as " %", enter "20250000" as the sequence value.

EXAMPLE 3: To define a 1 character sequence as ":", enter "3A000000" as the sequence value.

In the previous examples, hexadecimal digits for "A" through "F" are entered as a two key sequence as follows:

```
<SHF> <0> equates to "A"
<SHF> <1> equates to "B"
<SHF> <2> equates to "C"
<SHF> <3> equates to "D"
<SHF> <4> equates to "E"
<SHF> <5> equates to "F"
```

The following table of printable ASCII code values is provided to help the user define the required sequence value.

>20:space	>30: 0	>40: @	>50: P	>60: `	>70: p
>21: !	>31: 1	>41: A	>51: Q	>61: a	>71: q
>22: "	>32: 2	>42: B	>52: R	>62: b	>72: r
>23: #	>33: 3	>43: C	>53: S	>63: c	>73: s
>24: $	>34: 4	>44: D	>54: T	>64: d	>74: t
>25: %	>35: 5	>45: E	>55: U	>65: e	>75: u
>26: &	>36: 6	>46: F	>56: V	>66: f	>76: v
>27: '	>37: 7	>47: G	>57: W	>67: g	>77: w
>28: (	>38: 8	>48: H	>58: X	>68: h	>78: x
>29:)	>39: 9	>49: I	>59: Y	>69: i	>79: y
>2A: *	>3A: :	>4A: J	>5A: Z	>6A: j	>7A: z
>2B: +	>3B: ;	>4B: K	>5B: [	>6B: k	>7B: {
>2C: ,	>3C: <	>4C: L	>5C: \	>6C: l	>7C: |
>2D: -	>3D: =	>4D: M	>5D:]	>6D: m	>7D: }
>2E: .	>3E: >	>4E: N	>5E: ^	>6E: n	>7E: ~
>2F: /	>3F: ?	>4F: O	>5F: _	>6F: o	>7F:delete

54. SPECIAL END OF PROGRAM 2

This parameter allows a second "END OF PROGRAM WITH REWIND" sequence to be defined using the same format as the parameter SPECIAL END OF PROGRAM 1. Like the first sequence, this sequence can also be selectively enabled for use through the STANDARD PROGRAM FORMAT and CUSTOM PROGRAM FORMAT parameters.

For additional information on the format and definition of this parameter, see the SPECIAL END OF PROGRAM 1 parameter definition.

55. SPEED LOOP GAIN

This parameter defines the gain value used by the speed control algorithm. Its value is internally scaled so that a value of "1" generates an inch per minute speed correction for each inch per minute error in speed detected. This variable has a maximum value of 2. Normal values are in the range of ".125" to ".400". If set to ".001", which is the lowest possible value, no speed adjustment is performed. If set too high, the control loop will over compensate for errors in speed and will cause the machine to oscillate as it attempts to maintain the desired speed. (Typically set to ".125").

NOTE

On some machines, the normal position LOOP GAIN value (SYSTEM SETUP DATA variable 4) may be reduced so that higher SPEED LOOP GAIN values can be defined. However on many machines, the same position LOOP GAIN value is used with or without the speed loop enabled and a SPEED LOOP GAIN value of ".125" is used to perform adequate speed control operations.

56. SPEED LOOP RESET TIME

This parameter determines how quickly the control should accumulate and respond to continuous errors in speed. A reset time of 24ms indicates that a continuous error condition should remain for 24 milliseconds before all of the error is added to the error sum accumulator. The greater the time, the longer it takes to respond to continuous error conditions and the longer it takes to later deplete the accumulated error sum. The result is a speed overshoot which does not reset fast enough to maintain the correct path position. The smaller the reset time, the quicker the system responds to errors in speed (continuous and abrupt speed errors). Defining a reset time too short has an effect similar to setting the SPEED LOOP GAIN too high and may cause the machine to oscillate violently. Although SPEED LOOP RESET TIME is defined in milliseconds, it is internally saved as the number of 8ms scans. This forces all defined values to be a multiple of 8. Therefore, the smallest reset time possible is 8 ms. Normal values are in the range of 16 to 64 milliseconds. (Typically set to 64 milliseconds).

57. SPEED ERROR SUM LIMIT

This parameter, which is defined as a speed value, is used to limit the maximum amount of accumulated speed error on each axis. When continuous error conditions remain for long periods of time, the maximum speed adjustment that will be performed is limited to the SPEED LOOP GAIN times the ERROR SUM LIMIT. For example, if the SUM LIMIT is set to 200 ipm and a SPEED LOOP GAIN of ".125" is defined, the maximum speed adjust that will be performed is ".125 X 200" or 25 ipm. Normal values for the ERROR SUM LIMIT are in the range 200 to 600 ipm (or 5000 to 15000 mmpm). (Typically set to 200 ipm).

58. SPECIAL NC PROGRAM EXTENSION

This variable allows you to define an NC program file extension, which can replace the "CNC" extension used with the BURNY FLOPPY devices with any string of up to three characters. (The "." is not required.) You may include single "?" and multiple "*" wildcards for maximum flexibility.

You must enter these characters in ASCII code.

59. UNUSED

Although this parameter is unused at this time, it is supported as an 8 digit value. Its value should be set to zero.

60. UNUSED

Although this parameter is unused at this time, it is supported as an 8 digit value. Its value should be set to zero.

61. X MARKER 3 OFFSET (INCH/MM)

This parameter is used to define the plate marker 3 offset distance along the X axis. See the definition for X MARKER 1 OFFSET (parameter 26) for further details.

62. Y MARKER 3 OFFSET (INCH/MM)

This parameter is used to define the plate marker 2 offset distance along the Y axis. See the definition for X MARKER 1 OFFSET (parameter 26) for further details.

63. X MARKER 4 OFFSET (INCH/MM)

This parameter is used to define the plate marker 4 offset distance along the X axis. See the definition for X MARKER 1 OFFSET (parameter 26) for further details.

64. Y MARKER 4 OFFSET (INCH/MM)

This parameter is used to define the plate marker 4 offset distance along the Y axis. See the definition for X MARKER 1 OFFSET (parameter 26) for further details.

65. X MARKER 5 OFFSET (INCH/MM)

This parameter is used to define the plate marker 5 offset distance along the X axis. See the definition for X MARKER 1 OFFSET (parameter 26) for further details.

66. Y MARKER 5 OFFSET (INCH/MM)

This parameter is used to define the plate marker 5 offset distance along the Y axis. See the definition for X MARKER 1 OFFSET (parameter 26) for further details.

67. X MARKER 6 OFFSET (INCH/MM)

This parameter is used to define the plate marker 6 offset distance along the X axis. See the definition for X MARKER 1 OFFSET (parameter 26) for further details.

68. Y MARKER 6 OFFSET (INCH/MM)

This parameter is used to define the plate marker 6 offset distance along the Y axis. See the definition for X MARKER 1 OFFSET (parameter 26) for further details.

69. X MARKER 7 OFFSET (INCH/MM)

This parameter is used to define the plate marker 7 offset distance along the X axis. See the definition for X MARKER 1 OFFSET (parameter 26) for further details.

70. Y MARKER 7 OFFSET (INCH/MM)

This parameter is used to define the plate marker 7 offset distance along the Y axis. See the definition for X MARKER 1 OFFSET (parameter 26) for further details.

71. X MARKER 8 OFFSET (INCH/MM)

This parameter is used to define the plate marker 8 offset distance along the X axis. See the definition for X MARKER 1 OFFSET (parameter 26) for further details.

72. Y MARKER 8 OFFSET (INCH/MM)

This parameter is used to define the plate marker 8 offset distance along the Y axis. See the definition for X MARKER 1 OFFSET (parameter 26) for further details.

73. X HOME 1 OFFSET (FUTURE)

This parameter is currently unused and should be set to zero.

74. Y HOME 1 OFFSET (FUTURE)

This parameter is currently unused and should be set to zero.

75. X HOME 2 OFFSET (FUTURE)

This parameter is currently unused and should be set to zero.

76. Y HOME 2 OFFSET (FUTURE)

This parameter is currently unused and should be set to zero.

77. X HOME 3 OFFSET (FUTURE)

This parameter is currently unused and should be set to zero.

78. Y HOME 3 OFFSET (FUTURE)

This parameter is currently unused and should be set to zero.

79. X HOME 4 OFFSET (FUTURE)

This parameter is currently unused and should be set to zero.

80. Y HOME 4 OFFSET (FUTURE)

This parameter is currently unused and should be set to zero.

81. HEIGHT SENSOR DISABLE LOOKAHEAD DISTANCE

This parameter is used to define a specific distance where the PLASMA HEIGHT SENSOR should be disabled. It is used as a "look-ahead" operation before CUT OFF, HEIGHT SENSOR DISABLE, and other auxiliary functions where the PLASMA HEIGHT SENSOR should be disabled.

If this distance is less than the distance where machine speed is less than 90% of selected running speed, it has no affect. If the distance is greater, it defines the approximate position where the height sensor is disabled.

82. MINIMUM RADIUS SPEED

This parameter defines the lowest speed that an arc will be cut, when the ratio between the arc radius and the SLOWDOWN RADIUS parameter would otherwise slow down the machine too much.

This value must be set higher than the CORNER SPEED value in order for it to have any real affect on the arc speed. For example, if the SLOWDOWN RADIUS value is set to 5 inches and the arc radius is .05 inches, the speed defined by the ratio would cause a slowdown of about 99%. The resulting arc speed would then be only slightly above the CORNER SPEED value. This new parameter allows you to force the minimum arc speed to a higher value.

83. MINIMUM SLOWDOWN ANGLE

Together with variable 84 MAXIMUM SLOWDOWN ANGLE, this parameter allows you to define the amount of angular departure required at line and arc endpoints before any slowdown is required, the range over which slowdown scaling occurs, and the angle at which a full slowdown is performed.

The recommended value for MINIMUM SLOWDOWN ANGLE is 10 degrees. The recommended value for MAXIMUM SLOWDOWN ANGLE is 22 degrees. With these values, angular departures less than or equal to 10 degrees run at full speed, and those greater than or equal to 22 degrees cause a full corner slowdown. Angular departures between 10 and 22 degrees are linearly scaled. (For example, an angle of 13 degrees reduces the endpoint speed by about 25%.)

84. MAXIMUM SLOWDOWN ANGLE

See the description for 83 MINIMUM SLOWDOWN ANGLE.

85. START DELAY TIME

This parameter allows you to define or adjust the time delay between the activation of the PLASMA ENABLE relay and the PLASMA START relay. The PLASMA START DELAY is performed only in AUTO and MANUAL PLASMA cutting modes, which are selected by the PLASMA SELECT input. The PLASMA START DELAY has no affect in operations performed in the OXYGEN cut mode or when operating in the BURNY 5 / PLC system configuration.

The value for this parameter must be between .5 seconds and 327.67 seconds. The minimum value is forced by the system to ensure that the two relays will never be activated simultaneously.

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SYSTEM RUNTIME DATA VARIABLES

This section of the manual describes the internal RUNTIME DATA variables that are currently used and maintained in the BURNY 5 control system. Access to these variables is provided for "trouble shooting" and diagnostic purposes only. To display their values, first select "1. DISPLAY SYSTEM DATA" from the UTILITIES menu, and then "2. RUNTIME DATA" from the "DISPLAY DATA" menu. The following parameter values are currently provided:

1. PERCENT X DRIVE OUTPUT
2. X DIGITAL/ANALOG OUTPUT
3. PERCENT Y DRIVE OUTPUT
4. Y DIGITAL/ANALOG OUTPUT
5. MPC BACK PANEL INPUTS
6. ENCODER/STATUS BIT INPUTS
7. DRIVE RELAY OUTPUTS
8. CONTROL RELAY OUTPUTS
9. X ABSOLUTE POSITION
10. Y ABSOLUTE POSITION
11. X DIRECT ENCODER POSITION
12. Y DIRECT ENCODER POSITION
13. X LINE ERROR
14. Y LINE ERROR
15. ARC RADIAL ERROR
16. ARC SCALED RADIAL ERROR
17. SPEED DEPENDENT END POINT DISTANCE
18. ARC MINOR AXIS BOUNDARY DISTANCE
19. ACCEL/DECEL SCALE FACTOR
20. MPC SYSTEM JUMPERS
21. PRE-HEAT TIMER
22. ARC ON DELAY TIMER
23. BLEEDOFF DELAY TIMER
24. MARKER ON DELAY TIMER
25. X POSITION COUNTER
26. Y POSITION COUNTER
27. X SCALED ERROR VECTOR
28. Y SCALED ERROR VECTOR
29. C-AXIS SINE
30. C-AXIS COSINE
31. SPEED LOOP X ERROR
32. SPEED LOOP Y ERROR
33. SPEED LOOP X ERROR SUM
34. SPEED LOOP Y ERROR SUM
35. UNDEFINED
36. UNDEFINED
37. UNDEFINED
38. UNDEFINED
39. UNDEFINED
40. UNDEFINED

NOTE

The "undefined" variables at the end of the RUNTIME DATA VARIABLES list are used only to monitor other internal data values while performing in-house test and debug operations. Typically, these variables contain raw, unscaled data values that have no meaning to the end user. As a result, any values shown with these variables should be ignored.

1. PERCENT X DRIVE OUTPUT

This parameter displays the X drive output as a percentage from 0 to +/- 100%. The drive output value is defined by the position loop process and the SPEED CALIBRATION table process. If the speed loop process is enabled, this value also reflects adjustments made to control the speed of the machine. When a traverse move or a "HIGH SPEED" jog is being performed, a displayed value of 100% indicates that 100% of the MAXIMUM DRIVE SPEED value (SYSTEM SETUP DATA variable 16) is being commanded. These operations are not affected by the speed dial. They are, however, affected by the defined TRAVERSE SPEED LIMIT value if not set equal to the MAXIMUM DRIVE SPEED value.

When the operator is controlling the machine speed with the speed dial, a 100% value indicates that the position loop is requesting 100% of the commanded RUN SPEED. Since RUN SPEED is usually less than the MAXIMUM DRIVE SPEED value, the X DRIVE OUTPUT value is often less than 100%. For example, when the speed dial is set to the "full speed" position and the running speed is set to 50% of the MAXIMUM DRIVE SPEED value, the maximum DRIVE OUTPUT value will also be approximately 50%. RUN SPEED is initialized from the RUN SPEED LIMIT variable at power-up and can be modified by feedrate commands encountered in an executing NC program or by digital feedrate commands issued by the operator.

The speed dial is used to define the "percent" of RUN SPEED required. This allows the BURNY to internally control the speed of the machine for "programmed feedrate" and "digital feedrate" operations. External gain adjustments are still performed to reduce the "full reference" range but adjustments in drive output are used to define and maintain the speed of the machine. The "FEED:" display in the status window has also been changed in this release to show the currently selected and scaled RUN SPEED which may be defined by the operator or an NC program resident feedrate command.

This display is useful when the machine is not running at the correct speed. If the feedrate ("FEED:") displayed in the status window is correct and this display shows that the position loop is commanding 100% of the current feedrate, it indicates that the machine should be running at or near the feedrate speed. If it is running slower, it indicates a mechanical or electrical problem usually outside of the BURNY.

2. X DIGITAL/ANALOG OUTPUT

This parameter displays the actual "bit" value being sent to the X axis D/A converter. Since a 10 bit converter is used in the BURNY, a value of "03FF" indicates a full 100% bit value is being sent to the converter. A negative output will have an 8 in the first digit ("83FF"). The D/A bit value is determined by multiplying the X DRIVE OUTPUT value by the speed calibration factor for the X axis.

3. PERCENT Y DRIVE OUTPUT

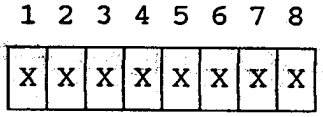
This parameter displays the same type of information as the PERCENT X DRIVE OUTPUT parameter but for the Y axis. See that parameter description for additional information.

4. Y DIGITAL/ANALOG OUTPUT

This parameter displays the same type of information as the X DIGITAL/ANALOG OUTPUT parameter but for the Y axis. See that parameter description for additional information.

5. MPC BACK PANEL INPUTS

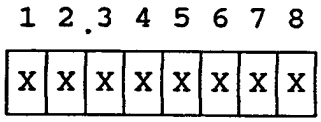
This parameter displays the current state of the 8 signal inputs from the back panel. The data is displayed as an 8 digit binary value. A "1" indicates that the associated input is "ON" while a "0" indicates "OFF".



Bit 1 - "PLASMA ARC ON" input from 31RECP on back panel
Bit 2 - "OXY CUT SWITCH" input from 32RECP on back panel
Bit 3 - "MARKER ON/SPARE" input from 32RECP on back panel
Bit 4 - "PLASMA SELECT" input from 31RECP on back panel
Bit 5 - "DRIVE CONTROL 1" input
Bit 6 - "DRIVE CONTROL 2" input
Bit 7 - "Y EXTERNAL DRIVE CONTROL" input
Bit 8 - "X EXTERNAL DRIVE CONTROL" input

6. ENCODER/STATUS BIT INPUTS

This parameter displays the current state of 8 miscellaneous inputs from the back panel. The data is displayed as an 8 digit binary value. A "1" indicates that the associated input is "ON" while a "0" indicates "OFF".



Bit 1 - 1 for "+5 VOLT SUPPLY" OK
Bit 2 - 0 for "AC POWER INPUT" OK
Bit 3 - 1 for "E-STOP INPUT" OK (E-STOP is NOT pending)
Bit 4 - 0 for "PGM MEMORY LATCH" enabled
Bit 5 - "NOT X ENCODER, CHANNEL A" input
Bit 6 - "NOT X ENCODER, CHANNEL B" input
Bit 7 - "NOT Y ENCODER, CHANNEL A" input
Bit 8 - "NOT Y ENCODER, CHANNEL B" input

7. DRIVE RELAY OUTPUTS

This parameter displays the current state of the 8 drive control outputs that are sent to the back panel. The data is displayed as an 8 digit binary value. Each digit controls a different function.

1	2	3	4	5	6	7	8
X	X	X	X	X	X	X	X

Bit 1 - SPARE DRIVE CONTROL output
Bit 2 - SPARE DRIVE CONTROL output
Bit 3 - SPARE DRIVE CONTROL output
Bit 4 - SPARE DRIVE CONTROL output
Bit 5 - "1" for OVERRIDE, "0" for "NC RUN"
Bit 6 - "1" for INTERNAL REFERENCE, "0" for SPEED DIAL
Bit 7 - "Y D/A SIGN BIT" output
Bit 8 - "X D/A SIGN BIT" output

8. CONTROL RELAY OUTPUTS

This parameter displays the state of the 8 relay control bits sent to the back panel relay control circuitry. The data is displayed as an 8 digit binary value.

NOTE

These bit states are represented using an inverted logic sense. Thus, a "0" indicates that the associated output is "ON" and a "1" indicates the output is "OFF".

1	2	3	4	5	6	7	8
X	X	X	X	X	X	X	X

Bit 1 - "OXYGEN STOP/NOT ENABLED" relay
Bit 2 - "MARKER 1" (SPARE) relay
Bit 3 - "OXYGEN PREHEAT" relay
Bit 4 - "OXYGEN START" relay
Bit 5 - "PLASMA STOP/NOT ENABLED" relay
Bit 6 - "PLASMA START" relay
Bit 7 - "MARKER 2" (SPARE) relay
Bit 8 - "PLASMA HEIGHT SENSOR" relay

9. X ABSOLUTE POSITION

This parameter displays the same X position data that is displayed in the status window, but it does not round the position to two decimal places. Here the value is always displayed using four decimal places.

10. Y ABSOLUTE POSITION

This parameter displays the same Y position data that is displayed in the status window, but it does not round the position to two decimal places. Here the value is always displayed using four decimal places.

11. X DIRECT ENCODER POSITION

This parameter displays the current X position value using actual input encoder counts. This value and its associated encoder scale factor (which is defined in SYSTEM SETUP DATA by the X ENCODER DISTANCE PER REVOLUTION and X ENCODER LINES PER REVOLUTION values) are used to calculate the X ABSOLUTE POSITION value as follows:

$$\text{DIRECT ENCODER POSITION} \times \frac{\text{ENCODER DIST./REV.}}{4 \times \text{ENCODER LINES/REV.}} = \text{ABSOLUTE POSITION (IN or MM)}$$

12. Y DIRECT ENCODER POSITION

This parameter displays the same type of information as the X DIRECT ENCODER POSITION parameter but for the Y axis. See that parameter for additional information.

13. X LINE ERROR

This parameter displays the X distance from the correct path when the BURNY is performing a program block LINE move.

When inaccurate parts are being cut, this display can be used to help determine if the problem is mechanical or is due to the BURNY "position loop". While a part is being cut (or test run), note the X and Y LINE ERROR values at various points along the part. If an error is very small or zero, it indicates that the BURNY is operating correctly and the problem is mechanical. This could be caused by a loose encoder bracket or torch holder, or backlash in the drive system. However if the displayed error value is large, it indicates that the BURNY "knows" that the path is incorrect but it is unable to correct for it. This can still be caused by a mechanical problem but is usually due to an electrical problem with either the drive system electronics or the BURNY interface card. Another possible reason for large errors while cutting a part is that the SYSTEM SETUP DATA parameter "LOOP GAIN" is set too low to allow the BURNY to correct for the path error.

14. Y LINE ERROR

This parameter displays the same type of information as the X LINE ERROR parameter but for the Y axis. See that parameter for additional information.

15. ARC RADIAL ERROR

This parameter displays the distance from the correct path when the BURNY is performing a program block ARC move. A positive value indicates that the machine is outside the correct radius. Negative values indicate that the machine is inside the correct radius.

This parameter can be used the same way as the X and Y LINE ERROR parameters to help determine why a part is inaccurate. See the X LINE ERROR parameter description for additional details.

16. ARC SCALED RADIAL ERROR

This parameter displays the commanded speed percentage after the "LOOP GAIN" has "scaled" any ARC RADIAL ERROR value. Once this value is calculated and displayed, it is separated into its X and Y axis components for display as the X and Y SCALED ERROR VECTOR parameter values. See the X SCALED ERROR VECTOR parameter description for additional details on the format of this displayed value.

17. SPEED DEPENDENT END POINT DISTANCE

This parameter is provided primarily for testing purposes and is not needed during normal installation and service operations.

18. ARC MINOR AXIS BOUNDARY DISTANCE

This parameter is provided primarily for testing purposes and is not needed during normal installation and service operations.

19. ACCEL/DECEL SCALE FACTOR

This parameter is provided primarily for testing purposes and is not needed during normal installation and service operations.

20. MPC SYSTEM JUMPERS

This parameter is provided primarily for testing purposes and is not needed during normal installation and service operations. It does however display the states of 8 jumpers located on the I/O board under the FIFO card. The data is displayed as an 8 digit binary value. A "1" indicates the associated jumper is "OFF" and "0" indicates the jumper is "ON".

H	G	F	E	D	C	B	A
1	0	0	0	0	0	0	1

Jumper H - "1" required for BURNY 5 operations.
Jumper G - Undefined but should be "0".
Jumper F - Undefined but should be "0".
Jumper E - Undefined but should be "0".
Jumper D - Undefined but should be "0".
Jumper C - Normally "0" but "1" enables "E-STOP" operations. (See RUNTIME DATA VARIABLE 6 for the actual input bit state.)
Jumper B - Normally "0" but "1" enables operations with a GE SERIES ONE PLUS programmable controller.
Jumper A - "1" required for BURNY 5 operations.

21. PRE-HEAT TIMER

This parameter displays the current "AUTO CUT: OXYGEN PREHEAT" delay timer value as an unsigned integer count. Each count unit represents 10 milliseconds. Therefore, a value of 1000 represents 10 seconds.

22. ARC ON DELAY TIMER

This parameter displays the current "PLASMA ARC ON" delay timer value as an unsigned integer count. Each count unit represents 10 milliseconds. Therefore, a value of 500 represents 5 seconds.

23. BLEEDOFF DELAY TIMER

This parameter displays the current "OXYGEN BLEEDOFF" delay timer value as an unsigned integer count. Each count unit represents 10 milliseconds. Therefore, a value of 200 represents 2 seconds.

24. MARKER ON DELAY TIMER

This parameter displays the current "MARKER ON" delay timer value as an unsigned integer count. Each count unit represents 10 milliseconds. Therefore, a value of 100 represents 1 second.

25. X POSITION COUNTER

This parameter displays the 8 bit X axis encoder counter value as a 2 digit hexadecimal value. This parameter can be used to check encoder input circuitry by making sure the counter counts smoothly when the encoder is turned.

26. Y POSITION COUNTER

This parameter displays the same type of information as the X POSITION COUNTER parameter but for the Y axis. See that parameter for additional information.

27. X SCALED ERROR VECTOR

This parameter displays the speed percentage that is commanded after a path error has been "scaled" by the "LOOP GAIN" value. This parameter is displayed when both LINE and ARC program blocks are run.

Example: Assume a part is being cut and the operator's speed dial is set to the "full speed" position. The internal reference speed at that point would be the "100%" speed value. If this parameter showed 2.0% and the MAXIMUM DRIVE SPEED value was 150 IPM, it would indicate that a speed of 3 IPM (2.0% of 150 IPM) was being commanded due to an error on the associated axis (X axis).

The speed dial is used to define the "percent" of RUN SPEED required so that internal speed control operations can be performed. Although the BURNY still internally defines and uses a reference speed value which is derived from the speed dial position and the defined MAXIMUM DRIVE SPEED value, this reference speed value is no longer displayed. The "FEED:" field in the status window is now used to display the currently selected and scaled RUN SPEED value.

28. Y SCALED ERROR VECTOR

This parameter displays the same type of information as the X SCALED ERROR VECTOR parameter but for the Y axis. See that parameter for additional information.

29. C-AXIS SINE

This parameter displays the percentage of analog reference output from the torch rotation circuitry on the FIFO board to the drive interface card. A value of 100% indicates a maximum positive voltage level on the SIN pin. (Pin 7 = SIN and pin 8 = NOT SIN on the cable from the FIFO card.)

30. C-AXIS COSINE

This parameter displays the percentage of analog reference output from the torch rotation circuitry on the FIFO board to the drive interface card. A value of 100% indicates a maximum positive voltage level on the COS pin. (Pin 5 = COS and pin 6 = NOT COS on the cable from the FIFO card.)

31. SPEED LOOP X ERROR

This parameter displays the X axis speed error value whenever speed loop operations are enabled. (Speed loop operations are enabled by a bit in SYSTEM SETUP DATA VARIABLE 37, SYSTEM CONFIGURATION 1.) This error value displays speed in inches per minute or millimeters per minute depending on the defined system unit type (ENGLISH or METRIC).

This display is useful when adjusting the external drive circuitry and defining appropriate setup values for SPEED LOOP GAIN and SPEED LOOP RESET TIME. Since this parameter value displays the amount of speed error that the BURNY is attempting to correct, drive adjustments should be made to minimize the amount of error detected in both the positive and negative directions. See the SYSTEM SETUP DATA VARIABLES section for additional information on the SPEED LOOP GAIN, SPEED LOOP RESET TIME and SPEED LOOP ERROR SUM LIMIT variables.

32. SPEED LOOP Y ERROR

This parameter displays the same type of information as the SPEED LOOP X ERROR parameter but for the Y axis. See that parameter for additional information.

33. SPEED LOOP X ERROR SUM

This parameter displays the X axis speed "error sum" value whenever speed loop operations are enabled. (Speed loop operations are enabled by SYSTEM SETUP DATA VARIABLE 37, SYSTEM CONFIGURATION 1.) The "error sum" value is an accumulated error value that is created from continuous speed error conditions on the axis. It is displayed in inches per minute or millimeters per minute depending on the defined system unit type (ENGLISH or METRIC).

Every 8ms when the speed error is calculated, a portion of the error is added to the accumulated value for use in the speed loop "integral" term. The "integral" term is used to create an additional error adjustment value to force the current speed closer to the desired speed. This term is particularly useful when running at low speeds and when an increased drive output is required to overcome machine binding or drag. The SPEED LOOP RESET TIME variable defines the amount of the speed error value that is added to the error sum value every scan. The SPEED LOOP ERROR SUM LIMIT variable defines a maximum error sum value to limit the amount of speed adjustment that can be generated. See the SYSTEM SETUP DATA VARIABLES section for additional information.

34. SPEED LOOP Y ERROR SUM

This parameter displays the same type of information as the SPEED LOOP X ERROR SUM parameter but for the Y axis. See that parameter for additional information.

BLANK

ERROR MESSAGES

This section lists all the error messages displayed by the BURNY 5 control. A brief description of each message is also included.

ABORT OPERATION COMMANDED

This message occurs after a load or store operation is aborted by the press of the RST or CE key.

ABORT RETURN

This message occurs after a load or store operation is aborted by the press of the RST or CE key.

BACKGROUND PROCESS BUSY

This error message occurs when trying to perform certain operations while the control is cutting a part.

BUFFER ALLOCATION ERROR

This error message occurs during certain operations while a "BACKGROUND" load, store or kerf operation is being performed. Wait till the "BACKGROUND" operation is complete, then try again. This message can also occur on old hardware when using new features such as MULTI-TASKING.

COMM FAILURE

This error message indicates that the communication between the MPC (Main Process Control) and the FPC (Front Panel Control) has been interrupted. The only way to restart communications is to cycle power to the control.

COPY/DATA CHECKSUM ERROR

This error can occur when loading from a cartridge or in INTERNAL format when the program checksum field in the program header does not match the number of bytes received in the program.

COPY/DATA SIZE ERROR

This error can occur when loading from a cartridge or in INTERNAL format when the program size field in the program header does not match the number of bytes received in the program.

DATA DEFINITION ERROR

This error message can occur when using the AUXILIARY CODE table if an entry in the table is invalid.

DATA FORMAT ERROR

This error message was used during product development and should never occur in actual operation.

DATA SETUP ERROR

This error message was used during product development and should never occur in actual operation.

DEVICE BUSY

This error message was used during product development and should never occur in actual operation.

DEVICE NOT INSTALLED

This error message occurs when accessing a panel device that has not been installed (ram cartridge etc.).

DEVICE NOT OPENED

This error message was used during product development and should never occur in actual operation.

DEVICE NOT READY

This error message occurs when loading from the "TAPE READER" device when it is not connected or turned on.

DEVICE OFF-LINE

This error message indicates that the connected serial device is not ready for communications (no CTS).

DEVICE OPENED FOR READ NOT WRITE

This error message was used during product development and should never occur in actual operation.

DEVICE OPENED FOR WRITE NOT READ

This error message was used during product development and should never occur in actual operation.

DUPLICATE FILE NAME

When "LOAD", "TEACH" or save program from "EDIT" or "NEST" is selected and a program number is entered as the number to be used in storing the program, it is checked to make sure that it is not the same number as an existing program. If a duplicate number is found, this error will be displayed. At this point, either use the "DELETE" function to erase the duplicate or enter a different program number for the new program.

END OF FILE ENCOUNTERED

This error message was used during product development and should never occur in actual operation.

FILE RECORD CHAINING ERROR

This error message occurs when a program has been corrupted in program memory. The only way to remove this error is by deleting the program and re-loading it.

FILE STRUCTURE FORMAT ERROR

This error message is displayed when program memory has been corrupted. This can happen if power is removed from the control during critical operations especially kerf. The "ERASE AND TEST" function must be executed to clear this condition. All programs will be lost.

FILE/DEVICE ALLOCATION ERROR

This error message occurs when accessing program memory with the read enable trip voltage set too low (pot adjustable) or when accessing a defective "RAM CARTRIDGE".

FILE/DEVICE BUSY

This error message was used during product development and should never occur in actual operation.

FILE/DEVICE EMPTY

This error message can occur if no programs are found in the specified device.

FILE/DEVICE ERASE/REBLD COMPLETED

This error message was used during product development and should never occur in actual operation.

FILE/DEVICE FULL

This error will occur when either "LOAD" or "TEACH" is selected and indicates that the program memory is full and cannot accept another program. Use the "DELETE" function to erase any unneeded programs and re-enter the desired function.

FILE/DEVICE PROTECTION ERROR

This error message occurs when saving a program to a "RAM CARTRIDGE" when the cartridge has not been enabled for write operations.

FPC READ COMMAND MISMATCH

This error message was used during product development and should never occur in actual operation.

FPC WRITE COMMAND MISMATCH

This error message was used during product development and should never occur in actual operation.

FRAMING ERROR

During data reception, if a character with the wrong number of bits is received, this error will occur and terminate the operation. This can occur if noise is present on the transmission line or if the wrong baud rate is used.

FUNCTION SETUP ERROR

This error message can occur when re-defining an AUXILIARY CODE values which has a predefined value (the first 28 codes when programmable I/O is enabled).

HANDSHAKE ERROR

This error message occurs during serial communications when the hardware/software protocol indicates an error occurred.

INVALID OPERATION

This error message was used during product development and should never occur in actual operation.

INVALID DEVICE

This error message appears when an unsupported device is selected from a menu. The selection of "MINI-FILE" will result in this error message.

MESSAGE COMMAND ERROR

This error message was used during product development and should never occur in actual operation.

MESSAGE FORMAT ERROR

This error message was used during product development and should never occur in actual operation.

NO PROGRAM HEADER FOUND

This error message occurs during serial communications when the end of file was encountered before the start of program (%).

OVERRUN ERROR

During data reception, if the data is transmitted too fast, or is sent at the wrong baud rate, an overrun error will occur and terminate the operation.

PARITY ERROR

This error indicates that during a serial operation, a PARITY ERROR was detected and caused the operation to abort.

PGM SIZE EXCEEDS MAX ALLOWED

This error message occurs when a program larger than 128k bytes is stored in program memory. This can happen during loading from a serial device or saving a program from the EDIT or NEST utilities. Programs sizes are usually smaller when compared to the same ascii file that exist on a computer. The BURNY 5 control discards unneeded ascii characters, such as block numbers, when loaded through the serial port. The is done to conserve memory.

PROGRAM FILE CHECKSUM ERROR

This error message occurs when accessing a program that has an invalid checksum. There is no way to fix this condition other than deleting the affected program.

PROGRAM FORMAT ERROR

When a "LOAD" operation is being performed, if the program being received does not match the specified program format type (ESSI, WORD ADDR, ETC,) this error will occur.

PROGRAM SYNTAX ERROR

This error message occurs during load or store operations when the control encounters an invalid program sequence, such as numeric values exceeding the maximum allowable or no valid END OF PROGRAM sequence was found (ie. missing M30, M02, etc). The load or store operation is aborted.

READ TIMEOUT

This error indicates that the data being received by the BURNY 5 has stopped for longer than the nominal timeout value (15 SEC). The operation has been aborted. (See SYSTEM DATA variables 44-48 to disable timeouts for selected devices.)

RECORD NOT FOUND

This error message occurs during serial communication when no program data is received, only the end of file control code.

SYNC ERROR

This error message was used during product development and should never occur in actual operation.

SYSTEM ERROR

This error message was used during product development and should never occur in actual operation.

WRITE TIMEOUT

This error indicates that data transmission has been delayed due to an in-operative device being connected to the RS-232 port for longer than a the nominal timeout value (15 SEC). (See SYSTEM DATA variables 44-48 to disable timeouts for selected devices.)

UNKNOWN COMM ERROR

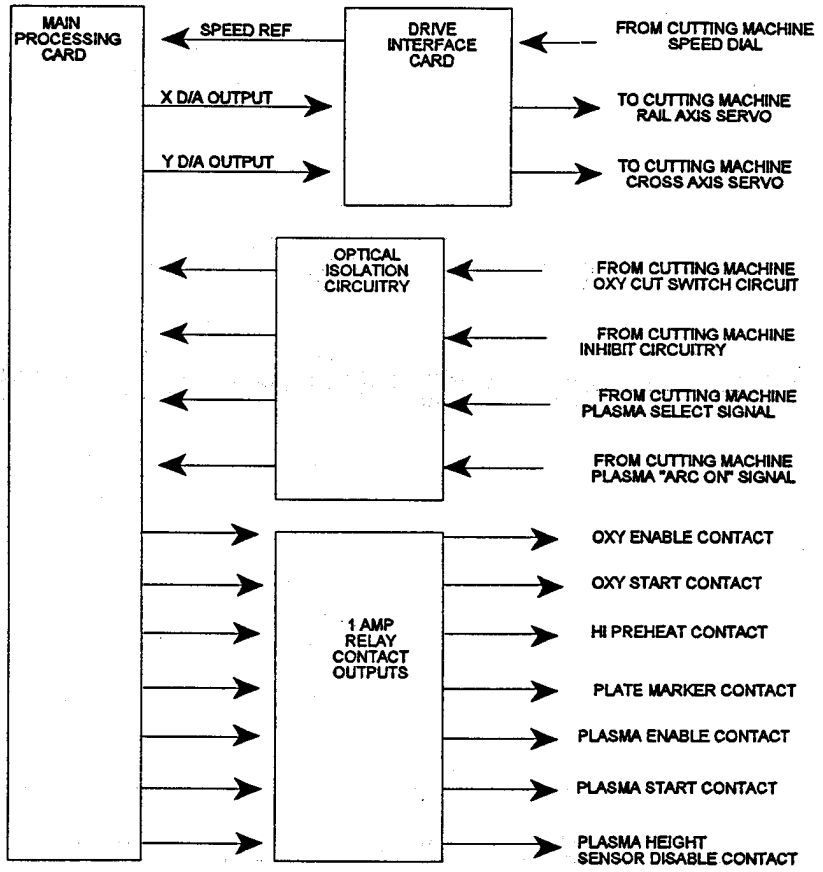
This error message was used during product development and should never occur in actual operation.

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MACHINE INTERFACE DESCRIPTION

The BURNY 5 requires a connection to certain signals on the cutting machine to allow it to control the various cutting and drive functions. The following is a block diagram showing the BURNY 5 drive and cutting circuitry interface connections.

BURNY 5 SYSTEM INPUT/OUTPUT BLOCK DIAGRAM



As the block diagram shows, there are separate "DRIVE" and "CUTTING" interface signals.

DRIVE INTERFACE

All drive interface connections use "30 RECEPTACLE" on the BURNY 5 back panel. A CUSTOM DESIGNED INTERFACE CARD is used to allow many different drive systems to be used with the BURNY 5.

It is impractical to describe the specific drive interface since these will vary on each type of drive system. However, 3 of the signals are the same for any drive system.

1. A speed reference signal input from the operators speed dial is required. This signal is used by the BURNY 5 to control the machine's speed in different modes. This signal is passed through the drive interface card to the main processor as the "A/D REFERENCE" signal. The MPC (MAIN PROCESSOR CARD) converts the analog signal to a digital value for use by the position loop software. The result of this conversion is displayed on the first line of status display window: FEED:X.XX. For proper operation of the control, the displayed feedrate value must be within 5% of the actual speed setting. If it is incorrect, there will usually be an adjustment on the interface card which will correct the problem (see specific interface card schematic).

2. X D/A OUTPUT- this output from the isolator card is the drive signal command to the X (rail) axis servo. It passes through the interface card and then out to the machine's rail axis servo drive.

3. Y D/A OUTPUT- cross axis servo command output from the isolator card. Again, it passes through the interface card and then to the machine's cross axis servo drive. Although there are typically other signals required for the drive interface, they are significantly different for each type of drive.

CUTTING INTERFACE

The cutting interface signals are connected to the machines cutting control circuitry so that the BURNY 5 can control the cutting operation. The OXY/FUEL functions are interfaced through 32 receptacle while the PLASMA interface is done through 31 receptacle, both on the back panel. The separate connectors are used to provide maximum isolation between the PLASMA and OXY/FUEL circuitry and help to minimize noise interference from the PLASMA system. The following is a description of the various inputs and relay outputs used for the cutting interface.

NOTE

The RELAY CONTACT outputs used for the cutting interface are capable of switching up to 1 AMP loads at up to 230VAC. Since these are Power contacts, it is not recommended that they be used for "Dry" circuit logic levels. All contacts are "Maintained" type. If a momentary action is required, the optional momentary relay adapter must be used.

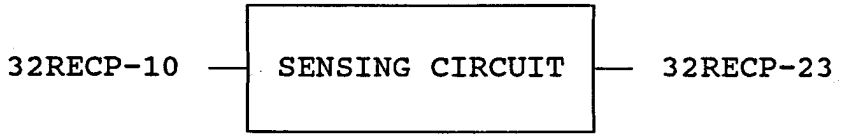
The SENSING INPUT circuits are all separate 2 wire inputs with no common connection. The standard inputs will respond to either AC or DC voltages between 24 and 120 VOLTS (48-230V inputs available). In most cases, they will respond to much lower levels, so care must be taken that when the input is supposed to be "Off" that there are no low level leakage paths (such as suppression capacitors across switches) which could provide enough current to be sensed as an "On" input.

In the following descriptions, the term "OVERRIDE" will be used to indicate that the operator has pressed the "NC" button to disable the BURNY 5 outputs and return to manual machine operation.

OXY CUT SENSE

OXY/FUEL, MARKER INTERFACE AND POWER INPUT RECEPTACLE (32RECP.)

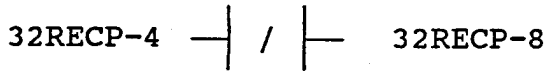
PINS 10 AND 23 OF 32RECP.



This input is used to sense when the CUTTING OXYGEN switch has been turned on and that motion along the cut path can begin. Typically, this signal is connected directly to the CUTTING OXYGEN SWITCH or to a signal line which operates at the same time. The cut switch must be sensed in an "OFF" condition before the logic will allow the cutting circuit to be enabled. Once a cut is finished and the machine has moved to a new pierce location, this signal must go off for at least 1 second before a new cut will be allowed to start.

OXY ENABLE CONTACT

PINS 4 AND 8 OF 32RECP



This contact must be connected to the OXYGEN CUTTING CIRCUIT in such a way that opening it will stop the cutting oxygen and reset any automatic relay sequencing. When running a part, this contact will not close until the "OXY SENSE INPUT" is first sensed to be in an "OFF" state. This prevents the enable contact from re-starting the cut. This contact is only supposed to enable the cutting circuit so the oxygen can be started either by the manual cut switch or by the BURNY 5 "OXYGEN START CONTACT". Once the cutting has started, this contact will be maintained in a closed position until the part has been completed or the operator presses the "STOP CYCLE" or "BACKUP" BUTTON. At these times, the contact will open, stopping the cutting oxygen.

If the BURNY 5 is set to "OVERRIDE", this contact will be maintained in a closed position to enable the existing machine cutting circuitry.

HI PREHEAT CONTACT

PINS 21 AND 22 OF 32RECP



This contact is connected to the cutting circuit in such a way that it can initiate the HIGH PREHEAT function of the gas controls. This contact will only operate when AUTO oxy fuel cutting is selected, in "MANUAL" cutting, the contact will remain open. This contact will close for the "PREHEAT" time specified by the operator and then open for the remainder of the cut.

If the BURNY 5 is in "OVERRIDE", this contact will remain open.

OXYGEN START CONTACT

PINS 32 AND 37 OF 32RECP



This contact is connected to the cutting circuit such that it can initiate the cutting oxygen, but only if the "OXY ENABLE CONTACT" is closed. It may either directly connect the cutting oxygen circuit, or may provide a signal to the machine's existing auto cut circuitry. This contact will only operate when "AUTO" oxy/fuel cutting is selected. THE contact will close after the "PREHEAT" time reaches zero (0) and will remain closed until the part is complete. If "MANUAL" cutting is selected, this contact will remain open, and the cutting oxygen must be started with the machines existing manual cutting controls.

If the BURNY 5 is in "OVERRIDE", this contact stays open.

PLATE MARKER #1 CONTROL CONTACT PLATE MARKER CONTROL

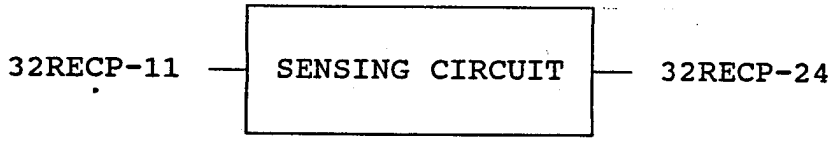
PINS 9 AND 15 OF 32 RECP



This contact is connected to the PLATE MARKER #1 CONTROL circuit so that it can close to initiate the PLATE MARKING cycle and open to stop it. After it closes, the machine will hold position for the time set by MARKER DELAY parameter and then begin moving along the marking path. This contact will only operate if the control has the plate marking option enabled, otherwise it will remain open. If the BURNY 5 is in "OVERRIDE", this contact stays open.

INHIBIT SENSE INPUT

PINS 11 AND 24 OF 32 RECP



This input performs a program "INHIBIT" function. When the input is sensed as being "ON", the BURNY 5 will stop running a part and hold position. All timers and relay outputs will be "FROZEN" in their current state. When the input goes "OFF", normal operation will resume. This input is used when external functions (such as lowering torches, height sensors, etc) require a delay in program execution in order to complete their function. It is not an "E-STOP" input and should not be used in a "FAIL-SAFE" operation. Only program execution will be inhibited, the jog functions will operate regardless of the state of this input.

AC INPUT POWER

PINS 1 AND 34 OF 32RECP

The AC INPUT POWER to the BURNY 5 is connected to these pins. The power source should be a non-switched 115vac 50/60HZ source capable of supplying 500W (ACTUAL POWER REQUIREMENT IS LESS). Note- 220VAC/50Hz power input is available as an option.

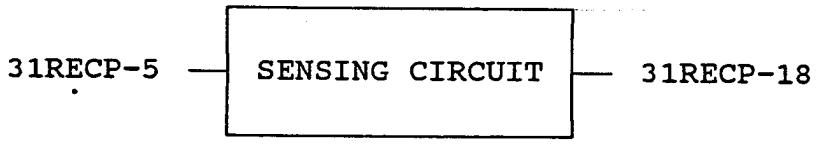
CHASSIS GROUND

PINS 18 AND 19 OF 32RECP

At least one, or both of these pins should be connected to the main chassis ground of the machine. On PLASMA INSTALLATIONS, it is RECOMMENDED THAT AN ADDITIONAL HEAVY WIRE OR STRAP BE CONNECTED BETWEEN THE MACHINE CHASSIS AND ONE OF THE SHIELD GROUNDING SCREWS ON THE BACK PANEL.

PLASMA SELECT INPUT

PINS 5 AND 18 OF 31RECP

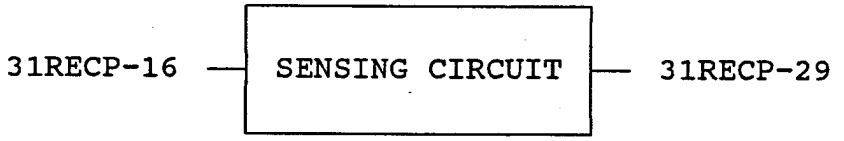


This input is used to select between OXY/FUEL and PLASMA CUTTING. If the input is "OFF", all PLASMA functions are disabled and the OXY/FUEL cutting controls will be active. When this input is "ON", all OXY/FUEL functions are disabled and the following PLASMA functions will operate. This input must be set to the correct state before the part program is run, otherwise the operator prompts will be incorrect (such as requesting a preheat time for a PLASMA CUT.)

This input allows the cutting process to be determined independent of the part program. Thus the programming commands do not specify PLASMA or OXY/FUEL, only cut ON or OFF.

PLASMA ARC ON "GO" INPUT

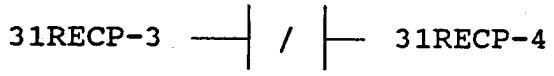
PINS 16 AND 29 OF 31RECP



This input is used for sensing when the ARC has transferred to the plate and motion along the cut can begin. It operates much the same as the "OXY SENSE INPUT" described earlier in that it must be in an "OFF" state before the PLASMA CIRCUIT will be enabled. Also, motion along the cut begins when the input goes "ON". Since some PLASMA UNITS do not have a "ARC ON" contact output, a timer function is provided which delays motion by a specific time after this input receives the "ON" signal. This PLASMA ON DELAY time is set with system setup data VARIABLE #11 "PLASMA ARC ON DELAY". A second timer set by system setup VARIABLE #12 "PLASMA ARC OFF DELAY" which causes a delay after the arc goes out. This allows the machine to continue moving after a part falls out and causes the arc to extinguish.

PLASMA ENABLE CONTACT

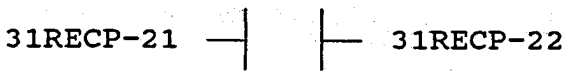
PINS 3 AND 4 OF 31RECP



This contact is typically connected in series with the PLASMA STOP CIRCUIT such that it can open to stop the cut BUT CLOSURE DOES NOT INITIATE THE CUT. The enable contact will not close until the "ARC ON" input is sensed as being "OFF". Once it has closed to enable a PLASMA cut, it will remain closed for the entire cut path and then open when it is finished. It will also open if either the "CYCLE STOP" or "BACKUP" buttons are pressed. If the BURNY 5 is set to "OVERRIDE", this contact will be maintained in a closed position, thus allowing for normal manual control of the PLASMA circuit.

PLASMA START CONTACT

PINS 21 AND 22 OF 31RECP

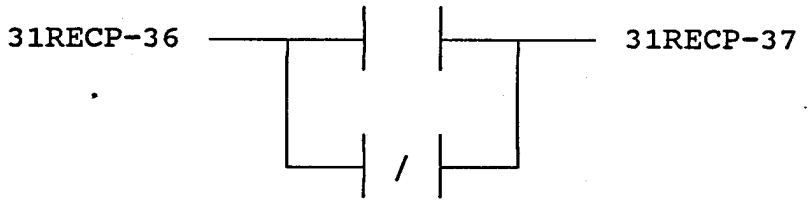


This contact should be connected to the PLASMA control circuitry such that it can close to initiate the PLASMA CUT, but the cut can still be stopped either by the "PLASMA ENABLE CONTACT" opening, or by the operator pressing the PLASMA STOP button. This contact only operates when "AUTO" PLASMA cutting is selected and will remain closed during the entire PLASMA CUT. If "MANUAL" cutting is selected, this contact will remain open.

If the BURNY 5 is in "OVERRIDE, this contact stays open.

PLASMA HEIGHT DISABLE CONTACT

PINS 36 AND 37 OF 31RECP



This contact is connected to the plasma's Height Sensing system such that when activated, The HEIGHT SENSOR is disabled and the torch is "FROZEN" at the existing height. When the contact is released, the height sensor regains control of the torch height. The normal (Non-activate) state of this contact is selectable by "SD#33 PLASMA HEIGHT RELAY" parameter for either normally open or closed operation. Thus it can be set to accommodate the various height sensing systems. The contact will maintain the "NORMAL" condition as long as the machine is running at the speed set by the operators speed dial. However, when the speed is slowed for a corner, this contact will switch and maintain the activated condition until the machine has re-accelerated back to the normal cutting speed. This prevents the height sensor from lowering the torch due to the reduced cutting speed in the corner.

If The BURNY 5 is in "OVERRIDE", this contact will be maintained in the "NORMAL" condition as set by the system setup data VARIABLE #33, "PLASMA HEIGHT RELAY" parameter.

PLATE MARKER #2 CONTROL CONTACT

PINS 20 AND 26 OF 31 RECP



This contact is connected to the PLATE MARKER #2 CONTROL circuit so that it can close to initiate the PLATE MARKING cycle and open to stop it. After it closes, the machine will hold position for the time set by VARIABLE #25, "MARKER DELAY TIME" and then begin moving along the marking path. This contact will only operate if the control has the plate marking option enabled, otherwise it will remain open. If the BURNY 5 is in "OVERRIDE", this contact stays open.

CUT CONTROL RELAY OUTPUT SEQUENCING DIAGRAMS

***** INITIAL POWER UP, OVERRIDE AND RST CONDITIONS *****

	1A POWER OFF	1B AFTER POWER UP	1C IF SYSTEM IS SET TO OVERRIDE AT ANY TIME	1D PRESS <RST>- ASSUMES THAT OVERRIDE IS NOT IN EFFECT
OXYGEN ENABLE CONTACT (32RECP-4, 8)	CLOSE	OPEN	CLOSE	OPEN
OXYGEN START CONTACT (32RECP-21, 22)	OPEN	OPEN	OPEN	OPEN
HIGH PREHEAT CONTACT (32RECP-32, 37)	OPEN	OPEN	OPEN	OPEN
PLASMA ENABLE CONTACT (31RECP-3, 4)	CLOSE	OPEN	CLOSE	OPEN
PLASMA START CONTACT (31RECP-21, 22)	OPEN	OPEN	OPEN	OPEN
PLASMA SENSOR DISABLE CONTACT (31RECP-36, 37)	OPEN	OPEN	OPEN	OPEN

*** The PLASMA HEIGHT DISABLE contact is shown assuming that the contact is set for normally "OPEN" operation where the contact be open for normal cutting and "CLOSE" when the machine decelerates when approaching a corner. If the contact is set for normally "CLOSED" operation, reverse the state of the information in the diagrams.

MANUAL OXY/FUEL CUTTING SEQUENCE

This sequence will be followed when the PLASMA select input (31RECP-5,18) is not energized. This selects OXY/FUEL cutting and all PLASMA control contacts will remain open.

	2A RECYCLE /RESET PROGRAM SELECT AND SETUP	2B PRESS CYCLE START MOVING TO NEW PIERCE POINT	2C ARRIVE AT PIERCE POINT WAIT UNTIL OXY SW INPUT IS OFF	2D OXY SW. SENSE INPUT OFF--- ENABLE OXY CUT CIRCUIT WAIT FOR OXY SWITCH TO BE TURNED ON	2E WAIT FOR OXY SENSE INPUT TO SENSE CUT OXYGEN IS ON, THEN START CUT MOTION	2F WHEN CUTTING PATH IS COMPLETE OR CYCLE STOP IS PRESSED. GOTO 2B	2G IF BACKUP PRESSED GOTO 2C
OXYGEN ENABLE	OPEN ----	OPEN ----	OPEN ----	---- CLOSE	---- CLOSE	OPEN ----	OPEN ----
OXYGEN START	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----
HIGH PREHEAT	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----
PLASMA ENABLE	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----
PLASMA START	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----
PLASMA HEIGHT DISABLE	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----

OXY/FUEL -"AUTOCUT" RELAY SEQUENCING

	3A RESET CYCLE SELECT PGM	3B AFTER CYCLE START PUSHED MOVING TO NEW PIERCE POINT	3C AT NEW PIERCE POINT PREHEAT FOR USER ENTERED TIME	3D PREHEAT OFF-- WAIT TILL OXY SENSE INPUT IS OFF	3E ENABLE OXY CIRCUIT AND START CUTTING OXYGEN	3F DON'T MOVE UNTIL OXY SENSE INPUT IS ON	3G TURN OFF OXY AT END OF CUT PATH GOTO 3B	3H IF CYCLE STOP PUSHED GOTO 3B	3I IF BACKUP PUSHED
OXYGEN ENABLE	OPEN ----	OPEN ----	OPEN ----	OPEN ----	---- CLOSE	---- CLOSE	OPEN ----	OPEN ----	OPEN ----
OXYGEN START	OPEN ----	OPEN ----	OPEN ----	OPEN ----	---- CLOSE	---- CLOSE	OPEN ----	OPEN ----	OPEN ----
HIGH PREHEAT	OPEN ----	OPEN ----	---- CLOSE	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----
PLASMA ENABLE	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----
PLASMA START	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----
PLASMA HEIGHT DISABLE	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----

PLASMA CUTTING- "MANUAL CUT" RELAY SEQUENCING

	4A RECYCLE SELECT PGM	4B PRESS CYCLE START MOVING TO NEW PIERCE POINT	4C ARRIVE AT PIERCE POINT WAIT FOR ARC-ON SENSE TO BE OFF	4D ENABLE PLASMA CUTTING OPERATOR STARTS PLASMA WAIT TILL ARC-ON IS SENSED	4E DELAY MOTION FOR PURGE DELAY TIME (SD01)	4F BEGIN MOTION ALONG CUT PATH	4G WHEN CUTTING PATH IS COMPLETE OR IF CYCLE STOP IS PRESSED GOTO 4B	4H IF BACKUP PRESSED GOTO 4C
OXYGEN ENABLE	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----
OXYGEN START	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----
HIGH PREHEAT	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----
PLASMA ENABLE	OPEN ----	OPEN ----	OPEN ----	---- CLOSE	---- CLOSE	---- CLOSE	OPEN ----	OPEN ----
PLASMA START	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----
PLASMA HEIGHT DISABLE	OPEN ----	OPEN ----	OPEN ----	OPEN ----	---- CLOSE	OPEN CLOSE SEE NOTE 1	OPEN ----	OPEN ----

NOTE 1 HEIGHT DISABLE CONTACT remains closed until machine accelerates to cutting speed. It then opens to allow height sensor operation. The contact will close again if machine slows for a corner in the part program, or if the HEIGHT SENSOR DISABLE function code is read from the part program.

PLASMA CUTTING- "AUTOCUT" RELAY SEQUENCING

	5A RECYCLE SELECT PGM	5B PRESS CYCLE START MOVING TO NEW PIERCE POINT	5C ARRIVE AT PIERCE POINT WAIT FOR ARC-ON SENSE TO BE OFF	5D ENABLE PLASMA BEGIN START DELAY TIMER (SD49)	5E START DELAY TIME =0.00 START PLASMA WAIT TILL ARC-ON SENSED	5F DELAY MOTION FOR PURGE DELAY TIMER "SD01"	5G BEGIN MOTION ALONG CUT PATH WHEN PURGE DELAY TIMER =0.00	5H WHEN CUTTING PATH IS COMPLETE OR IF CYCLE STOP IS PRESSED GOTO 5B	5I IF PREBASCK UP GOTO 5C
PLASMA ENABLE	OPEN ----	OPEN ----	OPEN ----	---- CLOSE	---- CLOSE	---- CLOSE	---- CLOSE	OPEN ----	OPEN ----
PLASMA START	OPEN ----	OPEN ----	OPEN ----	OPEN ----	---- CLOSE	---- CLOSE	---- CLOSE	OPEN ----	OPEN ----
PLASMA HEIGHT DISABLE	OPEN ----	OPEN ----	OPEN ----	OPEN ----	OPEN ----	---- CLOSE	OPEN CLOSE SEE NOTE 1	OPEN ----	OPEN ----

NOTE 1 HEIGHT DISABLE CONTACT remains closed until machine accelerates to cutting speed. It then opens to allow height sensor operation. The contact will close again if machine slows for a corner in the part program, or if the HEIGHT SENSOR DISABLE function code is read from the part program.

INSTALLATION

INSTALLATION OF THE BURNY 5

The **BURNY 5** should be installed in accordance with the National Electrical Code in the United States, and with IEC 364-4-41 in European Community countries. Additionally, the system must always be installed in accordance with local statute. The **BURNY 5** should be installed, adjusted, tested and serviced by qualified personnel familiar with electrical equipment and with the contents of this manual. The **BURNY 5** is intended for use only as described in this manual. These instructions have been prepared to ensure compliance with the European Community Electromagnetic Compatibility Directive, and Low Voltage Directive.

PHYSICAL INSTALLATION OF THE BURNY 5

Upon receipt of the unit, unpack all pieces. Retain all packaging until you have verified there is no physical damage to the contents, and the system has been installed. The contents of each shipping container should be recorded by model number and serial number, if serialized. It is further recommended that packaging be saved in case of future upgrade or service shipping needs. All pieces should be carefully inspected for shipping damage, loose parts, and, most importantly, exposed uninsulated electrical parts. Contact Burny™ immediately if any problems occur.

The location into which the **BURNY 5** will be installed should be chosen with consideration of many factors, some of which are listed here:

- accordance with the Environmental Operating Specifications of the **BURNY 5**
- away from sources of moisture
- avoiding undue sources of dust and other particles if possible
- located so that unit and operator are out of areas of travel
- unit and operator are away from zones through which objects may accidentally fall, roll, or slide
- away from sources of heat
- away from combustible vapors or gasses
- located so that cables can be routed safely to the unit
- sufficient clearance for cables to exit the cabinet
- access to rear panel to permit dis/connection of cables and reading of labels on rear panel
- field of view and physical environment of operator

The unit must always be mounted on top of a flat surface, using four mounting bolts,

lockwashers, and nuts of 1/4-20 thread size. Use the hole pattern shown in the cabinet drawing for the **BURNY 5**. Bolts are threaded into the **BURNY 5** from below.

The **BURNY 5** is supplied with a plastic plug for the 1 1/2 inch diameter hole in the bottom. The plastic plug should be removed only for the drop thru back panel with OpCon.

When bolting the cabinet to the mounting surface, the **BURNY 5** front panel should be opened to check that the bolts coming from below do not protrude more than 1/4 inch into the cabinet.

ELECTRICAL INSTALLATION OF THE BURNY 5

The ground for the system should be carried throughout the entire electrical system into which the product is installed by suitable conductors and connections. The conductors and connectors used for this should be in accordance with the National Electrical Code in the United States, the IEC in CE installations, and should be in accordance with all local statutes.

The **BURNY 5** cabinet must be grounded to the machine frame earth ground connection by a braided ground strap at least 12 mm in width. A wide flat ground strap provides a better RF ground path than a wire. The strap can be terminated with standard crimp terminals at both ends. The strap should connect to one of the chassis ground screws on the back of the **BURNY 5** cabinet. See the instructive ground strap installation drawing.

Cables must be obtained from, designed, or approved by Burny™.

Cables and leads shall be insulated. The insulation must be rated for the maximum voltage of insulated or uninsulated conductors that the cable does or could contact. If, after installation, there are unused connectors on the rear panel of the unit, the unused connectors must be covered with a plastic protective cap.

Metal ground clamps are used at each end of every cable to connect the cable shield to equipment casings. In cases where the shield is not snug within a clamp, the clamp should be gently crimped. Over-crimping can cause internal damage to the cable. The clamp must make snug contact with the shield around the full circumference of the cable.

Cable ends connected to the **BURNY 5** should have shield clamps connected directly to the **BURNY 5** cabinet. See the cable ground to back of cabinet drawing.

Cables ends connected to rack mounted encoders (H20 or H25 type) must have the shield clamp connected to the housing of the encoder. See customer instruction drawing for the rack mounted encoder ground clamp. Motor cables are handled in a like manner, as shown on the drawing for motor cable ground clamp installation.

If motor mounted encoders are used the Burny™-supplied kit must be installed over the junction of the plastic connectors, between the encoder cable and the short lead coming from the encoder. This kit and instructions are shipped with cables for encoders and motor mounted encoders. The connector shield is also shown on the customer instruction drawing for the encoder connector shield. A connection between two cables, for example, a cable connected to an extension cable, should be treated in the same way.

Tracer unit cables are handled in a like manner as shown on the customer instruction drawing for the tracer connector shield.

CHECKING THE INSTALLATION

A check of the installation is recommended to ensure that safety, performance, and time are not lost. In CE installations, these specific tests must be performed on the completed installation:

Non-accessibility Test,
Performance Test,
Insulation Resistance Test (greater than 0.5 MOhm measured from AC input to chassis.)

Here is a list that should be checked after any installation is complete. If possible, these types of checks should be assisted by a qualified person other than the persons that performed the installation.

* All holes in bottom of **BURNY 5** cabinet have been sealed to dust, obtrusive objects and fingers.
* Unused wires have been protected and insulated according to local standards.
* Electrically live parts are all protected from access by enclosures or barriers.
* No loose parts, including screws, especially **BURNY 5** front panel screws.
* Burny™ has been informed of all problems with the hardware.
* Environment within Burny™ operation specifications.
* Away from sources of moisture.
* Equipment away from combustible vapors and gasses.
* Equipment is not too close to source of high heat.
* Area dust and particulate level satisfactory.
* Operator and equipment away from areas where objects fall, slide, roll etc.
* Operator's view of work and equipment satisfactory.
* Operator and equipment out of way of travel.
* Cables routed so as to avoid damage after the installation.
* Cables not unduly cramped or stretched.
* Rear panel of unit accessible enough to see and to change cables.
* Operator not subjected to unsafe or unnecessarily stressful conditions.
* Wire size for AC and DC mains should be AWG 18 or larger.
* Each cable is either supplied by, designed by, or approved by Burny™
* The system and all other electrical devices associated with and in the proximity of the system have been properly grounded.
* Both ends of every cable have a ground clamp attached snugly to the cable shield.
* Every ground clamp is attached to the component in the proper manner.
* The system programs and files are backed up properly.

FUNCTIONAL TESTING OF THE SYSTEM AFTER INSTALLATION

Functional testing of the **BURNY 5** after installation is recommended. Each installed system can have a unique design, therefore a unique test may be required for the installed system. The test should be designed to ensure that:

* The equipment has been properly integrated.
* The **BURNY 5** is suitable for and functions correctly in its environment.
* Protective devices and control devices operate as intended.
* The **BURNY 5** is compatible with other equipment.
* The **BURNY 5** can perform to specifications when interconnected.
* The **BURNY 5** has sufficient range in its controls.
* The system programs and files are backed up properly.

LIST OF DIAGNOSTICS AND TESTS OF THE BURNY 5

This is a list of diagnostics and tests contained in this manual that will assist in checking various functions of the **BURNY 5.**

SUBJECT	TITLE	PAGE
Testing machine movements without cutting	RUN.4 TEST RUN	PART-2; RUN-9
Testing the Cutting Oxygen Enable Relay	OXY ENABLE CONTACT	PART-7: MACH-4
Testing the Cutting Oxygen Start Relay	OXY START CONTACT	PART-7: MACH-5
Testing the High Preheat Relay	HIGH PREHEAT CONTACT	PART-7: MACH-4
Testing the Plasma Torch hardware	PLASMA SELECT INPUT	PART-7: MACH-7
Testing the Plasma Enable Relay	PLASMA ENABLE CONTACT	PART-7: MACH-8
Testing the Plasma Start Relay	PLASMA START CONTACT	PART-7: MACH-8
Testing the Plasma Height Sensor Disable Relay	PLASMA HEIGHT DISABLE CONTACT	PART-7: MACH-9
Power-up Self Diagnostics	DIAGNOSTIC SUPPORT	PART-3: UTIL-33
ASCII CODES	ASCII CODES	PART-7: SETDATA-68
INITIAL MACHINE SETUP SETUP MOTION	MACHINE SPECIFIC ADJUSTMENT	PART-7: TYPSETUP-9
Displaying of Variables	SYSTEM SETUP DATA VARIABLE	PART 7: SETDATA-1

WARNING

When considering any type of disassembly, please note:

HIGH VOLTAGES ARE PRESENT IN BURNY™ SYSTEMS THAT CAN INJURE AND KILL.

ONLY QUALIFIED PERSONS SHOULD OPEN OR DISASSEMBLE ANY PART OF THE BURNY™ SYSTEM.

TURN OFF AND RED TAG ALL POWER SOURCES DURING SERVICE.

BE CERTAIN THAT UNAWARE PERSONS DO NOT TURN ON THE POWER DURING SERVICE.

USE A VOLTMETER TO BE CERTAIN THAT ALL POWER SOURCES HAVE BEEN TURNED OFF.

IMPORTANT

To avoid loss of programs, read the section of this manual entitled "Backup of Programs Stored in Burny™ Controls"

REPAIR OF THE BURNY 5

Generally, components for the **BURNY 5** system are not repairable by the user. In the case of malfunction of the system, Burny™ service personnel shall be consulted to assist in isolating

the component(s) causing the problem. If a component has sustained damage, the involved assembly is usually returned to the factory and a replacement assembly shipped to the user.

Service must be performed only by trained, authorized personnel. A special grounded wristband must be used when removing or installing EPROMS. All circuit cards must be shipped in special static protective packaging. Any card or part removed from a Burny™ product should be immediately placed in a static dissipative bag. Warranty replacement, repair, or credit will not be issued on circuit cards returned without the proper antistatic packaging. Contact Burny™ for specifications or help with any packaging.

FAULT FINDING AND TROUBLESHOOTING

If a suspected malfunction is observed, refer to the proper section of this manual to verify the observed problem is a malfunction.

The user is cautioned concerning activities directed toward finding components that are malfunctioning. Without current schematics, diagnostic equipment and training, field engineers run the risk of damaging more components than were initially damaged. This could extend down-time and repair expense. Always contact Burny™ Service when damage has occurred, in order to prevent further electrical damage. Burny™ service personnel can often assist via telephone concerning the advisability of swapping parts that are already on site. Avoidance of damage to the swapped-in part is a consideration here.

The on-site person can be most valuable in diagnosing problems:

* Being familiar with equipment and user manual.
* Knowing conditions and events before a failure.
* Being familiar with normal operation.
* Observing and reporting damage accurately

SPARE PARTS

Contact Burny™ Service to obtain needed parts. Always use replacement parts that are supplied, designed, or approved by Burny™.

Some users choose to keep various parts on-site in case of a sudden need. Spare parts for this purpose are not supplied with purchased equipment. However, replacement parts may be purchased from Burny™ for this purpose. Burny™ service personnel can give advice as to which replacement parts are best to have on hand.

SPECIAL TOOLS

Special tools are not required for installation and maintenance of the **BURNY 5**. In the unusual event that a user is to construct or repair a Burny™ supplied cable, proper crimping and extraction tools will be specified by Burny™.

BACKUP OF PROGRAMS AND TABLES STORED IN BURNY™ CONTROLS

The **BURNY 5** has a battery system which maintains power to the memory even when the AC power to the unit is removed. This keeps the programs stored in memory from being erased when the power is turned off. While this battery system is very reliable, there are still cases where something causes the stored programs to be lost. Sometimes it can be a failure of a component, or it can be an outside event, such as a lightning strike, or even dropping a plate on top of the control. There are also cases where a new version of software requires the memory to be erased and all programs re-loaded.

Regardless of the cause, there are cases where all the programs stored in memory are lost. FOR THIS REASON, ANY IMPORTANT PROGRAMS SHOULD ALWAYS HAVE A BACKUP COPY STORED AWAY FROM THE **BURNY 5** CONTROL. This way, after the damage has been repaired, or the defective component replaced, the important programs can be re-loaded from the Back-up copy.

It is important that the backup copy is stored AWAY from the **BURNY 5** since in the case of a dropped plate, or lightning strike, the backup copy may be damaged along with the control.

Custom Auxiliary codes are saved by the battery backup system in the **BURNY 5**. See the Part 3 Utilities, Section 4.6 in this manual These code tables cannot be backed up by floppy disk or RS232 from the **BURNY 5**, as are the user programs in the paragraphs below. The original documentation for the Auxiliary Code Translation Tables should be retained to guard against the loss of battery backup or physical damage to the **BURNY 5**. If the original documentation has not been retained, the files can be copied by hand from the **BURNY 5** screen.

If programs are already stored on a host computer, make sure there are back-up copies of the computer data since a problem there (such as a hard disk crash) could cause the loss of program information. If the programs are only stored inside the **BURNY 5**, the RS232 port on the control can be used to store the programs to one of several sources. If the unit is equipped with an internal floppy disk, all important programs should be copied to a floppy disk which is then removed from the unit (a second floppy disk containing the same information is advised also). If there is no internal floppy, the RS232 port can be used to send the programs out to a host computer. This requires software in the host computer that is capable of accepting the programs from the **BURNY 5** and storing them to a disk file. After the programs are sent to the computer, back-up copies of the computer programs should be made and stored AWAY from the computer.

Finally, there are portable floppy disk systems available which can accept programs from the **BURNY 5** RS232 port and store them directly to a floppy disk. Again, more than one copy is advised.

IT IS THE CUSTOMER'S RESPONSIBILITY TO MAINTAIN BACKUP COPIES OF ALL IMPORTANT PROGRAMS AND TABLES. ALL PROGRAMS MUST BE BACKED UP BEFORE ANY SERVICE WORK (OR NEW SOFTWARE UPDATE) IS DONE TO THE CONTROL. THIS WILL PREVENT ANY LOSS OF PROGRAM INFORMATION.

REPLACING THE BURNY 5 MEMORY BATTERY

The battery should be replaced every five years to ensure proper operation of the battery backup system. A replacement battery can be obtained from Burny™.

To replace the battery:

1. Ensure that all files and tables are backed up, as in the section of this manual "Backup of Programs and Tables Stored in Burny™ Controls."
2. Disconnect the unit from all cables and wires, keeping notes as to the proper method of reconnecting the cables and wires. Put on a wrist strap grounded to the Burny 5 cabinet.
3. Open the **BURNY 5** by removing the screws from the right side panel. Carefully lay this panel down horizontally beside the Burny 5 cabinet, using the brackets at either side of the panel to support it.

4. The top two circuit boards mounted to the side panel should be removed from their standoffs and layed back into the cabinet. Remove and tag cables as required.
5. The battery is mounted to the upper right of the board with thermal glue. A wire at each end makes electrical connection to the board, soldered into two holes.
6. The glue that is holding the battery in place should be cut with a hot scalpel.
7. The wires from the old battery can now be desoldered and the remaining solder removed from the holes in the circuit board.
8. Install the new battery in the proper polarity by putting its wires through the holes.
9. The battery should be soldered and heat glue applied.
10. The circuit boards should be reassembled in reverse order of the disassembly process.
11. The side panel screws should all be installed and tightened, for good electromagnetic integrity.
12. Reconnect the **BURNY 5** to the cables and wires external to the **BURNY 5**.
13. Programs and files should be reloaded into the machine.
14. The system should be tested to ascertain that performance limits important to the user are achievable. The "List Of Diagnostics and Tests Of The **BURNY 5**" section of this manual contains information for diagnostics, as well as table and file checking.

BEFORE CALLING BURNY™

Before a telephone call is made to BURNY™ for any type of assistance it is important that the **SOFTWARE SERIAL NUMBER** and **SOFTWARE VERSION DATE CODE** is known. The Banner Screen displays this information. Press RST, 6, 1, and 4. See Page PART-7:SERVICE-1 for details.

*** IMPORTANT ***

Before calling regarding a service or operation problem, write down the SOFTWARE SERIAL NUMBER, and FPC and MPC SOFTWARE VERSION NUMBER displayed on the Banner Screen. This will aid the service personnel in determining the type of system, and the software installed. NOTE- The serial number must be the one displayed on the screen, not the one found on a label somewhere on the enclosure.

RETROFIT

GENERAL EXPLANATION OF A CNC RETROFIT

The main reason to add a **BURNY 5** control to a cutting machine is to increase productivity. The **BURNY 5** eliminates the need to use a template. The **BURNY 5** also adds accuracy to the shape being cut and makes the operator's job of cutting easier.

The objective of the installation section is to graphically explain the mounting of necessary hardware utilized by the **BURNY 5** to run the cutting machine. A **BURNY 5** can be installed on almost any cutting machine with an X-Y coordinate drive system. The **BURNY 5** provides NC control with the capability of switching back to photocell control if it is desired.

At the end of this section are drawings of hardware that the **BURNY 5** uses and how it is mounted on a cutting machine. It would be difficult to supply a drawing for every cutting machine. Keep in mind that there are certain rules to be followed for mounting the necessary hardware as explained in this section. The purpose of the hardware mounting drawings is to give a basic idea of how the hardware is actually mounted. By using the drawings and following the specified rules for correct mounting procedure, it should be possible to mount the necessary hardware on almost any cutting machine. Keep in mind that this section gives the basic idea of the hardware mounting procedure. The actual method implemented by the customer is determined by the personal preference and added input from personnel involved in the project.

GEAR RACK MOUNTING

1. Always try to mount the gear rack teeth facing sideways or facing down. Mounting the rack with the teeth facing up will cause the rack to accumulate cutting dirt and the teeth to become clogged creating dimensional errors.

2. The gear rack should be mounted directly to the machine if possible. If this method does not allow for proper clearance or encoder mesh into the gear rack, another method must be used. One such method is to mount the gear rack on a separate angle bracket. By doing this, the gear rack is away from the cutting machine surface to give extra clearance for proper mesh. Washers or spacers can also be used to move the gear rack away from the cutting machine surface for added clearance.

3. Be sure that the gear rack covers the entire travel distance of both rail and cross axis. Allow enough rack at all travel limit ends so the encoder does not go off of the end of the gear rack.

4. When joining two sections of rack, always use a short piece (about 2 or 3 inches) to obtain proper mesh between six foot rack sections. Invert the short piece of rack into the two sections that are being joined together, over the joint to obtain proper mesh. DO NOT BUTT TWO SECTIONS AGAINST EACH OTHER. This will cause an improper mesh and result in dimensional errors on parts being cut.

5. Take the time to do a good job. Improper mounting of rack will result in problems and the control will not work to expectations.

6. Use whatever means is possible to insure that the gear rack is straight both horizontally and vertically. A bowed rack will cause dimensional errors on parts being cut.

ENCODER MOUNTING EXPLANATION

The purpose for using digital encoders with the **BURNY 5** system is to provide a feedback pulse. This tells the **BURNY 5** exactly where it is at all times. Incorrect mounting of the encoders will cause the **BURNY 5** to get false distance readings causing the cut part to be the wrong size. The following rules are provided so that encoders are mounted correctly insuring that accurate feedback is supplied to the **BURNY 5**. This in turn will insure the parts being cut are correct dimensionally.

1. Always have the encoder parallel to the gear rack (see drawing # B0-19621). The distance from the center of the encoder shaft and distance from the center of the shoulder screw pivot should be the same distance to the gear rack.

2. Choose a suitable location for encoder mounting. Try to stay away from mounting the encoder in a vulnerable location such as the end of a rail truck or next to the torches.

3. On a bridge type machine with a dual rail axis, always mount the rail encoder on the tracing table side away from the cutting torch side.

4. On a cantilever machine, always mount the rail encoder on the center support beam. If possible, mount the rail axis encoder on the tracing table side away from the cutting torch side.

5. If possible, mount the cross axis encoder to the cross axis drive gearbox. Mounting the encoder to the tracing eye is acceptable, but use this method as a second choice.

6. Encoders come with a universal mounting bracket. (See Drawing # BO-19618). The mounting bracket configuration can be re-arranged to meet mounting requirements.

7. Always leave enough clearance from the top of the encoder housing to any part of the cutting machine. An encoder cable is plugged into the connector on top of the encoder housing. This calls for a 3" clearance from the top of the housing to any part of the cutting machine.

8. Encoders are spring loaded with minimum tension into the gear rack. Encoders do not require a great amount of tension to hold them for proper mesh with the gear rack. Just enough tension to keep the encoder firmly meshed and to keep it from popping out of the rack will do. Too much tension will damage the encoder. A conventional tension or compression spring can be used to spring load the encoder into the gear rack.

9. After the encoders are mounted, be sure to run the cutting machine to all maximum travel limits. Verify that nothing interferes with either encoder.

10. Avoid any sharp impacts to the encoder. Sharp impacts will damage the encoder.

CABLE LENGTH DETERMINATION

1. In general, the cable lengths that are needed depend on the application and what additional options are ordered with the **BURNY 5**.

2. The determination of cable lengths is very important. In general, always allow more. (At least an extra 18 to 24 inches)

3. It is important to make sure all cables are long enough, but extremely long cables can act as an antenna for electrical noise.

4. For plasma cutting applications it is a MUST that all **BURNY 5** cables be routed to keep them separated from any plasma cables by a minimum of two feet. This is done to minimize the possible damage caused by high frequency spikes produced by a plasma system.

5. Always determine the location of the **BURNY 5** and encoders before measuring for cable lengths.

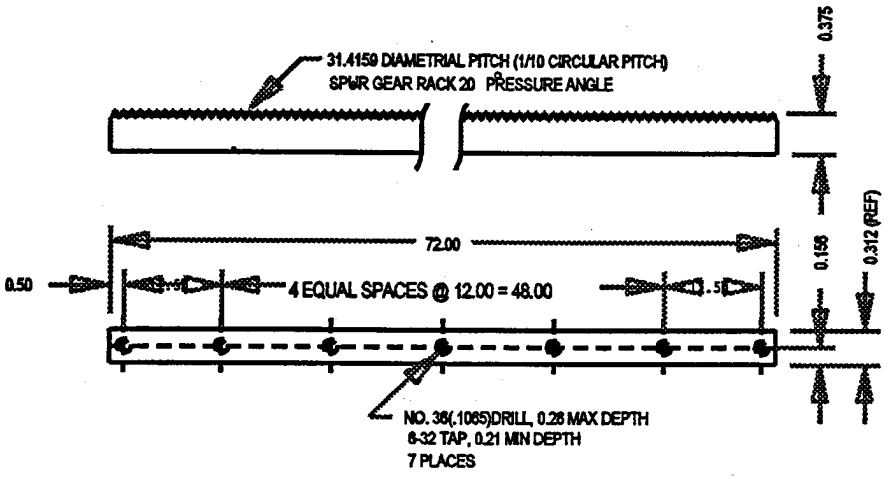
6. Encoder cables are always needed for the **BURNY 5** application. To determine the length of the encoders cables, first decide where the encoders will be mounted. Then measure the length from each encoder (X and Y) to the lower back panel of the **BURNY 5** . The two lengths normally will be different.

7. Generally, the cross axis encoder cable will be longer then the rail axis encoder cable. Because the **BURNY 5** and the rail axis encoder are both stationary, the distance from the **BURNY 5** to the rail axis encoder is fixed. The cross axis encoder cable length is determined by measuring from the **BURNY 5** to the tracing eye or the cross axis drive, where the encoder is mounted. This cable should be long enough to reach both limits of the axis.

8. Generally the **BURNY 5** is mounted to the operators station which contains all the signals needed to control the cut solenoids. However if this is not the case a power/oxy cable length may be needed for some **BURNY 5** application. This length is determined by measuring between the cutting machines existing operators panel,(where the gas function controls are located) and the back panel of the **BURNY 5**.

9. Generally the **BURNY 5** is mounted to the operators station which contains all the signals needed to control the drives However if a drive cable length may be needed on some **BURNY 5** applications. This length is determined by measuring between the cutting machines operating station, (where tracing and stripping controls are located) to the back panel of the **BURNY 5.**

10. When measuring for cables, DO NOT measure in a straight line from point to point. Allow enough cable for proper routing with existing machine cables.

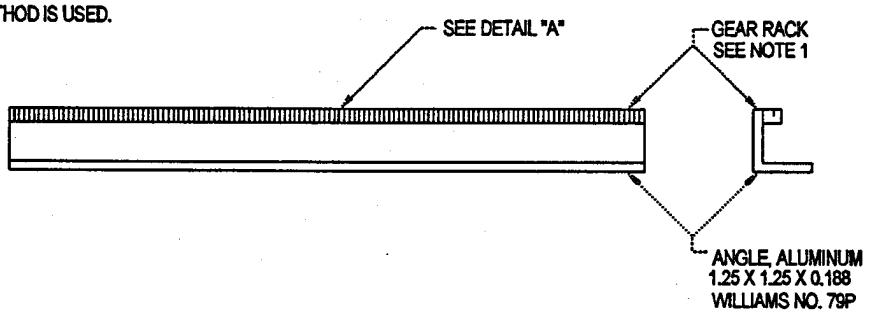


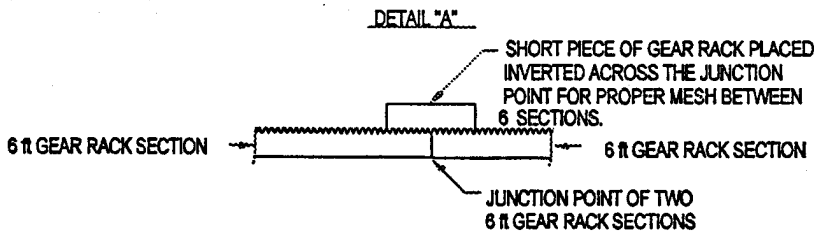
6 ft SPUR GEAR RACK, RECOMMENDED HOLE SPACING FOR DRILL & TAP MOUNTING OF GEAR RACK

NOTE: ALL DIMENSIONS ARE INCHES

AO4-6982

NOTE:
1.) GEAR RACK CAN BE DRILLED & TAPPED OR WELDED TO ANGLE BRACKET. EXERCISE EXTREME CARE IF TACK WELD METHOD IS USED.



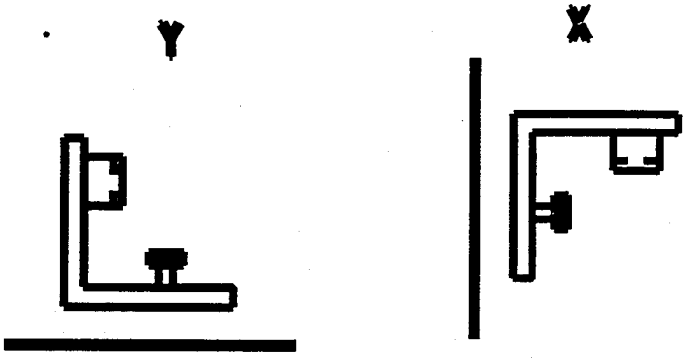


GEAR RACK BRACKET ASSEMBLY

B01-1684

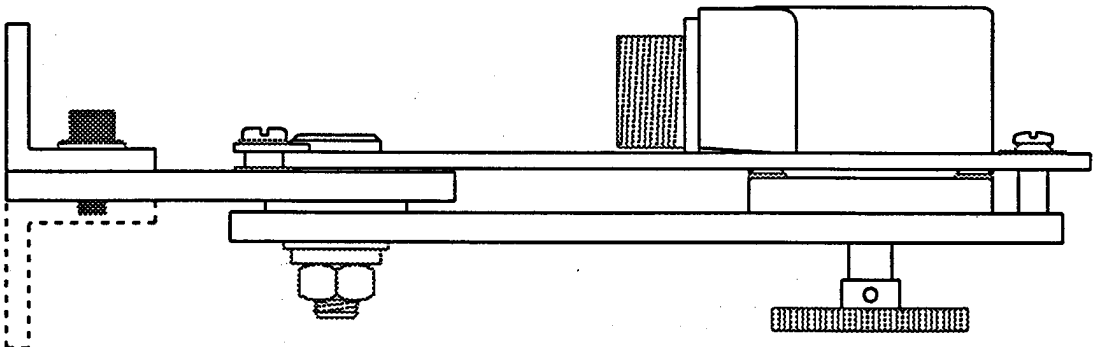
NOTE:

1.) TYPICAL MOUNTING OF GEAR RACK ON ANGLE BRACKET. GEAR RACK TEETH SHOULD FACE DOWN OR TO THE LEFT OR RIGHT, NEVER FACING UP. THIS IS DONE TO PREVENT THE GEAR RACK FROM ACCUMULATING DUST & DIRT.



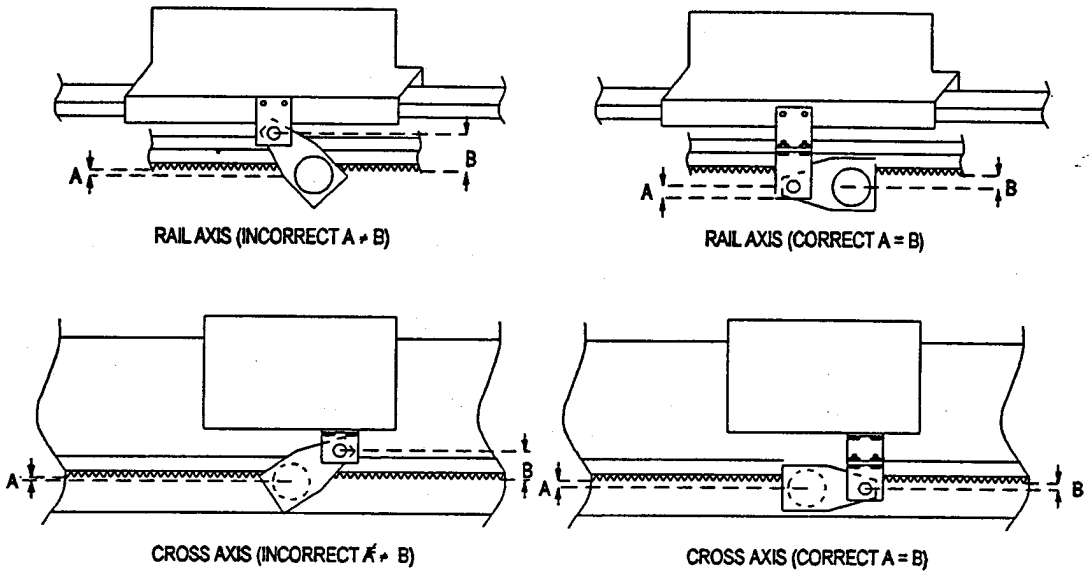
GEAR RACK BRACKET MOUNTING
UTILIZING ANGLE BRACKETS

AO-19617



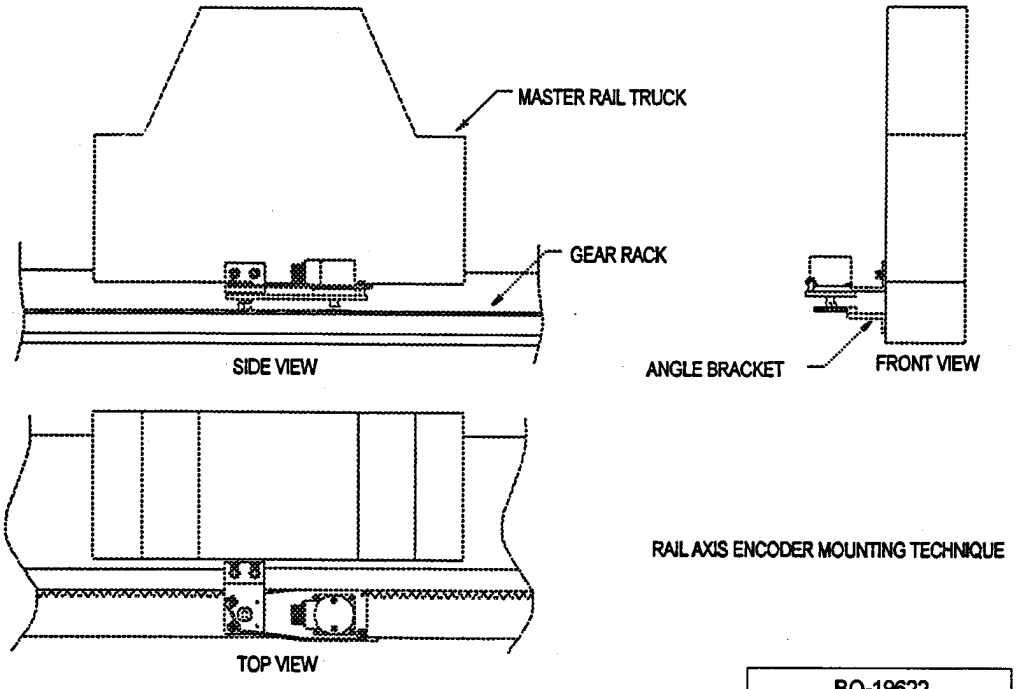
ENCODER AND BRACKET ASSEMBLY

BO-19618



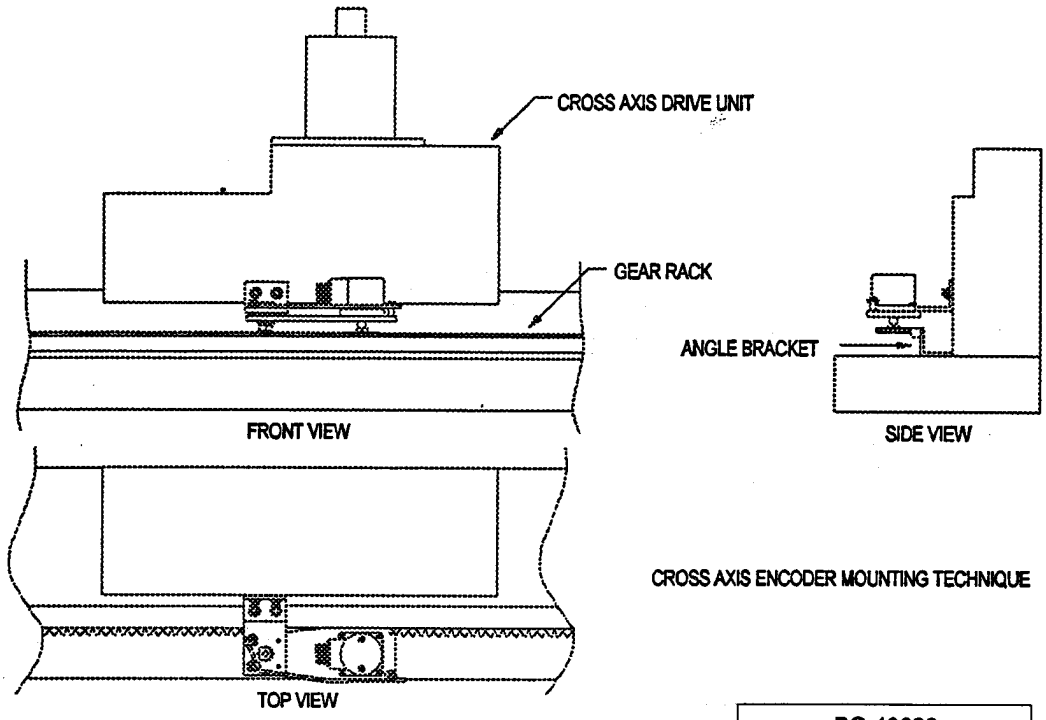
ENCODER MOUNTING TECHNIQUE

BO-19621



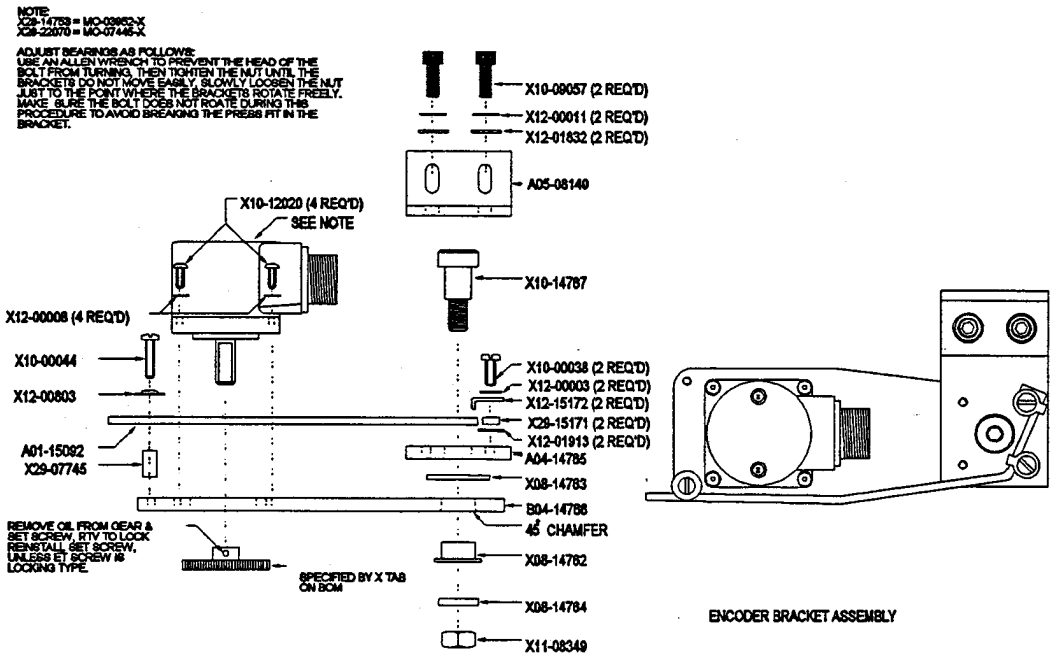
RAIL AXIS ENCODER MOUNTING TECHNIQUE

BO-19622

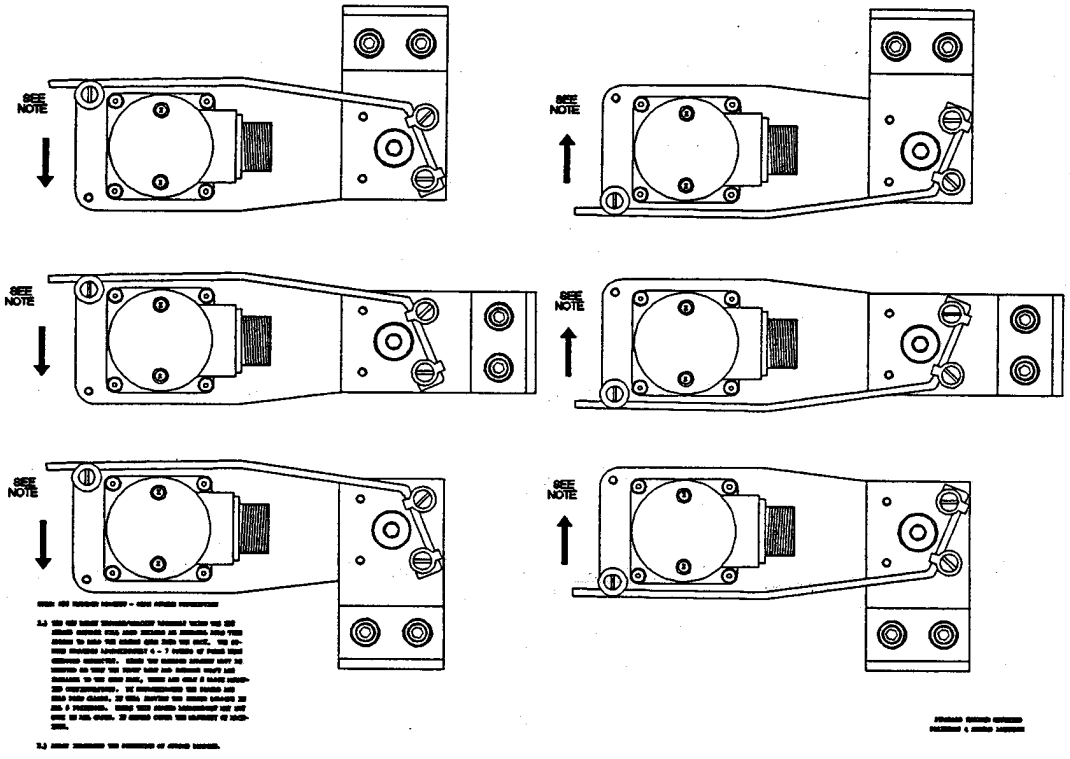


CROSS AXIS ENCODER MOUNTING TECHNIQUE

BO-19623



CO-12137 / 1 OF 2


SEE NOTE
SEE NOTE
SEE NOTE
SEE NOTE
SEE NOTE
SEE NOTE

*** READ FIRST ***
BEFORE SERVICING THE CONTROL

Before any type of service work is done on the **BURNY 5** control there are some precautions that should be taken.

SERVICE.1 BACKUP OF PROGRAMS STORED IN BURNY CONTROLS

The **BURNY 5** has a battery system which maintains power to the memory even when the AC power to the unit is removed. This keeps the programs stored in memory from being erased when the power is turned off. While this battery system is very reliable, there are still cases where something causes the stored programs to be lost. Sometimes it can be a failure of a component inside the **BURNY 5**, or it can be an outside event, such as a lightning strike, or even dropping a plate on top of the control. There are also cases where a new version of software requires the memory to be erased and all programs re-loaded. Regardless of the cause, there are cases where all the programs stored in memory are lost. **FOR THIS REASON, ANY IMPORTANT PROGRAMS SHOULD ALWAYS HAVE A BACKUP COPY STORED AWAY FROM THE BURNY 5 CONTROL.** This way, after the damage has been repaired, or the defective component replaced, the important programs can be re-loaded from the Back-up copy.

It is important that the Back-up copy is stored **AWAY** from the **BURNY 5** since in the case of a dropped plate, or lightning strike, the Back-up copy may be damaged along with the control.

If the programs are already stored on a host computer, make sure there are back-up copies of the computer data since a problem there (such as a hard disk crash) could cause the loss of program information. If the programs are ONLY stored inside the **BURNY 5**, the RS232 port on the control can be used to store the programs to one of several sources. If the unit is equipped with an internal floppy disk, all important programs should be copied to a floppy disk which is then removed from the unit (a second floppy disk containing the same information is advised also). If there is no internal floppy, the RS232 port can be used to send the programs out to a host computer. This requires software in the host computer that is capable of accepting the programs from the **BURNY 5** and storing them to a disk file. After the programs are sent to the computer, Back-up copies of the computer programs should be made and stored AWAY from the computer.

NOTE

The **BURNY 5** BACKUP DIRECTORY utility function allows all of the programs from a selected internal directory, **which do not have program number extensions,** to be saved with a single operator request to the internal or external BURNY FLOPPY or any other external SERIAL DEVICE. See PART-3 BACKUP DIRECTORY FILES for further information.

Finally, there are portable floppy disk systems available which can accept programs from the **BURNY 5** RS232 port and store them directly to a floppy disk. Again, more than one copy is advised.

IT IS THE CUSTOMER'S RESPONSIBILITY TO MAINTAIN BACKUP COPIES OF ALL IMPORTANT PROGRAMS. ALL PROGRAMS MUST BE BACKED UP BEFORE ANY SERVICE WORK (OR NEW SOFTWARE UPDATE) IS DONE TO THE CONTROL. THIS WILL PREVENT ANY LOSS OF PROGRAM INFORMATION.

SERVICE.2 BEFORE CALLING THE FACTORY

Before a telephone call is made to the factory for any type of assistance it is important that the **SERIAL NUMBER** and **SOFTWARE VERSION DATE CODE** is known. The Serial number and software version date code may viewed on the SYSTEM BANNER screen.

SYSTEM BANNER (DISPLAY DATA MENU)

The SYSTEM BANNER display is reached from the MAIN MENU select (6)UTILITIES then (1)DISPLAY SYSTEM DATA and then (4)SYSTEM BANNER. This function allows the user to re-display the system banner data that is initially displayed after the "power-up diagnostic" display. This display contains the copyright message, system name, serial number, version, date and a list of enabled options, if any. It also allows the user to modify the date and time.

After being selected from the DISPLAY DATA menu, the system banner screen is immediately displayed. Note that the actual data displayed will be based on the system configuration and version. Two version date codes are displayed, one for the main process controller "MPC VERSION:" and one for the front panel graphics controller "FPC VERSION(#):". **It is important that both date codes be supplied when calling the factory for assistance.** (The number provided in parenthesis next to "FPC VERSION", which identifies the FPC hardware version level, should also be provided when calling for assistance).

The following illustrates the format of the banner screen.

```
                    CLEVELAND MACHINE CONTROLS

                              BURNY 5

          COPYRIGHT - CLEVELAND MACHINE CONTROLS - 1985-1992
                       SERIAL NUMBER : 12345678
                       MPC VERSION   : 11-13-92
                       FPC VERSION(1): 11-13-92

          OPTIONS:  MULTITASKING
                    BACKGROUND
                    ALTERNATE LANGUAGE
                    FONT GENERATOR
                    COMMAND MESSAGES
                    KNIFE COMPENSATION


WANT TO CHANGE DATE/TIME? NO
```

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PART 8 - PRODUCT SPECIFICATIONS

Insert Tab – Part 8

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8. PRODUCT SPECIFICATIONS for the BURNY™ 5 CONTROL

These specifications cover the following Burny 5 Models:

- ME5E-10940-4 --Burny 5 14" Color – 115/230V power, 115V Cut
- ME5E-10940-5 --Burny 5 14" Color – 115/230V power, 230V Cut
- ME5E-10941 --Burny 5 14" Color – 115/230V power, Drop-Thru Back Panel

8.1 PHYSICAL ENVIRONMENT OPERATING LIMITS:

Temperature:	0° to 50° C
Relative Humidity:	5% to 85% (1 g/m3 to 25 g/m3)
Atmospheric Pressure:	86 kPa to 106 kPa
Climatic Class:	3K3

The BURNY 5 is intended for use in heavy industrial environments. It is not intended for use in commercial or light industry environments.

The electrical specifications for the various models of the Burny 5 can be found in the following tables. The relevant model numbers are indicated at the top of each table.

"31 RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

"PLASMA FUNCTION INTERFACE"
Electrical Ratings for CE Compliant Installations

PIN #(s)	DESCRIPTION	RATINGS
2, 3, 4	Plasma Stop (Enable) Output (Isolated Form-C dry-contact relay) Pin 4 – Normally Open contact Pin 3 – Common contact Pin 2 – Normally Closed contact	230 VAC, 2A maximum **or** 24 VDC, 3A maximum.
5, 18	Plasma Select Sense Input (Isolated) Pin 5 – source Pin 18 – return	For ME5E-10940-4: 24 to 115V AC or DC @ 30 mA max. For ME5E-10940-5: 230VAC @ 25 mA max.
13, 20, 26	Plate Marker #2 Output (Isolated Form-C dry-contact relay) Pin 26 – Normally Open contact Pin 20 – Common contact Pin 13 – Normally Closed contact	230 VAC, 2A maximum **or** 24 VDC, 3A maximum.
15, 21, 22	Plasma Start Output (Isolated Form-C dry-contact relay) Pin 22 – Normally Open contact Pin 21 – Common contact Pin 15 – Normally Closed contact	230 VAC, 2A maximum **or** 24 VDC, 3A maximum.
16, 29	Plasma Go (Arc On) Input (Isolated) Pin 16 – source Pin 29 – return	For ME5E-10940-4: 24 to 115V AC or DC @ 30 mA max. For ME5E-10940-5: 230VAC @ 25 mA max.
35, 36, 37	Plasma Height Sensor Disable Output (Isolated Form-C dry-contact relay) Pin 37 – Normally Open contact Pin 36 – Common contact Pin 35 – Normally Closed contact	230 VAC, 2A maximum **or** 24 VDC, 3A maximum.

"32 RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

"OXYGEN CUTTING INTERFACE AND AC POWER INPUT" Electrical Ratings for CE Compliant Installations

PIN #(s)	DESCRIPTION	RATINGS
1	Line HOT Input	115 or 230 VAC, 50/60 Hz, 4 A maximum. Protected by "FU" fuse on back panel power board, a 4 A time-delay fuse.
3, 4, 8	Oxy Stop Output (Isolated Form-C dry-contact relay) Pin 8 – Normally Open contact Pin 4 – Common contact Pin 3 – Normally Closed contact	230 VAC, 2A maximum **or** 24 VDC, 3A maximum.
9,14,15	Plate Marker #1 Output (Isolated Form-C dry-contact relay) Pin 9 – Normally Open contact Pin 15 – Common contact Pin 14 – Normally Closed contact	230 VAC, 2A maximum **or** 24 VDC, 3A maximum.
10, 23	Oxy Cut Switch Sense Input (Isolated) Pin 10 – source Pin 23 – return	For ME5E-10940-4: 24 to 115V AC or DC @ 30 mA max. For ME5E-10940-5: 230VAC @ 25 mA max.
11, 24	Program Inhibit Input (Isolated) Pin 11 – source Pin 24 – return	For ME5E-10940-4: 24 to 115V AC or DC @ 30 mA max. For ME5E-10940-5: 230VAC @ 25 mA max.
18, 19	Chassis Ground Input	(16 AWG, 300V, 105 C wire)
21, 22, 28	Preheat Start Output (Isolated Form-C dry-contact relay) Pin 21 – Normally Open contact Pin 22 – Common contact Pin 28 – Normally Closed contact	230 VAC, 2A maximum **or** 24 VDC, 3A maximum..
32, 36, 37	Oxy Start Output (Isolated Form-C dry-contact relay) Pin 32 – Normally Open contact Pin 37 – Common contact Pin 36 – Normally Closed contact	230 VAC, 2A maximum **or** 24 VDC, 3A maximum.
34	Line NEUTRAL Input	Neutral connection for pin 1 AC Line input.

"33 RECP" and "34 RECP" – All Models

"X ENCODER INPUT" and "Y ENCODER INPUT" Electrical Ratings for CE Compliant Installations

PIN #	DESCRIPTION	RATINGS Single-ended encoders "SW1" on back panel Board all open	Differential encoders "SW1" on back panel Board all closed
1	Supply Common (to power encoder)	0 V	0 V
2	/I channel input	Not used, do not connect anything to this pin.	Differential driver input paired with pin 6. 150 Ω internal resistor to ground. Minimum differential: 500 mV. Maximum differential: 5 V.
3	/B channel input	Not used, do not connect anything to this pin,	Differential driver input paired with pin 8. 150 Ω internal resistor to ground. Minimum differential: 500 mV. Maximum differential: 5 V.
5	/A channel input	Not used, do not connect anything to this pin,	Differential driver input paired with pin 9. 150 Ω internal resistor to ground. Minimum differential: 500 mV. Maximum differential: 5 V.
6	I channel input	Designed for open-collector type input. HIGH = Pulled to +5 VDC supply with 1.5 kΩ internal resistor. 3 VDC minimum. LOW = Pull down to Supply Common. 1 VDC maximum.	Differential driver input paired with pin 2. 150 Ω internal resistor to ground. Minimum differential: 500 mV. Maximum differential: 5 V.
7	+5 VDC supply output (to power encoder)	+5 VDC @ 200 mA	+5 VDC @ 200 mA
8	B channel input	Designed for open-collector type input. HIGH = Pulled to +5 VDC supply with 1.5 kΩ internal resistor. 3 VDC minimum. LOW = Pull down to Supply Common. 1 VDC maximum.	Differential driver input paired with pin 3. 150 Ω internal resistor to ground. Minimum differential: 500 mV. Maximum differential: 5 V.
9	A channel input	Designed for open-collector type input. HIGH = Pulled to +5 VDC supply with 1.5 kΩ internal resistor. 3 VDC minimum. LOW = Pull down to Supply Common. 1 VDC maximum.	Differential driver input paired with pin 5. 150 Ω internal resistor to ground. Minimum differential: 500 mV. Maximum differential: 5 V.

"37 RECP" – All Models

"AUXILIARY LINE POWER OUTPUT"
Electrical Ratings for CE Compliant Installations

PIN #	DESCRIPTION	RATINGS
1	Line HOT output	Voltage will be that supplied for AC Line input on "32 RECP" pin 1 (115 or 230 VAC, 50/60 Hz). 1 A maximum. Protected by "FU" fuse on back panel power board, a 4 A time-delay fuse.
4	Chassis Ground output	(18 AWG, 300V 80 C wire)
5	Line Neutral	Neutral connection for pin 1 AC Line output.
6	Chassis Ground output	(18 AWG, 300V 80 C wire)

"36 RECP"

"SERIAL I/O-B MODEM"

For communications to LDM-70 Modem by DATAFORTH©

Electrical Ratings for CE Compliant Installations

PIN #(s)	DESCRIPTION	RATINGS
2	Receive Data high input (RX+)	This pin is paired with pin 9 to create a current loop sensitive input. Current into pin 2 is a mark and current out of pin 2 is a space. 1000V isolation. 33 Ω input impedance. Exact specifications are proprietary to DATAFORTH©.
3	**Transmit Date high output (TX+)**	This pin is paired with pin 8 to create a current loop output. Current out of pin 3 is a mark and current into pin 2 is a space. 1000V isolation. Maximum output it 18 VDC. Exact specifications are proprietary to DATAFORTH©.
4, 5	Sense Input from multiplexer	Intended for use with BURNY Modem Switching Box. Logic LOW = 1 V maximum Logic HIGH = 8 V minimum
6, 7	Contact Output #1 to multiplexer (Isolated Form-A dry-contact relay)	Intended for use with BURNY Modem Switching Box. 25 VDC, 100 mA
8	**Transmit Date low output (TX-)**	See pin 3 ratings.
9	Receive Data low input (RX-)	See pin 2 ratings.

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-3204-x C&G MST-40,150 (-0) and MST-250 (-1) Tracing system Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
5	Burny Enable—connect 30RECP-5 to 30RECP-9 to enable the drive outputs from the Burny. Open connection to 30RECP-5 to pass external Rail and Cross reference signals from 30RECP-11 and 16 to through the interface card to the servo drives	+VDC when Open 0V @ 1mA when connected to Signal Common
6	Cross Axis Speed Reference output—connects to MST Cross Axis servo drive	+/- 5 VDC @ 2mA max. for MO-03204-0 +/- 10 VDC @ 2mA max. for MO-03204-1
7	Rail Axis Speed Reference output—connects to MST Rail Axis servo drive	+/- 5 VDC @ 2mA max. for MO-03204-0 +/- 10 VDC @ 2mA max. for MO-03204-1
9	Signal Ground	0V
11	Rail Axis Speed Reference input from MST Tracer—when 30RECP-5 is Open, voltage on this pin is switched to the rail axis speed reference output at 30RECP-7 Also acts as Speed reference input for Burny cutting speed control	0-+/-10 VDC @ 1 mA max.
15	Signal Ground	0V
16	Cross Axis Speed Reference input from MST Tracer—when 30RECP-5 is Open, voltage on this pin is switched to the cross axis speed reference output at 30RECP-6	0-+/-10 VDC @ 1 mA max.

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-3205-x Stewart Warner ECT 150 (-0) and ECT-250 (-1) Tracing system Interface Card.

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
6	Cross Axis Speed reference output to ECT Tracer Cross axis Servo drive	+/-10 VDC @ 2ma max.
7	Rail Axis Speed reference output to ECT Tracer Rail axis Servo drive	+/-10 VDC @ 2ma max.
8	-15VDC output to ECT-250 "Catch" signal used to enable servo drives on ECT-250 systems only	-15VDC @ 20ma max. – MO-3205-1 Only
9	Signal Common	0V
11	Rail axis speed reference from ECT Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Rail axis reference output at 30RECP-7	+/-10 VDC @ 0.1 mA Max
15	Signal Common	0V
16	Cross axis speed reference from ECT Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Cross axis reference output at 30RECP-6	+/-10 VDC @ 0.1 mA Max
17	Cutting speed reference input from ECT Tracer Speed dial circuit	0 to –10VDC @ 0.1 mA Max

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-3206 Stewart Warner HST-1000 Tracing system Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
1	Square Wave Speed Reference Sync signal from HST-1000 Tracer	20V P-P @ 0.1 mA Max.
3,4	Isolated contact connects to HST-1000 tracer to disable the tracer jog functions when Burny is in control (Note 1)	Maximum 30V AC/DC @ 0.1 A
6	Cross axis Speed Signal Output to HST-1000 Tracer—	0 to 20V P-P @ 2 mA Max -- Square wave
7	Rail axis Speed Signal Output to HST-1000 Tracer—	0 to 20V P-P @ 2 mA Max -- Square wave
9	Signal Ground	0V
10	Common for Drive enable outputs at 30RECP-11 and 16	0V
11	Sink Output Connects to HST-1000 to enable Rail axis drive when Burny is in control—Common is 30RECP-10	Sinks +24VDC @ 0.1A max
15	Signal Ground	0V
16	Sink Output Connects to HST-1000 to enable Cross axis drive when Burny is in control (Note 1)—Common is 30RECP-10	Sinks +24VDC @ 0.1A max
17	Cutting speed Reference input	0 to 20 V P-P @ 0.1 mA max

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-3209 Stewart Warner M33 Type Tracing system Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
1	Sine Wave Speed Reference Sync signal from M33 Type Tracer	33VAC @ 1 mA Max.
5	Burny Enable—connect 30RECP-5 to 30RECP-9 to enable the drive outputs from the Burny. Open connection to 30RECP-5 to pass external Rail and Cross reference signals from 30RECP-11 and 16 to through the interface card to the servo drives	+VDC when Open 0V @ 1mA when connected to Signal Common
3,4	Isolated contact connects to M33 type tracer to disable the tracer jog functions when Burny is in control (Note 1)	Maximum 30VDC, 42VAC @ 0.1 A
6	Cross axis Speed Signal Output to M33 Type Tracer--	8VAC @ 5 mA Max -- Sine wave
7	Rail axis Speed Signal Output to M33 Type Tracer--	8VAC @ 5 mA Max -- Sine wave
9	Analog Ground	0V
17	Cutting speed Reference input	0 to 8VAC @ 0.2 mA max

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-3210 Hancock Tracker Tracing system Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
6	Cross Axis Speed reference output to Hancock Tracker Tracing system/drive	+/-10VDC @ 2mA max
7	Rail Axis Speed reference output to Hancock Tracker Tracing system/drive	+/-10VDC @ 2mA max
8	Speed reference input from Hancock Tracker control panel	0 to +15 VDC @ 0.1 mA max
9	Signal Common	0V
11	Rail axis speed reference from Hancock Tracker. When Burny is not in control (Note 2), voltage at this pin is switched to the Rail axis reference output at 30RECP-7	+/-10 VDC @ 0.1 mA Max
15	Signal Common	0V
16	Cross axis speed reference from Hancock Tracker. When Burny is not in control (Note 2), voltage at this pin is switched to the Cross axis reference output at 30RECP-6	+/-10 VDC @ 0.1 mA Max

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-03387 PCT Tracing system Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
6	Cross Axis Speed reference output to PCT Tracer Cross axis Servo drive	+/-6.5 VDC @ 2ma max.
7	Rail Axis Speed reference output to PCT Tracer Rail axis Servo drive	+/-6.5 VDC @ 2ma max.
9	Signal Common	0V
11	Rail axis speed reference from PCT Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Rail axis reference output at 30RECP-7	+/-10 VDC @ 1.5 mA Max
15	Signal Common	0V
16	Cross axis speed reference from PCT Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Cross axis reference output at 30RECP-6	+/-10 VDC @ 1.5 mA Max
17	Cutting speed reference input from PCT Tracer Speed dial circuit	0 to +7.8VDC @ 0.02 mA Max

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-03469 Tanaka Tracing system Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
3,4	Isolated Relay contact will be OPEN when Burny is in control (Note 1)	30VDC @ 0.1 A Max
5,10	Isolated Relay contact will be closed when Burny is in control (Note 1). Used to Enable the Cross Axis Servo Drive.	30VDC @ 0.1 A Max
6	Cross Axis Speed reference output to TANAKA Tracer Cross axis Servo drive	+/-10 VDC @ 2ma max.
7	Rail Axis Speed reference output to TANAKA Tracer Rail axis Servo drive	+/-10 VDC @ 2ma max.
8,13	Isolated Relay contact will be closed when Burny is in control (Note 1). Used to Enable the Rail Axis Servo Drive.	30VDC @ 0.1 A Max
9	Signal Common	0V
11	Rail axis speed reference from TANAKA Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Rail axis reference output at 30RECP-7	+/-10 VDC @ 0.05 mA Max
15	Signal Common	0V
16	Cross axis speed reference from TANAKA Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Cross axis reference output at 30RECP-6	+/-10 VDC @ 0.05 mA Max
17	Cutting speed reference input from TANAKA Tracer Speed dial circuit	0 to +7.5VDC @ 0.02 mA Max

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with: MO-03471 Messer KS07 (KS0 Series) Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
1,17	Transformer isolated input for speed reference signal from KS07 type Variac speed dial circuit	0 to 26VAC @ .010 mA, 400 Hz
2,3	Isolated Hi/Lo speed switch detection input.	If jumper 1J installed on the MO-34781 card: 24V AC or DC @ 12 mA
13 23 24	Isolated Form-C contact connected to KS0 type tracer to disable tracer Jog function when Burny is in Control (Note 1) Pin 13 to Pin 24—Contact open when Burny is in Control Pin 23 to Pin 24—Contact Closed when Burny is in Control	30VDC or 42 VAC @ .10 A max.
Isolated Rail Axis Power, Common and Speed reference output		
4,11	Differential Input Rail axis speed reference from KS0 style tracing system. When Burny is NOT in control (Note 2) these inputs are connected to the Rail axis differential output at 30RECP 20 and 7 respectively	20 V Peak differential between 30RECP-4 and 30RECP-11
5	Rail Axis Isolated Circuit common	0V
7,20	Differential Rail Axis speed reference output connects to the KS0 tracer to command motion in the Rail axis.	20 V Peak differential between 30RECP-7 and 30RECP-20 @ 2 mA max.
10,14	Isolated transformer supply input for Rail axis output circuits	26VAC @ 50mA -- Center Tap of transformer connects to 30RECP-5

Continued for MO-03471:

PIN #	DESCRIPTION	RATINGS
Isolated Cross Axis Power, Common and Speed reference output		
8,16	Differential Input Cross axis speed reference from KS0 style tracing system. When Burny is NOT in control (Note 2) these inputs are connected to the Cross axis differential output at 30RECP 22 and 6 respectively	20 V Peak differential between 30RECP-8 and 30RECP-16
21	Cross Axis Isolated Circuit common	0V
6,22	Differential Cross Axis speed reference output connects to the KS0 tracer to command motion in the Cross axis.	20 V Peak differential between 30RECP-2 and 30RECP-22 @ 2 mA max.
18,19	Isolated transformer supply input for Cross axis output circuits	26VAC @ 50mA -- Center Tap of transformer connects to 30RECP-21

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO- 03603 C&G Tracer 9 Volt Reference Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
6	Cross Axis Speed reference output to C&G Tracer Cross axis Servo drive	+/-9.25 VDC @ 2ma max.
7	Rail Axis Speed reference output to C&G Tracer Rail axis Servo drive	+/-9.25 VDC @ 2ma max.
9	Signal Common	0V
15	Signal Common	0V
17	Cutting speed reference input from C&G Tracer Speed dial circuit	0 to +9.25VDC @ 0.02 mA Max

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-03840 Westinghouse HL71C Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
3	Open Collector Sink output used to turn on "NC" relay in HL71C when Burny is in control (Note 1)	Output sinks 24VDC @ .10 A max
6	Cross Axis Speed reference output to HL71C Tracer Cross axis Servo drive	+/-10 VDC @ 2ma max.
7	Rail Axis Speed reference output to HL71C Tracer Rail axis Servo drive	+/-10 VDC @ 2ma max.
8	Open Collector Sink output used to turn on "Start Sequence" relay in HL71C to initiate Cutting Oxygen Pierce cycle	24VDC @ .10A max
9	Signal Common	0V
11	Input circuit connected to HL71C "Cut ON" signal to indicate when cutting oxygen is ON	Open Circuit voltage -- +5 VDC When input connected to 30RECP-9 signal common—sink current = 12 mA
15	Signal Common	0V
16	Open Collector Sink output used to turn on "Cut Disable" relay in HL71C to turn OFF the cutting process	24VDC @ .10A max
17	Cutting speed reference input from HL71C Tracer Speed dial circuit	0 to +7.2 VDC @ 0.02 mA max.
18	7.2V Speed reference output connects to speed pot in HL71C	7.2 VDC @ 50 mA max.

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-03956 Westinghouse HL90 Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
1	Pin is connects to HL90 Lamp control circuit — connecting pin to signal common turns OFF the tracer flood lamp	Open Circuit voltage +12VDC When connected to signal common, sink current = 10 mA max.
2	Connects to HL90 Strip mode switch. Pin 2 is connected to signal common by the switch when set to strip mode.	Open Circuit voltage +12VDC When connected to signal common, sink current = 10 mA max
6	Cross Axis Speed reference output to HL90 Tracer Cross axis Servo drive	+/-7 VDC @ 2mA max.
7	Rail Axis Speed reference output to HL90 Tracer Rail axis Servo drive	+/-7 VDC @ 2mA max.
9	Signal Common	0V
11	Rail axis speed reference from PCT Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Rail axis reference output at 30RECP-7	+/-7 VDC @ 0.1 mA Max
15	Signal Common	0V
16	Cross axis speed reference from HL90 Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Cross axis reference output at 30RECP-6	+/-7 VDC @ 0.1 mA Max
17	Cutting speed reference input from HL90 Tracer Speed dial circuit	0 to +6.3 VAC @ 0.06 mA Max

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-04028 Multi-Drive Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
1,2	Relay contact and 7.2 Volt reference output used to connect to tracer or supply voltage to tracer or cutting machine speed pot. If Burny in control (Note 1): Pin 1 is Open (no connection) Pin 2 supplies 7.2 VDC reference If Burny not in control (Note 2): Relay contact closed between Pin 1 and Pin 2. No voltage supplied to either pin	Closed relay contact: 30VDC or 42VAC @ .1 A max 7.2V reference supplied 7.2 VDC @ 50 mA max.
3 4 5 10	3 interconnected relay contacts used to connect to tracer or servo drive as required. Relay operation is as follows. If Burny in control (Note 1): Contacts Closed: Pin 4 to Pin 10 Pin 5 to Pin 10 If Burny not in control (Note 2): Contacts Closed: Pin 3 to Pin 4	30VDC or 42VAC @ .1 A max
6	Cross Axis Speed reference output to Tracer Cross axis Servo drive	+/-10 VDC @ 2 ma max.
7	Rail Axis Speed reference output to Tracer Rail axis Servo drive	+/-10 VDC @ 2 ma max.
8,13	Isolated Relay contact is CLOSED when Burny is in Control (Note 1)	30VDC or 42VAC @ .1 A max
9	Signal Common	0V

Continued for MO-04028

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
11	Rail axis speed reference from Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Rail axis reference output at 30RECP-7	+/-10 VDC @ 1.5 mA Max
15	Signal Common	0V
16	Cross axis speed reference from Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Cross axis reference output at 30RECP-6	+/-10 VDC @ 1.5 mA Max
17	Cutting speed reference input from Tracer Speed dial circuit	0 to +10VDC @ 0.02 mA Max
19	External Jog input. Pin 19 is grounded (connected to Pin 9 signal common) when the external tracer or jog controls are being used to move the machine. While grounded, the external speed reference inputs at pin 11 and 16 are switched to the speed reference outputs at pins 6 and 7.	Open circuit voltage -- +5 VDC When input connected to signal common—sink current = 25 mA max

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-05311 Tanaka KT570 Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
1	Sine Wave Speed Reference Sync signal from Tracer	14VAC @ 1 mA Max.
3,4	Isolated contact connects to tracer to disable the tracer jog functions when Burny is in control (Note 1)	Maximum 30VDC, 42VAC @ 0.1 A
6	Cross axis Speed Signal Output to Tracer servo drive	8VAC @ 2 mA Max -- Sine wave
7	Rail axis Speed Signal Output to tracer servo drive	8VAC @ 2 mA Max -- Sine wave
9	Signal Ground	0V
15	Signal Ground	0V
17	Cutting speed Reference input	0 to 8VAC @ 0.2 mA max

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-06213 Westinghouse HL series Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
1,2	Relay contact and 7.2 Volt reference output used to connect to tracer or supply voltage to tracer or cutting machine speed pot. If Burny in control (Note 1): Pin 1 is Open (no connection) Pin 2 supplies 7.2 VDC reference If Burny not in control (Note 2): Relay contact closed between Pin 1 and Pin 2. No voltage supplied to either pin	Closed relay contact: 30VDC or 42VAC @ .1 A max 7.2V reference supplied 7.2 VDC @ 50 mA max.
3 4 5 10	3 interconnected relay contacts used to connect to tracer or servo drive as required. Relay operation is as follows. If Burny in control (Note 1): Contacts Closed: Pin 4 to Pin 10 Pin 5 to Pin 10 If Burny not in control (Note 2): Contacts Closed: Pin 3 to Pin 4	30VDC or 42VAC @ .1 A max Jumper J1 can be installed on the card to connect Pin 10 to Signal Common if desired
6	Cross Axis Speed reference output to Tracer Cross axis Servo drive	+/-10 VDC @ 2 ma max.
7	Rail Axis Speed reference output to Tracer Rail axis Servo drive	+/-10 VDC @ 2 ma max.
8,13	Isolated Relay contact is CLOSED when Burny is in Control (Note 1)	30VDC or 42VAC @ .1 A max
9	Signal Common	0V

Continued for MO-06213

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
11	Rail axis speed reference from Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Rail axis reference output at 30RECP-7	+/-10 VDC @ 1.5 mA Max
15	Signal Common	0V
16	Cross axis speed reference from Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Cross axis reference output at 30RECP-6	+/-10 VDC @ 1.5 mA Max
17	Cutting speed reference input from Tracer Speed dial circuit	0 to +10VDC @ 0.02 mA Max 0 to 7.2VDC when Burny is in control (Note 1)
20	External E-STOP Monitor input. An isolated relay contact from the cutting machine should be used to drive this input--- Pin 20 should be connected to signal Common (pin 9) when machine is ready to run. Pin 20 should be OPEN (no connection) when machine is in an E-STOP condition	Open Circuit voltage -- 7 VDC Sink current required when input connected to signal common: 1 mA max.

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-06214 Servopak / Multi-drive Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
1	Rail Axis External Jog input-- Pin 1 is open for normal operation where Burny is in Control of the machine. Pin 1 is grounded (Signal Common – Pin 9) to indicate that the external machine or tracer jog control is moving the Rail axis of the machine.	Open Circuit voltage +5 VDC Sink current required when input is connected to signal common: 1.5 mA max.
2	Cross Axis External Jog input-- Pin 2 is open for normal operation where Burny is in Control of the machine. Pin 2 is grounded (Signal Common – Pin 9) to indicate that the external machine or tracer jog control is moving the Cross axis of the machine.	Open Circuit voltage +5 VDC Sink current required when input is connected to signal common: 1.5 mA max.
3 4 5 10	Relay contact and 7.2 Volt reference output used to connect to tracer or supply voltage to tracer or cutting machine speed pot. If Burny in control (Note 1): Pin 3 is Open (no connection) Pin 4 supplies 7.2 VDC reference Pin 5 supplies 7.2 VDC reference Pin 10 supplies 7.2 VDC reference If Burny not in control (Note 2): Relay contact closed between Pin 3 and Pin 4. No voltage supplied to either pin. Pin 5 is Open—no voltage applied Pin 10 supplies 7.2 VDC reference	Closed relay contact: 30VDC or 42VAC @ .1 A max 7.2V reference supplied 7.2 VDC @ 50 mA max.
6	Cross Axis Speed reference output to Tracer Cross axis Servo drive	+/-10 VDC @ 2 ma max.
7	Rail Axis Speed reference output to Rail axis Servo drive	+/-10 VDC @ 2 ma max.

Continued for MO-06214

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
8,13	Isolated Relay contact is CLOSED when Burny is in Control (Note 1)	30VDC or 42VAC @ .1 A max
9	Signal Common	0V
11	Rail axis speed reference from Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Rail axis reference output at 30RECP-7	+/-10 VDC @ 1.5 mA Max
15	Signal Common	0V
16	Cross axis speed reference from Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Cross axis reference output at 30RECP-6	+/-10 VDC @ 1.5 mA Max
17	Cutting speed reference input from Tracer Speed dial circuit	0 to +10VDC @ 0.02 mA Max 0 to 7.2VDC when Burny is in control (Note 1)
20	External E-STOP Monitor input. An isolated relay contact from the cutting machine should be used to drive this input--- Pin 20 should be connected to signal Common (pin 9) when machine is ready to run. Pin 20 should be OPEN (no connection) when machine is in an E-STOP condition	Open Circuit voltage -- 7 VDC Sink current required when input connected to signal common: 1 mA max.

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-06241 Westinghouse HL Series w/Home Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
1,2	Relay contact and 7.2 Volt reference output used to connect to tracer or supply voltage to tracer or cutting machine speed pot. If Burny in control (Note 1): Pin 1 is Open (no connection) Pin 2 supplies 7.2 VDC reference If Burny not in control (Note 2): Relay contact closed between Pin 1 and Pin 2. No voltage supplied to either pin	Closed relay contact: 30VDC or 42VAC @ .1 A max 7.2V reference supplied 7.2 VDC @ 50 mA max.
3 4 5 10	3 interconnected relay contacts used to connect to tracer or servo drive as required. Relay operation is as follows. If Burny in control (Note 1): Contacts Closed: Pin 4 to Pin 10 Pin 5 to Pin 10 If Burny not in control (Note 2): Contacts Closed: Pin 3 to Pin 4	30VDC or 42VAC @ .1 A max Jumper J1 can be installed on the card to connect Pin 10 to Signal Common if desired
6	Cross Axis Speed reference output to Tracer Cross axis Servo drive	+/-10 VDC @ 2 ma max.
7	Rail Axis Speed reference output to Tracer Rail axis Servo drive	+/-10 VDC @ 2 ma max.
8,13	Isolated Relay contact is CLOSED when Burny is in Control (Note 1)	30VDC or 42VAC @ .1 A max
9	Signal Common	0V

Continued for MO-06241

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
11	Rail axis speed reference from Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Rail axis reference output at 30RECP-7	+/-10 VDC @ 1.5 mA Max
15	Signal Common	0V
16	Cross axis speed reference from Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Cross axis reference output at 30RECP-6	+/-10 VDC @ 1.5 mA Max
17	Cutting speed reference input from Tracer Speed dial circuit	0 to +10VDC @ 0.02 mA Max 0 to 7.2VDC when Burny is in control (Note 1)
18	Home Switch input Common—acts as common return for the X and Y home switch signals at 30RECP-21 and 22	+/-24VDC @ 30 ma max Voltage measured between Pin 18 and Pins 21 or 22
20	External E-STOP Monitor input. An isolated relay contact from the cutting machine should be used to drive this input--- Pin 20 should be connected to signal Common (pin 9) when machine is ready to run. Pin 20 should be OPEN (no connection) when machine is in an E-STOP condition	Open Circuit voltage -- 7 VDC Sink current required when input connected to signal common: 1 mA max.
21	Rail axis "X" home switch input. A 24 volt signal must be applied between Pin 21 and the Home switch common at 30RECP-18 for the X axis home switch. Switch can be either normally open or closed. For maximum versatility, either a 24V signal can be supplied from the home switch, with the Pin 18 switch common at 0V, or the 24V supply can be applied to the Pin 18 Switch common, and the individual X and Y home switch signals pulled to 0 Volts at pins 21 and 22.	+/-24VDC @ 15mA max. Voltage measured between Pin 21 and Pin 18

Continued for MO-06241

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
22	Cross axis "Y" home switch input. A 24 volt signal must be applied between Pin 22 and the Home switch common at 30RECP-18 for the Y axis home switch. Switch can be either normally open or closed. For maximum versatility, either a 24V signal can be supplied from the home switch, with the Pin 18 switch common at 0V, or the 24V supply can be applied to the Pin 18 Switch common, and the individual X and Y home switch signals pulled to 0 Volts at pins 21 and 22.	+/-24VDC @ 15mA max. Voltage measured between Pin 22 and Pin 18
23	Rail axis "X" encoder index signal. Jumper wires on Back panel connect the encoder index signal to special tabs on the pcb to bring the encoder signal to the interface card. The encoder index or Z channel is used as part of the homing process to detect the exact angular position of the encoder using the Z index signal	+5 Volt @ 10 mA max.
24	Cross axis "Y" encoder index signal. Jumper wires on Back panel connect the encoder index signal to special tabs on the pcb to bring the encoder signal to the interface card. The encoder index or Z channel is used as part of the homing process to detect the exact angular position of the encoder using the Z index signal	+5 Volt @ 10 mA max.

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-07248 Servopak / Multi-drive w/Home Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
1	Rail Axis External Jog input-- Pin 1 is open for normal operation where Burny is in Control of the machine. Pin 1 is grounded (Signal Common – Pin 9) to indicate that the external machine or tracer jog control is moving the Rail axis of the machine.	Open Circuit voltage +5 VDC Sink current required when input is connected to signal common: 1.5 mA max.
2	Cross Axis External Jog input-- Pin 2 is open for normal operation where Burny is in Control of the machine. Pin 2 is grounded (Signal Common – Pin 9) to indicate that the external machine or tracer jog control is moving the Cross axis of the machine.	Open Circuit voltage +5 VDC Sink current required when input is connected to signal common: 1.5 mA max.
3 4 5 10	Relay contact and 7.2 Volt reference output used to connect to tracer or supply voltage to tracer or cutting machine speed pot. If Burny in control (Note 1): Pin 3 is Open (no connection) Pin 4 supplies 7.2 VDC reference Pin 5 supplies 7.2 VDC reference Pin 10 supplies 7.2 VDC reference If Burny not in control (Note 2): Relay contact closed between Pin 3 and Pin 4. No voltage supplied to either pin. Pin 5 is Open—no voltage applied Pin 10 supplies 7.2 VDC reference	Closed relay contact: 30VDC or 42VAC @ .1 A max 7.2V reference supplied 7.2 VDC @ 50 mA max.
6	Cross Axis Speed reference output to Tracer Cross axis Servo drive	+/-10 VDC @ 2 ma max.
7	Rail Axis Speed reference output to Rail axis Servo drive	+/-10 VDC @ 2 ma max.

Continued for MO-07248

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
8,13	Isolated Relay contact is CLOSED when Burny is in Control (Note 1)	30VDC or 42VAC @ .1 A max
9	Signal Common	0V
11	Rail axis speed reference from Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Rail axis reference output at 30RECP-7	+/-10 VDC @ 1.5 mA Max
15	Signal Common	0V
16	Cross axis speed reference from Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Cross axis reference output at 30RECP-6	+/-10 VDC @ 1.5 mA Max
17	Cutting speed reference input from Tracer Speed dial circuit	0 to +10VDC @ 0.02 mA Max 0 to 7.2VDC when Burny is in control (Note 1)
18	Home Switch input Common—acts as common return for the X and Y home switch signals at 30RECP-21 and 22	+/-24VDC @ 30 ma max Voltage measured between Pin 18 and Pins 21 or 22
20	External E-STOP Monitor input. An isolated relay contact from the cutting machine should be used to drive this input--- Pin 20 should be connected to signal Common (pin 9) when machine is ready to run. Pin 20 should be OPEN (no connection) when machine is in an E-STOP condition	Open Circuit voltage -- 7 VDC Sink current required when input connected to signal common: 1 mA max.
21	Rail axis "X" home switch input. A 24 volt signal must be applied between Pin 21 and the Home switch common at 30RECP-18 for the X axis home switch. Switch can be either normally open or closed. For maximum versatility, either a 24V signal can be supplied from the home switch, with the Pin 18 switch common at 0V, or the 24V supply can be applied to the Pin 18 Switch common, and the individual X and Y home switch signals pulled to 0 Volts at pins 21 and 22.	+/-24VDC @ 15mA max. Voltage measured between Pin 21 and Pin 18

Continued for MO-07248

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
22	Cross axis "Y" home switch input. A 24 volt signal must be applied between Pin 22 and the Home switch common at 30RECP-18 for the Y axis home switch. Switch can be either normally open or closed. For maximum versatility, either a 24V signal can be supplied from the home switch, with the Pin 18 switch common at 0V, or the 24V supply can be applied to the Pin 18 Switch common, and the individual X and Y home switch signals pulled to 0 Volts at pins 21 and 22.	+/-24VDC @ 15mA max. Voltage measured between Pin 22 and Pin 18
23	Rail axis "X" encoder index signal. Jumper wires on Back panel connect the encoder index signal to special tabs on the pcb to bring the encoder signal to the interface card. The encoder index or Z channel is used as part of the homing process to detect the exact angular position of the encoder using the Z index signal	+5 Volt @ 10 mA max.
24	Cross axis "Y" encoder index signal. Jumper wires on Back panel connect the encoder index signal to special tabs on the pcb to bring the encoder signal to the interface card. The encoder index or Z channel is used as part of the homing process to detect the exact angular position of the encoder using the Z index signal	+5 Volt @ 10 mA max.

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-08158 Heath Tracer "Video Path" Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
1	Rail Axis External Jog input-- Pin 1 is open for normal operation where Burny is in Control of the machine. Pin 1 is grounded (Signal Common – Pin 9) to indicate that the external tracer jog control is moving the Rail axis of the machine.	Open Circuit voltage +5 VDC Sink current required when input is connected to signal common: 1.5 mA max.
2	Cross Axis External Jog input-- Pin 2 is open for normal operation where Burny is in Control of the machine. Pin 2 is grounded (Signal Common – Pin 9) to indicate that the external tracer jog control is moving the Cross axis of the machine.	Open Circuit voltage +5 VDC Sink current required when input is connected to signal common: 1.5 mA max.
6	Cross Axis Speed reference output to Tracer Cross axis Servo drive	+/-10 VDC @ 2 ma max.
7	Rail Axis Speed reference output to Rail axis Servo drive	+/-10 VDC @ 2 ma max.
8	-7.2 Volt input from Heath tracer used when 14.4 volt differential speed reference is supplied from the tracer. The other side of the differential input connects to 30RECP-17	There are several versions of the Heath tracer—some use the differential 14.4 volt reference and some use a single ended 6 or 8 volt reference Voltage on this pin: Either –7.2 volts @ 0.03 mA for differential or 0V for single ended inputs.
9	Signal Common	0V
11	Rail axis speed reference from Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Rail axis reference output at 30RECP-7	+/-10 VDC @ 0.1 mA Max
15	Signal Common	0V

Continued for MO-08158

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
16	Cross axis speed reference from Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Cross axis reference output at 30RECP-6	+/-10 VDC @ 0.1 mA Max
17	Cutting speed reference input from Tracer Speed dial circuit	Either –7.2V to +7.2V

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-09484 Replicator 900 Interface Card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
1	Rail Axis External Jog input-- Pin 1 is open for normal operation where Burny is in Control of the machine. Pin 1 is connected to –6 volts in the Replicator 900 tracer to indicate that the tracer jog control is moving the Rail axis of the machine.	Input off: Open circuit voltage= +5 VDC Input on: -6VDC @ 0.6 mA max
2	Cross Axis External Jog input-- Pin 2 is open for normal operation where Burny is in Control of the machine. Pin 2 is connected to –6 volts in the Replicator 900 tracer to indicate that the tracer jog control is moving the Cross axis of the machine.	Input off: Open circuit voltage= +5 VDC Input on: -6VDC @ 0.6 mA max
3	-6V supply from pin 14 connects to Rail Axis drive enable in Replicator servo drive	-6VDC @ 1mA max
4	-6V supply from pin 14 connects to Cross Axis drive enable in Replicator servo drive	-6VDC @ 1mA max
6	Cross Axis Speed reference output to Tracer Cross axis Servo drive	+/-3 VDC @ 2 mA max.
7	Rail Axis Speed reference output to Rail axis Servo drive	+/-3 VDC @ 2 mA max.
8,13	Isolated Relay contact is CLOSED when Burny is in Control (Note 1)	30VDC or 42VAC @ .1 A max
9	Signal Common	0V
11	Rail axis speed reference from Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Rail axis reference output at 30RECP-7	+/-3 VDC @ 0.5 mA Max
14	-6V supplied from Replicator for drive enable outputs at pins 3 and 4	-6 VDC @ 2 mA max
15	Signal Common	0V

Continued for MO-09484

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
16	Cross axis speed reference from Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Cross axis reference output at 30RECP-6	+/-3 VDC @ 0.5 mA Max
17	Cutting speed reference input from Tracer Speed dial circuit	0 to –3.0 VDC @ 0.02 mA Max
20	E-Stop monitor input-- connects to Replicator BUS supply. When BUS voltage is detected, normal operation is allowed. When BUS voltage is missing, Burny will indicate E-STOP condition	36VDC @ 2 mA max

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-10204 Stewart Warner LCT Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
1	Rail Axis External Jog input-- Pin 1 is open for normal operation where Burny is in Control of the machine. Pin 1 is connected to signal common in the tracer to indicate that the tracer jog control is moving the Rail axis of the machine.	Input off: Open circuit voltage= +5 to +24 VDC Input on: 0V @ 1.5 mA max
2	Cross Axis External Jog input-- Pin 2 is open for normal operation where Burny is in Control of the machine. Pin 2 is connected to signal common in the tracer to indicate that the tracer jog control is moving the Cross axis of the machine.	Input off: Open circuit voltage= +5 to +24 VDC Input on: 0V @ 1.5 mA max
3 4 5 10	3 interconnected relay contacts used to connect to tracer or servo drive as required. Relay operation is as follows. If Burny in control (Note 1): Contacts Closed: Pin 4 to Pin 10 Pin 5 to Pin 10 If Burny not in control (Note 2): Contacts Closed: Pin 3 to Pin 4	30VDC or 42VAC @ .1 A max
6	Cross Axis Speed reference output to Tracer Cross axis Servo drive	+/-10 VDC @ 2 ma max.
7	Rail Axis Speed reference output to Rail axis Servo drive	+/-10 VDC @ 2 ma max.
8,13	Isolated Relay contact is CLOSED when Burny is in Control (Note 1)	30VDC or 42VAC @ .1 A max
9	Signal Common	0V

Continued for MO-10204

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
11	Rail axis speed reference from Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Rail axis reference output at 30RECP-7	+/-10 VDC @ 0.1 mA Max
15	Signal Common	0V
16	Cross axis speed reference from Tracer. When Burny is not in control (Note 2), voltage at this pin is switched to the Cross axis reference output at 30RECP-6	+/-10 VDC @ 0.1 mA Max
17	Cutting speed reference input from Tracer Speed dial circuit	0 to 7V P-P AC Sine Wave @0.05 mA max
20	E-Stop monitor input-- connects to LCT –12V power supply. When -12V supply is detected, normal operation is allowed. When –12 voltage is missing, Burny will indicate E-STOP condition	-12VDC @ 1mA max.

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-11722 C&G MST-40,150 Tracing system w/E-Stop Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
5	Burny Enable—connect 30RECP-5 to 30RECP-9 to enable the drive outputs from the Burny. Open connection to 30RECP-5 to pass external Rail and Cross reference signals from 30RECP-11 and 16 to through the interface card to the servo drives	+VDC when Open 0V @ 1mA when connected to Signal Common
6	Cross Axis Speed Reference output—connects to MST Cross Axis servo drive	+/- 5 VDC @ 2mA max. for MO-03204-0 +/- 10 VDC @ 2mA max. for MO-03204-1
7	Rail Axis Speed Reference output—connects to MST Rail Axis servo drive	+/- 5 VDC @ 2mA max. for MO-03204-0 +/- 10 VDC @ 2mA max. for MO-03204-1
9	Signal Ground	0V
11	Rail Axis Speed Reference input from MST Tracer—when 30RECP-5 is Open, voltage on this pin is switched to the rail axis speed reference output at 30RECP-7 Also acts as Speed reference input for Burny cutting speed control	0-+/-10 VDC @ 1 mA max.
15	Signal Ground	0V
16	Cross Axis Speed Reference input from MST Tracer—when 30RECP-5 is Open, voltage on this pin is switched to the cross axis speed reference output at 30RECP-6	0-+/-10 VDC @ 1 mA max.
20	External E-STOP Monitor input. An isolated relay contact from the cutting machine should be used to drive this input--- Pin 20 should be connected to signal Common (pin 9) when machine is ready to run. Pin 20 should be OPEN (no connection) when machine is in an E-STOP condition	Open Circuit voltage -- 7 VDC Sink current required when input connected to signal common: 1 mA max.

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO- 11723 C&G Tracer 9 Volt Reference w/E-Stop Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
6	Cross Axis Speed reference output to C&G Tracer Cross axis Servo drive	+/-9.25 VDC @ 2ma max.
7	Rail Axis Speed reference output to C&G Tracer Rail axis Servo drive	+/-9.25 VDC @ 2ma max.
9	Signal Common	0V
15	Signal Common	0V
17	Cutting speed reference input from C&G Tracer Speed dial circuit	0 to +9.25VDC @ 0.02 mA Max
20	External E-STOP Monitor input. An isolated relay contact from the cutting machine should be used to drive this input--- Pin 20 should be connected to signal Common (pin 9) when machine is ready to run. Pin 20 should be OPEN (no connection) when machine is in an E-STOP condition	Open Circuit voltage -- 7 VDC Sink current required when input connected to signal common: 1 mA max.

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO-11945 C&G MST-40,150 Tracing system w/E-Stop, w/Home Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
5	Burny Enable—connect 30RECP-5 to 30RECP-9 to enable the drive outputs from the Burny. Open connection to 30RECP-5 to pass external Rail and Cross reference signals from 30RECP-11 and 16 to through the interface card to the servo drives	+VDC when Open 0V @ 1mA when connected to Signal Common
6	Cross Axis Speed Reference output—connects to MST Cross Axis servo drive	+/- 5 VDC @ 2mA max. for MO-03204-0 +/- 10 VDC @ 2mA max. for MO-03204-1
7	Rail Axis Speed Reference output—connects to MST Rail Axis servo drive	+/- 5 VDC @ 2mA max. for MO-03204-0 +/- 10 VDC @ 2mA max. for MO-03204-1
9	Signal Ground	0V
11	Rail Axis Speed Reference input from MST Tracer—when 30RECP-5 is Open, voltage on this pin is switched to the rail axis speed reference output at 30RECP-7 Also acts as Speed reference input for Burny cutting speed control	0-+/-10 VDC @ 1 mA max.
15	Signal Ground	0V
16	Cross Axis Speed Reference input from MST Tracer—when 30RECP-5 is Open, voltage on this pin is switched to the cross axis speed reference output at 30RECP-6	0-+/-10 VDC @ 1 mA max.
18	Home Switch input Common—acts as common return for the X and Y home switch signals at 30RECP-21 and 22	+/-24VDC @ 30 ma max Voltage measured between Pin 18 and Pins 21 or 22

Continued for MO-11945

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
20	External E-STOP Monitor input. An isolated relay contact from the cutting machine should be used to drive this input--- Pin 20 should be connected to signal Common (pin 9) when machine is ready to run. Pin 20 should be OPEN (no connection) when machine is in an E-STOP condition	Open Circuit voltage -- 7 VDC Sink current required when input connected to signal common: 1 mA max.
21	Rail axis "X" home switch input. A 24 volt signal must be applied between Pin 21 and the Home switch common at 30RECP-18 for the X axis home switch. Switch can be either normally open or closed. For maximum versatility, either a 24V signal can be supplied from the home switch, with the Pin 18 switch common at 0V, or the 24V supply can be applied to the Pin 18 Switch common, and the individual X and Y home switch signals pulled to 0 Volts at pins 21 and 22.	+/-24VDC @ 15mA max. Voltage measured between Pin 21 and Pin 18
22	Cross axis "Y" home switch input. A 24 volt signal must be applied between Pin 22 and the Home switch common at 30RECP-18 for the Y axis home switch. Switch can be either normally open or closed. For maximum versatility, either a 24V signal can be supplied from the home switch, with the Pin 18 switch common at 0V, or the 24V supply can be applied to the Pin 18 Switch common, and the individual X and Y home switch signals pulled to 0 Volts at pins 21 and 22.	+/-24VDC @ 15mA max. Voltage measured between Pin 22 and Pin 18

Continued for MO-11945

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
23	Rail axis "X" encoder index signal. Jumper wires on Back panel connect the encoder index signal to special tabs on the pcb to bring the encoder signal to the interface card. The encoder index or Z channel is used as part of the homing process to detect the exact angular position of the encoder using the Z index signal	+5 Volt @ 10 mA max.
24	Cross axis "Y" encoder index signal. Jumper wires on Back panel connect the encoder index signal to special tabs on the pcb to bring the encoder signal to the interface card. The encoder index or Z channel is used as part of the homing process to detect the exact angular position of the encoder using the Z index signal	+5 Volt @ 10 mA max.

"30RECP" -- Models ME5E-10940-4 and ME53-10950-5 only

Specifications when Burny 5 equipped with:

MO- 11946 C&G Tracer 9 Volt Reference w/E-Stop, w/Home Interface card

(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
6	Cross Axis Speed reference output to C&G Tracer Cross axis Servo drive	+/-9.25 VDC @ 2ma max.
7	Rail Axis Speed reference output to C&G Tracer Rail axis Servo drive	+/-9.25 VDC @ 2ma max.
9	Signal Common	0V
15	Signal Common	0V
17	Cutting speed reference input from C&G Tracer Speed dial circuit	0 to +9.25VDC @ 0.02 mA Max
18	Home Switch input Common—acts as common return for the X and Y home switch signals at 30RECP-21 and 22	+/-24VDC @ 30 ma max Voltage measured between Pin 18 and Pins 21 or 22
20	External E-STOP Monitor input. An isolated relay contact from the cutting machine should be used to drive this input--- Pin 20 should be connected to signal Common (pin 9) when machine is ready to run. Pin 20 should be OPEN (no connection) when machine is in an E-STOP condition	Open Circuit voltage -- 7 VDC Sink current required when input connected to signal common: 1 mA max.
21	Rail axis "X" home switch input. A 24 volt signal must be applied between Pin 21 and the Home switch common at 30RECP-18 for the X axis home switch. Switch can be either normally open or closed. For maximum versatility, either a 24V signal can be supplied from the home switch, with the Pin 18 switch common at 0V, or the 24V supply can be applied to the Pin 18 Switch common, and the individual X and Y home switch signals pulled to 0 Volts at pins 21 and 22.	+/-24VDC @ 15mA max. Voltage measured between Pin 21 and Pin 18

Continued for MO-11496

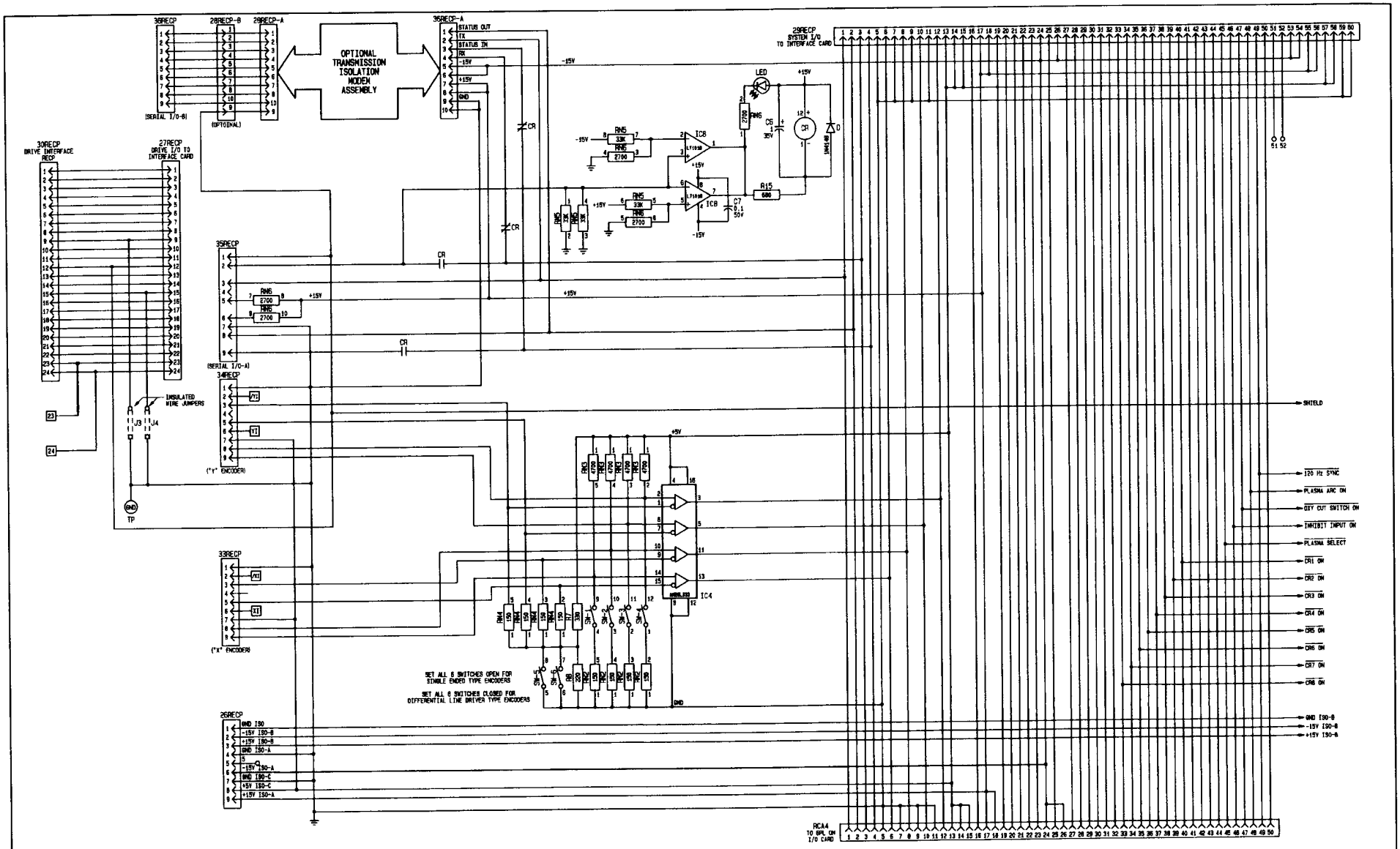
(Any pins not listed in this table are not used – do not make any connection to these pins)

PIN #	DESCRIPTION	RATINGS
22	Cross axis "Y" home switch input. A 24 volt signal must be applied between Pin 22 and the Home switch common at 30RECP-18 for the Y axis home switch. Switch can be either normally open or closed. For maximum versatility, either a 24V signal can be supplied from the home switch, with the Pin 18 switch common at 0V, or the 24V supply can be applied to the Pin 18 Switch common, and the individual X and Y home switch signals pulled to 0 Volts at pins 21 and 22.	+/-24VDC @ 15mA max. Voltage measured between Pin 22 and Pin 18
23	Rail axis "X" encoder index signal. Jumper wires on Back panel connect the encoder index signal to special tabs on the pcb to bring the encoder signal to the interface card. The encoder index or Z channel is used as part of the homing process to detect the exact angular position of the encoder using the Z index signal	+5 Volt @ 10 mA max.
24	Cross axis "Y" encoder index signal. Jumper wires on Back panel connect the encoder index signal to special tabs on the pcb to bring the encoder signal to the interface card. The encoder index or Z channel is used as part of the homing process to detect the exact angular position of the encoder using the Z index signal	+5 Volt @ 10 mA max.

PART 9 – DRAWINGS AND SCHEMATICS

Insert Tab - Part 9

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SHEET 1 OF 2

2.) † DENOTES FOR 24V-115V AC OR DC CUTTING INTERFACE, MOV1-MOV4
EQUAL 130V, 30J, R1-R4 EQUAL 4000 OHM, 5W, +/-5%.
FOR 230VAC CUTTING INTERFACE, MOV1-MOV4
EQUAL 250V, 55J, R1-R4 EQUAL 15K OHM, 5W, +/-5%.

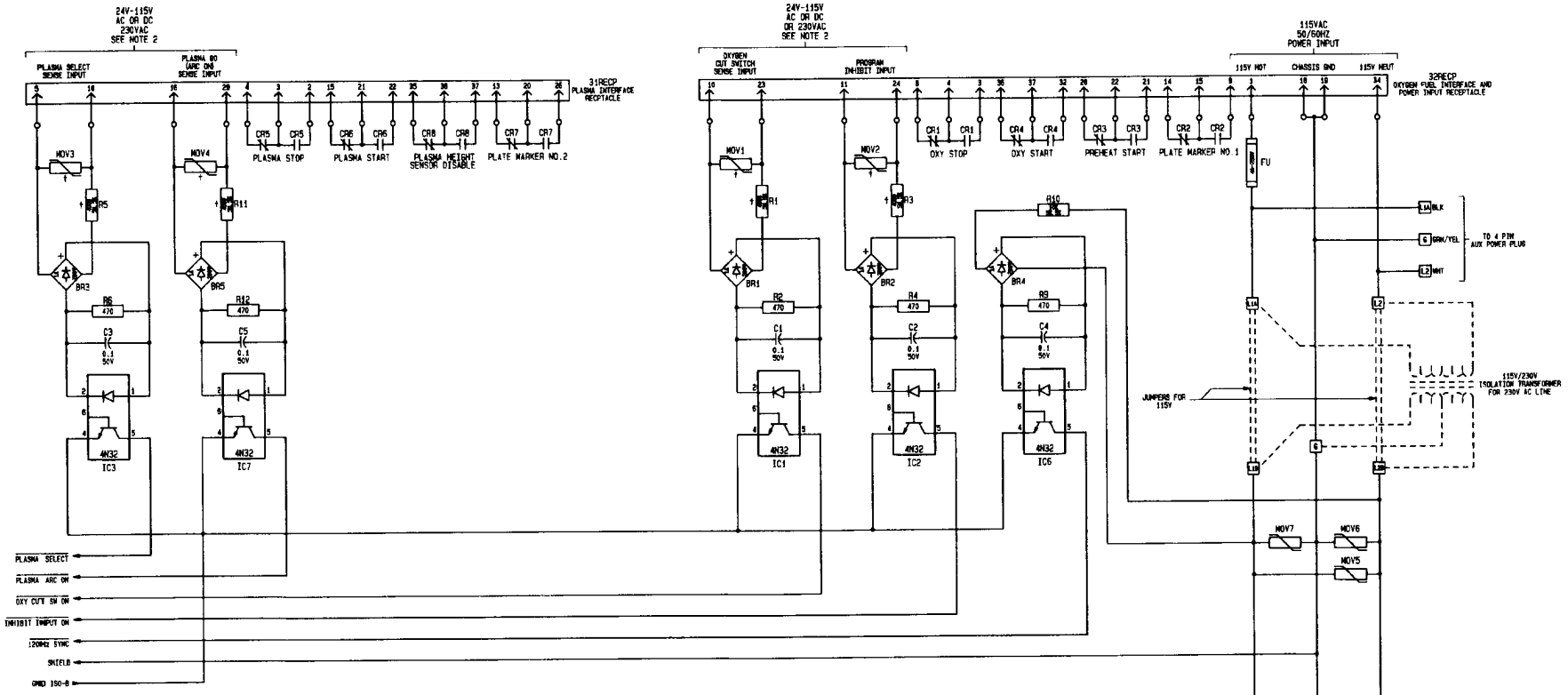
1.) ALL RESISTORS ARE 1/4W, +/-5%.

NOTE: UNLESS OTHERWISE SPECIFIED.

E						TOLERANCES UNLESS OTHERWISE SPECIFIED: DECIMAL X.X ± .005, X.XX ± .010, X.XXX ± .002, ANGULAR ± .5°	CMC CLEVELAND MACHINE CONTROLS	SCHEMATIC, BURNY 3/5 BACK PANEL, W/ENCODER TERMINATORS	
D									
C									
B	CHGD SIGNAL NAS RCA4-32	11810	RAP	10/08		MATERIAL	FINISH	SIZE	
A	ADD MORE SWITCHES	9488	BMC	10/09				NO. MC-92560-X	
REV	REVISED	ECO	BY	DATE	DO NOT SCALE DRAWING				

DRAWN BY	APPROVED BY	DRAWING NUMBER	REV
BMC	DJM	D0-28369	B
DATE 10-21-93	DATE 22 DEC 93		

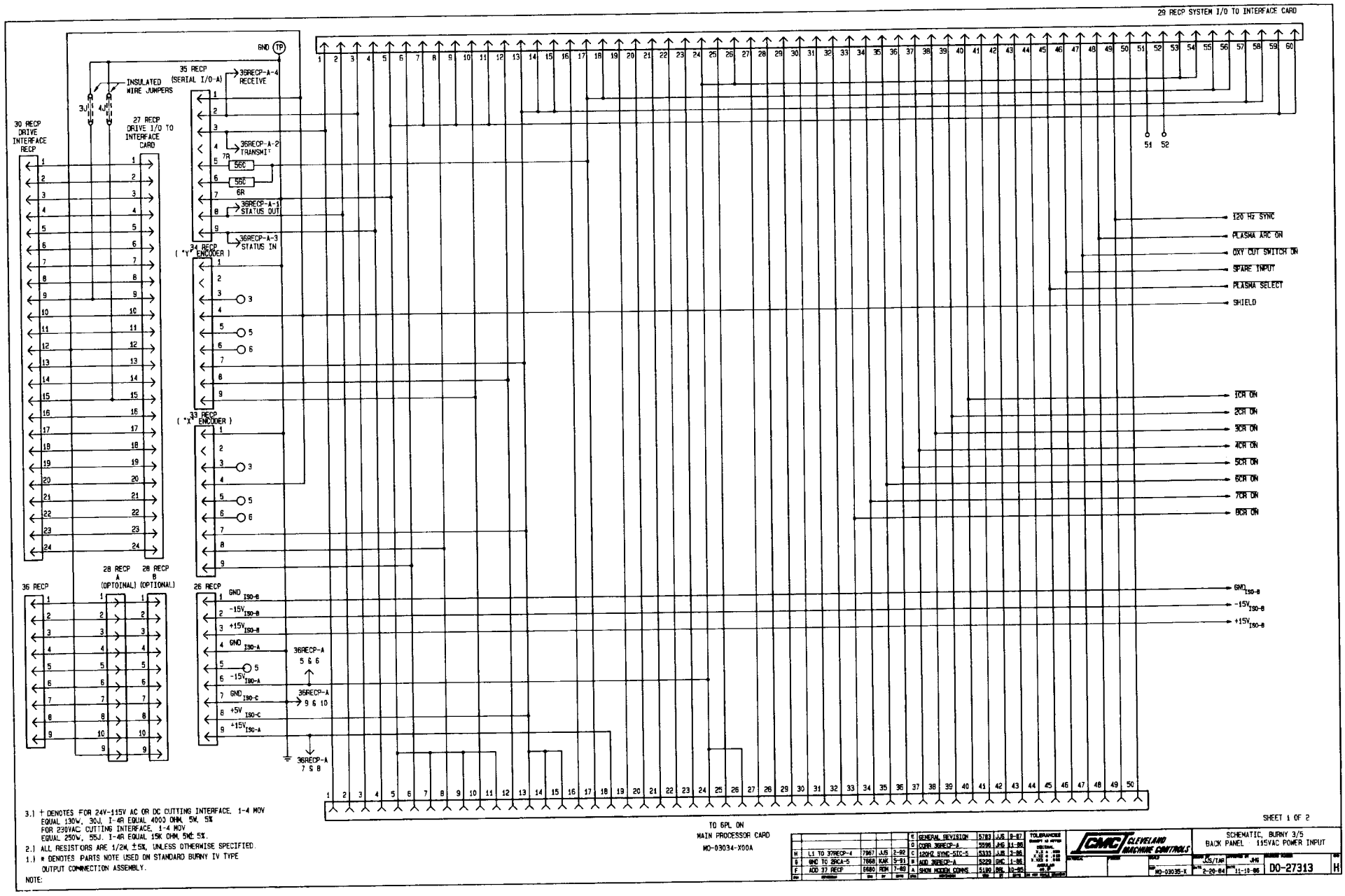
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24V-115V
AC OR DC
230VAC
SEE NOTE 2
PLASMA SELECT SENSE INPUT
PLASMA ARC ON SENSE INPUT
31RECP
PLASMA INTERFACE RECEPTACLE
CR5 CR5 PLASMA STOP
CR6 CR6 PLASMA START
CR8 CR8 PLASMA HEIGHT SENSOR DISABLE
CR7 CR7 PLATE MARKER NO.2
MOV3
MOV4
R5
R11
BR3
BR5
R6 470
R12 470
C3 0.1 50V
C5 0.1 50V
4N32 IC3
4N32 IC7
24V-115V
AC OR DC
OR 230VAC
SEE NOTE 2
OXYGEN CUT SWITCH SENSE INPUT
PROGRAM INHIBIT INPUT
32RECP
OXYGEN FUEL INTERFACE AND POWER INPUT RECEPTACLE
CR1 CR1 OXY STOP
CR4 CR4 OXY START
CR3 CR3 PREHEAT START
CR2 CR2 PLATE MARKER NO.1
MOV1
MOV2
R1
R3
BR1
BR2
R2 470
R4 470
C1 0.1 50V
C2 0.1 50V
4N32 IC1
4N32 IC2
115VAC
50/60HZ
POWER INPUT
115V HOT
CHASSIS GND
115V NEUT
FU
R10
BR4
R9 470
C4 0.1 50V
4N32 IC6
1A BLK
G GRN/YEL
1Z WHT
TO 4 PIN AUX POWER PLUG
JUMPERS FOR 115V
115V/230V ISOLATION TRANSFORMER FOR 230V AC LINE
MOV7
MOV6
MOV5
25RECP
AC POWER (115VAC)
24RECP
AC POWER (115VAC)
PLASMA SELECT
PLASMA ARC ON
OXY CUT SW ON
INHIBIT INPUT ON
120HZ SYNC
SHIELD
GND ISO-B
-15V ISO-B
+15V ISO-B
IC5
ALL RELAYS ARE ITT-L224
CR1 ON
CR2 ON
CR3 ON
CR4 ON
CR5 ON
CR6 ON
CR7 ON
CR8 ON
UDN-2580A
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
RN1 270

SHEET 2 OF 2

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3.) † DENOTES FOR 24V-115V AC OR DC CUTTING INTERFACE. 1-4 MOV EQUAL 130W, 30J. 1-4R EQUAL 4000 OHM, 5W, 5%
FOR 230VAC CUTTING INTERFACE. 1-4 MOV EQUAL 250W, 55J. 1-4R EQUAL 15K OHM, 5WE 5%.

2.) ALL RESISTORS ARE 1/2W, ±5%, UNLESS OTHERWISE SPECIFIED.

1.) * DENOTES PARTS NOTE USED ON STANDARD BURNY IV TYPE OUTPUT CONNECTION ASSEMBLY.

NOTE:

					C	GENERAL REVISION	5783	JJS	8-87	TOLERANCES UNLESS OTHERWISE SPECIFIED: .X ± .030 .XX ± .010 .XXX ± .005 ANGLES ± 1°
					B	CORR. 36RECP-A	5536	JJS	11-86	
H	L1 TO 37RECP-4	7967	JJS	2-92	C	120VZ SYNC-SIC-5	5535	JJS	3-86	
G	GND TO 29CA-5	7868	KAK	5-91	B	ADD 36RECP-A	5229	GHC	1-86	
F	ADD 37 RECP	5680	RDM	7-88	A	SHOW HIDDEN COMMS	5180	DSL	10-85	

CLEVELAND MACHINE CONTROLS

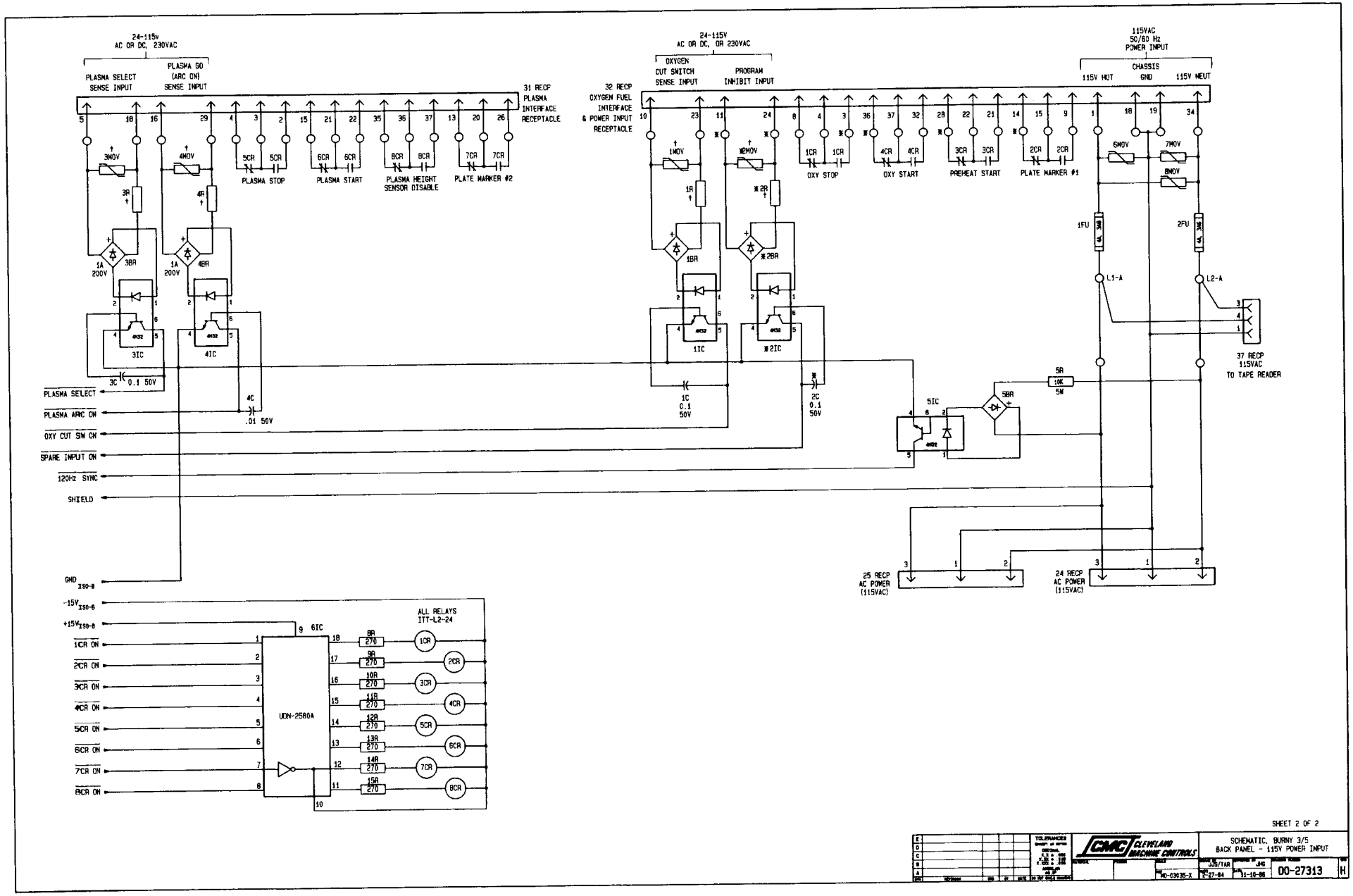
MO-03035-K

SCHEMATIC, BURNY 3/5
BACK PANEL 115VAC POWER INPUT

DRAWN JJS/TAP 2-20-84 | ENGINEER JHG 11-10-86 | DO-27313 | H

SHEET 1 OF 2

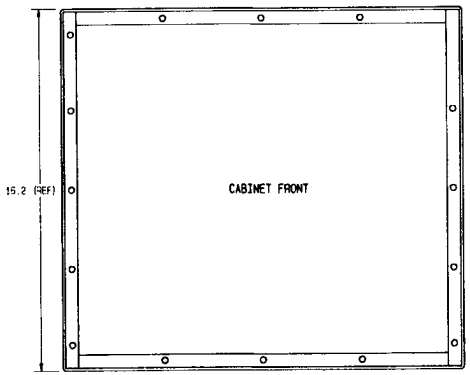
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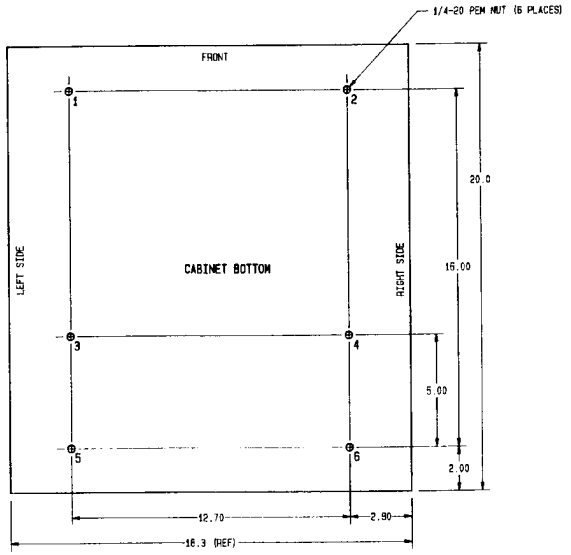


SHEET 2 OF 2

E									
D									
C									
B									
A									
DWG	DESCRIPTION	ZONE	BY	DATE	TOLERANCES UNLESS OTHERWISE SPECIFIED: FRACTIONAL ± .X = .125 .XX = .030 .XXX = .010 ANGULAR ± 45 MACH ± 30 BEND ± 1° DO NOT SCALE DRAWING	CMC CLEVELAND MACHINE CONTROLS		SCHEMATIC, BURNY 3/5 BACK PANEL - 115V POWER INPUT	
						MATERIAL	FINISH	SIZE: A	DRAWN BY: JAS/TAR
								DWG NO: 90-03635-X	DATE: 2-27-84
									APPROVED BY: JAS
									DATE: 11-10-86
								DO-27313	REV: H

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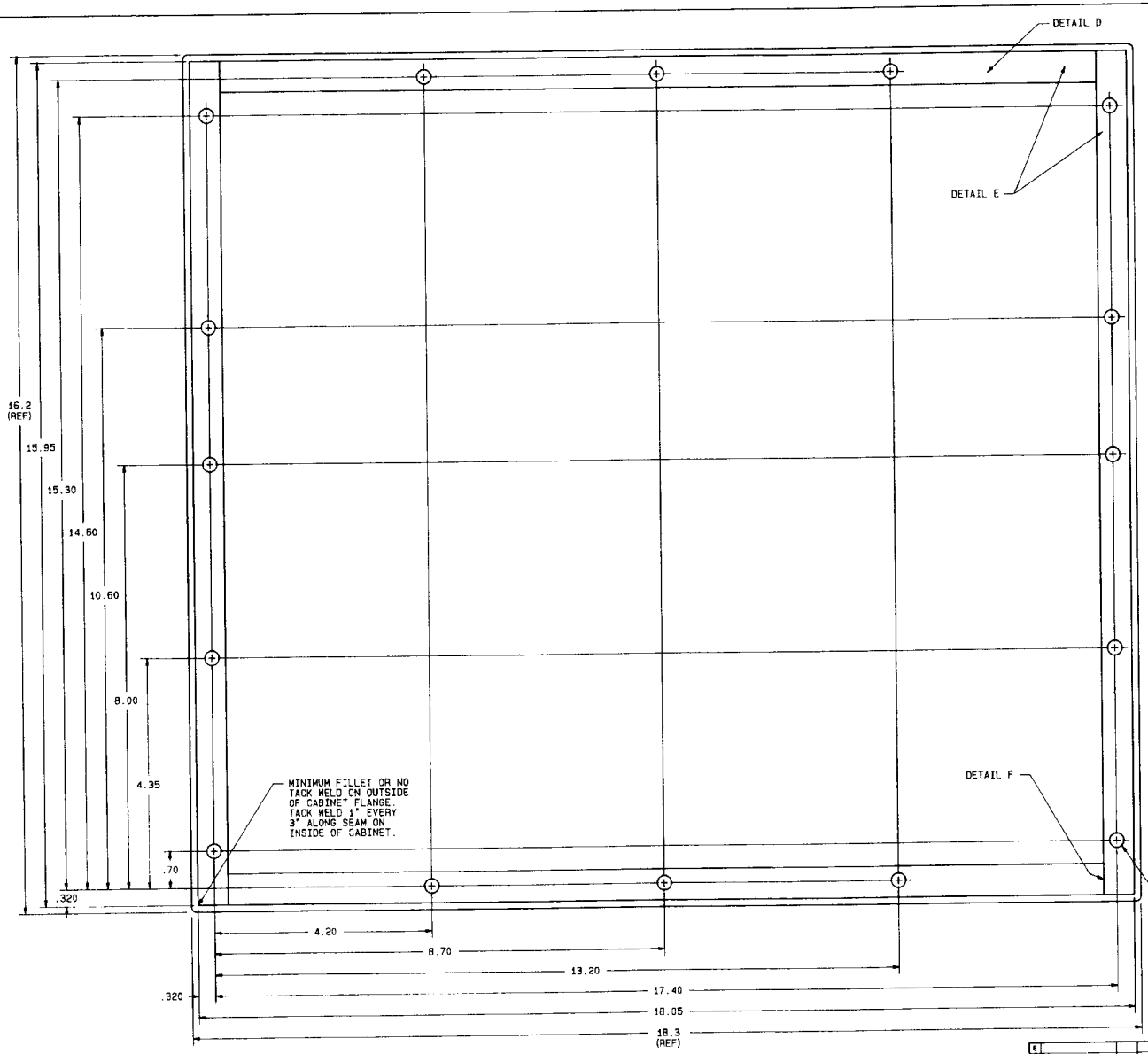


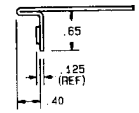
NOTE:

1.) BURNY 5 WEIGHS 55 LBS
2.) THERE ARE TWO HOLE PATTERNS FOR MOUNTING THE BURNY 5 TO A BASE PLATE. YOU CAN USE HOLE PATTERN 1, 2, 3 AND 4 OR HOLE PATTERN 1, 2, 5, AND 6

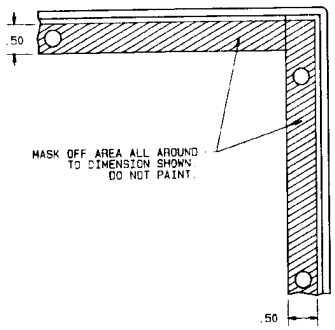
E						TOLERANCES UNLESS OTHERWISE SPECIFIED: X.X ± .030 X.XX ± .010 X.XXX ± .005 ANGLES ±2° DO NOT SCALE DRAWING	CMC CLEVELAND MACHINE CONTROLS		BURNY 5 CABINET MOUNTING DIMENSIONS		
D											
C											
B							MATERIAL	FINISH	WEIGHT	DRAWN BY JNS DATE 11-12-93	CHECKED BY S.P.M. DATE 11-17-93	D30-1093
A												
REV	REVISION	MADE	BY	DATE								

BLANK

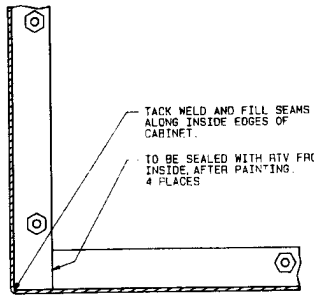




DETAIL D
FLANGE SPECIFICATIONS



DETAIL E
MASKING SPECIFICATIONS

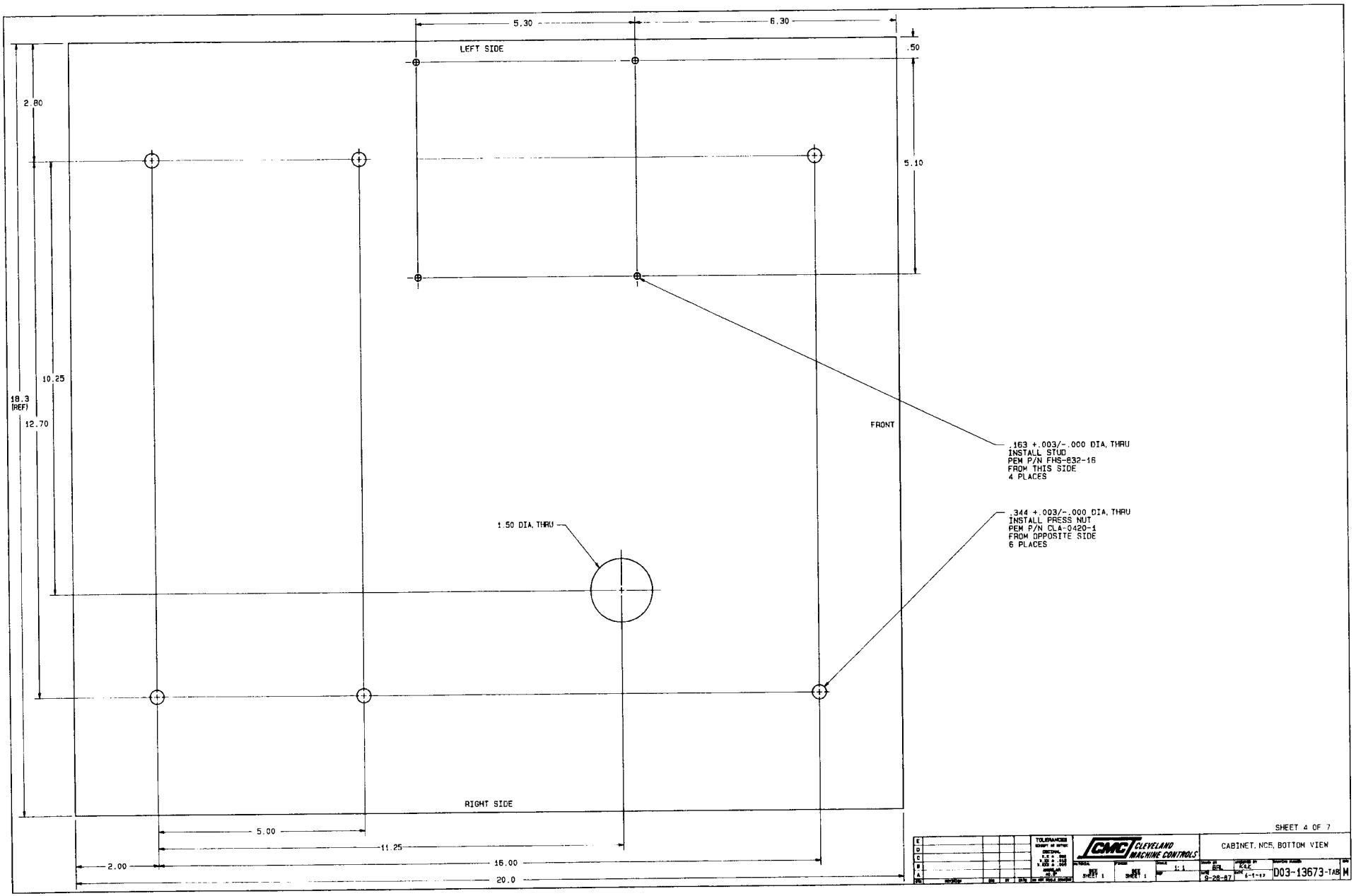


DETAIL F
RTV AND WELDING
SPECIFICATIONS

SHEET 5 OF 7

TOLERANCES	CLEVELAND MACHINE CONTROLS	CABINET, NC5, REAR VIEW				
MATERIAL	FINISH	SCALE	DRAWN BY	APPROVED BY		
SEE SHEET 1	SEE SHEET 1	1:1	BRL			
			DATE 6-26-87	DATE 6-1-13	D03-13673-TAB	M

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SHEET 4 OF 7

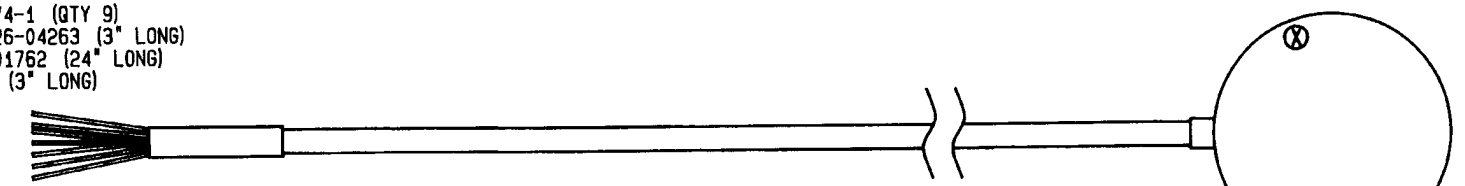
CLEVELAND MACHINE CONTROLS

CABINET, NC5, BOTTOM VIEW

D03-13673-TAB M

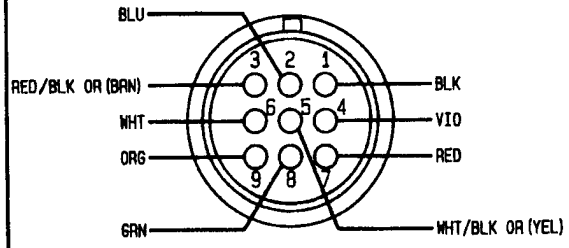
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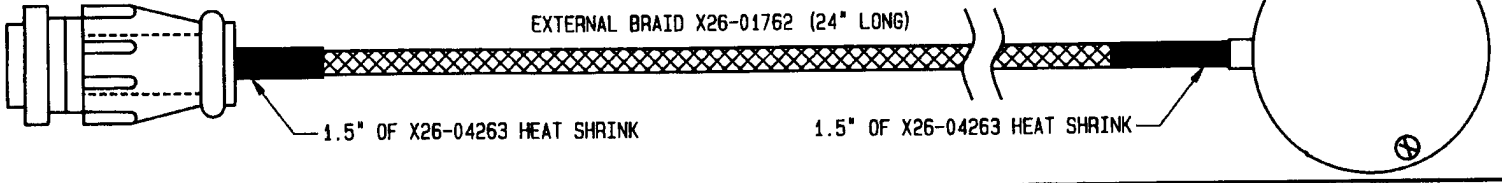
HOUSING X43-09107
CONN CLAMP X43-09108
FEMALE PINS X43-26274-1 (QTY 9)
.38 SHRINK TUBING X26-04263 (3" LONG)
EXTERNAL BRAID X26-01762 (24" LONG)
FOAM TAPE X09-08344 (3" LONG)



MODULAR ENCODER X28-25312

1	BLK	COMMON
2	BLU	MARKER
3	RED/BLK OR (BRN)	CHANNEL A
4	VIO	CHASSIS
5	WHT/BLK OR (YEL)	CHANNEL B
6	WHT	MARKER
7	RED	+5V
8	GRN	CHANNEL A
9	ORG	CHANNEL B





NOTE:
CONNECTOR CLAMP MUST BE TIGHTENED SECURELY ONTO THE THREADED CONNECTOR.

SYM	REVISION	ECO	BY	DATE
E				
D				
C				
B	ALTERNATE COLORS	11377	KAP	02/96
A	X43-09105 TO X43-26274	8778	JHG	03/93

TOLERANCES
EXCEPT AS NOTED
DECIMAL
X.X ± .030
X.XX ± .015
X.XXX ± .005
ANGULAR
±0.5°
DO NOT SCALE DRAWING

CMC CLEVELAND MACHINE CONTROLS

MATERIAL | FINISH | SCALE | WT

DRAWN BY JHG DATE 10-19-92
APPROVED BY KAK/SPK DATE 03-25-93

ASSEMBLY & SCHEMATIC, ENCODER & CABLE WIRING

DRAWING NUMBER B0-11464 SHT B

BLANK

MODULAR ENCODER INSTALLATION TO SERVOMOTOR

MOUNTING CONFIGURATION

PLEASE REFER TO FIGURE 1 FOR PROPER MOUNTING SURFACE CONFIGURATION. YOU WILL NOTE THAT TWO 4-40 X .18 DEEP TAPPED HOLES ARE REQUIRED. THE TWO TAPPED HOLES ARE USED TO MOUNT THE MODULAR ENCODER TO THE MOTOR SURFACE WITH THE 4-40 X .38 SOCKET HEAD SCREWS PROVIDED.

THE ENCODER COVER IS HELD IN PLACE USING TWO 2 X 3/8 P.H. SELF-TAPPING SCREWS. THESE SCREWS THREAD INTO THE MAIN ASSEMBLY AS SHOWN IN FIGURE 1.

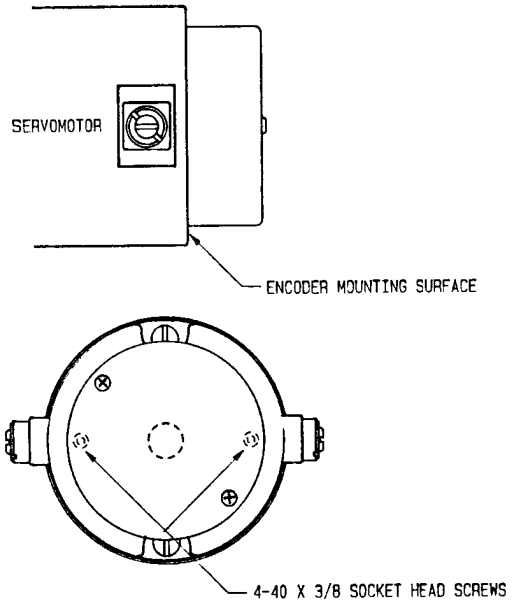


FIGURE 1

INSTALLATION PROCEDURE

STEP 1 - REMOVE COVER

BACK OUT THE TWO NO. 2 P.H. ENCODER COVER SCREWS WHICH SECURE THE COVER TO THE MAIN ASSEMBLY. REMOVE THE COVER BEING CAREFUL NOT TO DISLODGE THE GAP GAUGE (MYLAR SHIM) FROM THE ASSEMBLY.

STEP 2 - MOUNT MAIN ASSEMBLY

SLIDE THE MAIN ASSEMBLY ONTO THE MOTOR SHAFT, CARE SHOULD BE TAKEN TO AVOID ANY EXCESSIVE FORCE IN MOUNTING AS THE CAPTURED ENCODER DISK COULD BE DAMAGED. IF THE ASSEMBLY DOES NOT SLIDE ON FREELY, DO NOT PROCEED UNTIL THE CAUSE OF THE INTERFERENCE HAS BEEN DETERMINED. A SLIP FIT IS DESIRED, A DISK/HUB ASSEMBLY WHICH IS EXCESSIVELY LOOSE WILL RESULT IN UNACCEPTABLE SIGNAL ERROR CAUSED BY GAP VARIATION.

LOCATE AND ALIGN THE MOUNTING HOLE LOCATIONS OF THE ENCODER WITH THOSE OF THE MOTOR MOUNTING SURFACE. SECURE THE MAIN ASSEMBLY TO THE MOUNTING SURFACE USING THE MOUNTING HARDWARE PROVIDED. AFTER SECURING ENCODER TO MOTOR, LIFT THE DISK/HUB ASSEMBLY TO INSURE THAT IT MOVES FREELY UP AND DOWN THE MOTOR SHAFT WITHIN THE CONSTRAINT OF THE MAIN ASSEMBLY. IF THE DISK/HUB ASSEMBLY DOES NOT MOVE FREELY, DO NOT PROCEED AS DAMAGE COULD RESULT.

STEP 3 - GAPPING

LIFT AND ROTATE THE DISK/HUB ASSEMBLY, ALIGNING ONE OF THE TWO HUB SET SCREWS WITH THE ACCESS CHANNEL (SEE FIGURE 2), WHICH IS LOCATED RIGHT NEXT TO THE L.E.D. MOUNTING LOCATION. THE ACCESS CHANNEL PROVIDES A MEANS OF ACCESS TO THE HUB SET SCREWS USING THE 4-48 HEX WRENCH PROVIDED.

APPLY A VERY LIGHT PRESSURE TO THE TOP OF THE HUB WHICH WILL ENGAGE THE DISK WITH THE GAP GAUGE (MYLAR SHIM). USING THE HEX WRENCH, LIGHTLY TIGHTEN ONE OF THE TWO SET SCREWS, ROTATE THE MOTOR SHAFT BY HAND TO EXPOSE THE SECOND HUB SET SCREW WHICH IS 90 DEGREES FROM THE FIRST SET SCREW.

AFTER YOU HAVE TIGHTENED BOTH HUB SET SCREWS, ROTATE THE MOTOR SHAFT BY HAND, USE THE GAP GAUGE (MYLAR SHIM) TO INSURE THAT THERE IS CONSISTENT SPACING THROUGHOUT THE ENTIRE ROTATION OF THE MOTOR SHAFT. SHOULD THERE BE ANY BINDING, LOOSEN THE HUB SET SCREWS AND REPEAT THE PROCEDURE. DO NOT REMOVE THE GAP GAUGE (MYLAR SHIM) UNTIL SATISFIED THAT A CONSISTENT AIR GAP EXISTS. REMOVE GAUGE, DO NOT DISCARD AS GAUGE MUST BE USED IF UNIT IS TO BE REMOVED.

AFTER REMOVING GAP GAUGE (MYLAR SHIM), FURTHER TIGHTEN THE HUB SET SCREWS TO INSURE THAT THEY REMAIN SECURE. REPLACE COVER REMOVED IN STEP 1 BY REVERSING PROCEDURE.

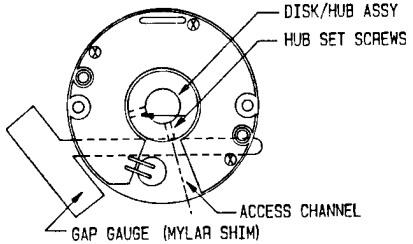


FIGURE 2

STEP 4 - ELECTRICAL CONNECTIONS

WIRE COLOR	OUTPUT FUNCTION
GREEN	A OUTPUT
RED/BLK	A COMP
BLUE	M COMP
BLACK	COMMON
RED	+VS
ORANGE	B OUTPUT
WHITE/BLK	B COMP
WHITE	M OUTPUT
VIOLET	SHIELD

NOTES:

1.) SHOULD IT BE NECESSARY TO REMOVE AN ENCODER FOR ANY REASON, IT CAN BE ACCOMPLISHED QUITE SIMPLY, WITHOUT CAUSING DAMAGE, BY REVERSING THE INSTALLATION PROCEDURE. BE SURE TO RE-INSERT THE GAP GAUGE (MYLAR SHIM) TO PREVENT DAMAGE TO THE ENCODER DISK.

2.) THE OUTPUT SIGNALS, PHASE RELATIONSHIP AND DUTY SIGNAL ARE FACTORY PREALIGNED AND SHOULD NOT REQUIRE ANY ADJUSTMENT. SEE FIGURE 3. IF THE OUTPUT SIGNALS DO NOT MEET PUBLISHED FACTORY SPECIFICATIONS, IT COULD BE DUE TO AN IMPROPERLY SET AIR GAP. IF THE UNIT IS FOUND TO BE OUT OF PUBLISHED SPECIFICATIONS, THE AIR GAP SHOULD BE CHECKED TO INSURE THAT IT WAS SET PROPERLY DURING THE INSTALLATION PROCEDURE.

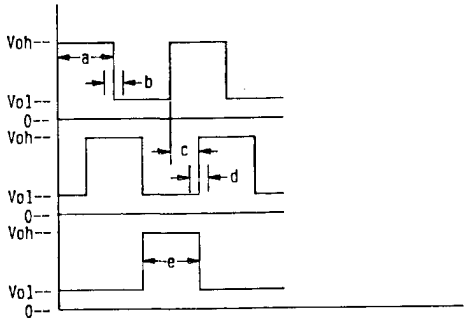


FIGURE 3

REV	REVISION	ECO	BY	DATE
E				
D				
C				
B				
A				

TOLERANCES EXCEPT AS NOTED: DECIMAL X.X ± .030, X.XX ± .015, X.XXX ± .005; ANGULAR ±0.5°. DO NOT SCALE DRAWING

CMC CLEVELAND MACHINE CONTROLS

ASSY, M21 ENCODER TO MT2630 SERVOMOTOR

MATERIAL	FINISH	SCALE	DRAWN BY	APPROVED BY	DRAWING NUMBER	REV
		REF	JHS	SPK	CO-11466	
			DATE 10-20-92	DATE 10-22-92		

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											1.5 P.D. PINION				SD20 AND SD21					
MODEL	DESCRIPTION	CURRENT CMC P/N	PREVIOUS CMC P/N	PREVIOUS CMC P/N	RATED DRIVE SPEED I.P.M.	RATED DRIVE SPEED M.P.M.	MOTOR MODEL	G.B. RATIO	MOTOR PULLEY	G.B. PULLEY	MOTOR SPEED	FINAL RATIO	INCHES PER ARM REV	mm PER ARM REV	1.25 P.D. PINION	1.5 P.D. PINION	1.625 P.D. PINION	1.6667 P.D. PINION	2.0 P.D. PINION	SD22 ENCODER LINES
SP-150	W/ENCODER, FOLDED	MO-11783-12F	MO-11344-12F	MO-08935-0	150	3.8	MT-2630-141AF	33.9	20	30	1619	50.85000	0.092672	2.354	3.0891	3.7069	4.0158	4.1189	- - -	8000
SP-150	W/ENCODER, FOLDED	MO-11783-22F	MO-11344-22F	MO-08795-0	250	6.4	MT-2630-141AF	33.9	24	28	2098	39.55000	0.119150	3.026	3.9717	4.7660	5.1632	5.2957	- - -	8000
SP-150	W/ENCODER, FOLDED	MO-11783-32F	MO-11344-32F	MO-08935-1	300	7.6	MT-2630-141AF	19.1	20	30	1824	28.65000	0.164481	4.178	4.1120	4.9344	5.3456	5.4828	- - -	6000
SP-150	W/ENCODER, FOLDED	MO-11783-42F	NONE	MO-09502-0	450	11.4	MT-2630-141AF	33.9	30	20	2158	22.6000	0.208513	5.296	4.1703	5.0043	5.4213	5.5605	- - -	4800
SP-150	W/ENCODER, FOLDED	MO-11783-52F	MO-11344-52F	MO-08795-1	500	12.7	MT-2630-141AF	19.1	24	28	2364	22.28333	0.211476	5.371	4.2295	5.0754	5.4984	5.6395	- - -	4800
SP-150	W/ENCODER, FOLDED	MO-11783-82F	MO-11344-82F	MO-10638	800	20.3	MT-2630-141AF	19.1	30	20	2162	12.73333	0.370083	9.400	4.6260	5.5512	6.0139	6.1682	- - -	3000
SP-150	W/ENCODER, INLINE	NONE	NONE	MO-10335	70	1.8	MT-2630-141AF	33.9	15	44	1477	99.44000	0.047389	1.204	3.9491	4.7389	5.1338	5.2655	- - -	20000
SP-150	W/ENCODER, INLINE	MO-11783-12I	MO-11344-12I	MO-08934-0	150	3.8	MT-2630-141AF	33.9	20	30	1619	50.85000	0.092672	2.354	3.0891	3.7069	4.0158	4.1189	- - -	8000
SP-150	W/ENCODER, INLINE	MO-11783-22I	MO-11344-22I	MO-08794-0	250	6.4	MT-2630-141AF	33.9	24	28	2098	39.55000	0.119150	3.026	3.9717	4.7660	5.1632	5.2957	- - -	8000
SP-150	W/ENCODER, INLINE	MO-11783-32I	MO-11344-32I	MO-08934-1	300	7.6	MT-2630-141AF	19.1	20	30	1824	28.65000	0.164481	4.178	4.1120	4.9344	5.3456	5.4828	- - -	6000
SP-150	W/ENCODER, INLINE	MO-11783-42I	NONE	MO-09501-0	450	11.4	MT-2630-141AF	33.9	30	20	2158	22.6000	0.208513	5.296	4.1703	5.0043	5.4213	5.5605	- - -	4800
SP-150	W/ENCODER, INLINE	MO-11783-52I	MO-11344-52I	MO-08794-1	500	12.7	MT-2630-141AF	19.1	24	28	2364	22.28333	0.211476	5.371	4.2295	5.0754	5.4984	5.6395	- - -	4800
SP-150	W/ENCODER, INLINE	MO-11783-82I	MO-11344-82I	MO-09267	800	20.3	MT-2630-141AF	19.1	30	20	2162	12.73333	0.370083	9.400	4.6260	5.5512	6.0139	6.1682	- - -	3000
SP-360	W/ENCODER, FOLDED	MO-11784-22F	MO-11343-22F	MO-09202	250	6.4	MT-3528-297CF	34.0	24	28	2104	39.66667	0.118800	3.018	3.9600	4.7520	5.1480	5.2801	- - -	8000
SP-360	W/ENCODER, FOLDED	MO-11784-32F	MO-11343-32F	MO-09200	350	8.9	MT-3528-297CF	34.0	28	24	2165	29.14286	0.1617	4.107	4.0425	4.8510	5.2552	5.3901	- - -	6000
SP-360	W/ENCODER, FOLDED	MO-11784-42F	MO-11343-42F	MO-09198	450	11.4	MT-3528-297CF	34.0	30	20	2165	22.66667	0.207900	5.281	4.1580	4.9896	5.4054	5.5441	- - -	4800
SP-360	W/ENCODER, FOLDED	MO-11784-52F	MO-11343-52F	MO-08956	500	12.7	MT-3528-297CF	34.0	30	18	2165	20.40000	0.230999	5.867	4.6200	5.5440	6.0060	6.1601	- - -	4800
SP-360	W/ENCODER, INLINE	MO-11784-22I	MO-11343-22I	MO-09203	250	6.4	MT-3528-297CF	34.0	24	28	2104	39.66667	0.118800	3.018	3.9600	4.7520	5.1480	5.2801	- - -	8000
SP-360	W/ENCODER, INLINE	MO-11784-32I	MO-11343-32I	MO-09201	350	8.9	MT-3528-297CF	34.0	28	24	2165	29.14286	0.1617	4.107	4.0425	4.8510	5.2552	5.3901	- - -	6000
SP-360	W/ENCODER, INLINE	MO-11784-42I	MO-11343-42I	MO-09199	450	11.4	MT-3528-297CF	34.0	30	20	2165	22.66667	0.207900	5.281	4.1580	4.9896	5.4054	5.5441	- - -	4800
SP-360	W/ENCODER, INLINE	MO-11784-52I	MO-11343-52I	MO-09175	500	12.7	MT-3528-297CF	34.0	30	18	2165	20.40000	0.230999	5.867	4.6200	5.5440	6.0060	6.1601	- - -	4800
SP-720	W/ENCODER, INLINE	MO-10070	NONE	NONE	250	6.4	MTE-4237-138BF	47.87	14	21	2857	71.80500	0.087503	2.223	- - -	- - -	- - -	- - -	5.2502	30000
SP-720	W/ENCODER, INLINE	MO-10071	NONE	NONE	250	6.4	MTE-4237-138BF	47.87	14	21	2857	71.80500	0.087503	2.223	- - -	- - -	- - -	- - -	5.2502	30000
SP-720	W/ENCODER, FOLDED	MO-10072	NONE	NONE	250	6.4	MTE-4237-138BF	47.87	14	21	2857	71.80500	0.087503	2.223	- - -	- - -	- - -	- - -	5.2502	30000
SP-720	W/ENCODER, FOLDED	MO-10073	NONE	NONE	250	6.4	MTE-4237-138BF	47.87	14	21	2857	71.80500	0.087503	2.223	- - -	- - -	- - -	- - -	5.2502	30000
SP-720	W/ENCODER, REV INLINE	MO-10070	NONE	NONE	250	6.4	MTE-4237-138BF	47.87	14	21	2857	71.80500	0.087503	2.223	- - -	- - -	- - -	- - -	5.2502	30000
SP-720	W/ENCODER, REV INLINE	MO-10071	NONE	NONE	250	6.4	MTE-4237-138BF	47.87	14	21	2857	71.80500	0.087503	2.223	- - -	- - -	- - -	- - -	5.2502	30000

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SYM	REVISION	ECO	BY	DATE
F				
E				
D				
C	ADD NEW CMC P/N	12590	KAP	07/98
B	ADD MO-10638/MO-10335	10727	KAP	03/95
A	GENERAL REVISION	10136	GMC	09/94

TOLERANCES (EXCEPT AS NOTED)
DECIMAL
X.X ± .030
X.XX ± .015
X.XXX ± .005
ANGULAR
± 0.5°
DO NOT SCALE DRAWING

Cleveland Motion Controls
An IMC Company
7550 HUB PARKWAY CLEVELAND, OHIO

MATERIAL | FINISH | SCALE | REF

PARAMETERS, 200 COUNT MODULAR ENCODER

CAD DWG NO. : BO-9371C01.DWG
SIZE: B
DRAWING NUMBER: BO-9371
REV: C
DRAWN BY: KAP
APPROVED BY: SPK
DATE: 18 MAY 94
DATE: 18 MAY 94
SHEET 1 OF 3

BLANK

STEP 1:
CALCULATE NUMBER OF MOTOR REVOLUTIONS FOR SPECIFIED NUMBER OF ENCODER LINES SD22.

$$\frac{\text{SD22 - ENC LIN/REV}}{\text{ACTUAL ENCODER LINES/REV}} \times \frac{1}{4} = \left[\text{NUMBER OF MOTOR REVS}\right]$$

Multiply by 1/4 if jumpers on processor or I/O card are moved to the X1 position instead of the normal X4

NOTE:
THIS ONLY OCCURS ON THE OLD STYLE SYSTEMS.
NEW BURNY 2.5 & BURNY 3 DO NOT HAVE JUMPERS

STEP 2:
CALCULATE NUMBER OF OUTPUT SHAFT REVOLUTIONS BASED ON NUMBER OF MOTOR REVOLUTIONS.

$$\left[\begin{matrix}\text{NUMBER}\\ \text{OF}\\ \text{MOTOR REVS}\end{matrix}\right] \times \frac{\text{MOTOR PULLEY}}{\text{GEARBOX PULLEY}} \times \frac{1}{\text{GEARBOX RATIO}} = \left[\begin{matrix}\text{NUMBER OF}\\ \text{GEARBOX OUTPUT}\\ \text{REVOLUTIONS}\end{matrix}\right]$$

STEP 3:
CALCULATE HOW FAR THE MACHINE TRAVELS BASED ON THE NUMBER OF OUTPUT SHAFT REVOLUTIONS AND THE DIAMETER OF THE PINION GEAR.

$$\left[\begin{matrix}\text{NUMBER OF}\\ \text{GEARBOX OUTPUT}\\ \text{REVOLUTIONS}\end{matrix}\right] \times \left[\begin{matrix}\text{PINION GEAR}\\ \text{CIRCUMFERENCE}\end{matrix}\right] = \left[\text{SD20, SD21 - ENC DIST/REV}\right]$$

FOR DIAMETRAL PITCH GEARS
CIRCUMFERENCE = (P.D.) x 3.1415962
Pitch Diameter — Pi

FOR CIRCULAR PITCH GEARS
CIRCUMFERENCE = TOOTH SIZE x NUMBER OF TEETH ON PINION
For .25 circular pitch teeth are .2500" inches

EXAMPLE: A) MO-08935-0 (REFER TO TABLE FOR SPECIFICATIONS)
B) A08-16223 (BURNY STANDARD PINION)
16DP, 20 DEGREE PA, 1.5" PITCH DIA, 24 TEETH

STEP 1: $\frac{8000}{200} = 40$ [NUMBER OF MOTOR REVS]

STEP 2: $40\left(\frac{20}{30}\right)\left(\frac{1}{33.9}\right) = .786627$ [NUMBER OF GEARBOX OUTPUT REVOLUTIONS]

STEP 3: .786627 (1.5) (3.1415926) = 3.70689 [SD20, SD21 - ENC DIST/REV]

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SYM	REVISION	ECO	BY	DATE
F				
E				
D				
C				
B				
A				

DO NOT SCALE DRAWING

TOLERANCES (EXCEPT AS NOTED)
DECIMAL
X.X ± .030
X.XX ± .015
X.XXX ± .005
ANGULAR
± 0.5°

Cleveland Motion Controls
An IMC Company
7550 HUB PARKWAY CLEVELAND, OHIO

MATERIAL	FINISH	SCALE	REF

PARAMETERS,
200 COUNT MODULAR ENCODER

CAD DWG NO. : B0-9371C02.DWG		SIZE	DRAWING NUMBER	REV
DRAWN BY KAP	APPROVED BY SPK	B	B0-9371	C
DATE 18 MAY 94	DATE 18 MAY 94	SHEET 2 OF 3		

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	PART_NO.	PITCH	P_ANG	PITCH_DIA	BORE	FACE	NO._TEETH	HUB_DIA	HUB_PROJ	SET_SCRW
1	A01-13087	24DP	14.5	1.625"	0.375"	0.375	39	0.75	0.375	8-32
2	A01-13088	24DP	20	1.6667"	0.375"	0.375	40	0.75	0.375	10-32
3	A01-15074	24DP	14.5	1.625"	0.625"	0.75	39	1.187	0.5	(2) 5/16-18
4	A01-15160	16DP	20	2.0"	1.0"	0.75	32	1.812	0.5	(2) 1/4-20
5	A01-15673	16DP	20	2.5"	0.625"	0.75	40	2.187	0.625	(2) 10-32
6	A01-16456	24DP	14.5	1.5"	0.625"	0.75	36	1.125	0.625	(2) 8-32
7	A01-16457	24DP	14.5	1.5"	0.625"	0.75	36	1.125	2.25	(2) 8-32
8	A01-18599	20DP	20	1.5"	0.625"	0.5	30	1.4375	0.4375	(2) 5/16-18
9	A01-26149	.25 CIR	20	1.5119"	0.625"	1.0"	19	1.1875	1.0"	(2) 5/16-18
10	A08-15894	16DP	20	2.5"	0.625"	0.75	40	2.187	0.625	(2) 10-32
11	A08-16195	16DP	20	1.5"	0.625"	0.75	24	1.187	0.5	(2) 5/16-18
12	A08-16223	16DP	20	1.5"	0.625"	0.75	24	1.187	0.5	(2) 5/16-18
13	B01-18856	.25 CIR	20	2.0"	1.0"	0.75	25	1.641	0.625	(2) 3/8-16
14	B01-18864	.25 CIR	14.5	2.0"	1.0"	0.75	25	1.641	0.625	(2) 3/8-16
15	B01-19539	12DP	20	1.5"	0.625"	1.0"	18	1.234	0.625	(2) 5/16-18
16	B01-19876	2.0 MOD	20	2.125"	1.0"	1.0"	27	1.688	1.75	(2) 3/8-16
17	B01-20066	.25 CIR	20	1.5"	0.375"	0.75	18	1.25	0.25	8-32
18	B01-21093	16DP	20	1.0"	12mm	0.75	16	0.812	0.5	(2) 1/4-20
19	B01-21902	16	20	2.0"	1.0"	0.75	32	1.688	1.125	(2) 5/16-18
20	B01-21960	.25 CIR	14.5	2.0"	1.0"	0.75	25	1.688	1.125	(2) 5/16-18
21	B01-22125	1/5 CIR	20	2.0"	1.0"	0.75	31	1.688	1.125	(2) 5/16-18
22	B01-22215	.25 CIR	20	2.0"	1.0"	0.75	25	1.688	1.125	(2) 5/16-18
23	B01-22299	12DP	20	2.0"	1.0"	0.75	24	1.688	1.125	(2) 5/16-18
24	B01-22319	24 DP	14.5	1.0"	0.475	0.75	24	0.812	0.5	10-32
25	B01-22362	.25 CIR	14.5	2.546"	1.0"	1.0"	32	2.125	1.125	(2) 5/16-18
26	B01-22826	----	20	----	----	----	30	----	----	----
27	B01-22827	----	20	----	----	----	18	----	----	----
28	B01-23406	1/5 CIR	20	1.528"	0.375"	0.375	24	0.75	0.5	10-32
29	B01-24566	1/5 CIR	20	1.5915"	0.375"	0.375	25	0.75	0.375	(2) 10-32
30	B01-25200	1.0 MOD	20	16mm	8mm	10mm	16	14mm	7mm	(2) M4
31	B08-24476	20DP	14.5	1.5"	0.625"	0.75	30	1.1875	0.5	(2) 5/16-18
32	C01-24535	16DP	20	2.0"	1.0"	0.75	32	1.688	1.125	(2) 5/16-18
33	X01-10255	1/10 CIR	20	1.5915"	0.375"	0.1875	50	0.5	0.25	6-32
34	X01-11177	24DP	20	1.6667"	0.375"	0.375	40	0.75	0.375	NONE
35	X01-13103	24DP	20	1.6667"	0.375"	0.375	40	0.75	0.375	10-32
36	X01-15343	16DP	20	1.5"	0.375"	0.5	24	0.75	0.5	10-32
37	X01-16137	20DP	20	1.5"	0.375"	0.375	30	0.75	0.375	10-32
38	X08-16217	16DP	20	1.5"	0.625"	0.75	24	1.1875	0.5	(2) 5/16-18
39	B01-27071	12DP	14.5	1.5"	0.625"	0.75	18	1.25	0.5	(2) 5/16-18
40	B01-27072	12DP	14.5	1.5"	0.375"	0.75	18	1.25	0.5	(2) 10-32

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TOLERANCES (EXCEPT AS NOTED)
DECIMAL
X.X ± .030
X.XX ± .015
X.XXX ± .005
ANGULAR
± 0.5°
DO NOT SCALE DRAWING

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An IMC Company
7550 HUB PARKWAY CLEVELAND, OHIO

MATERIAL | FINISH | SCALE | REF

PARAMETERS, 200 COUNT MODULAR ENCODER

CAD DWG NO. : B0-9371C03.DWG
DRAWN BY: KAP
APPROVED BY: SPK
DATE: 18 MAY 94
DATE: 18 MAY 94

SIZE: B | DRAWING NUMBER: B0-9371 | REV: C

SHEET 3 OF 3

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PART 10 - MANUAL ADDENDA

Insert Tab - Part 10

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PROBLEMS CORRECTED IN VERSION 1/15/97:

A) FEEDRATE SPEED REDUCTION ERROR

It was found that certain combinations of auxiliary functions could incorrectly cause the control to ramp the speed to zero instead of just smoothly changing from one feedrate to another. The condition was found in a part program that used excessive quantities of G01, G02, and G03 codes and programmable feedrate operations. However, other combinations of redundant auxiliary functions codes could also cause the same slowdown condition even without the programmable feedrate codes.

This correction was distributed in a preliminary 2/28/95-F1 MPC software version for field testing. However, that version was never officially released.

B) KERF CALCULATION ERROR

An error was found in the multiword integer math routines that are used by the KERF process to calculate a mathematically correct arc center point. This problem would only occur with a unique combination of large radius values. When the error occurred, an enormous arc was generated for the KERF path making the error condition very noticeable.

This correction was also distributed in a preliminary 2/28/95-F1 MPC software version for field testing. However, that version was never officially released.

IMPROVEMENTS MADE IN VERSION 1/15/97:

A) ENHANCED C-AXIS CALCULATIONS

While investigating a reported problem with the operation of the C-AXIS, it was found that when processing arcs, the first and the last outputs for the arc did not represent the actual direction of the tangential vector. In most cases, the vector continued to define the last output direction as defined by the preceding position loop scan. In normal applications when running a part program, this vector was so close to the tangent that no error was noted. However when single stepping through arcs or running at very low speeds (less than 1 IPM), a noticeable error could be observed.

This new enhancement, when enabled by the "0000 0040" bit in SYSTEM SETUP DATA variable 40 (SYSTEM CONFIGURATION 4), causes the control to perform additional calculations and then force the C-AXIS to the precise vector angle as it begins and ends an arc. Since the amount of overhead associated with these calculations is substantial, this feature should only be enabled when performing C-AXIS operations and then, only when cutting at very low speed and the maximum degree of accuracy is required.

When this feature is not enabled, the C-AXIS vectors are outputs continuously using the exact same technique as in earlier software versions. That is when not enabled, there are no functional differences between this software version and previous software versions.

B) CUT LOSS RECOVERY

Although the concept of recovering from a power failure condition seems quite simple, in reality many different enhancements were required to satisfy this new requirement. Some provided the fixed coordinate system and the mechanisms to re-establish a FIXED ZERO position using either a manual jog mode or an automatic hardware home search mode. Other enhancements provided techniques to internally advance through a part program while re-establishing the mode and relative position at a given point in the program. Techniques to continuously "remember" the position of the tool and various operating parameters were also incorporated. To better support "job interruption" and "rush order" processing, multiple plates can now be defined with not only different offsets but also different sizes, angles, and orientations (i.e. left or right plate conventions). The greatest challenge, however, was to enhance the graphics process so that it properly shows the relative positions of the plate, the tool, and the part as it will be cut when the <GO> key is pressed. Now whenever a plate is properly defined by the system, the operator can see the selected program block aligned about the tool position as it will be cut. If tool repositioning is required, the operator can simple jog the machine to a different location and request a redraw of the part. With these CUT LOSS graphic enhancements, the part image follows the tool position so that the operator can always see what will be cut and were the cut will occur on the plate. All the operator needs to do is remember to redraw the part after moving the tool.

Due to the large number of changes made to support the CUT LOSS RECOVERY feature and the related enhancements, the description for this software has been provided in 8 sections which follow a table of contents. SECTION 1 provides an overview of the various features resulting from these changes. Other sections provide more detailed information. The largest section provides a description of screen changes and operating differences as well as a description of the new TABLE/PLATE DEFINITIONS screen. Later all of this information will be added to the Burny 5 manual, but for now, this description will be the primary source of information for the operator.

1. CUT LOSS ENHANCEMENT SUMMARY
2. CUT LOSS RECOVERY SCREENS AND OPERATIONS
3. SYSTEM SETUP DATA CONSIDERATIONS
4. SYSTEM SETUP DATA CONFIGURATION BIT SUMMARY
5. BURNY 5 / PLC SYSTEM CONSIDERATIONS
6. HARDWARE REQUIREMENTS (FEATURE BASED)
7. HARDWARE HOME CONSIDERATIONS
8. HARDWARE VERSION DESCRIPTIONS

BURNY TECHNICAL BULLETIN NO. 011597-S5

PRODUCT/ MODEL: BURNY 5

NEW VERSION: FPC 1/15/97
MPC 1/15/97
REPLACES VERSION: FPC 2/28/95-E
MPC 2/28/95-F

UPDATE CATEGORY: FPC/MPC Software Revision

GENERAL INFORMATION:

This software release is the first to provide the CUT LOSS enhancements in an official version. Like others, it contains the nine supported alternate language tables. However at this time, all of the newly added strings are always displayed in ENGLISH regardless of the language selected.

WARNINGS:

- This version uses the new internal date format which was first introduced in the MPC 2/28/95-E software version. After running this new version in a control, versions before 2/28/95-E should not be reinstalled without first saving the SYSTEM SETUP DATA parameters as an ASCII DATA file for later recall.
- This official software version has only been approved for use in the current hardware version. Earlier hardware does not support all of the capabilities required for this new software version. Some difficulties relate to newly added features while others prevent previously supported features from operating at all. Generally, the older the hardware, the less functional this software will be. **SEE THE NC UPDATE.**

PROBLEMS CORRECTED:

- A programmable feedrate problem causing a full slowdown under certain conditions.
- A KERF calculation problem causing the adjusted center to be incorrectly defined in some cases.
- Plate, part, and tool display inconsistencies.

IMPROVEMENTS MADE:

- Power/Cut loss recovery.
- Fixed grid positioning.
- Job interruption with restart.
- Selectable block start.
- Multiple plate definitions.
- Enhanced C-axis positioning.

DATE ISSUED: 3 / 26 / 97

CMC CLEVELAND MACHINE CONTROLS

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SUBJECT: BURNY 5 SOFTWARE VERSION 1/15/97
DATE: 25-Mar-1997
BY: GSC

This NC UPDATE describes the enhancements and corrections that have been made in the BURNY 5 software since the last official release (FPC: 2/28/95-E, MPC: 2/28/95-F). Most of these changes were specifically made to support CUT LOSS RECOVERY operations after a power failure. Some changes extend this basic capability to support JOB INTERRUPTION, "RUSH ORDER" processing, and other related features. Still other changes improve the accuracy and response of the rotary C-AXIS when processing arcs, especially at the start and the end of each arc. The following enhancements, among others, are provided in this new official BURNY 5 MPC/FPC software version:

- Improved C-AXIS performance
- Power/Cut loss recovery
- Fixed grid positioning
- Improved real-time graphics
- Job interruption with restart
- Selectable block start
- Multiple plate definitions

In addition to these improvements, this software version also contains corrections for the following problems:

- A feedrate block problem which caused the speed to ramp to zero before continuing.
- A KERF calculation error which only occurred with certain numeric values.

This new software version is available in all supported languages, which includes ENGLISH, FRENCH, GERMAN, FINNISH, ITALIAN, SPANISH, SWEDISH, NORWEGIAN, DUTCH, and PORTUGUESE. However, all of the newly added strings are only displayed in English because updated translations have not yet been obtained.

WARNING

This software version should not be used with the MPC "TYPE 4" MAIN CARD due to the limitations of this card. More specifically, this card does not have the necessary SCRATCH RAM to support any of the recovery operations or the plate operations. As such, this software version cannot support plate alignment operations on this card. Consult the factory for hardware upgrade information.

This software version must not be installed any control used in the BURNY 5 / PLC SYSTEM configuration until an evaluation of its ladder program is performed to insure compatibility. This software version defines several new operating modes that must be properly detected and processed by the ladder logic to insure that the PLC and the BURNY 5 remain logically synchronized.

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CUT LOSS ENHANCEMENT SUMMARY

The primary purpose of the CUT LOSS RECOVERY feature is to allow the operator to resume the execution of a part program that was interrupted by a system power failure. In order to accomplish this, status and position data is now continuously saved in battery backed memory during the execution of every NC part program. The BURNY 5 checks this data at power-up to determine the state of the last run program. If it was completed (and terminated with an <RST> key press), no special operations are required. However, if the status is still defined as active, the BURNY changes this status to INTERRUPTED and performs the operations necessary to close the "active" program in an orderly manner. This internal data block always contains information about the last executed part program, including the CUT MODE, PREHEAT TIME, and other values defined on the RUN MODE screen so that all can be restored. This data block also contains starting and ending time values to help determine how long the program was active and the time when program execution terminated. As a operator convenience, many of these internal values can be displayed by simply pressing the <III> key on the RUN SELECT screen to call-up the RUN HISTORY data block.

Whenever the program termination status in the RUN HISTORY data block is defined as INTERRUPTED, STOPPED or ABORTED, a special warning message is displayed on the MAIN MENU and RUN SELECT screens. This message, "PART PROGRAM INTERRUPTED", is provided to remind the operator that the last executed program did not run to completion and for the highest level of recovery it should be restarted before any other part programs are cut. This is important because the RUN HISTORY data block can only retain the complete running environment for last part program executed. Other types of program restart are supported but they are only capable of restoring the plate number and program block position, not the entire RUN MODE environment.

JOB INTERRUPTION and RESTART

As implemented, it actually does not matter if a power failure occurred or the operator simply the execution of the part program in the middle of a program cycle with the <RST> key. In both cases, the BURNY 5 still updates the RUN HISTORY data block with status and position data so that a complete restoration of the running environment can be performed, if desired by the operator. The operator always has the option of restarting the last run or selecting another part program. However, a complete restoration can only be performed when the last executed program is restarted. If a different program is run, all of the job specific details in the RUN HISTORY block are overwritten and lost.

In addition to this total restart capability which only applies to the last run program, a second type is also supported. This capability saves the data for a block position recovery with every part program in battery backed memory. This data include the status, plate, block, and cycle values that were active when the program was last terminated. As a result, any previously executed part program can be restarted from the block position where it was last, terminated, regardless of how many other part programs have been run since that time. The only restriction is that the program cannot be reloaded or updated by the editor since these operations set the block recovery values to zero.

This second type of restart is also capable of restoring the physical tool position at the start of the interrupted block but only if the definition of associated plate has not been changed and the part or nest was started from the "HOME" position of the active plate environment. If necessary, the operator can always manually JOG the machine to the desired position before pressing <GO> to restart the process.

As a direct result of this second type of restart capability, any part program or nest can now be terminated by the operator before completion so that one or more "RUSH ORDER" part programs can be cut. Later, the original job can be simply restarted at the interrupted block position.

NOTE

The RUN HISTORY contains information on the last run program so that a complete restart can be automatically performed when the same program is immediately restarted. This includes cut mode, fuel type, preheat and pierce ramp timer values, part count, and other RUN SETUP specific data. However when performing "RUSH" order processing, only the status, plate, and block positioning data can be automatically restored when the interrupted part is later restarted. The various other RUN SETUP parameters remain as currently defined.

One other note. One of the values retained with the RUN HISTORY data is the offset between the selected plate home and its relative part zero position. Generally, this offset is zero because most parts are designed to start from the corner of a plate. When this occurs, synchronized to a previously cut physical block position can be automatically performed, provided the plate home offset and angle is not changed. When not starting from the home position of the active plate and/or the machine is jogged from the plate home position before <GO> is pressed, synchronization to the physical machine position can not be automatically performed when the program is not the last program run. In this case, manual jog operations are required to adjust the restart position.

MULTIPLE PLATES

To further enhance the JOB INTERRUPTION/RESTART capability, a MULTIPLE PLATE definitions are now supported. This allows the plate associated with an interrupted job to remain unchanged while other plates are setup and used for the "RUSH" order.

This feature allows up to four separate plates to be setup at the same time. As in the previous "single plate" version, each plate in this new software version is defined with its own plate size, offset, and angle values. As a result, each plate can be defined with a different plate angle when necessary. Another capability allows the plate home assignments to be made on a per plate basis so that some may define their home on the LEFT and others with their home on the RIGHT.

Whether or not any plate definitions are made, the active plate can be selected from either the TABLE/PLATE DEFINITIONS screen or the RUN MODE screen. Five plate home positions are actually available. One for each of the four plate positions (1 to 4) and one for the special "PLATE 0" home position (which represents the FIXED ZERO position of the machine). After a plate is selected, the X and Y position values at the bottom of the screen are update to reflect the current tool position with respect to the newly defined plate home position.

The concept of individually definable plate homes is also used to help the operator identify and return the machine to the home position of any defined plate after recovering from a power failure. This capability is possible because all of the table and plate data (including plate sizes, angles, and offsets) is automatically restored as part of the normal system power-up, regardless of whether or not the plate home offsets were define in SYSTEM SETUP DATA or by the operator on the new TABLE/PLATE DEFINITIONS screen.

NOTE

Generally when not running a part program, the <RET> key returns the machine to the currently active home position. Often this position identifies the floating home position of the selected plate or the (0,0) starting point of the last executed NC part program. The multiple home selection capability simply allows the operator to directly choose the home offset before pressing <RET> to move the machine.

SELECTABLE BLOCK START

Another powerful feature resulting from the CUT LOSS enhancements allows the operator to start or restart any part program at any block position. Whenever an executing part program is interrupted by a power failure or by the operator, the number

associated with the active block is automatically saved in battery backed memory for later display and use on the RUN MODE screen. From this screen the operator can either leave the block number unchanged or set it to another valid block number. Then, through a special internal block stepping process, the BURNY automatically repositions its internal logic to the specified block in preparation for a <GO> key press. No machine motion occurs until the <REV> key or the <GO> key is pressed. If <REV> is pressed before <GO>, the BURNY automatically moves the machine to the physical position associated with the selected program block position. However when <GO> is pressed, the BURNY immediately restarts part execution at the current machine position. If necessary, the starting block number can be changed and the machine moved any number of times to locate the desired position before pressing <GO>. Jogging operations can also be performed to refine the start position before pressing <GO>. To further the usefulness of this feature and simplify block selection, the graphics process now draws the part with the selected block about the current tool position, which is the position where the program will start when the <GO> key is pressed. The only requirement is that after jogging or pressing the <RET> key to move the machine, the operator must press <V> to redraw the part image about the new tool position.

FIXED HOME POSITIONING

One of the difficulties encountered after a power failure is that the actual machine position is not known. To resolve this, a new hardware home search process similar to the one used for automatic torch spacing operations is now supported. This process, however, allows the operator to initiate the home search operation from the front panel. The new hardware homing process, like the existing process, searches for the axis limit switch and, if provided, an encoder index pulse to establish a fixed machine position. As a alternative for machines that do not have the necessary hardware to support the automatic home search, a second method is also provided. This "software" method allows the operator to simply use the current machine position after jogging or physically moving the machine to a desired fixed point. In either case, the BURNY 5 establishes the FIXED ZERO position from this fixed position and the home adjustment offsets defined on the TABLE/PLATE DEFINITIONS screen or in SYSTEM SETUP DATA. This FIXED ZERO position, when combined with the floating plate and part home offsets, allows the BURNY to re-establish the physical tool and program start positions that were retained before power was removed.

NOTE

By default, the last active plate is automatically re-selected at power-up and the last retained machine position is restored to approximate the FIXED ZERO position. In some cases, this position may be close enough to the actual FIXED ZERO position that the operator can just select "PLATE 0"

and press the <RET> key to quickly move an approximated zero position before performing the hardware or software fixed home reset operation.

When "PLATE 0" is selected (which represents the FIXED ZERO machine position), only normal non-rotated plate operations can be performed. In order to perform plate alignment operations, the operator must first setup one or more of the four plate definitions on the TABLE/PLATE DEFINITIONS screen and then select one as the active plate from this same screen or the RUN MODE screen before running the part. In the CUT LOSS version, "PLATE 0" selects the fixed, non-rotated, cutting table area which is logically equivalent to "PLATE ENABLE: NO" in previous software versions.

INTERNAL BLOCK STEPPING

Two important internal capabilities are supported to perform repositioning operations for the CUT LOSS RECOVERY feature. One allows the BURNY to logically step through a part program to a specified block while establishing the programmed X/Y position (start and end with all scaling, KERF, mirror, and rotation attributes applied) and the states of all operating modes and outputs at that specific block in the program. With this capability and the data retained in the RUN HISTORY list, the BURNY 5 can advance to the last run block or any other block in the selected part program. Another internal capability allows the BURNY to further defined the physical X/Y position in the middle of a program block but only when restarting the last run program.

When performing internal positioning operations, only the internal position holdwords are actually defined in preparation for a <RET> or <REV> key press. No machine motion occurs until it is initiated by the operator. <REV> is used, as in the previous BURNY 5 version, to move the machine to the "RUN HOLD" position associated with the selected program block before pressing <GO>. Alternately, the <GO> key press without the <REV> starts part execution immediately at the current machine position. If necessary, the block number can be changed and the <REV> key pressed any number of times to locate the desired restart position before pressing the <GO> key.

NOTE

If, after selecting the restart position and pressing <REV> to advance to that position, a more precise restart point on the path is required, the operator can restart the program in a newly defined DRY RUN OVERRIDE test mode. This mode, which can be selected by the <B> key when enabled, allows the operator to press the <GO> key and test run the program in the forward or reverse directions with no movement of the part. When at the desired cut restart point, just press <STOP>, jog to the new pierce point, cancel DRY RUN OVERRIDE mode, and press <GO>. The BURNY will initiate the cut at the current tool position and then move to the point on the path from which it was jogged before continuing along the programmed path.

GRAPHIC IMAGE SYNCHRONIZATION

As currently implemented, two features are provided to help the user graphically identify the restart block position selected from the RUN MODE screen. One allows the selected part program block to be positioned about the tool cursor. This not only identifies the next block to be cut, it also shows the relative position of the part with respect to the selected plate, if any. The other feature, when enabled by a bit in SYSTEM SETUP DATA, allows all of the part program blocks before the selected block position to be drawn in WHITE. Only the program blocks not yet processed are drawn in the normal graphic inspect colors. This feature also is used to identify processed blocks when performing zoom and other redraw operations while cutting.

CUT LOSS RECOVERY SCREENS AND OPERATIONS

The following pages illustrate the changes that have been made to the various BURNY 5 screens to support the CUT LOSS RECOVERY feature and other related enhancements. Descriptions are also provided for a new TABLE/PLATE DEFINITION screen that can now be access with the <II> key from the MAIN MENU and other screens. Through this new screen the user can display and define the cutting table values (size and offset from a fixed position) as well as the size, offset, and angle values for up to four separate plates. With these values defined, the BURNY has the ability to move to one of five fixed positions on the cutting by direct selection by the operator through this same TABLE/PLATE DEFINITION screen.

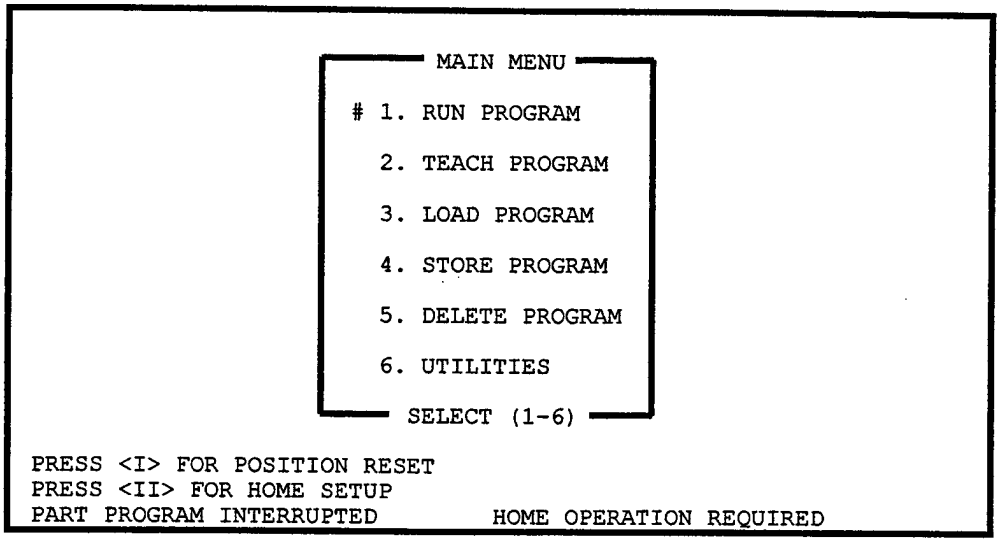
One notable difference on the RUN TRACE graphic screen is that the BURNY 5 graphics now accurately represent the relative positions of the plate, the tool cursor, and the part. In previous software versions, the RUN TRACE graphics always displayed the part with its zero position at the plate home position, not at the actual tool position. As a result, the graphic display was not helpful in establishing the desired starting position of the part on the plate. In the CUT LOSS version, this is no longer the case. The BURNY 5 RUN TRACE graphics now show the part about the tool cursor as it will be cut when the <GO> key is pressed. This combined with the fact that the relative position of the tool cursor to the active plate is now accurate allows the jog keys and the display to be used to select the desired starting position. After jogging, the user only needs to press the <V> to redraw the part about the newly defined tool cursor position.

MAIN MENU SCREEN

Numerous internal changes have been made to the BURNY 5 power-up sequence to perform the operations necessary for cut loss recovery. As a result, several new status messages may appear on the MAIN MENU screen. One possible message indicates that the last RUN part program did not run to a normal completion. The other indicates that a HOME RESET operation is required. This message, however, is only displayed if the home requirement feature has been enabled through SYSTEM SETUP DATA variable 40, (i.e. SYSTEM CONFIGURATION 4).

Other differences on this screen include two new key definition messages which are displayed regardless of whether NOVICE or EXPERT prompting mode is active. One reminds the operator that the <I> key is used to select the AXIS POSITION/SPEED screen, a capability that has always existed. The second reminds the operator that the <II> key is now used to select the new TABLE/PLATE DEFINITION screen. This "hot key" capability provides quick access to the screen where home reset and plate selection operations are performed. As a result, this same "hot key" definition is also supported on all of the UTILITIES menu screens and all of the RUN process screens.

The following illustrates the format of the new MAIN MENU screen. Note that a new "PLATE HOME:" data field has been added to the STATUS window at the bottom of the screen to identify the number of the currently selected plate home. Home values of 1 through 4 identify which of the four plates is currently selected. "PLATE HOME: 0" selects the FIXED ZERO table position as the active home.



Generally, the operations performed on this screen are the same as in previous software versions. The "PART PROGRAM INTERRUPTED" message simply indicates that the last program did not run to the end of a cycle. That is, the program was either terminated by a power failure or by an <RST> key press in the middle of a program cycle. This information message is provided as a reminder that for the most complete restart, the last run part program should be run before any others. From the MAIN MENU, none of the other system operations, including the EDIT and DELETE functions, are affected by the interrupt part condition. Note that this message is displayed on the MAIN MENU until the interrupted part program or some other part program is selected, executed, and allowed to perform a complete program cycle.

The "HOME OPERATION REQUIRED" message is used to warn the operator that a home operation must be performed before any part program can be executed. When the condition is active, this warning is displayed as both a red message on the line above the status window and as a normal status message in the status window to remind the user that entry into the RUN process is not allowed. All other MAIN MENU functions, however, are fully operable even though the status window continues to display

"HOME OPERATION REQUIRED" instead of the normal "WAITING FOR PARAMETERS" message.

The BURNY 5 determines the need for a home operation from a new bit definition in SYSTEM CONFIGURATION 4 (SYSTEM SETUP DATA variable 40). If not set, no operator initiated home operation is required. By default, the fixed and floating home values are restored at system power-up from the last saved values in battery backed memory regardless of whether or not this bit is set. When this bit is not set, the operator can simply continue using the approximated FIXED ZERO position. However when the home reset is required, the "HOME OPERATION REQUIRED" message remains displayed until a new fixed position is defined by the operator through the TABLE/PLATE DEFINITION screen. Only then is the status change to the normal "WAITING FOR PARAMETERS" message. Note that regardless of whether or not a home operation is required at power-up, the operator always has the ability to redefine the FIXED ZERO home position using either a software "jog and set" technique or, if supported by hardware, an automatic "home search" process.

One other notable difference on the MAIN MENU screen and all other screens is that the X/Y position values displayed in the status window at the bottom of the screen now show the relative position of the tool with respect to the currently active plate home. As a result, these values at not automatically set to zero at power-up as in previous software versions. These values and the active plate selection are now restored from values retained in battery backed memory. As a result, these values approximate the actual fixed coordinate position, allowing the operator to either 1) continue from the current position when home reset operations are not required by the control, 2) press <RET> to return to the approximated zero position of the active plate, or 3) select another plate or zero and press <RET> before performing a software or hardware home setup operation. As an operator convenience, the last retained tool position is also restored so that the <REV> key can be used to move back to this coordinate position after a home operation is performed. This position, however, is only retained until another plate or part position is selected by the operator.

RUN SELECT SCREEN

With the exception of the new novice mode message and the ability to use the <I>, <II>, and <III> keys to callup the AXIS/POSITION screen, the TABLE/PLATE DEFINITION screen, and the new RUN HISTORY screen, there are no operational differences on the RUN SELECT screen. As in previous versions, the <IV> key is still used to callup the NC program directory list and the <I> and <II> keys are still used to perform paging operations when the NC program directory list is displayed. As before, the up and down cursor keys are used to scroll through the NC program directory list whenever the "NUMBER:" prompt is selected, whether or not the program directory list is actually displayed.

Two new information message may now appear on the RUN SETUP screen. One, "PART PROGRAM INTERRUPTED", only appears when the "NUMBER:" field contains the number of the last run program and that program did not run to completion. This same message appears on the MAIN MENU screen for the same reason. The other message, which only appears when operating in NOVICE mode, is provided to remind the user that the RUN HISTORY pop-up window can be displayed by pressing the <III> key. As an operator convenience, the <I>, <II>, and <III> keys can also be used to cancel the existing screen. As a result, the user may simply press the <III> twice, once to clear the existing screen and once to call-up the desired screen.

The following illustrates the format of the new RUN SELECT when in NOVICE mode. Note that a new plate number field, "P: 0", now appears to the right of the "PARTS:" field. As on other screens, this value updates in real-time to reflect changes in the active plate made by the operator.

```
                          RUN PROGRAM

 NUMBER: 12345678-123
                                      DIRECTORY OF: NC PGM MEMORY
 NAME  : TEST PART                         TOP OF DIRECTORY
                                     321     LOAD  - 7/29/90
 SIZE  : 2345                      54321-1   ANOTHER TEST PART
                                   12345678-123 TEST PART
                                     9510    LOAD  - 7/29/90
                                     8888    EDIT  - 8/01/90
                                        2    TEACH - 8/29/90
 PRESS <III> FOR RUN HISTORY
 PRESS <SHF> <ENTER> TO RUN                 BOTTOM OF DIRECTORY
 PRESS <V> TO GRAPH PROGRAM
 PART PROGRAM INTERRUPTED

POSITION(IN):X0.000     Y0.000     FEED: 150.00   TIME : 13:30:02
OPERATION    : RUN                 MODE: OXYGEN   DATE : 05/31/1996
FUNCTION     : CUT OFF CCW KRF OFF KERF: 0.00     PARTS: 0      P:0
BLOCK:        X          Y         I          J          TBL: 0
STATUS: WAITING FOR PARAMETERS     MSG:
BACKGROUND:  INACTIVE
```

When requested with a <III> key press, the RUN HISTORY pop-up window provides the operator with information about the last part program executed including its termination status, starting and ending date and times, ending block, cycle, and plate values, and other significant data. Note that once the RUN HISTORY is displayed, either the <III> key can be pressed to clear the history list or the <I>, <II>, or <IV> keys can be used clear it, and then with a second press, call up the next desired screen.

NOTE

In previous software versions, the "NUMBER:" prompt at the top left side of the screen was always pre-loaded with zero at power-up and then it displayed the number of the last part program selected by the user for any function (RUN, LOAD, STORE, TEACH, etc.). However with the CUT LOSS RECOVERY feature, this prompt value is now pre-loaded with the number of the last run program whenever that program, as defined in the RUN HISTORY pop-up window, was interrupted by a power failure. This program number prompt is also pre-loaded at power up with the number of the last run program regardless of its status as a simple reminder.

The following illustrates the format of the RUN SELECT screen with the RUN HISTORY pop-up displayed. Note that the date and time displayed in the "STARTED" line represents the time when the <GO> key was first pressed to start execution. The line following this line contains a program termination status of "INTERRUPTED", "ABORTED", "STOPPED", or "COMPLETED" and the date and time at which execution was terminated. Only a status of "COMPLETED" removes the "PART PROGRAM INTERRUPTED" message condition.

```
                              RUN PROGRAM

  NUMBER: 12345678-123
                                        RUN PROGRAM HISTORY
  NAME  : TEST PART                PROGRAM NUMBER: 12345678-123
                                          STARTED: 05/31/96 14:12
  SIZE  : 2345                     INTERRUPTED: 05/31/96 17:43

                                      CUT MODE: AUTO CUT
                                     TOOL MODE: OXYGEN FUEL
                                    PART COUNT: 12345

                                   BLOCK NUMBER: 12345
                                   CYCLE NUMBER: 12345
                                   PLATE NUMBER: 1
                                     PLATE SIZE: X+12345.1234
                                                 Y-12345.1234
                                    PLATE ANGLE: 123.45
  PRESS <III> FOR RUN HISTORY      PLATE OFFSET: X+12345.1234
  PRESS <SHF> <ENTER> TO RUN                     Y-12345.1234
  PRESS <V> TO GRAPH
  PART PROGRAM INTERRUPTED

POSITION(IN):X0.000     Y0.000     FEED: 150.00   TIME : 13:30:15
OPERATION    : RUN                 MODE: OXYGEN   DATE : 05/31/1996
FUNCTION     : CUT OFF CCW KRF OFF KERF: 0.00     PARTS: 0      P:0
BLOCK:         X          Y        I          J          TBL: 0
STATUS: WAITING FOR PARAMETERS    MSG:
BACKGROUND:  INACTIVE
```

The RUN HISTORY data retained in battery backed memory contains all of the information required to perform a total restart on the part program that was last run.

However on this screen, only the start and end times and various other parameters that are required to advance to the suspended block position and tool position are shown. The primary purpose of this display is to identify the conditions under which the last part program terminated. With this information , the operator can decide if the execution of the part should be 1) continued from the last retained position, 2) adjusted to a new restart position, or 3) completely restarted from the first block of the program.

NOTE

In the current CUT LOSS RECOVERY implementation, only the last executed part program can be fully restarted at the last retained machine position. Other forms of restart are supported, but only the last run can be restarted with all parameters and offsets completely restored. Therefore, selecting and then running any program other than the last interrupted inhibits the ability of the control to automatically restart the interrupted program at the point on the path where the cut was lost.

The second form of restart allows the operator to use the plate, cycle, and block number values that are retained for every executed part program. With these values, the BURNY can still internally advance to the start of the last executed program block but not a position in the middle of the block. The actual offset between the plate and the part homes is also not automatically restored. As a result, operator interaction may be required. Other values which are not restored, remain as defined by the last program run.

Two date and time values and a termination status are provided following the program number in the RUN HISTORY pop-up window. The "STARTED" value identifies the time at which the <GO> key was first pressed to begin execution. Subsequent, <STOP> and <GO> key presses have no affect on this value. The second date and time values identify when part execution was terminated. The "COMPLETED" state indicates that the program "auto-stopped" at a "chain bottom", "program stop", or "end of program" auxiliary function code before it was terminated by the <RST> key. "STOPPED" and "ABORTED" indicate that the operator pressed <STOP> or <RST> to suspended program execution. "INTERRUPTED" indicates that program execution was terminated by a power failure and not an operator <RST> key press.

"BLOCK NUMBER" identifies the number of the part program block interrupted. However if the termination occurs between part program blocks, this value identifies the next block to be executed. By definition, a block number of 0 or 1 indicates the first block of the program file.

"CYCLE NUMBER" identifies the number of the program cycle in progress. Again by definition, a cycle number of 0 or 1 indicates the first program cycle. A program cycle is defined as the entire start to end program loop or a G97/G98 program loop.

"PLATE NUMBER", which identifies the plate last selected before the program was terminated, allows the BURNY 5 to re-establish the plate size, angle, and offset values associated with an individual part program. A plate number of 0 indicates that no such association is required. In this case, the normal non-rotated FIXED ZERO coordinate grid was used by the program.

RUN SETUP SCREEN

Once a part is selected, the BURNY 5 advances to the RUN SETUP screen. Generally, the values on this screen define the dimensional adjustments that affect the KERF and RUN DECEL calculation processes, such as the KERF width and SCALE factor. For the CUT LOSS RECOVERY feature, only one new prompt appears on this screen which now appears as follows:

```
                              RUN PROGRAM

          SELECTED PART
NUMBER: 12345678-123  SIZE:  2345
NAME  : TEST PART
MESG. : OPTIONAL 58 CHARACTER MESSAGE
      :

KERF ENABLE   : YES
KERF VALUE    : 0.2000

SCALE VALUE   : 1.000
ROTATION      : 0.00

MIRROR X-AXIS: NO
MIRROR Y-AXIS: NO

BLOCK 0 START: YES

OVERLAY TABLE: 0


WANT TO CHANGE PARAMETERS: NO

POSITION(IN):X0.000     Y0.000     FEED: 150.00   TIME : 13:30:21
OPERATION    : RUN                 MODE: OXYGEN   DATE : 05/31/1996
FUNCTION     : CUT OFF CCW KRF OFF KERF: 0.00     PARTS: 0      P:0
BLOCK:         X          Y        I          J          TBL: 0
STATUS: WAITING FOR PARAMETERS     MSG:
BACKGROUND:  INACTIVE
```

The new "BLOCK 0 START" prompt allows the user to either continue program execution from the last retained part program block position or reset all of the internal values to start from the first block of the program. The default response for this prompt is determined by the program number selected. When the last run program is re-selected and it was interrupted by a power-failure, the response is pre-set to "NO". Otherwise, the default response is set to "YES" to select a complete restart from the first block of the program. The display of this prompt on the RUN SETUP screen allows the

operator to alter the default response before advancing to the RUN MODE screen where the INITIAL PLATE, CYCLE, and BLOCK values are displayed for further adjustment. A response of "YES" clears the BLOCK and CYCLE values and sets the PLATE to the currently active plate number, if any. When the operator selects "BLOCK 0 START: NO", the restart values acquired from the program are simply retained for display on the RUN MODE screen.

NOTE

If the RUN SETUP screen is bypassed because of a <SHF> <ENTER> from the RUN SELECT screen, the INITIAL PLATE, CYCLE and BLOCK values are defined using the same rules.

RUN MODE SCREEN

Several changes were made on the RUN MODE screen to support part/nest restart operations. Although the primary purpose of the CUT LOSS RECOVERY feature is to allow the operator to resume a cutting operation that was interrupted by a power failure, the techniques incorporated allow any part to be started at any program block position. This allows the operator to either accept the starting block position defined for the selected part program or adjust it to any other block position. It also provides the ability to select and then cut only a section of an NC part program or individual parts from a program nest when the desired starting block number is known.

NOTE

As an aid in graphically identifying the position of the selected block number in the part program when the exact block number is not known, a new WHITE REDRAW capability is supported which, when enabled, draws all of the block before the currently selected block in WHITE. In this mode, only the blocks following the selected block are drawn in the usual inspection colors. The WHITE REDRAW feature is enabled through bit "0000 0100" of SYSTEM SETUP DATA variable 38, (SYSTEM CONFIGURATION 2).

The differences on this screen are primary caused by the removal of the plate definition prompts and the addition of the "INITIAL PLATE", "INITIAL CYCLE", and "INITIAL BLOCK" prompts. Plate setup operations are now performed on the TABLE/PLATE DEFINITION screen which is accessed by pressing the <II> key from the RUN MODE screen, the MAIN MENU screen, and others. From that new screen, the operator can display and define the size of the cutting table, a table home adjustment and up to four plate home position offsets, but only when these values are not pre-defined in SYSTEM SETUP DATA. Each plate definition also includes its own size and rotation angle

values which are retained in battery backed memory so that in the event of a power failure, all can be properly restored for graphic display and machine positioning operations. For additional information on this screen, see the TABLE/PLATE DEFINITION SCREEN description.

The following illustrates the format of the RUN MODE screen as it may appear when it is first entered from the RUN SETUP screen. This example assumes that no plate is active and either "YES" was selected at the prompt "BLOCK 0 START" or "NO" was selected for a part program that was loaded but not yet run.

```
                    RUN PROGRAM

                  SELECTED PART
NUMBER: 12345678-123  SIZE:  2345      KERF    : 0.2000 T: 0
NAME  : TEST PART                      SCALE   : 1.000
MESG. : OPTIONAL 58 CHARACTER MESSAGE  ROTATION: 0.0
      :                                MIRROR X: NO     Y: NO

CUT RUN MODE : AUTO CUT
TEST RUN MODE: NO TEST

PRE-HEAT TIME: 0.00
PIERCE TIME  : 0.00

NUMBER PARTS : 1

INITIAL PLATE: 0
INITIAL CYCLE: 0
INITIAL BLOCK: 0



WANT TO CHANGE PARAMETERS: NO

POSITION(IN):X0.00      Y0.00      FEED: 150.00   TIME : 11:34:50
OPERATION    : RUN  -  AUTO        MODE: OXYGEN   DATE : 05/31/1996
FUNCTION     : CUT OFF CCW KRF OFF KERF: 0.20     PARTS: 0      P:0
BLOCK:        X          Y         I          J          TBL: 0
STATUS: WAITING FOR PARAMETERS     MSG:
BACKGROUND:  INACTIVE
```

The three new parameters added to the RUN MODE screen provide the BURNY with the information needed to internally advance the RUN process to the desired program block. Other information retained in the RUN HISTORY data is used to restore operating values such as the pierce ramp and pre-heat times, the cut mode, and the number of parts requested when the program was initially executed.

"INITIAL PLATE" identifies the number of the plate that is to be used when program execution is started. "INITIAL BLOCK" identifies the number of the part program block to be executed when the <GO> key is pressed and "INITIAL CYCLE", the number of the "start to end" or "chain top to chain bottom" cycle. All of these initial values are needed to determine the physical machine position and mode for the restart operation. However once program execution is started with the <GO> key, these values can no longer be changed. When this occurs, the prompting process simply skips over

these prompts when changing other values on the RUN MODE. These initial values also do not change in real-time as the program executes or when stopping and restarting execution with the <STOP> and <GO> keys.

Regardless of how the initial PLATE, CYCLE, and BLOCK values are defined or whether the selected program has been previously run or not, these prompt values may be changed any number of times to adjust the restart position. However to actually initiate the internal setup process logic and prepare the BURNY for cutting, the operator must first select "NO" at the "WANT TO CHANGE PARAMETERS" prompt and press <ENTER>. This causes the BURNY 5 to initiate a special internal "block stepping" operation were program blocks are logically processed with no machine motion involved. Once at the specified block position, two additional messages appear above the "WANT TO CHANGE PARAMETERS" prompt. One indicates that the <REV> key can be used to physically move the machine and re-synchronize the part with the selected plate or a previously established part home. The other message, "PRESS <GO> TO RUN", indicates that part execution can now be restarted from the current tool position with a <GO> key press.

NOTE

Two different types of graphic displays are presented to the operator from this screen when the <V> key is pressed. One is a static imaging display and the other, a real-time representation of the part, the tool and, if selected, the plate. The static display can only be displayed when the operator enters the RUN MODE screen and presses <V> before pressing <ENTER> to select "WANT TO CHANGE PARAMETERS: NO". This display shows the part program with the specified number of parts in an "ideal" situation as in previous software versions. When a plate is selected, this static display also shows the relative size and angle of the plate with the part or parts aligned so that the part home resides at the plate home position. On this screen, the cursor is used to identify the ZOOM position. No tool cursor is shown.

The second type of graphic display is a real-time image which accurately shows the plate (if selected), the relative position of the tool, and the part or parts aligned about the tool position as it will be cut when the <GO> key is pressed. In this mode, the operator can jog the machine and/or use the <REV> and <RET> keys to establish a new logical or physical machine position and then press <V> to redraw all and observe the new relative positions before pressing <GO>. This display type always occurs after the operator presses <ENTER> to select "WANT TO CHANGE PARAMETERS: NO" and the internal block stepping operation has been performed.

The following illustrates the format of the RUN MODE screen after the first "block stepping" operation is performed. It also shows the new "hot key" help menu. In NOVICE mode, this menu is automatically displayed. In EXPERT mode, this menu can be displayed by pressing the <IV> one or more times to toggle from the normal "YES/NO" help menu, to the new "HOT KEY" menu, and then back to the cleared window state.

```
                              RUN PROGRAM

                            SELECTED PART
NUMBER: 12345678-123  SIZE:  2345        KERF    : 0.2000 T: 0
NAME  : TEST PART                        SCALE   : 1.000
MESG. : OPTIONAL 58 CHARACTER MESSAGE    ROTATION: 0.0
      :                                  MIRROR X: NO      Y: NO

CUT RUN MODE : AUTO CUT                        HOT KEYS
TEST RUN MODE: NO TEST                    <I> - AXIS SCREEN
                                         <II> - PLATE SCREEN
PRE-HEAT TIME: 0.00                     <III> - STATUS PAGE
PIERCE TIME  : 0.00                      <IV> - TOGGLE HELP
                                          <V> - FOR PART GRAPHICS
NUMBER PARTS : 10                       <RET> - MOVE TO SELECTED HOME
                                        <REV> - MOVE TO PART POSITION
INITIAL PLATE: 3                         <GO> - START EXECUTION
INITIAL CYCLE: 6                      <STOP> - SUSPEND EXECUTION
INITIAL BLOCK: 15

PRESS <REV> TO POSITION
PRESS <GO> TO RUN
WANT TO CHANGE PARAMETERS: NO    OXYGEN FUEL NOT SELECTED

POSITION(IN):X30.500    Y-22.100   FEED: 150.00   TIME : 11:35:12
OPERATION    : RUN  -  AUTO        MODE: OXYGEN   DATE : 05/31/1996
FUNCTION     : CUT ON  CW  KRF ON  KERF: 0.20     PARTS: 5      P:3
BLOCK: 15    X4.00      Y4.00     I4.00      J0.00      TBL: 0
STATUS: WAITING FOR PARAMETERS    MSG:
BACKGROUND:  INACTIVE
```

Once in the "PRESS <GO> TO RUN" state, the user as several choices available. One allows the INITIAL PLATE, CYCLE, and BLOCK numbers to be changed, the "stepping" process repeated, and the <REV> key operation repeated to move the machine before pressing <GO>. Another allows the <RET> key to be used to internally step to the block associated with the last pierce, the last start of cycle, or back to the INITIAL BLOCK before pressing <RET> or <GO>. Yet another allows the jog keys to be used to adjust the restart position before pressing <GO>.

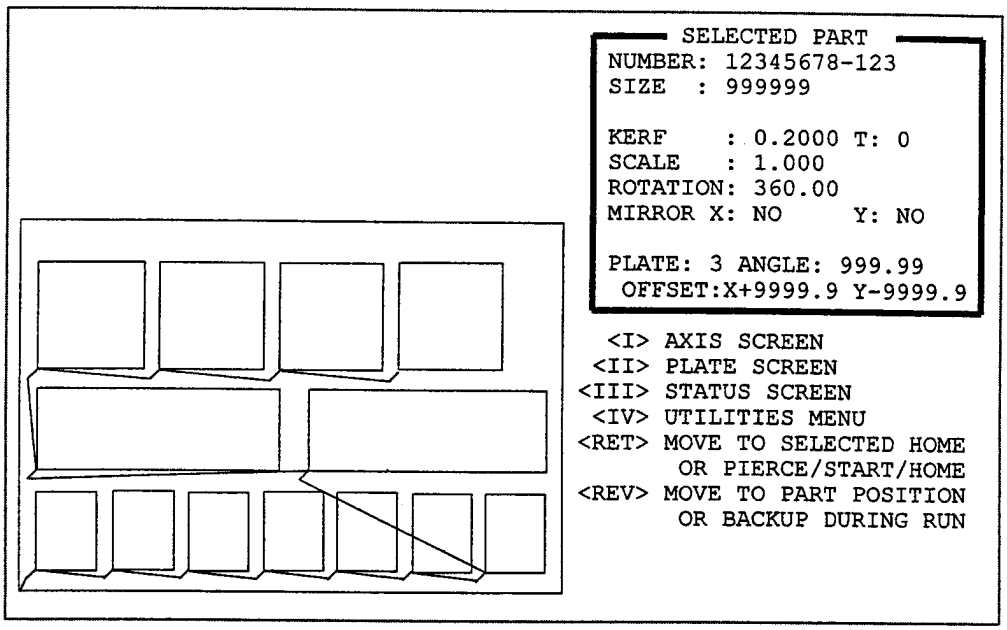
One of the major enhancements in the CUT LOSS version is its ability to accurately display the relative positions of the tool cursor, the part (as it will be cut from the tool position), and the plate (if any) with respect to the FIXED ZERO position. The only requirement is that the operator press <V>, <0>, <5>, or one of the zoom keys after jogging or "stepping" to a new block position to refresh the graphic image with the new relative positions before pressing <GO>.

When resuming the execution of a part program terminate by a power failure or the operator, automatic repositioning uses the last snapshot block and tool position saved. This position, however, may be one or two seconds behind the actual cut termination point. To resolve this, additional positioning adjustments may be required to establish the restart position for cutting and/or defining a new pierce point. In order to make this type of manual machine positioning easier, a new DRY RUN test mode now exists which allows the operator to start execution and move along the programmed path with no cut or auxiliary functions active as in CONTINUOUS TEST mode. However in this new mode, jog operations change the X/Y position values so that no shifting of the part occurs. To further simplify its use, the <B> key can now be used (when enabled by a configuration bit in SYSTEM SETUP DATA variable 40) to quickly select this new DRY RUN OVERRIDE mode. This eliminates the need to step back to the RUN MODE screen to change the desired CUT MODE prompt value. When activated, the corresponding <B> key LED is illuminated and the "OPERATION:" value in the status window at the bottom of the screen displays "TEST - DRY RUN OVERRIDE". This allows the CUT LOSS RECOVERY operation to restore all of the mode, timer, and positioning data on the RUN MODE screen and still allow the operator to advance to the RUN GRAPHICS screen to refine the position using the following sequence:

1) Press <B> to enable DRY RUN OVERRIDE mode.
2) Press <GO> to move forward or backward along the path.
3) Press <STOP> at the uncut position on the path.
4) Jog to a new re-start position.
5) Press <B> to disable DRY RUN OVERRIDE mode.
6) Press <GO> to re-start the cut at the current position
   and continue in the mode defined by the RUN MODE screen.

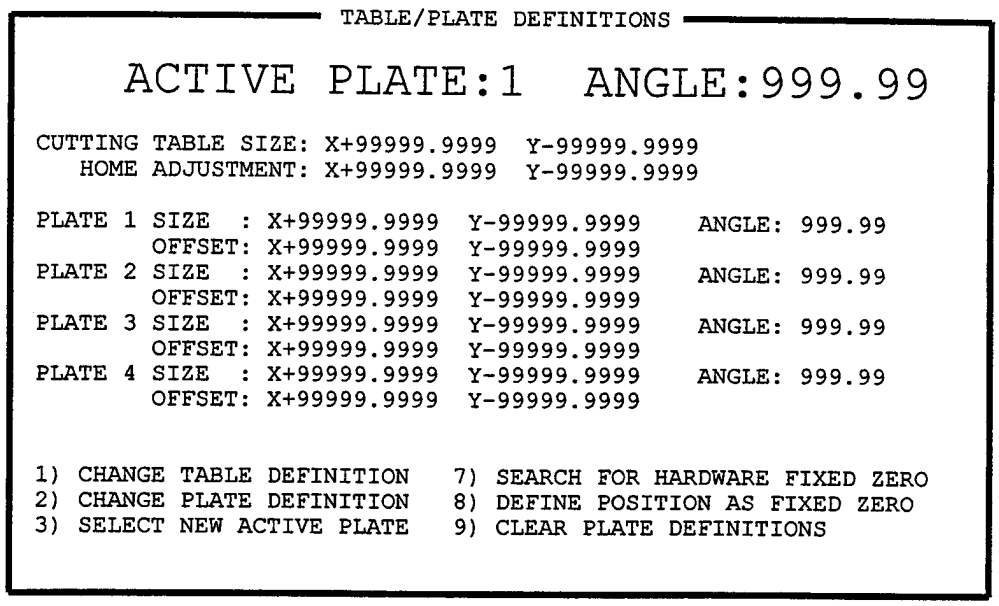
RUN TRACE GRAPHIC SCREEN

Several items have been added to the RUN TRACE graphics screen. One is the "help key" menu which is displayed regardless of whether NOVICE mode is enabled or not. Another provides the number, angle, and offset of the plate initially selected by the operator to the "SELECTED PART" information block. A third is the real-time display of the plate number as "P: #" in the status window at the bottom of the screen. The following illustrates the format of this newly revised RUN TRACE screen.



TABLE/PLATE DEFINITIONS SCREEN

This new TABLE/PLATE screen provides the interface for display and, in some cases, entry of values defining the cutting area and four separate plates. Most of the values on this screen define PLATE SIZE, ANGLE, and OFFSET parameters. The X and Y CUTTING TABLE SIZE values define the total area in which plates reside. The HOME ADJUSTMENT values define the X and Y offsets from a hardware or user defined fixed point to the FIXED ZERO position. By definition, FIXED ZERO is defined at the lower left or right corner of this imaginary cutting table area, depending on the PLATE SIDE variable in SYSTEM SETUP DATA. PLATE SIDE also defines the default home position for each plate at either its lower left or right corner as in the previous software versions. However, a new capability allows this default assignment to be mirrored on a per plate basis so that some can define home on the left corner and some on the right corner. Plate home position mirroring is accomplished by simply specifying the Y PLATE SIZE dimension for the plate as a negative value.



Because of the importance of this new TABLE/PLATE DEFINITIONS screen when performing system and run setup operations, easy access is provided by pressing the <II> key when on the MAIN MENU screen, the RUN MODE screen, the GRAPHIC RUN TRACE screen, or any of the UTILITIES menu screens. On these same screens, the <I> key can also now be used to access the AXIS POSITION/SPEED screen. As in earlier versions, this screen not only shows position and speed values. It also supports digital feedrate operations and "C" axis jog operations.

Generally, most of the operations performed on the TABLE/PLATE DEFINITIONS screen are only permitted when a program is not running. Once program execution is started with the first <GO> key press, only the plate and table size values may be changed without restriction. The plate angle and offset values and the home adjustment values can never be changed when actively running. In addition, the SELECT ACTIVE PLATE function, the CLEAR PLATE DEFINITIONS function, and both the hardware and software FIXED ZERO definition functions can only be performed when not running. Therefore, if any of these values need to be changed or any of these functions are required, the operator must either press <RST> to first terminate the active program, or press <STOP> and then <RET> one or more times to return to the first block of the program before the desired operation can be performed.

One reason for defining all of the table and plate setup operations on a single screen is that it provides a simple way to both display and modify the configuration of the entire cutting area. In previous software versions, only one plate definition was supported so it could be directly defined on the RUN MODE screen. This made it easy to change for every job but it also made it easy to change by accident. Another problem was that none of the plate definition values were retained in battery backed memory. When power was removed, the plate position and angle values were lost making it virtually impossible to manually re-align the plate angle and the tool with the part. Another limitation was that once a plate was defined, all of the cuts had to be made before changing the angle for another job since there was no way to re-establish the exact same angle at a later date. None of these difficulties exist in this new software version because four separate plate definitions are supported. In addition, all of the plate and table data is now retained in battery backed memory so that it can be automatically restored at power-up.

One advantage resulting from the new FIXED ZERO logic is that it provides a fixed coordinate system from which every tool, part, and plate position can be referenced. This, combined with the values retained in battery backed memory, allows the BURNY 5 to re-establish the same physical positions on the cutting table after a power down, provided that the same FIXED ZERO position can be re-established. As a result, physical plate positions defined by way of fixtures on the cutting table can now also be restored. One potential difficulty, however, is that the operator may accidentally change the home adjustment or the plate offset values on the TABLE/PLATE DEFINITIONS screen. To prevent this from occurring, these critical offset values can be defined as permanent defaults in SYSTEM SETUP DATA, which is password protected. Once defined in this way, the associated values on the TABLE/PLATE DEFINITIONS screen can no longer be changed by the operator from that screen. Any attempt to do so displays the message "DEFAULTS FROM SYSTEM SETUP DATA" and no data entry is allowed. The table and plate offset values can only be modified on TABLE/PLATE DEFINITIONS screen when their associated values in SYSTEM SETUP DATA are set to zero.

A command list is provided at the bottom of the TABLE/PLATE DEFINITIONS window to identify the operations that are supported. Commands are selected with a single numeric key press. A brief description of each command follows.

1) CHANGE TABLE DEFINITION

When selected, the X and Y value fields of the CUTTING TABLE SIZE definition are highlighted for entry, but only if both of the associated X and Y TABLE DIMENSION values in SYSTEM SETUP DATA are set to zero. Similarly, after the table size values, the HOME ADJUSTMENT values are highlighted for entry, but only if their corresponding values in SYSTEM SETUP DATA have both been set to zero and the RUN process is not active.

NOTE

These values are provide for future use in graphic imaging operations. See the SYSTEM SETUP DATA CONSIDERATIONS section for a description of the TABLE DIMENSION variables (number 86 and 87) for additional information.

2) CHANGE PLATE DEFINITION

When this function is selected, the command menu is cleared and the prompt "CHANGE PLATE NUMBER: __" is displayed at the bottom of the window. After specifying the plate number and pressing <ENTER>, the X and then Y SIZE fields of the specified plate definition are highlighted for entry of a new value. Then, if not running a part program, a "WANT TO CHANGE PLATE ANGLE" prompt appears at the bottom of the window to determine if a plate angle change is also required. If it is, the same prompting sequence that was used in previous software versions on the RUN MODE screen is now performed on this screen. This logic allows the user to jog to and define the lower left or right corner of the plate as the plate home (i.e. the first point), and then a second point on the bottom edge or the left or right side depending on the PLATE SIDE value in SYSTEM SETUP DATA and now the sign of the Y PLATE SIZE value. When the sign of the size value is positive, plate home is defined at the lower corner closest to the operator and the main rail as define by PLATE SIDE. A negative size value simply mirrors the plate so that the home position appears at the lower corner farthest from the operator.

From these plate angle prompts, the BURNY 5 automatically defines the angle for the specified plate. It also defines the coordinates of the plate home position if the home position was established by the first point in the prompting sequence, but only if the associated HOME OFFSET values in SYSTEM SETUP DATA are set to zero. If plate angle prompting is not performed and the associated plate home values in SYSTEM SETUP DATA are set to zero, the X and then Y fields of the PLATE OFFSET definition are then highlighted for direct numeric entry.

NOTE

To automatically define the plate offset values but still define a plate angle of zero, simply select "CHANGE ANGLE:YES", jog to the desired plate home position, respond with "YES" to the first point prompt and "NO" to the two second point prompts. If necessary, the operator can still manually override the plate home offset position by direct numeric entry, even if the assignments were automatically determined by the "CHANGE ANGLE" process.

3) SELECT NEW ACTIVE PLATE

When this function is selected, the system first checks if a new plate selection is allowed. If the RUN process is active, the command request is rejected and the error message "BACKGROUND PROCESS BUSY" is displayed. However if it is allowed, an additional prompt is displayed at the bottom of the window requesting the plate number as "SELECT ACTIVE PLATE: __". After specifying a number and pressing <ENTER>, the plate number and its associated rotation angle are both displayed at the top of the screen. Numbers "1" through "4" select one of the four plates now supported. A value of "0" selects the imaginary cutting table with its home at the FIXED ZERO position.

NOTE

Changing the plate number does not cause the machine to move. The BURNY 5 simply defines a new floating home position and then adjusts all displayed X/Y values to reflect the current tool position with respect to the newly selected zero position. After changing the home number, the operator can then 1) press <RET> to move to the new plate home position, 2) press <REV> to return the machine to its current position, or 3) use the jog keys to move the machine to any other position.

Once the active plate number is changed, all run and graphic operations use the new plate size, angle and offset values, regardless of whether it was changed from the TABLE/PLATE DEFINITION screen or the RUN MODE screen.

7) SEARCH FOR HARDWARE FIXED ZERO

When this function is selected, the system first checks to determine if the search process is enabled by bit "0000 0002" in SYSTEM SETUP DATA variable 40 (SYSTEM CONFIGURATION 4). If not, "HOME SEARCH NOT ENABLED" is displayed and the request is rejected. This is to insure that the home search is only performed when the necessary hardware is installed. If enabled, the BURNY 5 continues by checking if the running process is active. If it is, the request is also rejected and "BACKGROUND PROCESS BUSY" is displayed. However if the search is allowed, "HOME TYPE (1=X,2=Y,3=BOTH)", is displayed at the bottom of the window requesting the operation type. After selecting the type and pressing <ENTER>, "PRESS <GO> TO BEGIN SEARCH" is displayed. When <GO> is pressed, the operation status at the bottom of the screen changes to "HOME SEARCH ACTIVE". The prompt line also changes to "PRESS <STOP> TO SUSPEND" to remind the operator that the home search can be stopped and

restarted any number of times until the specified operation is completed. If allowed to finish normally, the resulting fixed points adjusted by the HOME ADJUSTMENT values, are then used to define the FIXED ZERO home position. This position, which identifies the lower left or lower right corner of the cutting table area depending on the PLATE SIDE value in SYSTEM SETUP DATA, is also identified as the "PLATE 0" home position.

NOTE

In order to perform automatic home search operations, special hardware is required in the BURNY 5 control and the cutting machine must be configured with the necessary home switches. Encoders with index pulses further enhance the accuracy of the automatic homing operation but they are not always required. Other considerations include the setup of SYSTEM SETUP DATA variable 40, which contains configuration bits to 1) enable the hardware home search operation, 2) force an optional home requirement at power up, 3) define the search directions, 4) define the active true input states for the limit switches and encoder index pulses, 5) define the type of operation required when "3=BOTH" is selected as sequential or simultaneous, and if sequential, 6) the axis search order (X before or after Y). For additional information, see the definition for setup variable 40 in the section SYSTEM SETUP DATA CONSIDERATIONS.

8) DEFINE POSITION AS FIXED ZERO

When this function is selected, the system first checks to determine if the running process is active. If it is, the operation is not permitted and the error message "NOT ENABLED DURING RUN" is displayed. However if it is allowed, an "ARE YOU SURE? NO" prompt is displayed. This is provided to prevent the operator from accidentally resetting the FIXED ZERO position. To continue, the operator must toggle the response to "YES" and press <ENTER>. The system then displays the prompt, "HOME TYPE (1=X,2=Y,3=BOTH)", to request the operation type. After selecting the operation type and pressing <ENTER>, a "JOG TO FIXED POSITION THEN PRESS <ENTER> TO CONTINUE" message is displayed. At this time, the operator should move the machine to a fixed position or mark and then press <ENTER> to define the current X, Y, or both positions as the fixed points. The BURNY 5 then uses these points and the HOME ADJUSTMENT values to define the new FIXED ZERO position.

9) CLEAR PLATE DEFINITIONS

When selected with no program active, this function clears all of the plate size and plate angle values, but only after the operator responds favorably to an "ARE YOU

SURE?" prompt that is displayed at the bottom of the window. This function also clears the plate home offset values when they are not predefined in SYSTEM SETUP DATA. However, the CUTTING TABLE and HOME ADJUSTMENT values are not affected by this function even when they are not defined in SYSTEM SETUP DATA.

NOTE

Like other operations on this screen, this function is only allowed if the running process is not active. Selecting this function while running displays the message "NOT ENABLED DURING RUN".

SYSTEM SETUP DATA CONSIDERATIONS

This section describes the additions and changes that have been made to the variables in SYSTEM SETUP DATA for the enhancements in this new software version. Many of these descriptions are also provided in other sections. However, this section focuses on the variables themselves and differences from previous software versions. For a description based on functionality, see the OPERATION / SCREEN SUMMARY section in this NC UPDATE.

Some of the changes in SYSTEM SETUP DATA simply use data values and bits that were previously allocated and/or defined but never actually used. These include the HOME OFFSET values (for the four separate homes) and the "undefined" bit positions in SYSTEM CONFIGURATION 1, 2, and 4. Other changes include new variables to define the size of the cutting area and its home offset from a fixed point. Another new variable defines the high search speed used by the new hardware home search process. The remaining changes remove the definitions for several features that are no longer supported or needed because of the newly added fixed coordinate system logic. All of these additions and differences are described in detail in this section.

The following variables have been added or somehow used in a different way in this new software version.

31. PLATE SIDE
37. SYSTEM CONFIGURATION 1
38. SYSTEM CONFIGURATION 2
40. SYSTEM CONFIGURATION 4
73. X HOME 1 OFFSET
74. Y HOME 1 OFFSET
75. X HOME 2 OFFSET
76. Y HOME 2 OFFSET
77. X HOME 3 OFFSET
78. Y HOME 3 OFFSET
79. X HOME 4 OFFSET
80. Y HOME 4 OFFSET
86. X TABLE DIMENSION (FUTURE)
87. Y TABLE DIMENSION (FUTURE)
88. X HOME ADJUSTMENT
89. Y HOME ADJUSTMENT
90. HARDWARE HOME SEARCH SPEED

Note that a summary list of all of the configuration bit definitions for variables 37-40, 51, and 52 is provided at the end of this NC UPDATE as a "field reference" guide.

PLATE SIDE (Variable 31)

In this software version, the purpose of the PLATE SIDE variable remains the same. That is, it establishes the relative position of the cutting area to the left or right of the operator console. It is primary used by the STANDARD SHAPE process to create NC part programs that start at the corner of the plate closest to the operator. It is also used by the NEST EDITOR to define the default starting corner of the plate. However, the NEST EDITOR allows the operator to override this default and select any of the four corners of the plate. The STANDARD SHAPE process always uses the corner defined by PLATE SIDE.

The use of PLATE SIDE has changed in two ways. First, it no longer affects home search operations. In previous versions, the default Y axis search direction was towards the operator. Now, negative Y is the default. The second change is that PLATE SIDE now defines the relative home position for each of the four new plate definitions. When PLATE SIDE is LEFT, the home position of each plate is assumed to reside in the lower right corner of each plate, which is the corner closest to the operator and the easiest to see. As a result, when creating STANDARD SHAPE programs or nested part programs (assuming the default is used in the NEST EDITOR), the home position is consistently defined in all functions.

In some cases, downloaded program nests may assume the opposite lower corner of the plate is its home position. To resolve this graphical problem, a special technique is supported on the TABLE/PLATE DEFINITION screen which allows the home assignment for the selected plate to be mirrored. Simply put, whenever the Y PLATE SIZE value is specified as a positive value, the normal PLATE SIDE assignment is used by the graphic process. However, when a negative Y PLATE SIZE value is defined, the opposite lower corner is used as plate home for graphic imaging operations. For consistency, negative Y PLATE SIZE values also affect the PLATE ALIGNMENT setup process so that the proper "mirrored state" prompting logic is used. As always, the first PLATE ALIGNMENT prompt asks for the home corner (LOWER LEFT or LOWER RIGHT) as defined by PLATE SIDE and now, adjusted by the sign of the associate Y PLATE SIZE value.

NOTE

For this software version as in others, PLATE SIDE should be defined as it is required for the STANDARD SHAPE process. Other capabilities allow the operator to mirror the plate home side for NEST EDITOR operations, when required, and graphic home imaging operations, regardless of where and how the part was created. The TABLE/PLATE DEFINITION screen supports plate home mirroring on a per plate basis so that some may be defined with homes on the LEFT and some on the RIGHT in order to satisfy the requirements of a particular job.

SYSTEM CONFIGURATION 1 (Variable 37)

In this variable, only two minor changes were made. The first change relates to the use and definition of bit "0000 0100" in this variable. This bit was added in the 11/21/91 software version to invert the direction of the Y axis home search when performing PROGRAMMABLE HOME SEARCH operations. In this new software version, this bit is also now used to define the Y axis search direction for the HARDWARE HOME SEARCH operation. However, a much more significant difference is that the Y axis search direction for both of these operations is now directly determined from the state of this bit. The direction is no longer affected by the PLATE SIDE variable in SYSTEM SETUP DATA. In the original definition, this bit was used to invert the default direction established by PLATE SIDE so that the search could be performed away from the main rail instead of towards it. In this software version, Y axis search operations always default to the -Y direction, regardless of the state of the PLATE SIDE variable. Now whenever this bit is set, the Y axis search direction is performed in the +Y direction.

NOTE

In order to minimize any difficulties which may arise from the change in the use of this bit, this new software version automatically checks the state of the PLATE SIDE variable when the control first powers up and then updates the state of this bit to insure that the original "user defined" search direction is maintained. However after installing the software, the user should update any lists defining the setup parameters so that the wrong state is not accidentally restored by the operator at a later date.

The other change in this configuration variable is that bit "0000 0001" no longer changes the status window to display the X and Y position values in absolute. This capability was originally added as a temporary solution to the graphic plate and part positioning problems that existed in previous software versions. With the new "fixed grid" positioning logic in this software version, these positioning problems have been resolved. As such, this bit is no longer supported and should be set to zero to eliminate potential problems in future software releases.

SYSTEM CONFIGURATION 2 (Variable 38)

In this variable, two changes were made. First, the definition for configuration bit "0004 0000" has been discarded. This bit was originally provided as a temporary solution for the graphic plate and part positioning problems in previous software versions. In this new software version, no special configuration bits are required to properly display the relative position of the tool, the part, and the plate. As such, this bit should be set to zero to eliminate potential problems in future releases.

The second change reuses configuration bit "0000 0100" which was used in previous software versions to enable a temporary "part drag" capability. In this software version, this bit enables a new WHITE REDRAW feature. When set, all part program blocks up to the currently active block (or the selected restart block position when stepping) are drawn in WHITE to indicate that they have already been processed. This capability can also be used to identify the amount of processing still required, even after a zoom or a total redraw is requested by the operator. This feature, when combined with the operator selected block restart feature, allows the operator to easily identify which part will be cut when the <GO> key is pressed. As such, it can be a great help when repositioning to cut one or more parts out of a large nested part program.

SYSTEM CONFIGURATION 4 (Variable 40)

A majority of the configuration bits added for this new software version are defined through the low four digits of this SYSTEM SETUP DATA variable. In previous software versions, these bits were not assigned to any operation or function. Only the high digits were used. In this software version, these high digits continue to define both the MAIN and the ALTERNATE language select codes when the ALTERNATE LANGUAGE option is enabled.

Most of the new bit definitions in this variable are used to enable HARDWARE HOME SEARCH operations and define how the search operation is performed. Three of these new bits are used to 1) enable a new DRY RUN OVERRIDE capability, 2) enable an enhanced C-AXIS positioning capability, and 3) disable a new ARC/ARC tangent calculation process in the event that a geometry is found that operates better with the original logic.

The following list summaries the layout of the low sixteen bit flags now defined in the low four digits of this variable. An expanded definition for each of these items is provided in the paragraphs that follow. A summary list containing all of the bit definitions for variables 37 to 40, 51, and 52 is also provided at the end of this NC UPDATE as a "quick reference" guide.

DIGIT 5 (0000 F000) : Home Creep Speed Scaling Factors
DIGIT 6 (0000 0F00) : Home Switch/Encoder Index Logic Inversion Flags
DIGIT 7 (0000 00F0) : Disable for New ARC/ARC Tangent Logic
Enable for Enhanced C-AXIS Positioning
Enable for "B" key as DRY RUN OVERRIDE
X Home Search Invert (converts -X to +X search)
DIGIT 8 (0000 000F) : Dual Axis Home Search Configuration Bits
Hardware Home Search Enable
Fixed Home Power Up Requirement Bit

HOME CREEP SPEED SCALING FACTORS (Variable 40: Bits 0000 F000)

One of the features of the automatic HARDWARE HOME SEARCH scanning logic is that the creep speed used to back off of the home switch and search for the encoder index pulse is automatically defined by the control. The initial creep speed is determined from the actual encoder count size. Adjustments are then made to insure that the machine continues to move at the necessary speed to accurately detect the edge of the encoder index pulse. The position of this pulse is then used as the "fixed point" for the home logic.

In most cases, these new configuration bits are set to zero since no special creep speed scaling is required. However in some installations with the older I/O cards ("TYPE 0": MO-03400, MO-3401), hardware jumpers are used to reduce the incoming encoder rate by a factor of 2, 3 or 4. This prevents the encoder count accumulators from overflowing at higher speeds, especially in motor mounted encoder configurations. Unfortunately, these hardware jumpers cannot be read by the software. These new configuration bits effectively tell the software how these hardware jumpers are set so that the actual incoming encoder rate can still be used to generate the correct creep speed and not a speed that is too fast to accurately detect the edge of the encoder index pulse. These home creep speed factor bits can also be used to simply lower the creep speed, which can be helpful when first setting up the home logic. This capability can also be used if the index is occasionally missed and/or the established fixed home position appears to be one "distance per revolution" or more from the expected position. However under normal conditions, this should not be necessary.

This four bit value defines both the X and the Y creep speed factors. The top two bits define the X axis factor and the low two bits, the Y axis factor. As a result, the value selected for each axis factor must be merged to determine the required hexadecimal digit. The format and position of these configuration bits follows. A reference to commonly used values where both axes are the same is also provided for those that are not familiar with hexadecimal arithmetic.

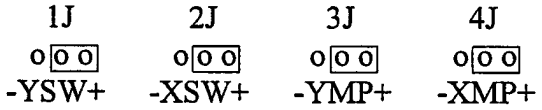
CONFIGURATION SUMMARY FOR DIGIT 5 (0000 F000)

CREEP SPEED FACTOR:	X bits:	Y bits:	Both axes bits=hex:
100% of calculated speed	00**	**00	0000 = 0
50% of calculated speed	01**	**01	0101 = 5
33% of calculated speed	10**	**10	1010 = A
25% of calculated speed	11**	**11	1111 = F

To enter the hexadecimal value of "A", enter the sequence <SHF> <0>, and for "F", <SHF><5>.

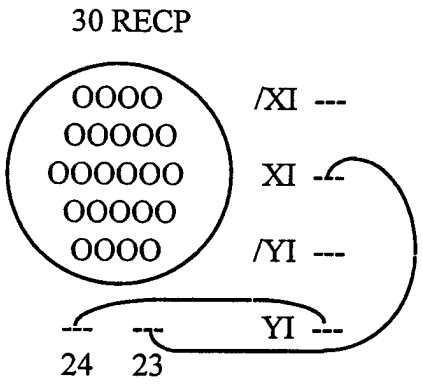
HOME SWITCH/INDEX INVERSION FLAGS (Variable 40: Bits 0000 0F00)

These configuration bits, simply put, are used to invert the logic states of the input signals for the X and Y home switches and the X and Y encoder index pulses (i.e. marker pulses). This software capability performs the same function as the hardware jumpers on the home switch/encoder index interface card (MO-06242) which is connected to the underside of the drive interface card on the back panel. On this card, these jumpers are identified as follows:



With these new software configuration bits, the hardware jumpers are no longer necessary. Differences in logic state caused by external cabling and/or the types of home switches used can now be easily inverted through the operator interface. The recommendation is that all of these hardware jumpers be set to the "+" setting which is effectively the same as "no jumper installed". OEMs using specific external hardware may prefer different hardware jumper settings so that in SYSTEM SETUP DATA, these new bits can remain cleared.

In addition to the hardware jumpers on this special interface card, inversion of the encoder index pulses can also be performed when adding the jumper wires to the back panel (assuming back panel MO-09560 is installed). In order for these signals to actually be read by the software, wire jumpers must connect tabs 23 and 24 to the appropriate signal tabs that appear in a column to the right of 30RECP. The recommended positions are 23 to XI and 24 to YI so that no additional inversion is performed. These connections are provided on back panel hardware version MO-09560. Older back panels (such as M0-3035) do not have this capability and as such, can not be used to perform hardware home operations.



The four bits defined by this configuration digit are used to define both the X and the Y home switch and encoder index pulse logic states. When these bits are not set, the states defined by the jumper positions on the interface cards are directly used by the software. However when set, the associate input is logically inverted before it is actually used by the homing process. The top two bits define the inversion bits for the home switch inputs and the low two bits, the inversion bits for the encoder index pulse (i.e. marker pulse) inputs. As a result, the bits set for each required inversion must be merged to determine the required hexadecimal digit. The following table has been provided to help determine the desired hexadecimal digit. Each column indicates the inversion settings selected by the digit at the top of the column. When zero is selected, no inversion operations are performed by the software.

CONFIGURATION SUMMARY FOR DIGIT 6 (0000 0F00)

	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Invert X Home Switch Logic								X	X	X	X	X	X	X	X
Invert Y Home Switch Logic				X	X	X	X					X	X	X	X
Invert X Encoder Index Logic		X	X			X	X			X	X			X	X
Invert Y Encoder Index Logic	X		X		X		X		X		X		X		X

Remember that hexadecimal values are entered as a two key sequence where <SHF> <0> enters an "A", <SHF><1> enters a "B", etc.

One final note. The state of these inputs from the back panel can be shown by accessing the RUNTIME DATA function via the DISPLAY SYSTEM DATA utility menu. In this function, the MPC BACK PANEL INPUTS (Variable 5) data is displayed as an 8 bit binary value defined as follows:

1	2	3	4	5	6	7	8
X	X	X	X	X	X	X	X

Bit 1 - PLASMA ARC ON input
Bit 2 - OXYGEN CUT SWITCH input
Bit 3 - RUN INHIBIT input
Bit 4 - PLASMA SELECT input
Bit 5 - Y HOME SWITCH/ENCODER INDEX input
Bit 6 - X HOME SWITCH/ENCODER INDEX input
Bit 7 - Y EXTERNAL DRIVE CONTROL input
Bit 8 - X EXTERNAL DRIVE CONTROL input

In this variable, a "1" indicates that the associated input is "ON" and "0" indicates the "OFF" state.

By default at power-up, bits 5 and 6 show the states of the HOME SWITCH inputs. Then, as the HOME SEARCH process changes from "switch mode" to "index mode" for the each axis, these inputs show the states of the index inputs. The home process software is deliberately written in a way that allows the last required input mode to remain active whether the home process completes normally or it is aborted by the operator. As a result, a manual abort of the home process at the proper time allows the operator to inspect the state of the encoder index inputs instead of the home switch inputs on these RUNTIME DATA variable bits.

NOTE

As a safety precaution, the HARDWARE HOME SEARCH process was implemented using inverted logic. As a result, whenever the input states are "OFF" (i.e. the associated MPC BACK PANEL INPUT bit shows a "0"), the search logic assumes that the home switch and index pulse inputs are "active" so that the high speed search and the index pulse search are not performed. As a result, to actually search for the required input states when using active high inputs, all of the inversion configuration bits must be set to one. If set to zero with this type of input signal, the Burny simply assumes that it is already on the home switch and immediately enters the backup state using the creep speed to find the location where the home switch is **not** active.

FUNCTIONS DEFINED BY DIGIT 7 (Variable 40: Bits 0000 00F0)

This digit in SYSTEM CONFIGURATION 4 is used to define four separate functions. The following table identifies the hexadecimal digit required to select any combination of these functions. A description for each of these functions is provided in the sections that follow.

	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
New ARC/ARC Process Disable								X	X	X	X	X	X	X	X
Enhanced C-Axis Update Enable				X	X	X	X					X	X	X	X
Dry Run Override with "B" Key		X	X			X	X			X	X			X	X
Invert X Home Search Direction	X		X		X		X		X		X		X		X

Remember that hexadecimal values are entered as a two key sequence where <SHF> <0> enters an "A", <SHF><1> enters a "B", etc.

NEW ARC/ARC TANGENT LOGIC DISABLE (Variable 40: Bit 0000 0080)

This bit is used to disable a new tangent ARC to ARC processing routine that was added to eliminate small fill-in blocks between poorly programmed arcs. These fill-in blocks caused the RUN DECEL logic to generate a slowdown at what appeared to be a smooth arc transition. This new process, which was actually introduced in the 2/28/95-F version, eliminates these types of fill-in blocks by calculating the correct arc intersection point. As of this release, no problems have been reported with this new logic so this configuration bit should ***not*** be set.

ENHANCED C-AXIS UPDATE ENABLE (Variable 40: Bit 0000 0040)

One of the new features added in the 1/15/97 software version not related to CUT LOSS is the C-AXIS positioning enhancement. When this bit is set, additional calculations are performed so that the outputs to the C-AXIS interface at the start and end of every arc are significantly more accurate. For most applications where cutting speeds are 10 IPM or greater, the additional overhead associated with these calculations does not improve the accuracy of the part. As such, this feature should not be enabled. However in applications where cutting speeds are slow and the best possible C-AXIS control is desired, this bit should be set to one to enable the feature.

"B" KEY AS DRY RUN OVERRIDE ENABLE (Variable 40: Bit 0000 0020)

This bit allows the "B" drive key on the front panel to quickly select a special DRY RUN OVERRIDE mode that has been added to this software version. Like the new DRY RUN TEST MODE, this override mode allows the operator to run in the forward or reverse direction along the path, stop, and then jog off of the path without re-positioning the part on the table. This feature was added primarily as a tool to help the operator locate the desired position on the part when restarting after a power failure or a operator initiated program abort. In this mode, a new pierce point can also be defined since no part movement occurs when jogging. As in the AUTO / NO TEST and MANUAL / NO TEST modes when <GO> is pressed, the BURNY performs the cut start logic at the current tool position and then cuts back to the point where the operator jogged from the programmed path. As an OVERRIDE function, the operator only needs to unlatch the "B" key with a second key press to return to the original CUT or TEST mode selected.

This feature is not always enabled since it may conflict with other uses of the "B" key when running in the PLC SYSTEM configuration. As a result, this feature must be enabled by setting this bit to a one. If zero, the special DRY RUN OVERRIDE "hot key" function is not available.

INVERTED X HOME SEARCH ENABLE (Variable 40: Bit 0000 0010)

Similar to the Y axis home search inversion bit defined in SYSTEM CONFIGURATION 1, this bit inverts the direction of the high speed X axis "home switch" search. When set to a one, the normal -X default search direction is changed to the +X direction. In previous software versions, the search direction for the X axis was always towards the operator (i.e. in the -X direction). This bit affects the X axis high speed search direction for both the new HARDWARE HOME SEARCH and the existing PROGRAMMABLE HOME SEARCH auxiliary function operations.

FUNCTIONS DEFINED BY DIGIT 8 (Variable 40: Bits 0000 000F)

This digit in SYSTEM CONFIGURATION 4 is used to define four separate functions. The following table identifies the hexadecimal digit required to select any combination of these functions. A description for each of these functions is provided in the sections that follow.

	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Reverse Home Axis Sequence								X	X	X	X	X	X	X	X
Sequential Home Axis Search				X	X	X	X					X	X	X	X
Hardware Home Search Enable		X	X			X	X			X	X			X	X
Home Required At Power-Up	X		X		X		X		X		X		X		X

Remember that hexadecimal values are entered as a two key sequence where <SHF> <0> enters an "A", <SHF><1> enters a "B", etc.

DUAL AXIS SEARCH CONFIGURATION (Variable 40: Bits 0000 000C)

One of the features supported in the HARDWARE HOME SEARCH function is the ability to perform home search operations on both the X and Y axes with a single request. The configuration bits in this variable define the way in which these searches are performed. When "BOTH" is selected for the SEARCH FOR HARDWARE FIXED ZERO operation on the TABLE/PLATE DEFINITION screen, the BURNY 5 performs the search operation by default on both axes simultaneously. One configuration bit (bit "0000 0008") allows this default mode to be changed from a "parallel" mode to a "sequential" mode where the home operation is first performed on one axis and then the other. The other configuration bit (bit "0000 0004) allows the order of the axis search to be swapped when performing "sequential" operations. By default, Y HOME is performed before X HOME. When this bit is set to a one, the X HOME operation is performed before the Y HOME.

HARDWARE HOME SEARCH ENABLE (Variable 40: Bit 0000 0002)

In order to actually perform hardware home search operations, the cutting machine must be configured with the necessary home limit switches and/or encoders with index pulses (i.e. marker pulses). The BURNY 5 must also be configured with the appropriate interface cards and internal jumpers. This configuration bit is used to enable the SEARCH FOR HARDWARE FIXED ZERO operation on the TABLE/PLATE DEFINITION screen. If it is not set to one, an error message is displayed whenever the HARDWARE HOME operation is selected.

FIXED HOME POWER UP REQUIREMENT (Variable 40: Bit 0000 0001)

One of the major advantages of this new software version is its ability to establish and maintain a new fixed coordinate grid from which all plate, part, and tool positions can be referenced. However in order to use this capability, the operator must re-establish this fixed coordinate grid from some fixed point after every power-up. This new configuration bit, when set to one, prevents the operator from running any part programs before the fixed coordinate grid is established. This is accomplished by warning the operator with the message HOME OPERATION REQUIRED on the MAIN MENU screen, and then by redisplaying this same message when the operator selects the RUN PROGRAM function. To remove this warning, the operator **must** call up the TABLE/PLATE DEFINITION screen (by pressing the <II> key on the MAIN MENU or any other place this "hot key" is supported) and perform either a hardware home operation (function 7) or a software home operation (function 8). As soon as the home for **both** axes is successfully performed (whether done together or separately), this warning condition is removed.

X AND Y HOME OFFSETS (Variables 73 to 80)

One of the major enhancements in this new software version is the multiple plate capability. Generally, all of the functions needed to setup and maintain four separate plates are performed through the new TABLE/PLATE DEFINITION screen. This includes the prompting operations to define not only the size and angle for each of the four plates but also the offsets of their home positions from the "fixed zero" position. This allows the operator to easily define and redefine the size, position, and angle of a plate on a per job basis from a single setup screen. Note that all of the values defined on this screen are retained in battery backed memory so that they can be automatically restored after a power down condition.

Variables 73 through 80 are used to define the home offset values for some or all four plates in a more permanent way. Once these offsets are define in SYSTEM SETUP DATA and saved in non-volatile memory, the plate home offset values can only be displayed on the TABLE/PLATE DEFINITION screen. That is, once a non-zero value is defined in either the X or Y HOME OFFSET variable associated with a specific plate, the home position of that plate can no longer be changed on the TABLE/PLATE DEFINITION screen. As a result, applications that need one or more plates defined at specific locations to satisfy fixture requirements, need only to define the X and/or Y plate home offset distances in the associated SYSTEM SETUP DATA variables to protect them from accidental change.

NOTE

Whenever the home offsets for a selected plate are defined in SYSTEM SETUP DATA, the ability to change them from the TABLE/PLATE DEFINITION screen is disabled. As a result, when stepping through the PLATE SETUP prompting operations, the normal WHITE value highlight on these values is replaced with a YELLOW highlight and the warning message DEFAULTS FROM SYSTEM SETUP DATA is displayed in RED at the bottom right side of the display window. This warning is simply a reminder that the plate home offset value prompts are no longer allowed for the selected plate. This is not an error condition.

The easiest way to define the home offset for a particular plate is to first select PLATE 0 (which identifies the fixed grid as the active coordinate system) and then jog the machine to the appropriate position on the table. In this mode, the X and Y values displayed in the status window at the bottom of the screen can be directly entered into the X and Y HOME OFFSET values for the associated plate. Remember that SYSTEM SETUP DATA must be saved in non-volatile memory using the SAVE CONFIGURATION function on the UTILITY MENU in order for the values to be retained after the next power down condition.

X AND Y TABLE DIMENSION VALUES (Variables 86 and 87)

These variables are provide for use in future software versions. In this new software version, they are only used for display purposes even though all of the software exists to define them as temporary values on the TABLE/PLATE DEFINITION screen and as more permanent values through SYSTEM SETUP DATA. As with the HOME OFFSET values, display and modify operations are only allowed on the TABLE/PLATE DEFINITION screen when these values are defined as zero in SYSTEM SETUP DATA.

In this software version, these dimension values have no real use except to fix the CUTTING TABLE SIZE parameters to values that can not be changed on the TABLE/PLATE DEFINITION screen. Later, these SYSTEM SETUP DATA variables will be used to define the dimensions of the "PLATE 0" work space for graphic imaging operations. When this occurs, these values will be defined large enough to include the entire cutting area. By definition, HOME 0 (or PLATE 0) is at the FIXED ZERO position of the machine. The cutting area will be defined to the left or right of this point as with the definitions for plates 1 through 4. Until these features are added, no silhouette of the table area will be shown whenever "0" is selected as the active plate.

X AND Y HOME ADJUSTMENT VALUES (Variables 88 and 89)

These variables define the distance from some fixed point to the FIXED ZERO position of the control. Several techniques exist to establish this fixed point. These include automatic hardware home search operations as well as operator initiated jogging operations. The actual technique used will depend on the configuration of the machine and/or the capabilities of the resident BURNY 5 hardware.

Like the HOME OFFSET parameters, the HOME ADJUSTMENT parameters can be defined directly on the TABLE/PLATE DEFINITION screen, or they can be defined through these SYSTEM SETUP DATA variables. Defining a non-zero value for one or both of these HOME ADJUSTMENT variables in SYSTEM SETUP DATA inhibits the operator from changing them on the TABLE/PLATE DEFINITION screen, thus making them more permanent and more difficult to change accidentally. Only when both of these HOME ADJUSTMENT values in SYSTEM SETUP DATA are zero can the HOME ADJUSTMENT values be changed on the TABLE/PLATE DEFINITION screen.

NOTE

Both positive and negative values can be defined for these variables. However the user must remember that when performing HARDWARE HOME SEARCH operations, the search is always performed in one direction. As a result, the X and Y HOME ADJUSTMENT values should move the machine away from the hardware home switches toward the normal cutting area.

HARDWARE HOME SEARCH SPEED (Variable 90)

This variable allows the HIGH SEARCH SPEED used to locate the hardware home switches to be fixed at a given speed. Any speed up to the maximum drive speed of the machine can be specified. When defined in this way, the position of the speed dial has no affect on this search speed (with the exception of zero, which cause the search process to pause until a non-zero speed dial setting is defined).

When this variable is set to zero, HIGH SEARCH SPEED is defined from the selected running speed of the machine. This speed is define by the scaling the currently defined run speed limit (or digital feedrate value if so enabled) by the speed dial setting. In this way the operator can alter the HIGH SEARCH SPEED with the speed dial, running faster when far from the home switch positions and slower as the machine approaches the home switches to minimize the overshoot.

SYSTEM SETUP DATA CONFIGURATION BIT SUMMARY

On the pages that follow, a consolidated bit description is provided for each of the four SYSTEM CONFIGURATION variables (37, 38, 39, and 40) and the two PROGRAM FORMAT variables (51 and 52) defined in SYSTEM SETUP DATA. The summary for each variable is provided in a format that can be used to individually identify bits as well as define the 8 digits for each of these configuration variables. The primary purpose of this section is to provide a quick reference guide for each enabling and disabling bit, not a detailed description for each function. For additional information, see the SYSTEM SETUP DATA section in the BURNY 5 manual or, if a more recent feature, the appropriate NC UPDATE.

NOTE

A majority of the more recent changes in this summary list are found in the description for variable 40 (bits 0000 FFFF). However, changes in variable 37 (bits 0000 0101) and variable 38 (bit 0004 0100) should also be noted.

37. SYSTEM CONFIGURATION 1:

BITS	DESCRIPTION
8000 0000	disable plasma logic, inputs, and outputs
4000 0000	disable oxygen logic, inputs, and outputs
2000 0000	disable marker 1 logic and output
1000 0000	disable marker 2 logic and output
	D1 digit value
0800 0000	currently undefined - do not set
0400 0000	currently undefined - do not set
0200 0000	currently undefined - do not set
0100 0000	currently undefined - do not set
	D2 digit value
0080 0000	enable aux output 1 as auxiliary torch control
0040 0000	enable aux output 2 as auxiliary torch control
0020 0000	enable aux output 3 as auxiliary torch control
0010 0000	enable aux output 4 as auxiliary torch control
	D3 digit value
0008 0000	future aux output 5 as auxiliary torch control
0004 0000	future aux output 6 as auxiliary torch control
0002 0000	future aux output 7 as auxiliary torch control
0001 0000	future aux output 8 as auxiliary torch control
	D4 digit value
0000 8000	speed loop enable (enables "PI" control algorithm)
0000 4000	feed percentage enable
0000 2000	120% speed dial enable
0000 1000	program feedrate enable
	D5 digit value
0000 0800	speed loop filter disable
0000 0400	digital feedrate enable
0000 0200	high speed jog enabled (enables "A" key as HIGH JOG SELECT)
0000 0100	inverted Y home search (reverses normal -Y search to +Y direction)
	(bit 0000 0010 of variable 40 inverts X search direction)
	D6 digit value
0000 0080	transmit codes to PLC after processing (default is "before")
0000 0040	incremental "HOME AXIS RETURN" movement (default is absolute move)
0000 0020	enable latched backup (default is momentary backup when key held)
0000 0010	enable "CYCLE STOP" when path error detected (default is "warn only")
	D7 digit value
0000 0008	disable double axis returns
0000 0004	future absolute position adjustment enable - do not set
0000 0002	enable "constant rate" accel ramp (disables "constant time" ramp)
0000 0001	currently undefined - do not set
	D8 digit value

38. SYSTEM CONFIGURATION 2:

BITS	DESCRIPTION
8000 0000	currently undefined - do not set
4000 0000	currently undefined - do not set
2000 0000	screen saver disable
1000 0000	special password enable (ZERO key)
	D1 digit value
0800 0000	currently undefined - do not set
0400 0000	currently undefined - do not set
0200 0000	currently undefined - do not set
0100 0000	currently undefined - do not set
	D2 digit value
0080 0000	currently undefined - do not set
0040 0000	currently undefined - do not set
0020 0000	currently undefined - do not set
0010 0000	custom banner screen enable
	D3 digit value
0008 0000	overlay table prompt enable on 2nd RUN screen
0004 0000	currently undefined - do not set
0003 0000	define graphic cursor type
	0=> star cursor during run trace
	1=> X cursor
	2=> box cursor
	3=> no cursor
	D4 digit value
0000 8000	currently undefined - do no set
0000 4000	enable underline prompting (if monochrome bit set)
0000 2000	all characters and graphics displayed in white
0000 1000	monochrome display selected (reverse video prompting)
	D5 digit value
0000 0800	select white cursor for real-time trace
0000 0400	no cartridge installed
0000 0200	enable alphanumeric program name prompting
0000 0100	enable WHITE redraw up to current block position
	D6 digit value
0000 0080	MPC home position offset adjustment enable
0000 0040	scale bar during run enabled
0000 0020	internal floppy drive installed
0000 0010	graphics home offset enable (resets program start)
	D7 digit value
0000 0008	delete directory password enable
0000 0004	edit/nest password enable
0000 0002	alternate language enable
0000 0001	novice mode enable
	D8 digit value

39. SYSTEM CONFIGURATION 3:

BITS	DESCRIPTION
8000 0000	command messages enclosed in codes <SOH> and <EOT> (HEX 01 and 04)
4000 0000	currently undefined - do not set
2000 0000	currently undefined - do not set
1000 0000	currently undefined - do not set
	D1 digit value
0800 0000	currently undefined - do not set
0400 0000	currently undefined - do not set
0200 0000	currently undefined - do not set
0100 0000	currently undefined - do not set
	D2 digit value
00F0 0000	baud rate for command message option (forced with programmable I/O)
	0=> default (9600) 1=> 110 baud 2=> 300 baud
	3=> 600 baud 4=> 1200 baud 5=> 2400 baud
	6=> 4800 baud 7=> 9600 baud 8=> 19200 baud
	D3 digit value
000F 0000	character type for command messages (forced with programmable I/O)
	0 => default (8 data bits, odd parity, 2 stop bits out)
	1,8=> 7 data bits, no parity (1=> 2 stop bits out, 8=> 1 stop bit)
	2,9=> 8 data bits, no parity (2=> 2 stop bits out, 9=> 1 stop bit)
	3,A=> 7 data bits, even parity (3=> 2 stop bits out, A=> 1 stop bit)
	4,B=> 8 data bits, even parity (4=> 2 stop bits out, B=> 1 stop bit)
	5,C=> 7 data bits, odd parity (5=> 2 stop bits out, C=> 1 stop bit)
	6,D=> 8 data bits, even parity (6=> 2 stop bits out, D=> 1 stop bit)
	D4 digit value
0000 8000	future encoder speed averaging enabled - do not set
0000 4000	future drift compensation filter enable - do not set
0000 2000	future drift compensation algorithm enable - do not set
0000 1000	enable MINIMUM HOLD SPEED scaling operations
	D5 digit value
0000 0800	disable "missed" arc endpoint correction
0000 0400	enable OXYGEN PIERCE TIMER HOLD (disables pierce ramping)
0000 0200	enable PLASMA PIERCE TIMER HOLD (disables pierce ramping)
0000 0100	enable extended 8 bit RUN DECEL speed values (default is 5 bits)
	D6 digit value
0000 0080	disable new kerf "arc center fix" logic (for testing only)
0000 0040	currently undefined - do not set
0000 0020	super hi-res program mode (ENGLISH: 0.0001 inch, METRIC: .002 mm)
0000 0010	hi-res program mode (ENGLISH: 0.0005 inch, METRIC: .010 mm)
	D7 digit value
0000 0008	enable additional PLC timer data register transmissions
0000 0004	enable PIERCE TIMER FREEZE (overrides <GO> key cancel)
0000 0002	auto select OVERLAY TABLE 1 with PLASMA
0000 0001	special E-STOP status messages
	D8 digit value

40. SYSTEM CONFIGURATION 4:

BITS	DESCRIPTION
F000 0000	main language select 0=> English 1=> German 2=> French 3=> Finnish 4=> Italian 5=> Spanish 6=> Swedish 7=> Dutch 8=> Norwegian 9=> Portuguese (added in 2/28/95-E version) D1 digit value
0F00 0000	alternate language select 0=> English 1=> German 2=> French 3=> Finnish 4=> Italian 5=> Spanish 6=> Swedish 7=> Dutch 8=> Norwegian 9=> Portuguese (added in 2/28/95-E version) D2 digit value
00FF 0000	currently undefined - do not set D3, D4 digit values
0000 C000	X axis creep speed factor (0 => full creep speed) 4 => 1/2 speed 8 => 1/3 speed C => 1/4 speed
0000 3000	Y axis creed speed factor (0 => full creep speed) 1 => 1/2 speed 2 => 1/3 speed 3 => 1/4 speed D5 digit value
0000 0800	invert X home switch logic state
0000 0400	invert Y home switch logic state
0000 0200	invert X encoder index logic state
0000 0100	invert Y encoder index logic state D6 digit value
0000 0080	disable new ARC/ARC tangent logic
0000 0040	enable enhanced C-AXIS positioning updates
0000 0020	dry run override enable (enables "B" key as DRY RUN override)
0000 0010	invert X home search (reverses normal -X to +X search direction) (bit 0000 0100 of variable 37 inverts Y search direction) D7 digit value
0000 0008	sequential search order reversal (default is Y before X)
0000 0004	sequential home search enable (default is simultaneous X & Y)
0000 0002	hardware home search enable (default is not allowed)
0000 0001	home required at power-up enable (default is not required) D8 digit value

51. STANDARD PROGRAM FORMAT:

BITS	DESCRIPTION
F000 0000	currently undefined - do not set D1 digit value
0800 0000	currently undefined - do not set
0400 0000	currently undefined - do not set
0200 0000	currently undefined - do not set
0100 0000	enable "SINGLE QUADRANT" arc load conversion mode D2 digit value
0080 0000	enable program compression (discards redundant aux functions)
0040 0000	disable WORD ADDRESS function/dimension block chaining
0020 0000	enable special "end-of-program 2" string operations
0010 0000	enable special "end-of-program 1" string operations D3 digit value
0008 0000	disable ESSI program number and name output operations
0004 0000	disable program name operations
0002 0000	disable program message operations
0001 0000	disable WORD ADDRESS line number output and ESSI NULL output D4 digit value
0000 E000	WORD ADDRESS dimension shift count; 3 bit value defined as follows: 2 => dimension shift of 1 (e.g. X1000 Y1000 => X100.0 Y100.0) 4 => dimension shift of 2 (e.g. X1000 Y1000 => X10.00 Y10.00) 6 => dimension shift of 3 (e.g. X1000 Y1000 => X1.000 Y1.000) 8 => dimension shift of 4 (e.g. X1000 Y1000 => X0.100 Y0.100) A => dimension shift of 5 (e.g. X1000 Y1000 => X0.010 Y0.010) C => dimension shift of 6 (e.g. X1000 Y1000 => X0.001 Y0.001) E => dimension shift of 7 (e.g. X1000 Y1000 => X.0001 Y.0001)
0000 1000	enable custom code conversion table operations D5 digit value
0000 0800	enable aux function before motion (overrides normal aux priorities)
0000 0400	enable axis swap during load/store/edit/save conversion
0000 0200	enable X axis sign invert during load/store/edit/save conversion
0000 0100	enable Y axis sign invert during load/store/edit/save conversion D6 digit value
0000 0080	invert arc directions in ESSI and WORD ADDRESS program formats
0000 0060	WORD ADDRESS dwell shift count; 2 bit value defined as follows: 2 => dwell shift of 1 (e.g. F100 => 10.0 seconds) 4 => dwell shift of 2 (e.g. F100 => 1.00 seconds) 6 => dwell shift of 3 (e.g. F100 => .100 seconds)
0000 0010	enable FORCED INCREMENTAL I/J DIMENSION mode (overrides X/Y mode) D7 digit value
0000 0008	enable multiquadrant AUTO I/J sign calculations
0000 0006	WORD ADDRESS feedrate shift count; 2 bit value defined as follows: 2 => feedrate shift of 1 (e.g. F100 => 10.0 seconds) 4 => feedrate shift of 2 (e.g. F100 => 1.00 seconds) 6 => feedrate shift of 3 (e.g. F100 => .100 seconds)
0000 0001	enable ABSOLUTE DIMENSION mode as default (normally INCREMENTAL) D8 digit value

52. CUSTOM PROGRAM FORMAT:

BITS	DESCRIPTION
F000 0000	currently undefined - do not set D1 digit value
0800 0000	currently undefined - do not set
0400 0000	currently undefined - do not set
0200 0000	currently undefined - do not set
0100 0000	enable "SINGLE QUADRANT" arc load conversion mode D2 digit value
0080 0000	enable program compression (discards redundant aux functions)
0040 0000	disable WORD ADDRESS function/dimension block chaining
0020 0000	enable special "end-of-program 2" string operations
0010 0000	enable special "end-of-program 1" string operations D3 digit value
0008 0000	disable ESSI program number and name output operations
0004 0000	disable program name operations
0002 0000	disable program message operations
0001 0000	disable WORD ADDRESS line number output and ESSI NULL output D4 digit value
0000 E000	WORD ADDRESS dimension shift count; 3 bit value defined as follows: 2 => dimension shift of 1 (e.g. X1000 Y1000 => X100.0 Y100.0) 4 => dimension shift of 2 (e.g. X1000 Y1000 => X10.00 Y10.00) 6 => dimension shift of 3 (e.g. X1000 Y1000 => X1.000 Y1.000) 8 => dimension shift of 4 (e.g. X1000 Y1000 => X0.100 Y0.100) A => dimension shift of 5 (e.g. X1000 Y1000 => X0.010 Y0.010) C => dimension shift of 6 (e.g. X1000 Y1000 => X0.001 Y0.001) E => dimension shift of 7 (e.g. X1000 Y1000 => X.0001 Y.0001)
0000 1000	enable custom code conversion table operations D5 digit value
0000 0800	enable aux function before motion (overrides normal aux priorities)
0000 0400	enable axis swap during load/store/edit/save conversion
0000 0200	enable X axis sign invert during load/store/edit/save conversion
0000 0100	enable Y axis sign invert during load/store/edit/save conversion D6 digit value
0000 0080	invert arc directions in ESSI and WORD ADDRESS program formats
0000 0060	WORD ADDRESS dwell shift count; 2 bit value defined as follows: 2 => dwell shift of 1 (e.g. F100 => 10.0 seconds) 4 => dwell shift of 2 (e.g. F100 => 1.00 seconds) 6 => dwell shift of 3 (e.g. F100 => .100 seconds)
0000 0010	enable FORCED INCREMENTAL I/J DIMENSION mode (overrides X/Y mode) D7 digit value
0000 0008	enable multiquadrant AUTO I/J sign calculations
0000 0006	WORD ADDRESS feedrate shift count; 2 bit value defined as follows: 2 => feedrate shift of 1 (e.g. F100 => 10.0 seconds) 4 => feedrate shift of 2 (e.g. F100 => 1.00 seconds) 6 => feedrate shift of 3 (e.g. F100 => .100 seconds)
0000 0001	enable ABSOLUTE DIMENSION mode as default (normally INCREMENTAL) D8 digit value

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PLC SYSTEM CONSIDERATIONS

Several enhancements have been made in this software version to functions that are only performed when operating in the BURNY 5 / PROGRAMMABLE LOGIC CONTROLLER system configuration. In the normal "stand-alone" BURNY 5 system configuration, these changes have no affect.

When operating in this optional PLC SYSTEM configuration, status and mode data is transferred from the BURNY 5 to the PLC to keep it logically synchronized. In this new software version, several bits in DATA REGISTER 61 (which were previously undefined) are now used to identify DRY RUN mode, INTERNAL STEPPING mode, and PROGRAM STARTED mode. The only other differences in this data register are that the existing bits for SPEED CALIBRATION mode and CONTINUOUS TEST mode are now also used to indicate conditions such as an active HARDWARE HOME SEARCH operation or an active new test mode.

WARNING

The impact of the new test modes on the operation of the system may or may not be significant, depending on how the logic program in the PLC was implemented. Although an effort has been made to eliminate and/or reduce undesirable affects, this software version ***should not*** be installed in a PLC SYSTEM configuration without first determining if the logic program is indeed compatible. More information on implementation of these new test modes and the status bits used to identify them to the PLC is provided in the paragraphs that follow.

Generally in the PLC SYSTEM configuration, all of the motion is controlled by the BURNY 5 hardware and all of the tool logic is controlled by ladder logic program running in the PLC. Nearly all of the information required to maintain this synchronization is communicated by a serial link and a special protocol which allows the BURNY 5 to write and read data registers in the PLC's memory. In the original implementation, data registers 50 through 64 were reserved for use by this communication process but only registers 60 through 64 were actually used. Starting with software version 8/10/94-A, registers 50 through 59 could be used to supply various timer values to the PLC, but only when enabled through SYSTEM SETUP DATA variable 39 (bit "0000 0008"). The following register definitions are currently supported in the PLC SYSTEM data interface.

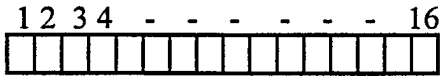
50 - PLASMA ARC DELAY
51 - PLASMA ARC OFF DELAY
52 - OXYGEN FUEL BLEED OFF
53 - TABLE #0 MINIMUM OFF TIME

54 - TABLE #0 DEFAULT DWELL
55 - MARKER DELAY TIME
56 - TABLE #0 PLASMA START DELAY
57 - PIERCE RAMP/HOLD TIME
58 - RESERVED
59 - RESERVED

60 - AUXILIARY CODE VALUE
61 - KEY/STATUS DATA BITS
62 - USER DEFINED PREHEAT VALUE
63 - DRIVE RELATED KEYBOARD BITS
64 - LATCHED KEYBOARD/LED BITS

Three new bit descriptions are now provided in DATA REGISTER 61. One indicates when a new DRY RUN TEST mode is selected and a second, when a new INTERNAL STEPPING mode is actively running. The third new bit was added to help the PLC identify when a program is active so that if necessary, the PLC can perform special program startup and/or termination logic.

The following status bit assignments are now defined in DATA REGISTER 61. Note that * highlights new bit definitions and + highlights expanded bit definitions.



BIT 1 (8000) : RST (RECYCLE) KEY PRESSED
BIT 2 (4000) : STOP (CYCLE STOP) KEY PRESSED
BIT 3 (2000) : GO (CYCLE START) KEY PRESSED
BIT 4 (1000) : RET (RETURN) KEY PRESSED
* BIT 5 (0800) : ***PROGRAM STARTED AND READY***
* BIT 6 (0400) : ***INTERNAL STEPPING IN PROGRESS***
\+ BIT 7 (0200) : SPEED CAL ***OR HOME SEARCH*** IN PROGRESS
BIT 8 (0100) : TEACH MODE IN PROGRESS
* BIT 9 (0080) : ***DRY RUN TEST MODE SELECTED***
BIT 10 (0040) : PROGRAM RUNNING OVER 90% SPEED
BIT 11 (0020) : PROGRAM RUNNING (GO KEY LED)
BIT 12 (0010) : RUN DIRECTION (1=FORWARD, 0=BACKUP)
BIT 13 (0008) : PC MODE (0=NORMAL NC MODE FROM CNC KEY)
BIT 14 (0004) : CUT MODE (1=AUTO, 0=MANUAL)
\+ BIT 15 (0002) : CONTINUOUS TEST MODE SELECTED
BIT 16 (0001) : SINGLE STEP TEST MODE SELECTED

As indicated earlier, BIT 5 in DATA REGISTER 61 now provides status information to the PLC about the state of the selected NC part program. This bit contains a value of

zero when no part program is selected to run and/or the control is in the RESET state. After a part program has been selected and the <GO> key is pressed for the first time, this value changes to one. It then remains set until the <RST> key is pressed to terminate the active part program ***or*** the <RET> key is pressed to return to "BLOCK 0" for a total restart of the program. When either of these occur, the value of this bit is again reset to zero.

One other minor change worth noting is that the previously defined SPEED CAL status bit (BIT 7) is now also used to indicate when HARDWARE HOME SEARCH operations are active. Since both of these operations which move the machine can only be selected by the operator when not running a part program, no special PLC operations should be required.

In order to properly understand the purpose and function of the other new bits, a brief review of how the BURNY 5 identifies the existing modes is necessary. In previous software versions, the BURNY 5 supported two cutting modes (AUTO and MANUAL) and two test modes (CONTINUOUS and SINGLE STEP). To identify these modes to the PLC, three status bits in DATA REGISTER 61 were used (bits 14, 15, and 16). When none of these bits were set, MANUAL CUT/NO TEST was the selected mode. BIT 14 was only set when AUTO CUT/NO TEST was selected. BIT 15 was only set when CONTINUOUS TEST mode was selected, and BIT 16, only when SINGLE STEP TEST MODE was selected. This allowed the PLC to run through its ladder logic in the various modes and only perform cutting operations when not in TEST MODE even though BIT 11 (PROGRAM RUNNING) indicated that part program execution was active. The other data registers supplying timer and auxiliary code values were also updated in all modes so that the operator could change the CUT or TEST mode at any time and then continue with all logic states properly defined.

In order to minimize the affects of the newly added test and internal stepping modes, these modes have been defined as extensions to the existing modes. For the new DRY RUN TEST mode, both the CONTINUOUS TEST and the new DRY RUN bits are set when this mode is selected by the operator. This is appropriate since the only functional difference between these two modes is that in DRY RUN mode, the position of the part can not be changed by jogging.

The same rational has been used for the new internal stepping mode. In order for the PLC to remain synchronized with the BURNY 5 as it advances to the selected restart block position, the BURNY 5 enters a special internal test mode which operates very much like CONTINUOUS TEST mode except no machine motion occurs. When internal stepping is required, the BURNY changes into this mode and sets bits 11, 15, and 6 to indicate that it is RUNNING in CONTINUOUS TEST mode for an INTERNAL STEPPING operation. All other communication and data register updates operate identical to CONTINUOUS TEST mode. Even the direction bits in register 61 and the auxiliary code register 60 are updated. The only difference is that the delays caused by moving the machine are not present. Once the BURNY 5 finds the selected

block (whether stepping in the forward or reverse direction), it immediately returns to the previously defined CUT or TEST mode with all status bits defined for a possible <GO> key press by the operator.

One other subtle difference should also be noted. Whenever the BURNY 5 performs the internal stepping operation in MANUAL CUT, AUTO CUT, or the new DRY RUN TEST modes, BIT 9 (DRY RUN) is also turned on. When in CONTINUOUS or SINGLE STEP TEST mode, BIT 9 remains off.

The following table identifies which status bits in DATA REGISTER 61 are active under the various conditions. Note that whenever the new DRY RUN TEST mode is selected or INTERNAL STEPPING is active, BIT 15 (CONTINUOUS TEST) is also set. This should allow existing ladder programs operate with few, if any, changes. However, this will actually depend on how the PLC ladder logic was programmed and whether or not there are any difficulties resulting from the faster block processing speeds. ***Remember that this new software version should not be used before compatibility with the PLC logic program is verified.***

	ACTIVE BITS WHEN READY	ACTIVE BITS WHEN STEPPING
AUTO CUT MODE	_,14,__,__	6,9,11,14,15
MANUAL CUT MODE	NONE	6,9,11,__,15
CONTINUOUS TEST MODE	_,__,15,__	6,_,11,__,15
SINGLE STEP TEST MODE	_,__,__,16	6,_,11,__,15
DRY RUN TEST MODE	9,__,15,__	6,9,11,__,15

HARDWARE REQUIREMENTS (FEATURE BASED)

The primary focus of this section is to identify the hardware revision level required to fully support the CUT LOSS RECOVERY version enhancements. In earlier hardware versions, some of the features are only partially functional. However, many of these limitations are not significant. As a result, a software upgrade can still be performed to enhance the operation of the control without the added cost of a hardware upgrade. The only significant limitation is that this software version does not support plate alignment operations on MPC "TYPE 4" MAIN CARD hardware. As such, **the CUT LOSS software should not be used with the MPC "TYPE 4" MAIN CARD hardware**.

NOTE

The hardware type installed in the Burny 5 control can be determined a variety of ways. One is to determine the "MO" numbers from the stickers on the cards in the system and then look up the description in the HARDWARE VERSION DESCRIPTIONS section in this NC UPDATE. For the MPC MAIN CARD, the hardware type can also be determined by the number of SCRATCH RAM tests performed on the power up diagnostics screen since MPC "TYPE 4" only performs one SCRATCH RAM test. The easiest way to determine the main and graphics processor card types and the I/O card type is to look at the SYSTEM BANNER screen when using software version 12/20/93 or later. The codes for these hardware types are displayed in parentheses in the date lines. For the MPC, the format is 'MPC VERSION (XX-YY) :' where XX indicates the MPC MAIN CARD type code and YY, the MPC I/O CARD type code. For the FPC, the format is "FPC VERSION (XX-Y) :' where XX indicates the FPC GRAPHIC CARD type code and Y, the number of alternate languages detected and enabled in the software.

Basically, two factors determine if a hardware upgrade is required in an existing control. One relates to the memory configuration on the MPC MAIN CARD. The original MPC "TYPE 4" MAIN CARD lacks the SCRATCH RAM required for not only the CUT LOSS RECOVERY feature but also the SECTIONAL KERF, OVERLAY TABLE and BACKGROUND features. As a result, **"TYPE 4" should NOT be used with the CUT LOSS RECOVERY software version**. The MPC "TYPE 6" MAIN CARD, which was placed in service at the end of 1989, provides all of the SCRATCH RAM required for these features but it still lacks the non-volatile "permanent" memory space needed to save all of the SYSTEM SETUP DATA. This limitation, however, does not prevent the supported functions from operating. It only requires the operator to manually reload the "lost" non-zero values after every power up. The current MPC "TYPE 14" MAIN CARD, which was placed in service in the first quarter of 1994, satisfies all of these memory requirements and, as such, it is the recommended MAIN CARD for all users of the CUT LOSS RECOVERY and OVERLAY TABLE features.

For additional information on the capabilities of the various Burny 5 hardware cards, see the HARDWARE VERSION DESCRIPTIONS section in this NC UPDATE.

The second factor that determines the need for a hardware upgrade is whether or not the HARDWARE HOME SEARCH feature is required. If it is, a special drive interface card and a more recent backpanel card is required to provide the interface for the home switch and encoder index inputs. In addition, home switches must be installed on the machine in a way that meets certain requirements. Encoders with index pulses can also be used to improved the accuracy of the resulting home position. However, this requires new cabling because the existing encoder cables do not have the extra wires for the index pulses. Note that other less precise techniques exist which allow the operator to establish the "FIXED ZERO" home position without the added cost of a hardware upgrade. However, these techniques rely on the operator to manually jog and then establish the "FIXED ZERO" position. For additional information on the hardware home operation requirements, see the HARDWARE HOME CONSIDERATIONS section in this NC UPDATE.

NOTE

To obtain all of the benefits from this new CUT LOSS RECOVERY software version, the most recent hardware version with a special drive interface card must be installed in the Burny 5 control. The machine must also be configured with home switches, encoders with index pulses, and upgraded cabling.

Other factors related to the FPC GRAPHICS card type and the I/O card type are important but not significant to the operation of the CUT LOSS RECOVERY software version. Any existing graphics card or I/O card can be used. For example, the benefit of using the "TYPE 1" or "TYPE 2" FPC GRAPHIC card over "TYPE 0" remains the same. The advantage of more memory and a faster processor improves the operation of all software versions. The CUT LOSS RECOVERY software version is no exception. However, the improvements in drawing speed and plate/tool/part positioning in this version were obtained through FPC software changes. No special graphic hardware requirement exists.

Similar to the FPC GRAPHIC card, any existing I/O card can be used with this new CUT LOSS RECOVERY software version. While the newer MPC "TYPE 2" I/O card has the advantage of supporting higher frequency encoder input rates when used with the latest MPC "TYPE 14" MAIN CARD, this actually has no direct affect on the operation of the CUT LOSS RECOVERY software. This combination of I/O and MAIN cards can, however, improve the resolution of the "FIXED ZERO" position, especially when using 2500 line encoders. Operations with older I/O cards can still be

performed at high encoder pulse rates by using the scaling jumpers on the I/O card. These jumpers effectively reduce the incoming rate to prevent the count accumulators from overflowing, especially in motor mounted encoder applications.

In sections that follow, brief descriptions of various CUT LOSS RECOVERY software items are provided with respect to each hardware version. Related capabilities (such as SECTIONAL KERF) are also described with respect to each hardware type. Here the primary purpose is to identify the limitations when not using the latest MPC MAIN CARD. For a description of the hardware and the capabilities of each card referenced by type, "MO" number, and "PCB" number, see the HARDWARE VERSION DESCRIPTIONS section in this NC UPDATE.

POWER FAILURE / CUT LOSS RECOVERY

In order to "remember" the operating environment of the system in preparation for a loss of power, numerous data values are saved and maintained in battery backed memory and SCRATCH RAM at regular intervals. As a result, this feature can not be supported on the original MPC "TYPE 4" MAIN CARD because of inadequate memory space. Recovery operations can only be performed when using the MPC "TYPE 6" or "TYPE 14" MAIN CARD hardware.

"LAST RUN" PART HISTORY DATA

This feature is not supported on MPC "TYPE 4" MAIN CARD because of insufficient SCRATCH RAM space. If used on that card, all of the values associated with this data are continuously reset to "ZERO". This feature requires "TYPE 6" or newer.

FIXED HOME POSITIONING

All MPC MAIN CARD versions support the logic necessary to define and maintain a "FIXED ZERO" home position. Home may be established using either the "software jog and set" technique or the "hardware home search" technique, provided the necessary I/O hardware and home switches are installed.

RUSH ORDER PROCESSING
JOB INTERRUPTION WITH RESTART

Regardless of the MPC MAIN CARD type, every program in NC program memory now retains the active plate, block and cycle numbers as part of its program header. As a result, any program can be stopped and then later restarted from the same block

position. Physical positioning on the plate or table, however, can only be restored when program operations are initiated from the corner of a plate. As such, physical repositioning with "TYPE 4" hardware is more difficult because plate operations are **NOT** supported. Plate operations are only supported in the CUT LOSS software version when using MPC "TYPE 6" or newer hardware.

SELECTABLE BLOCK START
INTERNAL BLOCK STEPPING

Every MPC MAIN CARD allows the operator to either accept the "last run" plate, block, and cycle numbers or specify any other valid values for the INITIAL PLATE, BLOCK, and CYCLE numbers on the RUN MODE screen. Thus any program can be started from any block position, regardless of the MPC MAIN CARD type.

MULTIPLE PLATE DEFINITIONS
SELECTABLE PLATE HOMES
PLATE ALIGNMENT

Due to changes in the way the Burny 5 defines and then maintains the plate size, angle and offset values in battery backed memory, these operations can now only be performed when using MPC "TYPE 6" or newer hardware. **When using this new CUT LOSS RECOVERY software version, plate alignment operations are no longer supported on MPC "TYPE 4" hardware**. In addition, both the "TYPE 6" and "TYPE 14" hardware can be used to setup and define multiple plates but only the "TYPE 14" has the necessary "permanent" non-volatile memory to define "fixed" home offsets through SYSTEM SETUP DATA. When using "TYPE 6", the plate home offset values in SYSTEM SETUP DATA (variables 73 through 80) are reset to zero at every power up. This effectively enables the operator's ability to display and modify the plate home offsets on the TABLE/PLATE DEFINITIONS screen. These values, like others on this screen, are automatically restored at power up from values retained in battery backed memory. As a result, the only short coming is that these offset values can not be password protected through SYSTEM SETUP DATA when using "TYPE 6" hardware.

RUN PROGRAM

When using the original MPC "TYPE 4" MAIN CARD with this new CUT LOSS version, none of the RUN HISTORY data is available to restore the operating environment at power up. As a result, the program number and all of the other RUN PROGRAM values are set to zero as in earlier software versions. However, when using "TYPE 6" or newer hardware, all of these values are restored at power up.

After the control is up and running, the program number field only reverts back to the "last run" number when that program was interrupted by a power failure. Otherwise, the default for the program number is determined from the last number that was loaded, edited, or run as in earlier software versions.

SECTIONAL KERF

In order to perform SECTIONAL KERF operations, MPC "TYPE 6" or newer hardware must be installed and the BACKGROUND option enabled.

TABLE/PLATE DEFINITIONS SCREEN
CUTTING TABLE SIZE, HOME ADJUSTMENT,
PLATE HOME OFFSET, ANGLE, and SIZE

Generally, all of the values displayed and modified from the TABLE/PLATE DEFINITIONS screen are maintained in SCRATCH RAM that is only available on the MPC "TYPE 6" or "TYPE 14" cards. As a result, none of the plate and table definition operations are supported when using MPC "TYPE 4" hardware. The only other notable short coming when using MPC 'TYPE 6" is that this card does not have sufficient "permanent" non-volatile memory space to save all of the newly added SYSTEM SETUP DATA parameters. As a result, only the battery backed value operations are used for all of the values displayed and modified on this screen. In order to define "permanent" password protected assignments through SYSTEM SETUP DATA, the MPC "TYPE 14" MAIN CARD hardware must be installed in the control.

HARDWARE HOME SEARCH SPEED

The "fixed" hardware home search speed value can only be permanently defined when using the MPC "TYPE 14" or newer hardware. With MPC "TYPE 6" hardware, this speed value is automatically reset to zero at every power up, thus permitting the selected RUN SPEED, adjusted by the speed dial percentage pot, to define the home search speed.

OVERLAY TABLES

In order to perform OVERLAY TABLE operations, MPC "TYPE 6" or newer hardware must be installed in the control. In addition, "TYPE 14" should also be used if all 4 overlay tables are required since "TYPE 6" only has enough "permanent" non-volatile memory space to save the default table and OVERLAY

TABLE 1. In "TYPE 4" hardware, the data for tables 2, 3 and 4 is pre-loaded with the default table values at every power up.

MULTITASKING, BACKGROUND, MARKER FONTS, COMMAND MESSAGES, and FLOPPY DIRECTORIES

In order to use all of the capabilities supported by these options, MPC "TYPE 6" or newer hardware must be installed in the control.

HARDWARE HOME CONSIDERATIONS

The primary focus in this section is the setup and operation of the HARDWARE HOME SEARCH function. Although this operation is not the only type of home reset supported, it is probably the most desirable because of its automatic nature and the accuracy of the resulting FIXED ZERO position. However, in order to perform the HARDWARE HOME SEARCH function, the Burny 5 must be configured with the necessary hardware interface cards and the cutting machine must have home limit switches installed. Encoders with index pulses can also be used to increase the accuracy and repeatability of the FIXED ZERO position, but their use is optional. If home switches are not available, only a software FIXED ZERO home reset operation can be performed. This operation only requires the operator to jog to some fixed point on the machine and then press <ENTER> to establish a new FIXED ZERO home position.

Both the "hardware" and the "software" FIXED ZERO home reset functions are performed from the TABLE/PLATE DEFINITIONS screen, which is accessed by pressing the <II> key on the MAIN MENU and several other screens including the RUN process screens. However, to actually perform one of the home reset operations, the running process cannot be active. If it is, the message "NOT ENABLED DURING RUN" is displayed and the request is denied.

One similarity between the "hardware" and the "software" home reset functions is that in both operations, only a "fixed point" is actually found by the control or defined by the operator. The actual FIXED ZERO home position is then determined from this point using the offsets defined by the X/Y HOME ADJUSTMENT values on the TABLE/PLATE DEFINITIONS screen (or through SYSTEM SETUP DATA). As a result when using the "software" home reset function, the end of travel can actually be used to define the fixed point since FIXED ZERO can then be defined at some distance away from this absolute end of travel position. The resulting FIXED ZERO position becomes, by definition, the lower left or right corner of the imaginary "cutting table" depending on the PLATE SIDE parameter in SYSTEM SETUP DATA. The size of this cutting area, which is provided only for use in future graphic operations, is also defined on the TABLE/PLATE DEFINITIONS screen or in SYSTEM SETUP DATA.

In the sections that follow, descriptions of the required hardware, the various software configuration capabilities, and the sequence performed by the HARDWARE HOME SEARCH process are provided. Their purpose is to help identify difficulties that may occur and provide insight into what is supposed to happen so that problems can be easily resolved. Other sections in this NC UPDATE provide information about the various Burny 5 hardware versions, the TABLE/PLATE DEFINITIONS screen, and the related SYSTEM SETUP DATA variables. However, the descriptions in this section provide an overview of what is required and what to consider in order to support the HARDWARE HOME SEARCH function.

HARDWARE CONFIGURATION ISSUES

The CUT LOSS software version can be easily installed to provide numerous enhancements in any Burny 5 control manufactured in the last several years. However, to fully take advantage of the automatic position recovery capability, special hardware is required both in the control and on the cutting machine. This hardware provides the mechanism by which the Burny can automatically locate a fixed point on the machine defined by home switches and, optionally for even greater accuracy, an index or marker pulse from the encoders. This section provides an overview of the type of hardware required both inside and outside the Burny 5 control.

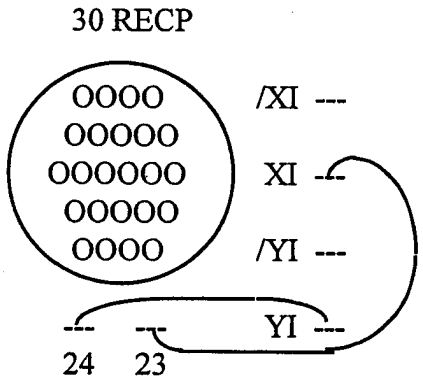
1) INTERNAL HARDWARE REQUIREMENTS

In order to perform the HARDWARE HOME SEARCH function, several important pieces of hardware must be installed in the Burny 5 control. This includes the MPC processor card "TYPE 6" or newer, back panel MO-09560 or newer, and a special drive interface card configured with the MO-06242 HOME SWITCH/ENCODER INDEX PULSE interface card installed. Any of the I/O card hardware versions can be used. However when using the original "TYPE 0" I/O card, it may be necessary to use a special creep speed scaling factor if the encoder count jumpers (1J, 2J, 3J, and 4J) are not all set to the "A" position. If not set to the "A" position, the user needs to know these jumper settings when configuring the home operation through SYSTEM SETUP DATA.

NOTE

The MPC processor and I/O card types are both displayed on the SYSTEM BANNER screen. These two type values are enclosed in parenthesis in the MPC software version date line. The first value is the MPC processor type and the second the I/O card type. As an example, the string "(6-2)" indicates that the MPC processor type is 6 and the I/O card type is 2.

Another requirement inside the Burny 5 control box is the installation of two jumper wires on the MO-09560 back panel to provide the connections for the encoder index inputs (i.e. marker pulses) and establish the logic sense (active high or low). These jumpers, however, are only actually required if encoders with index pulses are available and they have been properly wired to the back panel. The following figure illustrates the recommended wire jumper positions on the MO-09560 back panel for no inversion (i.e. 23 to XI and 24 to YI). Older back panels (such as MO-03035) do not have this capability and as such, can not be used to perform hardware home operations.



In addition to these wire jumpers, jumpers 1J, 2J, 3J, and 4J on the special HOME SWITCH/ENCODER INDEX interface card (MO-06242) should also be set to the "+" position (or not installed at all) for **NO** inversion.

2) EXTERNAL HARDWARE REQUIREMENTS

Outside the Burny 5 control, the minimum configuration for the HARDWARE HOME SEARCH operation requires the installation of home switches on the X and Y axes in a manner that meets the following important guidelines.

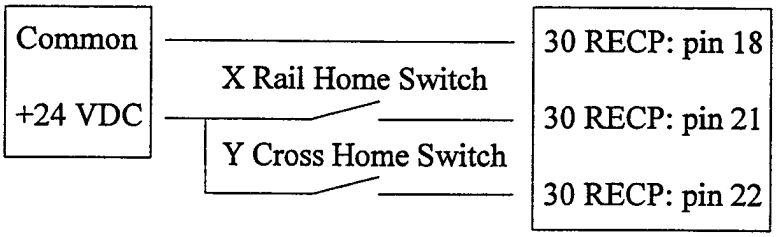
- Since the initial high speed home search is always performed in the same configured direction, the machine should be on "correct" side of the home switch before initiating the search operation.

- Since the initial high speed search can overshoot the home switch trip point, the switch must remain active after it is tripped. This allows the control to then creep back to the point were the switch was not active. This also allows the home search process to bypass the high speed search logic and just creep to the "non-active" position whenever the home process is started with the machine on the wrong side of the home switch (i.e. where the switch is already active).

- Since the amount of overshoot when performing the initial high speed home switch search depends on the speed actually used, the home switch trip point must be far enough away from the end of travel so that sufficient space exists to slow the machine to a stop before it reaches the physical end of travel or else the machine may be damaged.

Since the initial high speed direction of both the X and the Y can also be inverted by configuration bits in SYSTEM SETUP DATA, the home switches can be placed at the positive or negative extremity of the cutting area. However, by default, both axes perform their initial high speed search in the negative direction (i.e. the X rail axis towards the operator and the Y cross axis to the right).

The home switches are connected to the Burny 5 through 30RECP. Pin 18 provides the signal common, pin 21 the X home input, and 22 the Y home input. Generally, an external 24 volt supply is used to provide the active high inputs as shown in the following representation.



If encoders with index pulses are used, they are wired to the Burny 5 as usual with the addition of the two signals in both the X and Y encoder receptacles as follows:

Encoder marker signal "M" goes to Burny encoder pin 6
Encoder marker signal "/M" goes to Burny encoder pin 2

3) EXTERNAL HARDWARE CHECK

After the external hardware has been installed and properly wired to the Burny 5 control, the MPC BACK PANEL INPUTS (variable 5 in RUNTIME DATA) can be used to monitor changes in these input values. One complication, however, is that both the home switch input and the encoder marker pulse input for an axis are read at the same associated input bit position. The home search operation selects which of the two input sources is actually used as it performs the search. As a result, the input source displayed in these bits depends upon the last selection made by the home process before it was terminated. By default at power-up, the home switch inputs are always selected. This allows the user to manually verify the operation of the home switches before the home search is actually performed.

The state of these inputs from the back panel can be shown by accessing the RUNTIME DATA function via the DISPLAY SYSTEM DATA utility menu. In this function, the MPC BACK PANEL INPUTS data is displayed as an 8 bit binary value as follows:

1	2	3	4	5	6	7	8
X	X	X	X	X	X	X	X

Bit 1 - PLASMA ARC ON input
Bit 2 - OXYGEN CUT SWITCH input
Bit 3 - RUN INHIBIT input
Bit 4 - PLASMA SELECT input
Bit 5 - Y HOME SWITCH/ENCODER INDEX input
Bit 6 - X HOME SWITCH/ENCODER INDEX input
Bit 7 - Y EXTERNAL DRIVE CONTROL input
Bit 8 - X EXTERNAL DRIVE CONTROL input

In this variable, a "1" indicates that the associated input is "ON" and "0" indicates the "OFF" state.

SYSTEM CONFIGURATION ISSUES

This section identifies the values that must be defined in SYSTEM SETUP DATA to configure the home search process to meet the requirements of the user's machine. Generally, all should be established before the home process is actually enabled and performed. However, in some cases, the user may have to adjust the configuration to resolve differences in wiring and switch type. For additional information on the configuration values noted here, see the SYSTEM SETUP DATA CONSIDERATIONS section in this NC UPDATE.

1) HOME SEARCH DIRECTION

By default, both the X and the Y home search operations are initiated in the negative direction, regardless of the value of the PLATE SIDE variable in SYSTEM SETUP DATA. To invert these directions, two configuration bits are provided. To change the initial Y home search direction to positive (i.e. to the left), set bit "0000 0100" in SYSTEM CONFIGURATION 1 (variable 37) to a one. To change the initial X home search direction to positive (i.e. away from the operator), set bit "0000 0010" in SYSTEM CONFIGURATION 4 (variable 40) to a one.

2) HOME SWITCH/ENCODER INDEX LOGIC SENSE

As a safety precaution, the HOME SEARCH process was implemented using inverted logic. As a result, whenever the input states are "OFF" (i.e. the associated MPC BACK PANEL INPUTS bit shows a "0"), the search logic assumes that the home switch and index pulse inputs are "active" so that the high speed search is not performed. As a result, to actually search for the required input states when using active inputs (i.e. a "1" in this value indicating that the machine is on the home

switch or at the index pulse), all of the inversion configuration bits must be set to one. If set to zero with this type of active input signal configuration, the Burny 5 simply assumes that it is already at the home switch and the index pulse positions.

Two logic inversion bits are defined for each axis in bits "0000 0F00" of variable 40 in SYSTEM SETUP DATA (i.e. SYSTEM CONFIGURATION 4) as follows. Choose the digit at the top of the column identifying the desired configuration. Zero indicates that no logic inversion is required.

	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Invert X Home Switch Logic								X	X	X	X	X	X	X	X
Invert Y Home Switch Logic				X	X	X	X					X	X	X	X
Invert X Encoder Index Logic		X	X			X	X			X	X			X	X
Invert Y Encoder Index Logic	X		X		X		X		X		X		X		X

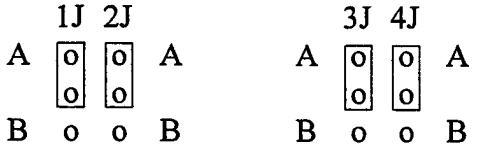
Remember that hexadecimal values are entered as a two key sequence where <SHF> <0> enters an "A", <SHF><1> enters a "B", etc.

3) HARDWARE HOME SEARCH SPEED

Home search operations are performed using two different speeds. The initial speed is the high speed that is used when searching for the home switches on the machine. The second speed is a creep speed that is used to first back off the home switch and then search for the encoder index pulse. The high speed is defined in two ways using the HARDWARE HOME SEARCH SPEED parameter in SYSTEM SETUP DATA (variable 90). When defined with a non-zero value, the high search speed is fixed at the specified value and the speed pot has no affect on the search speed. However when a value of zero is defined in this same variable, the high speed is determined from the selected running speed, scaled by the current speed dial setting. This allows the operator to alter the home search speed with the speed dial, moving faster when far away from the home switch and then slower as the machine approaches the home switch to minimize the overshoot.

The home creep speed is determined from the physical encoder count size so that the edge of the encoder index pulse is not missed. Generally, no special setup parameters are required for this calculation process to operate properly. However, in some installations with the original "TYPE 0" I/O cards (MO-03400, MO-03401), hardware jumpers may be used to reduce the incoming encoder rate by 25, 50, or 75 percent. This prevents the encoder count accumulators from overflowing at higher speeds, especially when using motor mounted encoders. Unfortunately, these jumpers can not read by the software and, as a result, the calculated creep speed may be too fast to accurately and reliably detect the leading edge of the index pulse. To resolve this problem, a special creep speed scaling factor is supported for each axis through SYSTEM CONFIGURATION 4 (variable 40 in SYSTEM SETUP DATA).

This capability simply scales the calculated creep speed by 50, 33, or 25 percent so that the index pulse can be reliably detected. The following illustrates the encoder count jumper configuration that appears along the top edge of the "TYPE 0" I/O card with the jumpers installed in the "A" position for "1 to 1" counting operations. Jumpers 1J and 2J are used for the X axis and jumpers 3J and 4J, for the Y axis. When configured in this way (or without any jumpers at all), no special configuration bits are required to scale the home search creep speed.



The following table is provided to help identify the configuration value that should be set in digit 5 of SYSTEM CONFIGURATION 4 when the I/O card jumpers are not all set to the "A" position. Generally both the X and the Y axes are set the same, but they may be different. In either case, the values for the X and Y axes must be added together using hexadecimal arithmetic to determine the resulting digit for this configuration value. Remember that hexadecimal values are entered as a two key sequence where <SHF> <0> enters an "A", <SHF> <1> enters a "B", etc.

1J 2J => X COUNT RATE	X AXIS BITS => SCALE FACTOR
A A => 4 OF 4 = 100%	0000 0000 => 100%
A B => 3 OF 4 = 75%	0000 4000 => 50%
B A => 2 OF 4 = 50%	0000 8000 => 33%
B B => 1 OF 4 = 25%	0000 C000 => 25%

3J 4J => Y COUNT RATE	Y AXIS BITS => SCALE FACTOR
A A => 4 of 4 = 100%	0000 0000 => 100%
A B => 3 of 4 = 75%	0000 1000 => 50%
B A => 2 of 4 = 50%	0000 2000 => 33%
B B => 1 of 4 = 25%	0000 3000 => 25%

4) HARDWARE HOME SEARCH ENABLE

One of the protection mechanisms built into the CUT LOSS software version prevents the HARDWARE HOME SEARCH function from being performed until the user has enabled the function through SYSTEM SETUP DATA. If it is not enabled, the message "HOME SEARCH NOT ENABLED" is displayed whenever the HARDWARE HOME SEARCH function is selected on the TABLE/PLATE DEFINITIONS screen. The function is enabled by setting bit "0000 0002" in SYSTEM CONFIGURATION 4 (variable 40) to a one.

5) HOME SEARCH TYPE

One of the features supported by the hardware home process is the ability to perform search operations on both the X and Y axes with a single request. Two configuration bits are used to change the default search type when "BOTH" is selected. One bit changes the search type from parallel, where both axes move at the same time, to sequential, where one axis is homed before the other. The other configuration bit allows the default "Y HOME BEFORE X" to be reversed so that the X HOME occurs first. Sequential homing is enabled by setting bit "0000 0008" in SYSTEM CONFIGURATION 4 (variable 40) to a one and the axis order is reversed by setting bit "0000 0004" in the same variable to a one.

6) HOME POWER-UP REQUIREMENT

In order to take full advantage of the position recovery logic that is incorporated into the CUT LOSS software version, the operator should perform a home reset operation immediately after restoring power to the control, and more importantly, before running any part programs. However do to the wide variety of applications and machine configurations this may not always be desired. As a result, by default, the Burny does not force the operator to perform the home reset at power-up.

The recommendation is that every machine configured with the necessary hardware to perform the HARDWARE HOME SEARCH function should also be configured to require a home reset at power-up. This is achieved by setting bit "0000 0001" in SYSTEM CONFIGURATION 4 (variable 40) to a one and, of course, saving the configuration values in non-volatile memory before power is removed. When this feature is enabled, the message "HOME OPERATION REQUIRED" appears on the MAIN MENU screen and remains displayed until either a "hardware" or a "software" home reset operation is performed on both axes. This feature also prevents the operator from entering the RUN PROGRAM process until the home reset is properly performed.

7) X/Y HOME ADJUSTMENTS

Although these values need not be defined to actual perform the HARDWARE HOME SEARCH function, they do play an important role. By definition, both the "hardware" and the "software" home reset functions only search for or define a "fixed point" somewhere on the machine. The relative offset to the FIXED ZERO position is then defined using these HOME ADJUSTMENT offset values. If defined as zero, the FIXED ZERO position is at the "fixed point". However in most cases, this "fixed point" is outside the normal cutting area of the machine so these adjustment offsets are used to define FIXED ZERO, which is also identified as

"PLATE 0" or "HOME 0", at the lower right or left corner of the cutting area, depending on the PLATE SIDE variable in SYSTEM SETUP DATA.

These HOME ADJUSTMENT values can be defined in one of two ways. When non-zero values are defined in SYSTEM SETUP DATA variables 88 and 89, these values can only be displayed on the TABLE/PLATE DEFINITIONS screen. However when zero values are defined in SYSTEM SETUP DATA, these values can be both displayed and modified on the TABLE/PLATE DEFINITIONS screen. The recommendation is to first defined these values as zero in SYSTEM SETUP DATA while setting up the machine and determining the actual offsets. Then, go back and enter the HOME ADJUSTMENT values in SYSTEM SETUP DATA, which is password protected, to prevent accidental changes from the TABLE /PLATE DEFINITIONS screen.

8) X/Y TABLE DIMENSIONS

By definition, the FIXED ZERO position defines the default "HOME 0" position of the imaginary cutting area defined by these table dimension values. Their purpose is to define the area in which all cutting operations and all plates are defined for graphical imaging operations. However at this time, these values are not actually used. The recommendation is that variables 86 and 87 in SYSTEM SETUP DATA define the approximate size of the cutting so that the operator can not change the CUTTING TABLE SIZE values on the TABLE/PLATE DEFINITIONS screen.

HARDWARE HOME SEQUENCE

Regardless of whether or not a HARDWARE HOME SEARCH function is performed on a single axis or both axes simultaneously, the same sequence of movements is always performed to locate the fixed point on an axis. This section describes the sequence used to establish the FIXED ZERO position. Often when first setting up the machine, one or more of the input logic states are not correctly defined causing steps to be bypassed. This section is provided to help the user understand what may be happening so that the correct setup can be easily obtained. To minimize possible confusion, only single axis home operations should be performed until the correct configuration is defined.

NOTE

The following descriptions assume that all of the hardware and software configuration issues have addressed and HOME SEARCH SPEED in SYSTEM SETUP DATA (variable 90) has been set to a value of 50 IPM or greater so that the high speed and the creep speed values can be easily distinguished from each other. It also assumes that the user has carefully

checked the I/O card type to determine if "TYPE 0" is used and, if so, the configuration of the encoder count jumpers. Remember that if one or more is set to the "B" position, the special creep speed scaling factors must be enabled. For more information, see the HARDWARE HOME SEARCH SPEED description in the SYSTEM CONFIGURATION ISSUES section.

- When a home search operation is selected on the TABLE/PLATE DEFINITIONS screen, the command menu and the table and plate definition values are cleared and the message "PRESS <GO> TO BEGIN SEARCH" appears. No motion occurs before the user presses the <GO> key. When the homing process is active, the message changes to "PRESS <STOP> TO SUSPEND" and the operation status field at the bottom of the screen changes to "HOME SEARCH ACTIVE". By definition, the user can start and stop the search process any number of times since <STOP> does not abort the homing process, it only stops the motion. The home process is aborted by pressing the <RST> key or the <CE> key.

- When the home search process is active, the screen displays the feedrate as well as the X and Y positions and speeds. The speed values can be particularly helpful in monitoring the progress of the homing process. When performing the high speed movements, the speed value should approximate the fixed speed value defined in SYSTEM SETUP DATA or, if set to zero, the current running speed adjusted by the speed dial. When performing creep speed operations, these values can be used to verify that the machine is actually moving at the correct speed. For example, when using 500 line encoders with 5 inches per revolution, the creep speed should be approximately 18.75 IPM, assuming no creep speed scaling factors are enabled. However when using 2500 line encoders and a distance per revolution of 2 inches, the creep speed should only be about 1.5 IPM. When creep speed scaling operations are enabled, the displayed axis creed speed should be 50, 33 or 25 percent of the speed calculated from the line and distance values in SYSTEM SETUP DATA and less than or equal to the speed calculated using the *actual* line and distance values. The requirement is that creep speed must be slow enough to read only one *physical* encoder count per 8 ms scan.

- When the home process is started with the <GO> key, the selected axis should move towards home switch at the high search speed defined by the HOME SEARCH SPEED variable or, if set to zero, the speed established by the speed pot. If it moves at high speed away from the home switch, the home search direction bit must be inverted. Remember that by default, both the X and the Y axis perform the initial high speed home search in the negative directions. If it moves at the creep speed away from the home switch, the search direction is probably correct but the logic state of the home switch input is inverted causing the home process to bypass the high speed home search operation. Another possibility, however, is that the input is not properly connected.

- After the search locates the home switch trip point, the machine ramps to zero speed. Then as soon as it stops, it reverses direction and moves at the creep speed as it looks for the point where the home switch is no longer active. As a result, the home switch must remain tripped until the machine backs up to the initial trip position. This also allows the home process to be started with the machine already past the trip position since the logic will simply bypass the high speed search and backup until it comes off the switch.

- Once the machine backs off the home switch, it continues to creep in the same direction as it looks for the encoder index pulse. When index pulses are not available, the logic state of the index input must be configured so that the active signal state is always present. In that case, as soon as machine comes off the home switch, the "predetermined" index signal will appear active and the home search process will immediately terminate. When actually using encoder index pulses, the position of the index pulse should be adjusted so that the home switch is completely cleared when the index becomes active. If the encoder index pulse is used and the home search process immediately terminates when the machine comes off the home switch, the state of the index input most likely needs to be inverted using the bits in SYSTEM CONFIGURATION 4. However, if after enabling the inversion of the index pulse, the home process never stops when it comes off the home switch (i.e. it creeps more than one encoder revolution distance past the home switch trip point), the index pulse input is probably not properly connected to the Burny 5 control.

- After the home search process terminates, the HOME ADJUSTMENT distances are added to the fixed point position to determine the new FIXED ZERO position. The fixed coordinate grid is then established from the FIXED ZERO position and the displayed X and Y positions in the status window at the bottom of the screen are updated to reflect the machine position with respect the active PLATE HOME position. When "0" is the active plate, the current machine position appears as the negated HOME ADJUSTMENT value position as required. Pressing the <RET> key with "PLATE HOME: 0" selected always causes the machine to move to the FIXED ZERO position.

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HARDWARE VERSION DESCRIPTIONS

This section lists the various hardware versions that have been used over the years in the Burny 5 control. Each hardware version is identified by a unique "MO" number which appears on a label on the each card and a PCB (printed circuit board) number which is etched into the card. In many cases, the same physical card is configured for a variety of functions using jumpers or different installed components. As such, the "MO" number must be used to properly identify each card.

For the main and graphics processor cards and the main I/O card, the hardware type can also be determined by the software, which provides this information on the SYSTEM BANNER screen of the Burny 5. These hardware type codes are displayed in parentheses in the MPC and the FPC date lines. For the MPC, the format is 'MPC VERSION (XX-YY) :' where XX indicates the MPC MAIN CARD type code and YY, the MPC I/O CARD type code. For the FPC, the format is "FPC VERSION (XX-Y) :' where XX indicates the FPC GRAPHIC CARD type code and Y, the number of alternate languages detected and enabled in the software.

FPC GRAPHIC CARDS:

MO-03850 (FPC "TYPE 0") (PCB D41-14350)

Original FPC graphic hardware that was used up to the end of 1990.

MO-06457 (FPC "TYPE 1") (PCB C41-14372)

This card, which was put into service at the end of 1990, requires FPC software version 7/20/90 or later. It provides all of the capabilities of the FPC "TYPE 0" card plus the following enhancements:

- A real-time clock to maintain the date/time while the control is not powered up.
- Additional VIDEO RAM pages which allow images to be retained, not erased and redrawn, when performing graphic edit/inspect operations while running.
- Additional DYNAMIC RAM for system operations.
- Improved keyboard operations supporting maintained backup operations and repeating cursor key operations.

MO-10448 (FPC "TYPE 2") (PCB D41-28054)

This card, which was put into service in the first quarter of 1994, provides all of the capabilities of the FPC "TYPE 1" card plus several video enhancements to support CGA and VGA video monitors.

MO-11147 (FPC "TYPE 2") (PCB D41-28054)

This card is the same as MO-10448 except the TI GRAPHIC processor is replaced with a pin array socket for insertion of the new graphic chip replacement hardware. This card requires the new BOX DRAW routines that were first added to the 2/28/95-D version FPC software. If used with earlier software versions, none of the RED boxes on the various screens are displayed. There are no other functional differences when using this card.

FPC EPROM CARDS:

MO-03851 (No type code displayed) (PCB C41-14372)

This 12 socket card uses 512K bit EPROM chips (such as the AM27C512) which can only hold the FPC executive code with NO alternate languages.

MO-06079 (No type code displayed) (PCB C41-18982)

This 16 socket card uses 512k bit EPROM chips (such as the AM27C512) which can hold only the executive code and the FRENCH and GERMAN alternate language tables.

MO-09224 (No type code displayed) (PCB C41-26344)

This 4 socket card uses 4 megabit EPROMs (such as the TMS27C040) which can hold the executive code and up to 10 alternate languages. When using this card, the FPC GRAPHICS card must contain the updated addressing pal 18555C in IC30. The 12/20/93 FPC software version was the first supported on this card.

MPC MAIN CARDS:

MO-03397 (MPC "TYPE 4", AKA B3P2 card) (PCB D41-13249)

Original main process controller card with the following characteristics:

- 16K battery backed memory on card.
- 1 page of SYSTEM RAM (i.e. only 1 diagnostic test is performed) .
- 1 page of SCRATCH RAM (i.e. only 1 diagnostic test is performed).

NOTE

This card does **not** support most of the newer features and options added to the Burny 5 control. As such, it **cannot** support the BACKGROUND, MARKER FONT, and COMMAND MESSAGE options or any of the following operations: OVERLAY TABLES, SECTIONAL KERF, FLOPPY DISK DIRECTORIES, CUT LOSS RECOVERY, RUN HISTORY DATA, or MULTIPLE PLATE SETUP.

MO-04724 (MPC "TYPE 6", AKA B3P3 card) (PCB D41-16275)

This card, which was put into service in the fourth quarter of 1989, requires software version 9/15/89 or later. It provides all of the capabilities of the "TYPE 4" card plus the following enhancements:

- Additional on-board program memory (128k total on card).
- 2 more pages of SYSTEM RAM (i.e. 3 diagnostic tests are now performed).
- 3 more pages of SCRATCH RAM (i.e. 4 diagnostic tests are now performed).

This card was the first to provide the SCRATCH RAM to support many of the features and options that were later added to the Burny 5. This card, or a later version, must be used for the BACKGROUND, MARKER FONT, and COMMAND MESSAGE options. It is also required to support OVERLAY TABLES, SECTIONAL KERF, FLOPPY DISK DIRECTORIES, CUT LOSS RECOVERY, RUN HISTORY DATA, and MULTIPLE PLATE SETUP operations.

NOTE

This card does **not** provide enough non-volatile memory space to retain all of the values defined through SYSTEM SETUP DATA. For the OVERLAY TABLE operations, only the data for the default table and table 1 is saved. OVERLAY TABLES 2 through 4 as well as the four

plate HOME OFFSETS, the CUTTING TABLE SIZE and HOME ADJUSTMENT values, and the HARDWARE HOME SEARCH SPEED value are not retained after power to the control is removed, even if the "SAVE CONFIGURATION DATA" operation is performed. As such, these values are reset to zero at every system power up. With this card, the user must manually restore these values numerically or by using the ASCII DATA save/restore technique. In order to automatically restore these values, the MPC "TYPE 14" or later MAIN CARD hardware must be used in the control.

MO-08923 (MPC "TYPE 14", AKA B3P4 card) (PCB D41-25500)

This card, which was put into service in the first quarter of 1994, provides all of the capabilities of the MPC "TYPE 6" card plus the following enhancements:

- Additional on-board program memory (512k total on card).
- Additional non-volatile memory (two 4096 bit chips added).
- Additional addressing capabilities for use with "TYPE 2" MPC I/O card.

This card provides the additional non-volatile memory space that is required to retain the data for the four OVERLAY TABLES and the four plate HOME OFFSETS first supported in software version 12/20/93, and the CUTTING TABLE and MULTIPLE PLATE definition data supported in the CUT LOSS version, which was first BETA tested as version 5/31/96 and then officially released as version 1/15/97. Without this MPC main card, all of these SYSTEM SETUP DATA values are automatically reset to zero at every power-up.

MPC EPROM CARDS:

MO-03404	(Uses special "zero insertion force" sockets)	(PCB C41-13250A)
MO-03403	(Uses normal sockets)	(PCB C41-13250B)
MO-04712	(Uses normal sockets)	(PCB C41-13250C)

These 5 socket cards are configured by a wire jumper for either 256k or 512k bit EPROMs. Burny 5 software versions prior to 10/15/90 used the 256k configuration. Versions from 10/15/90 up to 2/28/95 provided all of the motion controller executive software using four 512K bit EPROM chips (such as the AM27C512). However starting with the 2/28/95 version, five chips were required when using this card.

MO-10131 (No type code displayed) (PCB C41-27681)

This card provides all of the motion controller executive software in a single 4 megabit EPROM, such as the TMS27C040. This card can also provide additional RAM for future software enhancements. However at this time, the RAM socket remains empty. The 2/28/95 software version was the first supported on this card.

MPC BATTERY BACKED MEMORY CARDS:

MO-03517	(64k for use with MPC "TYPE 4" card)	(PCB D41-13561)
MO-03521	(128k for use with MPC "TYPE 4" card)	(PCB D41-13561)
MO-03524	(256k for use with MPC "TYPE 4" card)	(PCB D41-13561)
MO-04104	(512k for use with MPC "TYPE 4" card)	(PCB D41-13561)
MO-04105	(1024k for use with MPC "TYPE 4" card)	(PCB D41-13561)
MO-05985-0	(Provides 128k total on MPC "TYPE 4" card)	(PCB D41-18757)
MO-05985-1	(Provides 384k total on MPC "TYPE 4" card)	(PCB D41-18757)
MO-05985-2	(Provides 1024k total on MPC "TYPE 4" card)	(PCB D41-18757)
MO-05985-0	(Adds 128k to MPC "TYPE 6" card, 256k total)	(PCB D41-18757)
MO-05985-1	(Adds 384k to MPC "TYPE 6" card, 512k total)	(PCB D41-18757)
MO-05985-2	(Adds 1024k to MPC "TYPE 6" card, 1152k total)	(PCB D41-18757)
MO-09561	(Adds 512k to MPC "TYPE 14" card, 1024k total)	(PCB C41-26731)

MPC I/O CARDS:

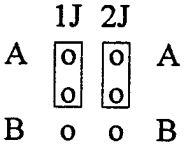
MO-03400	(I/O "TYPE 0")	(PCB D41-13248)
MO-03401	(I/O "TYPE 0" with secondary port card installed)	(PCB D41-13248)

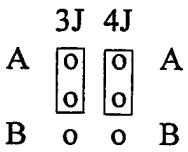
Original Burny 5 I/O card with the following characteristics:

- Encoder input frequencies up to 238,125 lines per minute or, with quadrature encoding, 952,500 counts per minute. (When using 500 line encoders and 5 inches per revolution, at a top speed of 1310 IPM the input line rate of 131,000 is well below the maximum supported by this card.)
- One serial I/O port which can be expanded to two with an RS-422 capability for the PLC interface using a separate add-on card (factory installed only).
- FIFO and C-AXIS capabilities supported using a separate add-on card.
- Interface for panel mounted floppy supported using a separate add-on card.

- On board jumpers to allow the incoming encoder pulse rate to be scaled by 75, 50 or 25 percent so that in high input frequency applications, the count accumulators do not overflow.

The following illustrates the encoder count jumper configuration that appears along the top edge of the "TYPE 0" I/O card with the jumpers installed in the "A" position for "1 to 1" counting operations. Jumpers 1J and 2J are used for the X axis and jumpers 3J and 4J, for the Y axis. When configured in this way (or without any jumpers installed at all), every pulse is counted for maximum input resolution.





1J 2J => X COUNT RATE	3J 4J => Y COUNT RATE
A A => 4 OF 4 = 100%	A A => 4 of 4 = 100%
A B => 3 OF 4 = 75%	A B => 3 of 4 = 75%
B A => 2 OF 4 = 50%	B A => 2 of 4 = 50%
B B => 1 OF 4 = 25%	B B => 1 of 4 = 25%

MO-09406 (I/O "TYPE 2", MO-09722 with FIFO installed) (PCB D41-26549)

This card, which was put into service in the second quarter of 1994, has all of the capabilities of "TYPE 0" with the exception of the encoder count scaling jumpers which are not provided since they are not required when this card is used with the MPC "TYPE 14" card and software version 12/20/93 or later. However, when this card is used with "TYPE 4" or "TYPE 6" MPC MAIN CARDS or earlier software versions, the high input frequency enhancement cannot be used and, as such, the encoder count accumulators may overflow in some applications. This I/O card provides the following enhancements:

- Incorporation of MPC/FPC FIFO communication hardware.
- Incorporation of PANEL FLOPPY port hardware.
- Incorporation of secondary RS-422 serial port for PLC operations.
- Improved encoder count hardware for high frequencies but only when using "TYPE 14" MAIN CARD and MPC software version 12/20/93 or later. With encoder input frequencies of up to 61,438,125 lines per minute or with quadrature encoding 245,752,500 counts per minute, maximum speeds of up to 1310 IPM can still be support in motor mounted encoder applications with resolutions of .0001" per line or smaller. (When 50,000 encoder lines represent 5 inches of travel, the resolution is .0001 inches per line and at 1310 IPM, the incoming rate of 13,100,000 lines per minute is well below the maximum supported by this card.).

MO-10954 (I/O "TYPE 4", MO-10955 with FIFO installed) (PCB D41-28676)

This card, which was put into service in the first quarter of 1997, requires software version 1/15/97 or later. It has all of the capabilities of I/O card "TYPE 2" plus the following enhancements:

- A new dual channel serial UART.
- On board jumpers to configure second port for RS-232 or RS-422 signal characteristics.
- An special expansion port for future use.

FIFO / C-AXIS EXPANSION CARDS:

MO-03849 (No type code displayed, FIFO only installed) (PCB C41-14947)
MO-04469 (No type code displayed, C-AXIS only installed) (PCB C41-14947)
MO-05265 (No type code displayed, both installed) (PCB C41-14947)

This card was placed in service in the last quarter of 1987. It can provide the FIFO logic and/or the C-AXIS logic depending on the components installed. This card is used with the "TYPE 0" I/O card to provide an interface to FPC graphics card through the 4PL connector. Later, the FIFO logic was added to "TYPE 2" I/O card making the use of this card unnecessary when only the FIFO logic is required.

MO-09708 (No type code displayed, C- AXIS only installed) (PCB C41-19615)

MO-06240 (No type code displayed, C-AXIS only installed) (PCB C41-19650)
MO-06257 (No type code displayed, C-AXIS only installed) (PCB C41-19650)

These cards were placed in service in the last quarter of 1989. They also can provide the FIFO logic and/or the C-AXIS logic depending on the components installed.

SECONDARY RS-422 SERIAL PORT CARD:

MO-05784 (No type code displayed) (PCB XXX-xxxxxx)

This special add-on card expands the normal single serial port into a dual port configuration for use in the BURNY 5 / PROGRAMMABLE LOGIC CONTROLLER system configuration. This card is factory installed as a permanent extension to the I/O card. With the release of the enhanced MPC "TYPE 2" I/O card, this add-on card is no longer necessary.

PANEL FLOPPY INTERFACE CARD:

MO-08035 (No type code displayed) (PCB C41-22997)

This special add-on card provides the interface for the panel mounted floppy drive through 6PL connector. The logic performed by this card was later incorporated into the "TYPE 2" I/O card making the use of this add-on card unnecessary.

BACK PANEL CARDS:

MO-03069-x (No type code displayed, 115 VAC line) (PCB D41-11750)
MO-06014-x (No type code displayed, 230 VAC line) (PCB D41-11750)

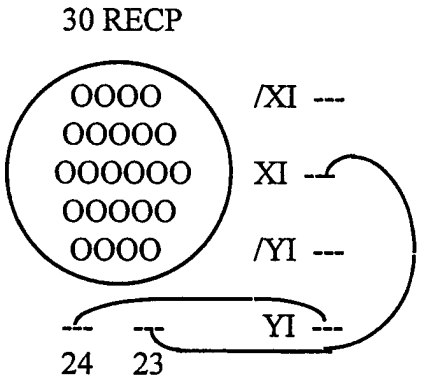
Original back panel card that has no provision for home switch and encoder index pulse inputs.

MO-09560 (No type code displayed) (PCB D41-26732)

This card, which was put into service in the last quarter of 1993, provides the following enhancements:

- Provides encoder termination for single ended open collector types and differential line driver types.
- Supports signals for the home switch and the encoder index pulse inputs.
- Provides tabs for encoder index (i.e. marker pulse) input wire jumper connections for normal or inverted logic. The recommendation is to used the

positive logic connections since inversion logic is supported starting with the 1/15/97 BURNY 5 CUT LOSS software version. This is accomplished by connecting 23 to XI and 24 to YI as shown in the following figure.



MO-09681 (No type code displayed) (PCB D41-22981)

This special "DROP THRU BACK PANEL" is used in the special Operator Console applications.

DRIVE INTERFACE CARDS:

MO-03203	(Standard HL interface without E-STOP logic)	(PCB C41-12368)
MO-06213	(Same as MO-03203 with E-STOP logic installed)	(PCB C41-12368)
MO-06241	(Same as MO-06213 with MO-06242 installed)	(PCB C41-12368)
MO-04028	(Standard Servopak interface without E-STOP logic)	(PCB C41-12368)
MO-06214	(Same as MO-04028 with E-STOP logic installed)	(PCB C41-12368)
MO-07248	(Same as MO-06214 with MO-06242 installed)	(PCB C41-12368)

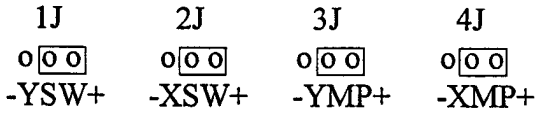
This card satisfies a wide variety of applications depending on the components used and whether or not a special home switch/encoder index add-on card is mounted to the underside of the interface card, all of which must be installed at the factory.

HOME SWITCH/ENCODER INDEX CARD:

MO-06242 (No type code displayed) (PCB C41-19063)

This special add-on interface card mounts to the underside of the drive interface card to process the X and Y home switch inputs and the X and Y encoder index pulse inputs. Four jumpers are provided on this card to invert the normal positive "TRUE" logic as required in earlier software versions. However starting with the

1/15/97 BURNY 5 CUT LOSS version, these logic states can be inverted through SYSTEM SETUP DATA variable 40 (SYSTEM CONFIGURATION 4). As a result, the recommendation is to set all four jumpers to the "+" position (or just remove them) so that no logic inversion is performed. These jumpers appear on this card as follows:



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Insert Tab - Part 11

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XON/XOFF SOFTWARE PROTOCOL (PART-7:SERIAL-12)
Y ABSOLUTE POSITION (PART-7:RUNDATA-6)
Y DIGITAL/ANALOG OUTPUT (PART-7:RUNDATA-3)
Y DIRECT ENCODER POSITION (PART-7:RUNDATA-6)
Y DRIVE SENSE (PART-7:SETDATA-14)
Y ENCODER DISTANCE PER REV. (PART-7:SETDATA-14)
Y ENCODER SENSE (PART-7:SETDATA-14)
Y LINE ERROR (PART-7:RUNDATA-7)
Y MARKER 1 OFFSET (PART-7:SETDATA-15)
Y MARKER 2 OFFSET (PART-7:SETDATA-15)
Y MARKER 3 OFFSET (PART-7:SETDATA-57)
Y MARKER 4 OFFSET (PART-7:SETDATA-57)
Y MARKER 5 OFFSET (PART-7:SETDATA-57)
Y MARKER 6 OFFSET (PART-7:SETDATA-58)
Y MARKER 7 OFFSET (PART-7:SETDATA-58)
Y MARKER 8 OFFSET (PART-7:SETDATA-58)
Y POSITION COUNTER (PART-7:RUNDATA-10)
Y SCALED ERROR VECTOR (PART-7:RUNDATA-11)
ZOOM
DURING RUN (PART-2:RUN-14)
NESTING (PART-3:NEST-23)

BLANK