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Section 1: Safety

Read This Manual

Read and understand this instructional manual, the cutting machine manuals, and your employer's safety practices. ***Note***: This product is not designed to be field serviceable. Please return to an authorized repair center for any required service.

Dangerous Machinery

Operation and maintenance of automated equipment involves potential hazards. Personnel should take precautions to avoid injury.

Injury and entanglement may occur if hands and limbs come in contact with moving machinery.

KEEP HANDS CLEAR of dangerous moving machinery. All control, including manual, can be effected using the front panel keys or remote interface.

Loose fitting clothing or ties may become entangled in the machinery. These items should not be worn while operating or servicing the machine.

High Voltages

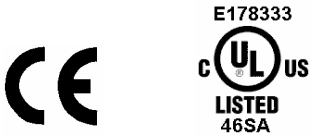
Electric shock can kill. Be sure this equipment is safely installed in accordance with enclosed procedures and specifications.

Avoid contact with electrical wires and cabling while power is on.

This equipment should only be opened by trained service personnel.

Product Listings

Type "M" and "P" Controls

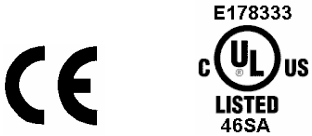


Note: This product has been designed and manufactured in accordance with CE and UL Safety Standards.

UL has successfully tested and listed the type " M" and "P" (with 10.4" display) control products in accordance with the applicable U.S. and Canadian Safety Standards. File number E178333. Note: Suitable for pollution degree 2 environment only.

This appliance has been successfully tested and listed by CE under the following standards; EN 500081-2 1994, EN 61000-6-2 1999 and EN 55011:1998. Certificate number: Retlif R-3909N

Type "E" and "V" Controls



Note: This product has been designed and manufactured in accordance with CE and UL Safety Standards.

UL has successfully tested and listed the type "E" and "V" control products in accordance with the applicable U.S. and Canadian Safety Standards. File number E178333.

This appliance has been successfully tested and listed by CE under the following standards; EN 500081-2 1994, EN 61000-6-2 1999 and EN 55011:1998. Certificate number: Retlif R-3738N1

Type "B" Controls

Note: This product has been designed and manufactured in accordance with CE Safety Standards.

This appliance has been successfully tested and listed by CE under the following standards; EN 500081-2 1994, EN 61000-6-2 1999 and EN 55011:1998. Certificate number: Retlif R-3909N

Note: This product has not been safety tested for outdoor use.

Section 2: Overview

Front Panel Layout

The front panel keypad of the control is shown below. In the upper center is the color LCD display. The power switch is located in the upper left-hand corner of the front panel. The power switch is illuminated when in the on position.

Located in the upper half of the control is the View Screen. The View Screen offers a simple to follow graphical interface for the operator to view all aspects of control operation such as machine setup, part file management, part programming and cutting operations.

Below the View Screen, there are several groups of push buttons or *keys* on the front panel. The eight keys located directly below the display and labeled as Soft Keys act as programmable keys. The functions of these keys are shown in the display. This allows many different functions to be included without an excessive number of separate keys. It also gives us complete flexibility should we need to add a new feature at a later date.

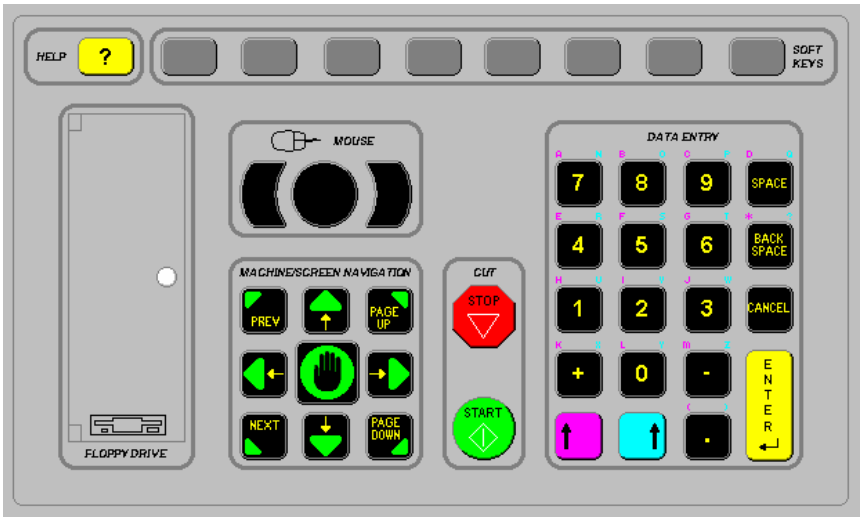
The yellow key labeled HELP is for on-line documentation and help. Simply press this key at any time and this document will be displayed.

The keys to the lower right of the front panel comprise the alpha numeric keypad, which is used for entering data. To the far left, under the label Machine/Screen Navigation, are keys which control manual motion and cursor location during data input. These include the MANUAL key (for Manual Mode jogs) and the eight arrow keys (for jog and cursor direction).

The two keys under the label CUT are for program start and stop.

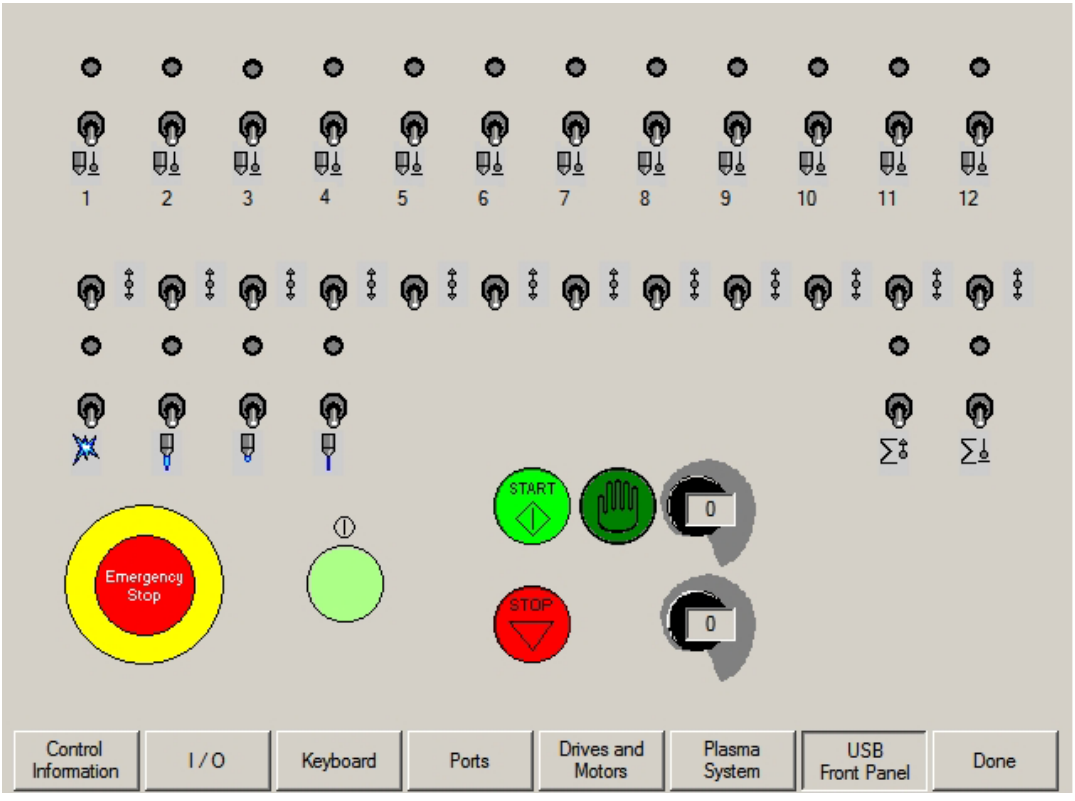
Behind the small door labeled *FLOPPY DRIVE* is the internal 3.5” 1.44 Mbyte floppy disk drive. In addition, there is a small potentiometer behind this door to adjust the LCD brightness and contrast. This potentiometer should only need to be set once, at the time of installation, unless the control is being operated in an extreme temperature environment.

Front Panel



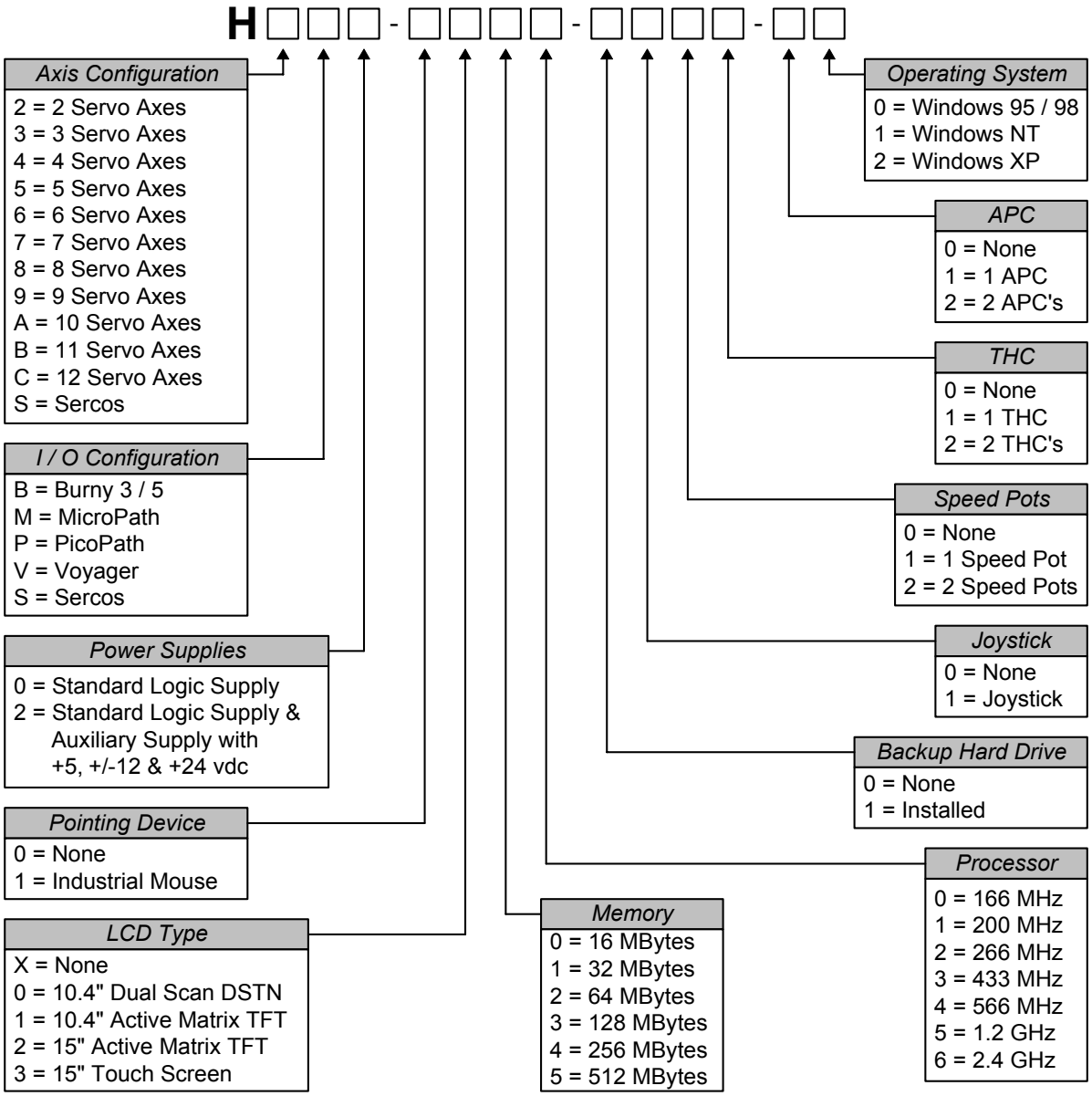
Optional PC Style Keyboard

Optional USB Front Panel



Model Numbering System

The control is available with the following hardware and software configurations. Features and control configuration options in software are based on the I/O configuration of the control. Generally, the information presented in this guide is based on the I/O configuration as outlined below. Please refer to your control I/O configuration for available features and product information. The specific configuration is determined by the Model Number, as shown below:



Model Numbers

You may wish to record your Model Number in the space provided below.

Model Number Information
Model Number:
Serial Number:

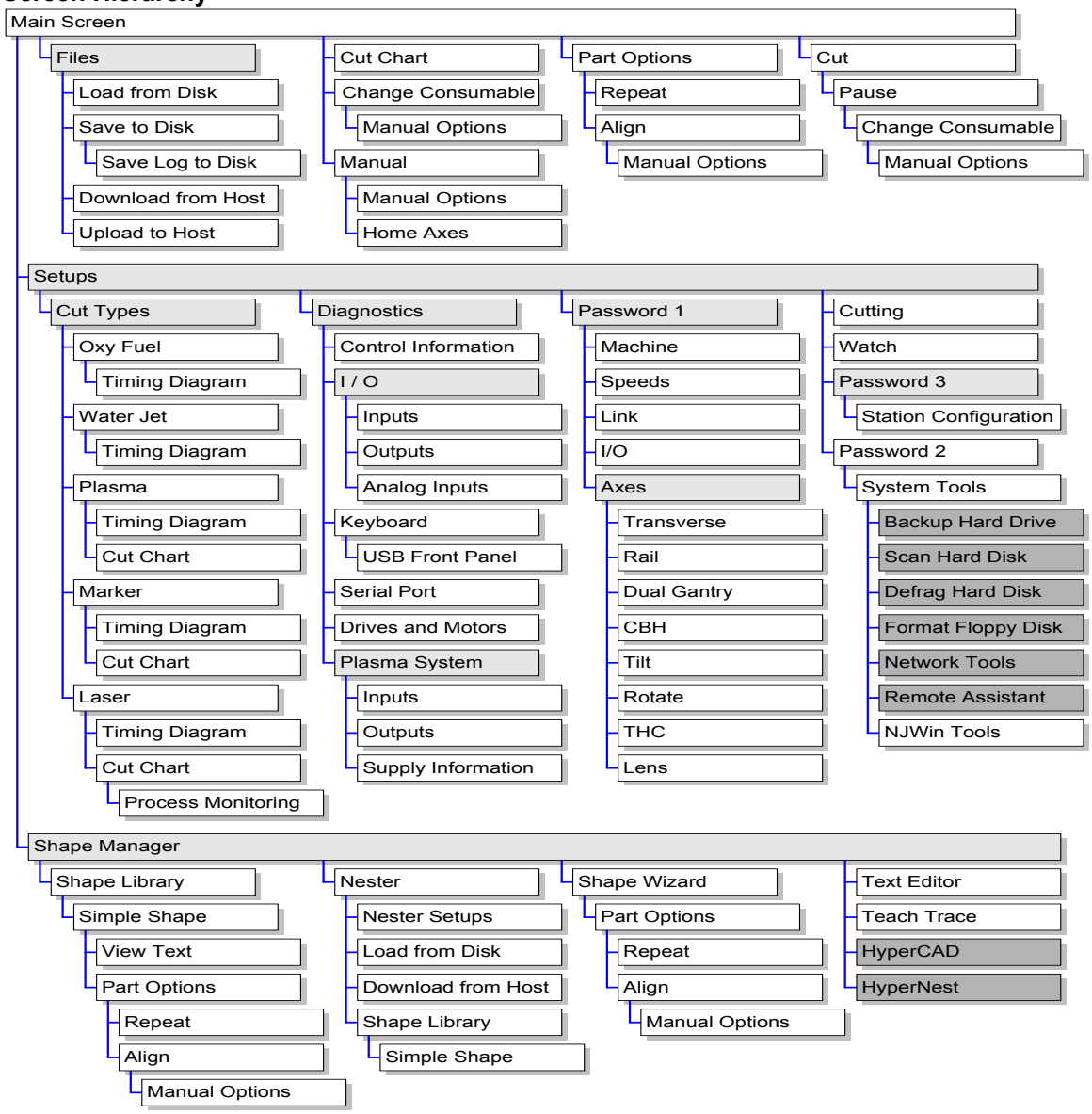
Operation Summary

The programming and operation of the control is menu-driven. The following diagram shows the Screen Hierarchy for the menu structure.

The menu that appears in the display when the unit is first turned on is referred to throughout this manual as the Main Menu. All other menus and functions are accessed at some level under Main Menu, or else appear as part of a special operational sequence, such as when the cutting process is interrupted during the middle of a part.

The **DONE** and CANCEL keys have special functions in relation to the menu structure. The **DONE** key returns to the menu from which the present selection was entered and retains any changes that were made. The CANCEL key returns to the menu from which it was entered and deletes/discards any changes that were made. There are, however, some operations during which CANCEL is not active.

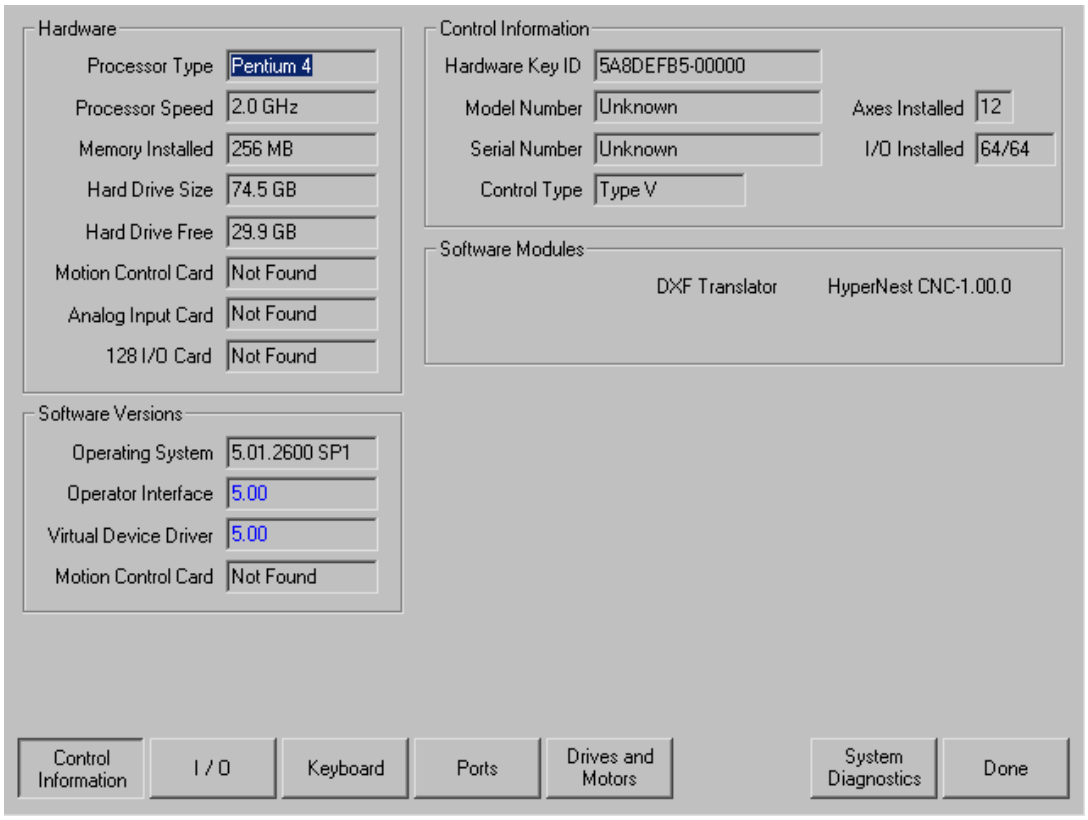
Screen Hierarchy



Section 3: Diagnostics

Control Information

Shows the current software versions and hardware configuration of the control. This information is required when contacting the factory for support. Below is a typical control information screen.



Hardware
The Hardware section shows the current hardware configuration which includes the Processor Type, Processor Speed, Memory Installed, Hard Drive Size, Hard Drive Free Space and Motion Control Card revision.

Software Versions
The Software Versions section shows the current version of the Control's Operating System, Operator Interface (software version), Virtual Device Driver and the Motion Control Card software.

Control Information
The control Information section displays the Hardware Key number, the control model number, serial number, control I/O type, axes enabled and I/O enabled.

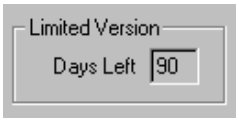
Software Modules
The Software Modules information will display the optional software features which have been loaded or have been enabled for use (e.g. DXF Translator, McAfee VirusScan Software or NJWIN font Viewer).

Voltage
System Voltages at the motherboard will be displayed for motherboards equipped with this monitoring feature.

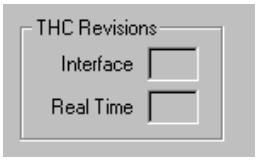
Temperature
Temperature at the motherboard will be displayed for motherboards equipped with this monitoring feature.

Fans
Fans speed at the motherboard will be displayed for motherboards equipped with this monitoring feature.

Limited Version
The Limited Version information will be displayed if the control is operating on a trial version of software. The version of software is available for 90 days of use and may be enabled for permanent use through use of a password available from the control vendor.

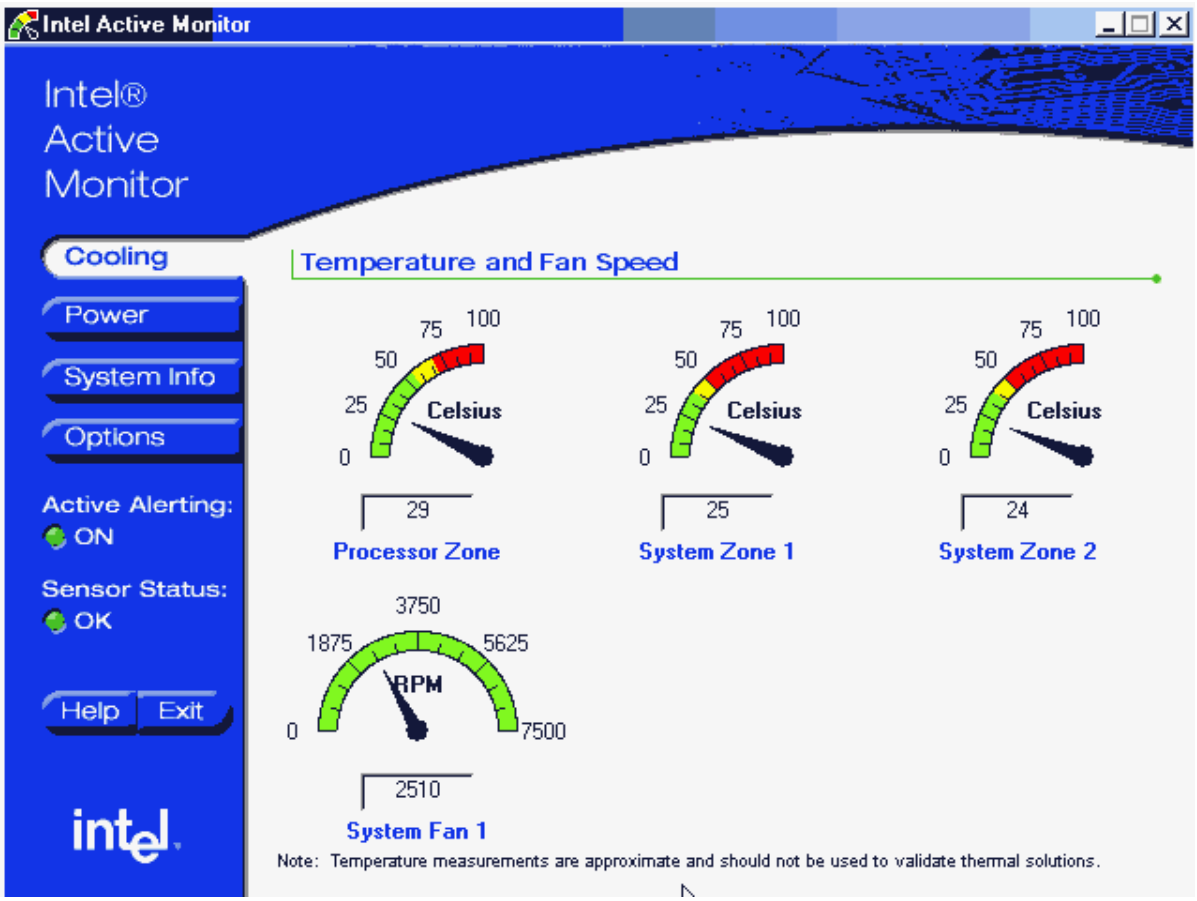


THC Revision
The current Command® THC Interface and Real Time Revision Levels will be displayed at the Control Information screen when enabled.



System Diagnostics

Pressing the System Diagnostics Softkey allows the user to use the optional INTEL® Active Monitor. Note: A Mouse is required for screen navigation.



The INTEL® Active Monitor allows the user to view Cooling, Power and System information. Additionally, this allows active alerts to set and posted on screen during operation.

Touch Screen Calibration

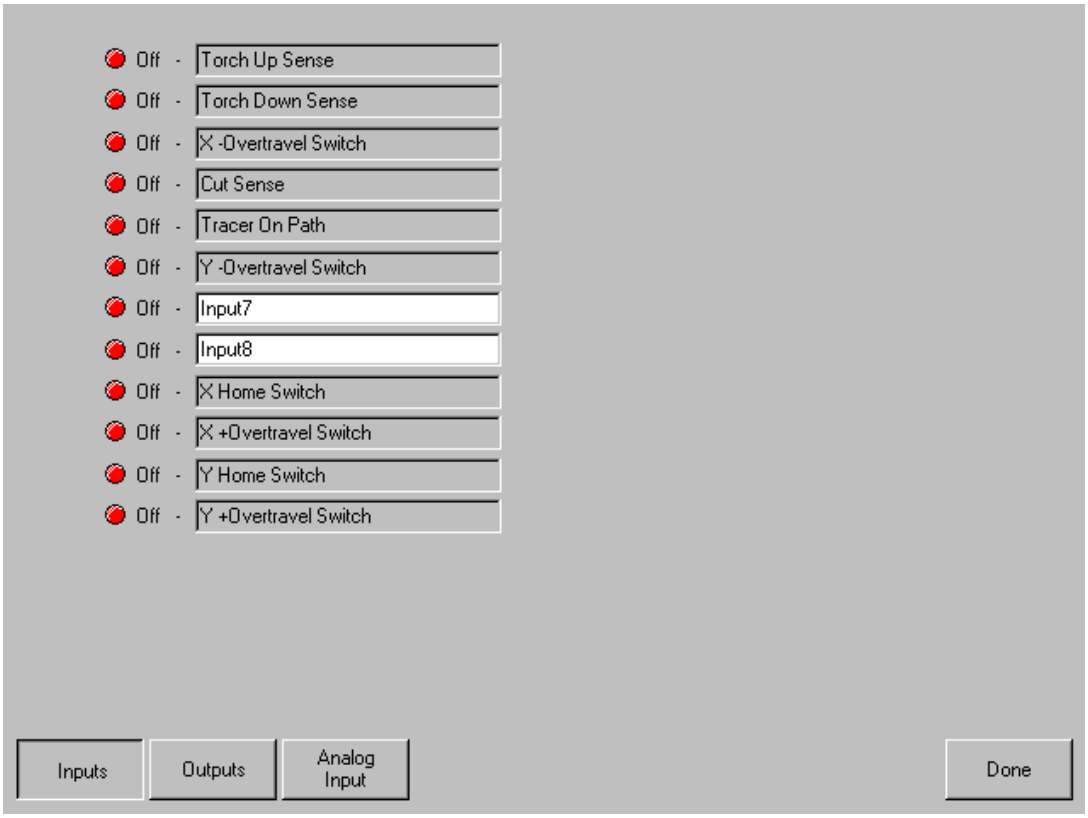
If your CNC is equipped with a Touch Screen Display, you will also have the option to launch a Touch Screen Calibration utility for tuning touch screen response.

I/O

Inputs
This test continuously monitors and displays the current state of all of the optically-isolated discrete inputs in the control. The current state of each input, On or Off, is displayed to the left of the input name. Below is an input screen with all of the inputs off.

Inputs displayed with a white background allow for the input name to be changed by the user. To change the input name, use the Previous/Next arrow key to highlight the desired input and type the new text for the input name. The input can then be connected to the control and used as commanded in the part program. Example: The EIA W7 S1 code will pause the program and wait for input 7 to become active.

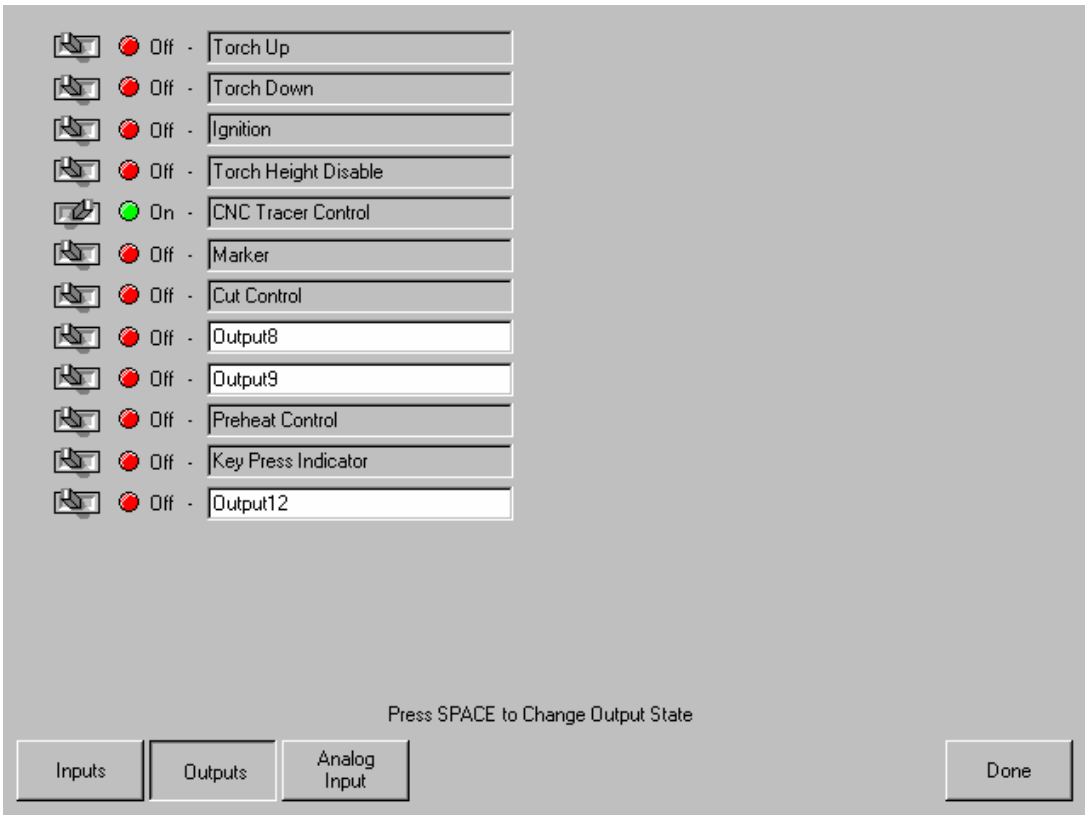
A password is required when entering this screen.



Note: The number and name of the Inputs will vary due to control software and hardware configurations.

Outputs
This test allows the activation of all optically-isolated discrete outputs in the control. Each Output's state can be changed by selecting the desired output with the PREV and NEXT keys and then pressing the SPACE key. The current state of each output, On or Off, is displayed to the left of the output name. Below is an output screen all of the outputs Off.

Warning: When manually activating the control's outputs, Machine, Torch and Marker motion may occur and the cutting device may activate.



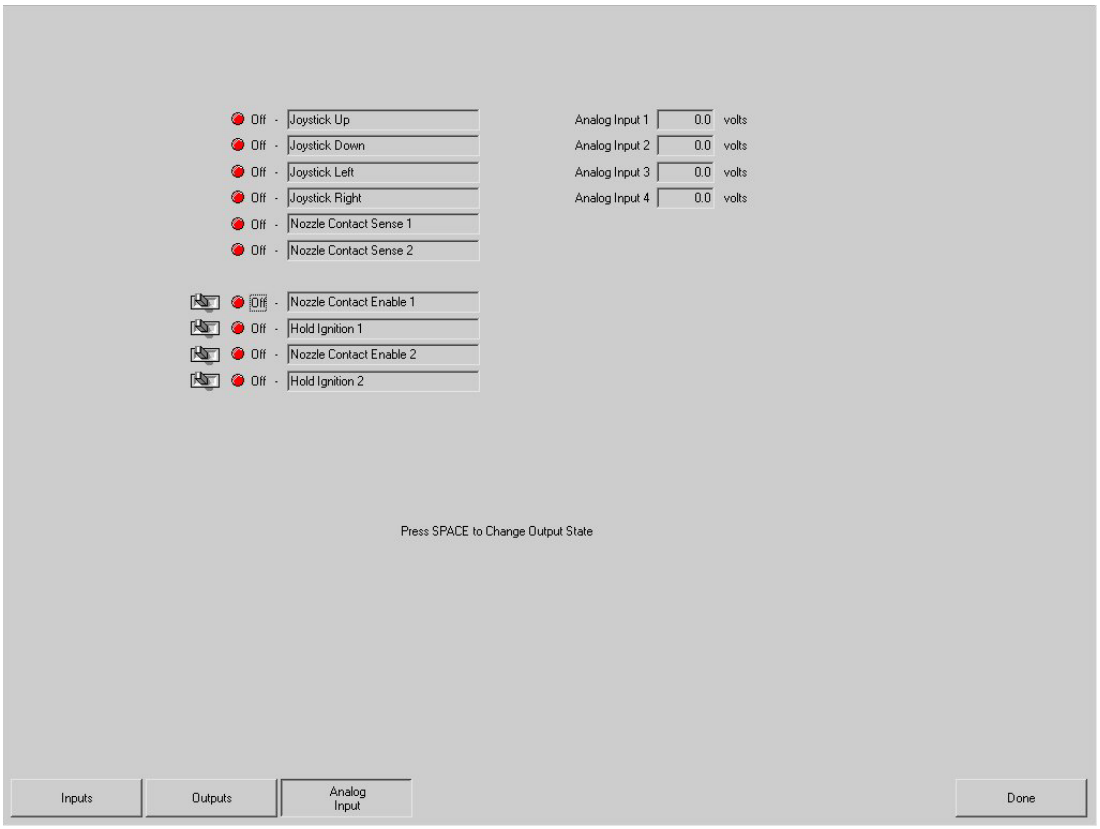
Outputs displayed with a white background allow for the Output name to be selected by the user. To change the output name, use the Previous/Next arrow key to highlight the desired output and type the new text for the output name. The output can then be connected to the control and used as commanded in the part program. Example: The EIA M22 and M23 code will turn on and off output 12.

Note: The number and name of the Outputs will vary due to control software and hardware configurations.

Analog

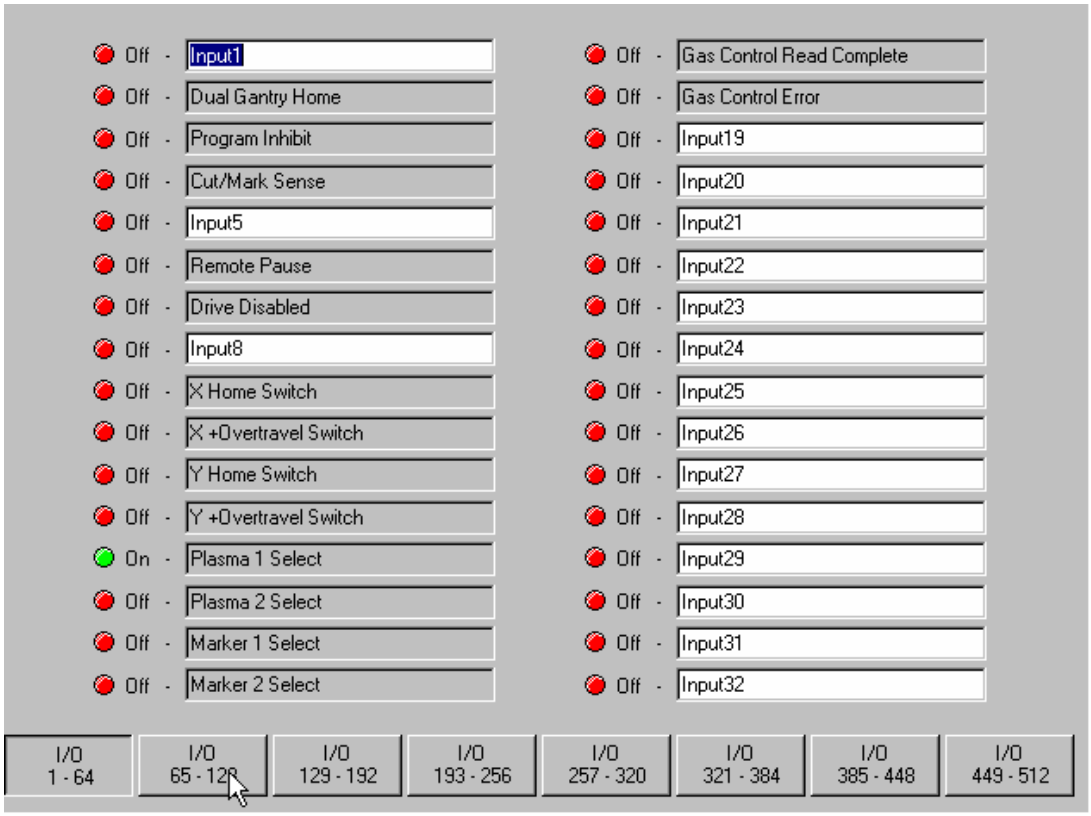
The Analog I/O Diagnostic screen allows the user to view the input state and activate optically-isolated discrete outputs for the Analog Input card. The Analog Input card is used as an interface card to support option Sensor™ THC, APC™, Joystick and external Speed Pot options.

Note: The Analog Input screen will vary slightly depending on control hardware configuration.



Expaned I/O

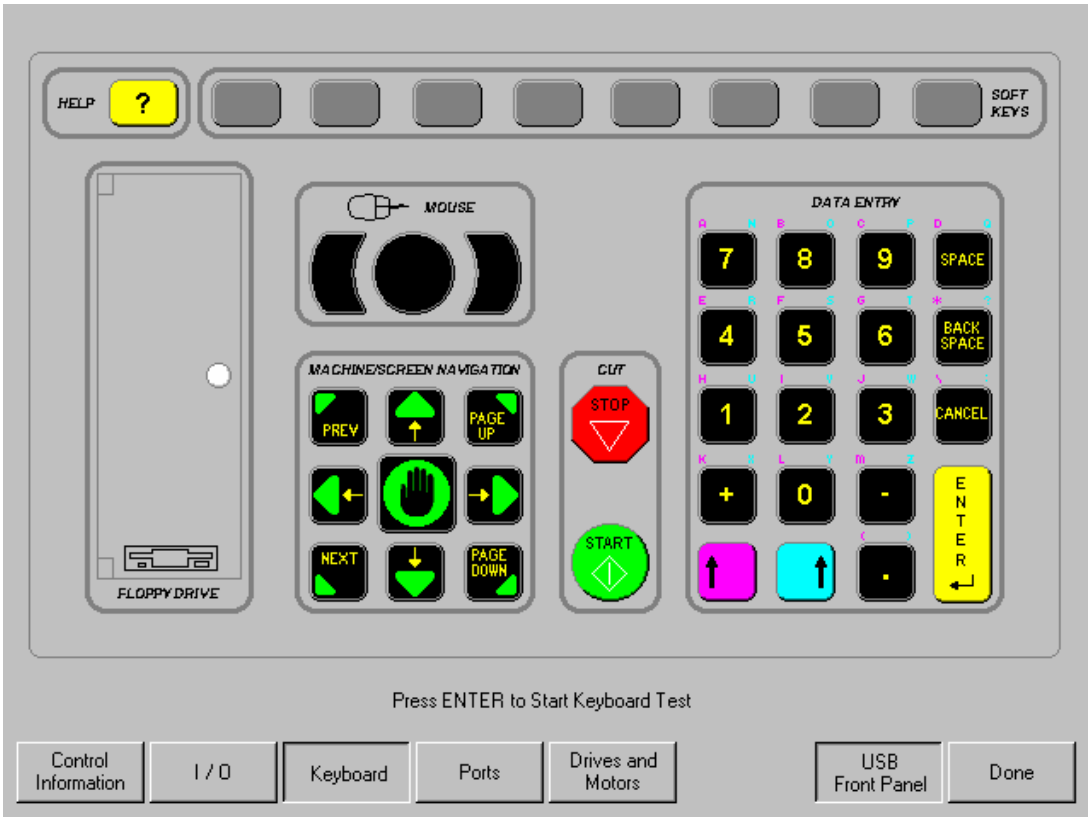
For controls equpped with more than 64 I/O a series of selection softkeys are avialable to access the required Inputs. Ouputs and Analog I/O.



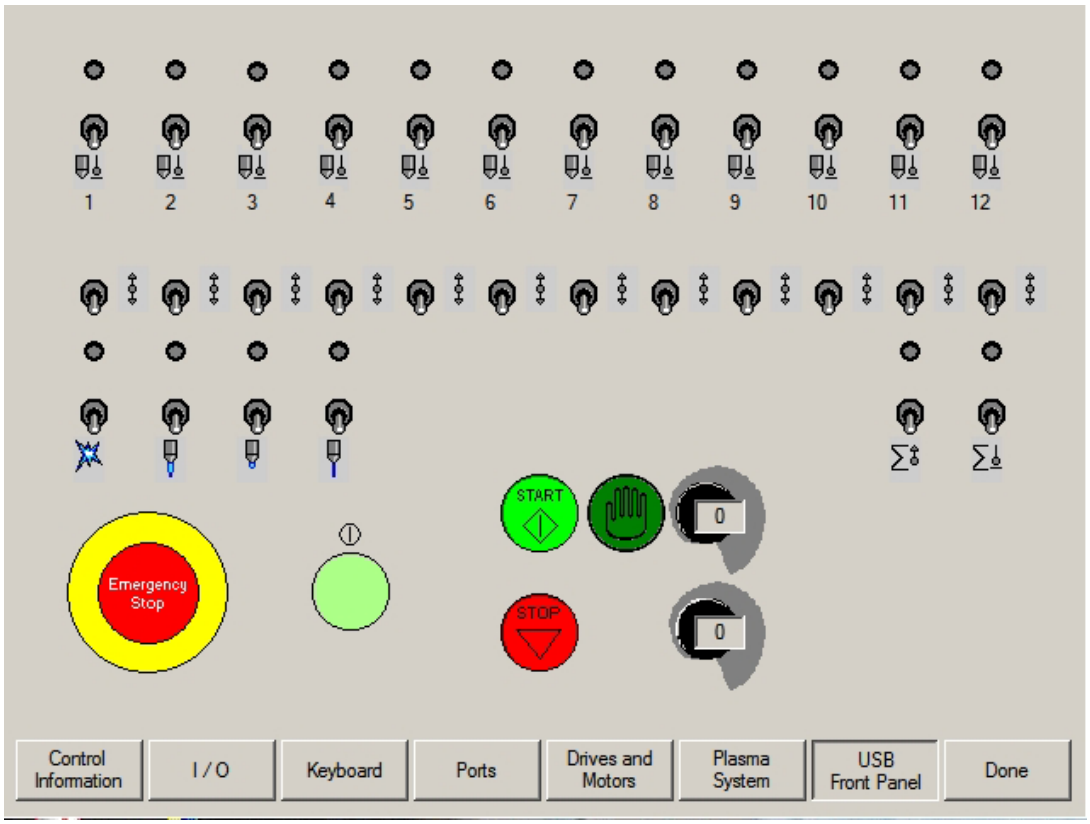
Note: The optional USB Front Panel I/O are not accessible form the I/O Diagnostics screen. Functionality for the USB Front Panel may be tested through the Keyboard Diagnostics.

Keyboard

This diagnostic screen allows each key of the control keyboard to be tested. To start the keyboard test, press the ENTER key from within the keyboard diagnostic screen. As each key is pressed on the control keyboard, the corresponding key will activate on the display. If any of the keys do not activate on the display during the keyboard test, then the control keyboard may be defective and the factory should be consulted for further instructions. To exit the keyboard test, press and hold either Shift key and then press the CANCEL key. Below is the Keyboard Test Screen.

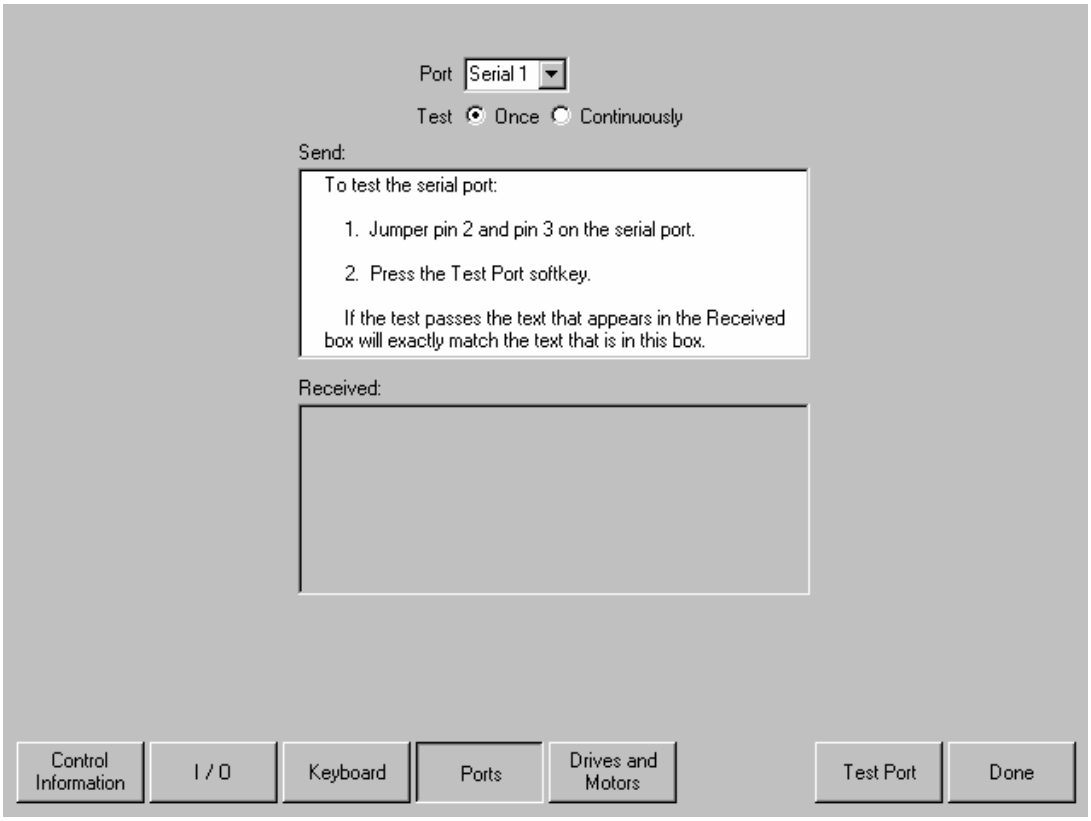


Optional USB Front Panel



Serial Port

This diagnostic screen allows the testing of the control serial ports. To perform the test, install the appropriate jumper or jumpers. If the serial port being tested is configured for RS-232, jump pin 2 to pin 3. If the serial port being tested is configured for RS-422, jump pin 2 to pin 3 and pin 4 to pin 7. Select the appropriate serial port to test and press the Test Port softkey to initiate the test. If the serial port is functioning properly, the exact text in the Send window will appear in the Received window. If the serial port is not functioning properly, a Communications Time Out message will appear below the Received window. If the serial port test fails, then the control may be defective and the factory should be consulted for further instructions. Below is a serial port test screen with a successful test.



Port
The Port parameter is used to select which port will be tested.
Test
The Test feature is used to select a single or continuous signal is to be sent for testing.

Send
This window contains the text that will be transmitted during the serial port test.

Received
This window will contain the text that is received during the serial port test. If the test is successful, it should match the text contained in the Send window.

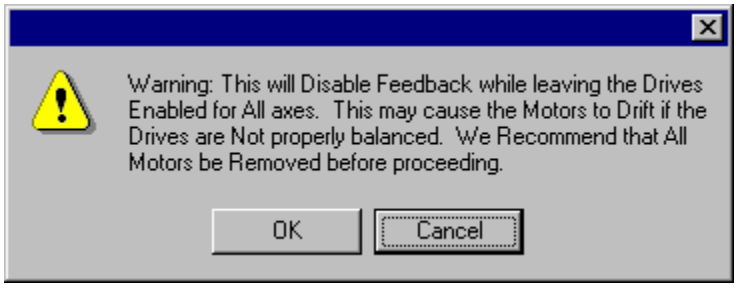
Test Port
Used to initiate the serial port test on the selected port.

Drives and Motors

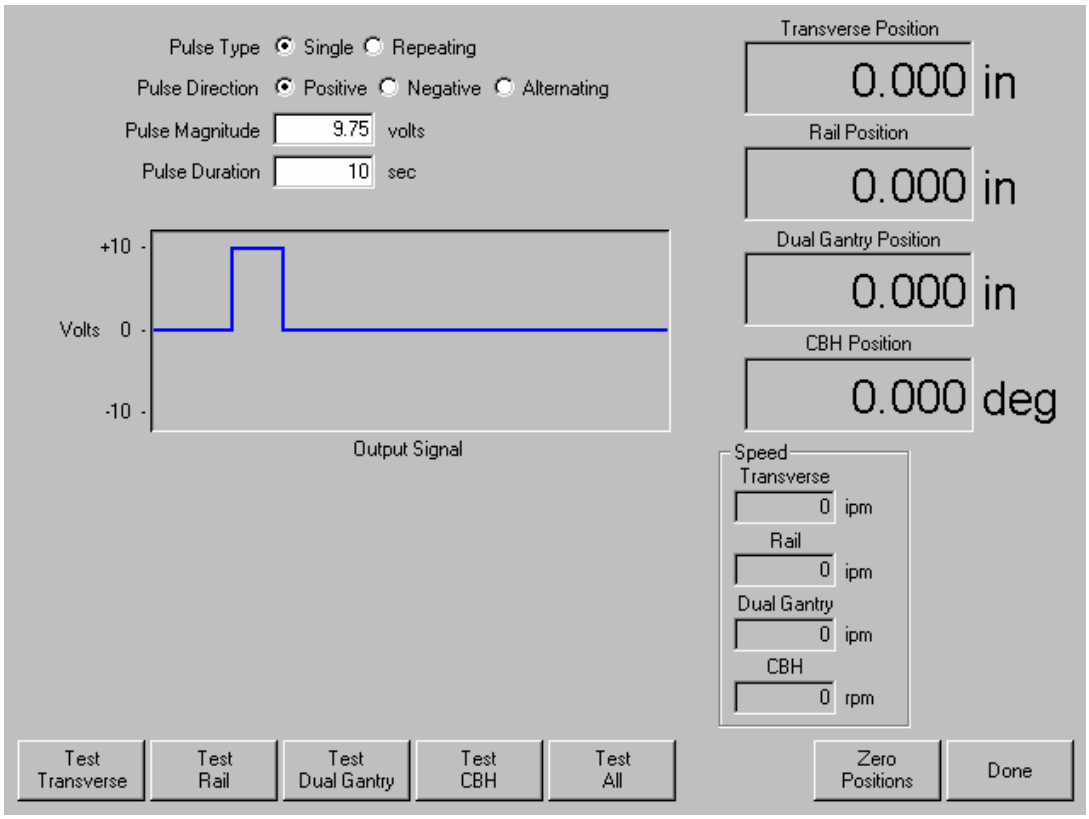
The Drives and Motors diagnostic screen allows a technician to send a direct signal to the drive amplifiers without enabling the servo loop for testing purposes.

Warning! When sending direct signals to the drive amplifiers, unexpected motion on the cutting table may occur and extreme caution should be used.

When the Drives and Motors screen has been pressed, the following warning message will appear.



Select OK and then enter the machine password to view the Drives and Motors screen.



Pulse Type
Selects whether the signal that will be sent to the drive amplifier will be a single pulse or a repeated pulse. If the repeated pulse is selected, the signal will continue until the Test softkey for that axis is pressed again.

Pulse Direction
Selects whether the signal that will be sent to the drive amplifier will be a positive, negative or alternating pulse.

Pulse Magnitude
Sets the voltage of the signal to be sent to the drive amplifier.

Pulse Duration
Sets the amount of time for each segment of the signal to be sent to the drive amplifier.

Test Transverse/Rail/Dual Gantry/CBH
The Test buttons will send the selected output signal to the appropriate drive amplifier. If a repeating signal has been selected, any combination of available test buttons may be used for the test. Each drive amplifier will be sent the selected output signal until the selected output softkey has been pressed a second time to end the test.

Test All
Pressing the Test All softkey will send the selected output signal to all drive amplifiers.

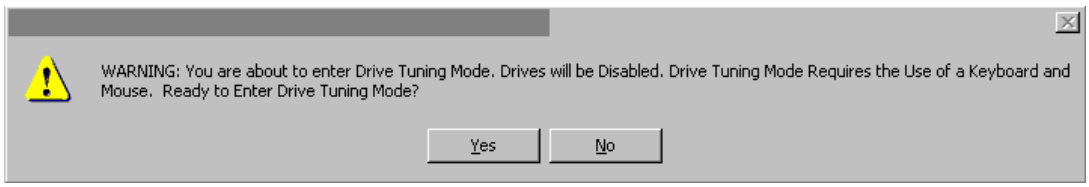
Speed
The Speed window displays the current speed for each axis.

SERCOS Drives & Motors

Use of the SERCOS Interface™ allows the user to easily expand the number of axes available for use. The form of communication with the drives for Motion commands is over a serial link using diagnostic software provided by the Drive vendor.

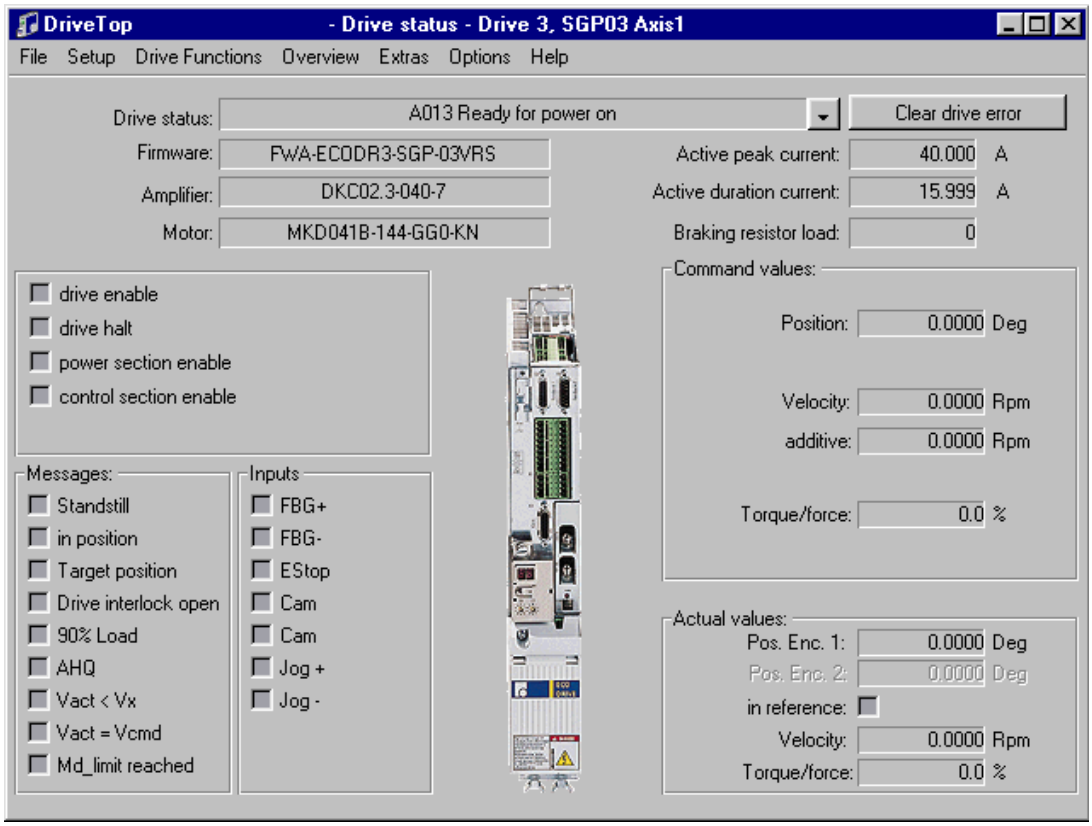
Warning! When sending direct signals to the drive amplifiers, unexpected motion on the cutting table may occur and extreme caution should be used.

When the Drives and Motors screen has been pressed, the following warning message will appear.

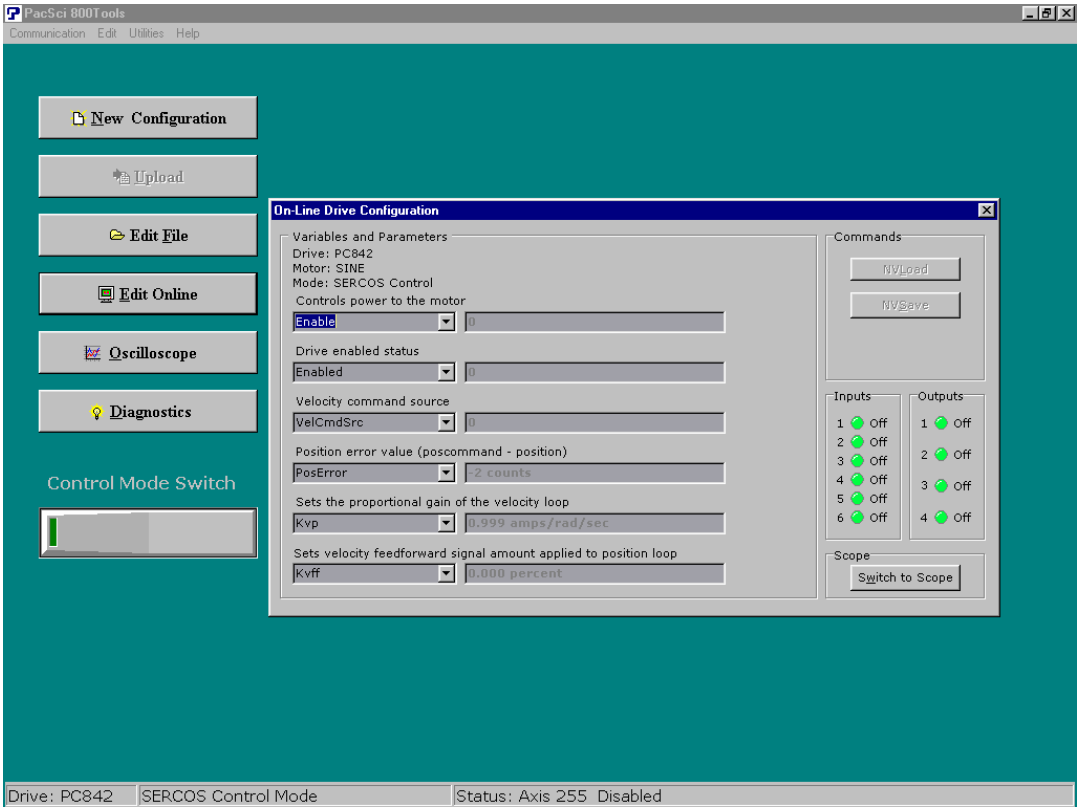


When entering the Drive and Motors Diagnostics screen the specific drive communications software will be launched for the drive being used. Please refer to information supplied by the Drive vendor on how to use the drive setup software for the specific drive being used. The following are some examples of drive setup and tuning software.

DriveTop from Indramat



PacSci 800Tools from Pacific Scientific



Note: screen resolution may temporarily change during use of the above utilities.

Error Messages

The control contains a number of error messages that will be displayed when programming, machine, or internal errors are detected. A list of the more common error messages are explained below.

SERCOS Errors
A number of different errors can be posted from the SERCOS Interface™ for both motor and I/O performance. The error messages are specific to the drive and I/O modules being used. Please refer to information supplied by the Drive and I/O hardware supplier for appropriate response.

SERCOS Ring Not Running
This error indicates that communication with the SERCOS ring has been lost. Generally this is due to a fault condition on the ring. Check SERCOS hardware and cycle power.

No Part Loaded
This message is displayed whenever the control does not contain a valid part program in memory. To clear this error message, load a valid part program from either the Shape Library, hard drive, diskette or from a Host system.

Part Larger than Plate
This message will be displayed if the part program that has been loaded is larger than the plate size information in Setups. The operator may choose to ignore and continue the cut or return to Setups to correct the plate size.

Kerf too Large, Arc/Line has Disappeared. Abort Cut?
This message is displayed when the Kerf size selected is too large and will affect the shape of the part. The operator can continue to cut the part, abort the cut to review the Kerf information selected or abort the cut to review the part program for any errors. Electing to continue cutting of a part program which prompts the display of this error, may lead to unexpected results.

Cut Sense Lost
This message is displayed if the Arc ON Feedback setup parameter is enabled and the Cut Sense input is deactivated by the plasma unit while cutting. When this condition occurs, the control displays the Pause screen, which allows use of the Cut Recovery features to finish cutting the piece.

Communications Time Out
This message is displayed whenever the Host system does not respond within the Link Time Out setup parameter for either a Host Upload or Download. To correct this problem, increase the Link Time Out setup parameter and check the communications setup parameters on the Host system and the control.

Host Not Responding
This message is displayed whenever the communications is lost to the Host system after the initial communication was established. To correct this problem, try exiting and re-entering the Upload or Download to Host screens to re-establish communications and/ or check the communications setup parameters on the Host system and the control.

Scale Factor must be between .001 and 1000
This message is displayed whenever a value less than .001 or greater than 1000 is entered for a Scaling Factor. To correct this problem, enter a value between .001 and 1000 for the Scaling Factor.

Radius at Arc Beginning and Radius at Arc End are not within the Arc Radial Error Tolerance
This message is displayed whenever the radius beginning-arc and the radius-ending arc of a part program are not within the Arc Radial Error setup parameter in the Main Setup screen. To correct this problem, either increase the Arc Radial Error Tolerance setup parameter or correct the part program itself.

Transverse Position Error Exceeded
This message is displayed whenever the current Transverse position error exceeds the Servo Error Tolerance Setup parameter in the machine setups screen. It also may appear if the position feedback loops are not operating properly, or the machine is being commanded to move or accelerate faster than it is capable. To correct this problem, either increase the Servo Error Tolerance Setup parameter in the machine setups screen, re-tune the system, decrease the Maximum machine speed setup parameter or the acceleration rate setup parameter. Generally, this error is displayed when the setting for Incremental or Absolute EIA I and J codes is set to the wrong state for the active part program.

Rail Position Error Exceeded
This message is displayed whenever the current Rail position error exceeds the Servo Error Tolerance Setup parameter in the machine setups screen. It also may appear if the position feedback loops are not operating properly or the machine is being commanded to move or accelerate faster than it is capable. To correct this problem, either increase the Servo Error Tolerance Setup parameter in the machine setups screen, re-tune the system, decrease the maximum machine speed setup parameter, or the acceleration rate setup parameter. This error generally indicates a servo drive or motor problem. First check for fault indications on the servo drives.

Dual Gantry Position Error Exceeded
This message is displayed whenever the current Dual Gantry position error exceeds the Servo Error Tolerance Setup parameter in the machine setups screen. It also may appear if the position feedback loops are not operating properly or the machine is being commanded to move or accelerate faster than it is capable. To correct this problem, either increase the Servo Error Tolerance Setup parameter in the machine setups screen, re-tune the system, decrease the Maximum machine speed setup parameter, or the acceleration rate setup parameter. This error generally indicates a servo drive or motor problem. First check for fault indications on the servo drives.

Transverse Positive Hardware Overtravel Reached
This message is displayed whenever the control detects a positive limit switch in the Transverse axis. This can also occur if the limit switch input is set for the wrong polarity or the limit switch wiring is not properly connected. If the Transverse axis did trip the positive limit switch, use Manual mode to jog the Transverse axis away from the limit switch. This error generally indicates a servo drive or motor problem. First check for fault indications on the servo drives.

Rail Positive Hardware Overtravel Reached
This message is displayed whenever the control detects a positive limit switch in the Rail axis. This can also occur if the limit switch input is set for the wrong polarity or the limit switch wiring is not properly connected. If the Rail axis did trip the positive limit switch, use Manual mode to jog the Rail axis away from the limit switch.

Transverse Negative Hardware Overtravel Reached
This message is displayed whenever the control detects a negative limit switch in the Transverse axis. This can also occur if the limit switch input is set for the wrong polarity or the limit switch wiring is not properly connected. If the Transverse axis did trip the negative limit switch, use Manual mode to jog the Transverse axis away from the limit switch.

Rail Negative Hardware Overtravel Reached
This message is displayed whenever the control detects a negative limit switch in the Rail axis. This can also occur if the limit switch input is set for the wrong polarity or the limit switch wiring is not properly connected. If the Rail axis did trip the negative limit switch, use Manual mode to jog the Rail axis away from the limit switch.

Transverse Positive Software Overtravel Reached
This message is displayed whenever the Transverse axis position is greater than the Maximum Travel Limit setup parameter for the Transverse axis. When this occurs, use Manual mode to jog the Transverse axis to a position within the Travel Limit setup parameters.

Rail Positive Software Overtravel Reached
This message is displayed whenever the Rail axis position is greater than the Maximum Travel Limit setup parameter for the Rail axis. When this occurs, use Manual mode to jog the Rail axis to a position within the Travel Limit setup parameters.

Transverse Negative Software Overtravel Reached
This message is displayed whenever the Transverse axis position is less than the Minimum Travel Limit setup parameter for the Transverse axis. When this occurs, use Manual mode to jog the Transverse axis to a position within the Travel Limit setup parameters.

Rail Negative Software Overtravel Reached
This message is displayed whenever the Rail axis position is less than the Minimum Travel Limit setup parameter for the Rail axis. When this occurs, use Manual mode to jog the Rail axis to a position within the Travel Limit setup parameters.

Dual Gantry Skew Error Exceeded
This error message is displayed when the control has detected a position error fault between the two drive axes on the dual gantry. It also may appear if the position feedback loops are not operating properly, or the machine is being commanded to move or accelerate faster than it is capable. To correct this problem, either increase the Skew Error Tolerance Setup parameter in the machine setups screen, re-tune the system, decrease the maximum machine speed setup parameter or the acceleration rate setup parameter.

Need Station Selection
The Need Station Selection error message is displayed if the input for a station or process has not been activated. Example: When cutting in Plasma mode, a Plasma 1 or Plasma 2 input may be required to execute the selected Plasma cut process.

Buffer Time Out
This may appear if there is an instance where the motion buffer is full and cannot record the data being saved. This error allows the operator stop the motion back up on path to the last pierce and start over without a position error. This error should be reported to the control vendor.

CNC Time Out
This is a general error that may appear if there is an instance when any buffer is full and cannot record the data being saved. This error allows the operator stop the motion back up on path to the last pierce and start over. This error should be reported to the control vendor.

Unable to Find HASP
The HASP is Hardware protection key (dongle) that enables the software and features for use. If the HASP is not installed the control will not work. If this message appears and the hardware key is in place, please contact your control vendor for assistance.

Norton Ghost™ Utility

In the unlikely event that an extreme system error has occurred which prevents the control from operating, the Norton Ghost™ Utility is available on specified controls to replace core system files and re-enable operation of the control. Norton Ghost™ must be previously installed on the control hard drive with an appropriate ghost image file.

The Norton Ghost Utility works by allowing the user to retrieve an image file from the D: partition of the hard drive to replace all data on drive C: The Ghost Image may be a factory default or custom user created image files. **NOTE:** All current information on Drive C: will be lost. It is recommended that a unique user image be created after table configuration which will include all the important table settings.

This feature may be executed from the System Tools screen or through use of a diskette shipped with the control. It may also be obtained from the control supplier on diskette or transmitted via the Internet.

Norton Ghost™ is a Trademark of Symantec™ Corporation.

Create Diskette from E-mail
To create a Norton Ghost tool disk from the compressed software sent via the Internet:

The file sent by the Internet will be an auto-executable file which will place the required files onto a diskette to be used at the control. First place a blank diskette into your PC. Double click on the recovery EXE file. A message box will be displayed. Click on the “Create Floppy” button to execute. The EXE will copy the new files to the floppy disk to take to the control.

Instructions for Diskette Recovery

Creating a Custom Image File: Place the Norton Diskette into the control and turn the unit on.
Norton Ghost will progress as follows.

“Starting PC DOS.....”

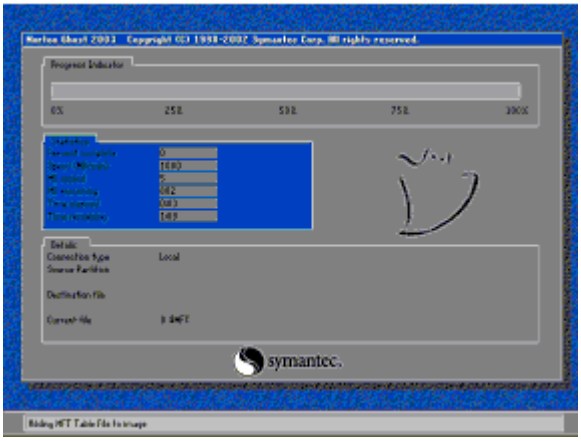
Current Copyright information will be displayed

“Select 1 to make a New Backup Image or 2 to restore existing [1,2]”

Press 1 to create a new back up image. Up to three custom images may be created. They are created as “newest” to “oldest” image and are automatically assigned. The “original” ghost image is the factory default and may not be over written.

Back up will begin automatically.

“----------Backing Up Drive, Please Wait ----------“



Norton Ghost will launch as above indicating back up progress. The following Message will appear when complete.

“---------- Back Up Complete, Please Remove Disk and Reboot ----------“

Remove the diskette. Turn the control Off and then On. Table setups and software updates may need to be reloaded if the image is not current.

Retrieving an Image File

Place the Norton Diskette into the control and turn the unit on. Norton Ghost will progress as follows.

"Starting PC DOS....."

Current Copyright information will be displayed

"Select 1 to make a New Backup Image or 2 to restore existing [1,2]"

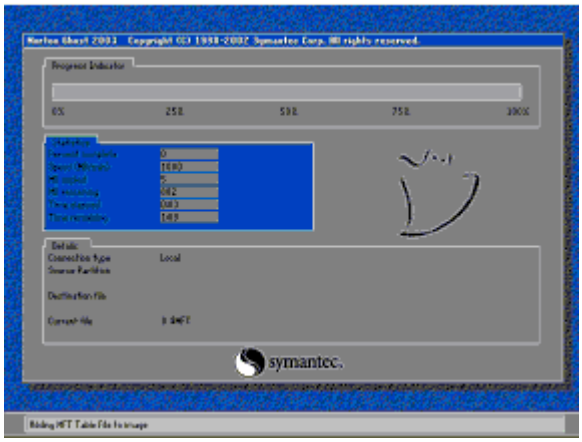
Press 2 to retrieve the back up image. Up to three custom images may be created. They are created as "newest" to "oldest" image. The "original" ghost image is the factory default. The next message allows the user to select which version to use when restoring.

"1. Newest.gho"
"2. Older.gho"
"3. Oldest.gho"
"4. Original.gho"

"Select the Number of the Image to restore from the choices above [1,2,3.4]"

Press the number for the desired image.

"----------Restoring, Please Wait ----------"



Norton Ghost will launch as above indicating restore progress. The following Message will appear when complete.

"----------End Restoring, Please Remove Disk and Reboot ----------"

Remove the diskette. Turn the control Off and then On. Table setups and software updates may need to be reloaded if the image is not current.

Section 4: Password Setups

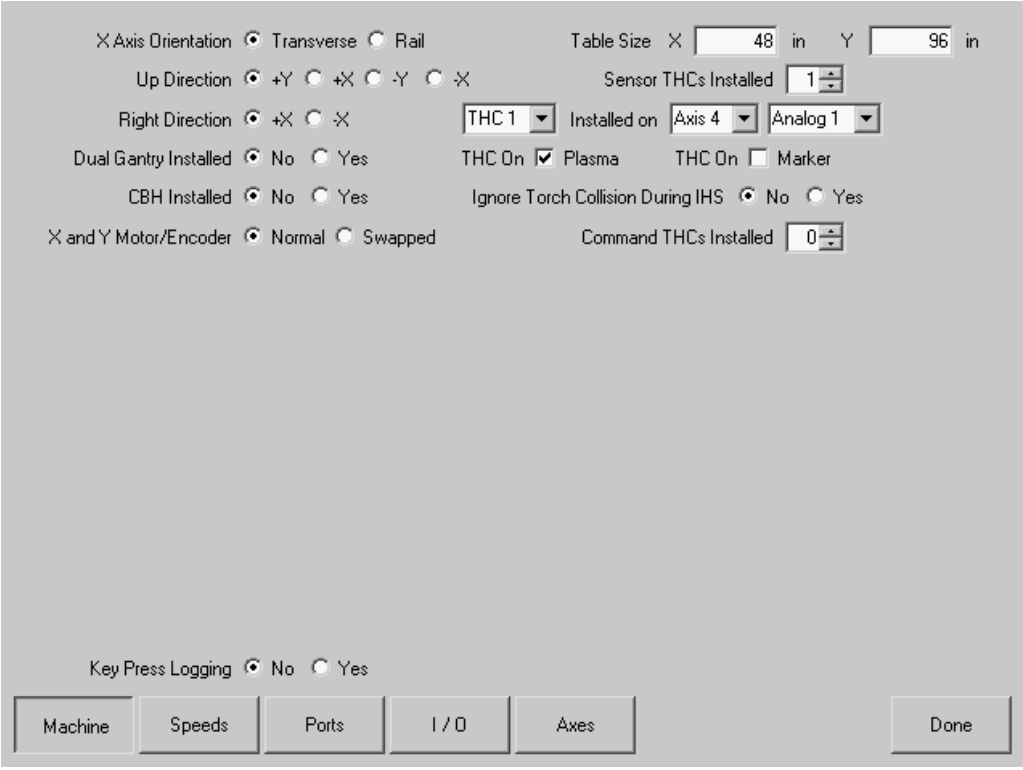
The following setup screens are only available with the supervisory passwords. This will help prevent unauthorized personnel from entering these screens.

Warning! Extreme care should be taken when changing these parameters as they may cause machine damage if incorrectly set. Only trained service personnel should have access to these passwords.

The “2865” password is provided for viewing of the Machine, Speeds, Link and Axes setups without allowing changes. This password is useful for verifying setups without the danger of accidentally changing them or revealing the supervisory password to an unauthorized user.

Note: After installation of the control to the cutting table or if any setup parameters are changed, it is important to save the current setup file to both the hard drive and floppy disk for future reference.

Machine



X Axis Orientation
The control allows specifying the X axis as being either the Transverse or Rail axis. The default setting is Transverse. This parameter should be set before cutting the part.

Up Direction

This parameter defines the machine motion that will occur when the ↑ arrow key is pressed during manual mode.

Right Direction
This parameter defines the machine motion that will occur when the → arrow key is pressed during manual mode.

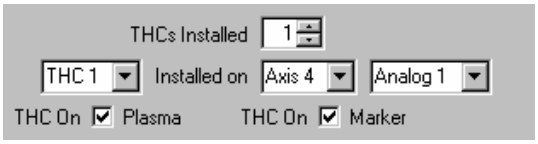
Dual Gantry Installed
Selecting Yes will enable the Dual Gantry axis and allows configuring of that axis.

CBH Installed
Selecting Yes will enable the Contour Bevel Head axis and allows configuring of that axis.

X and Y Motor/Encoder
Selecting this feature as Swapped will internally swap the X and Y Axis encoder signals. This feature simplifies the installation to systems with alternate wiring configurations.

Key Logging
The Key Logging feature is used as a troubleshooting diagnostic tool to record key presses made at the control during operation. When enabled, all key presses and application faults will be saved to a daily log file that may be sent to the control manufacturer for evaluation. The files may be retrieved and stored to diskette through the Files screen at the control. Please refer to the Files Screen information provided in the operator's guide for additional information on this feature.

Table Size
Enter a value for the active cutting area for the X and Y axis. These values are used to limit the Plate size parameter in the cutting setup screen to the maximum size of the table.



THCs Installed
The THC Installed parameter defines the total number of Sensor™ THC Axes assigned for operation at the control.

THC Installed On Axis / Analog
This setup parameter is used to define the THC Axis for use. The user can select which axis the THC is to be commanded on, the analog input to use (arc voltage feedback) and which plasma.

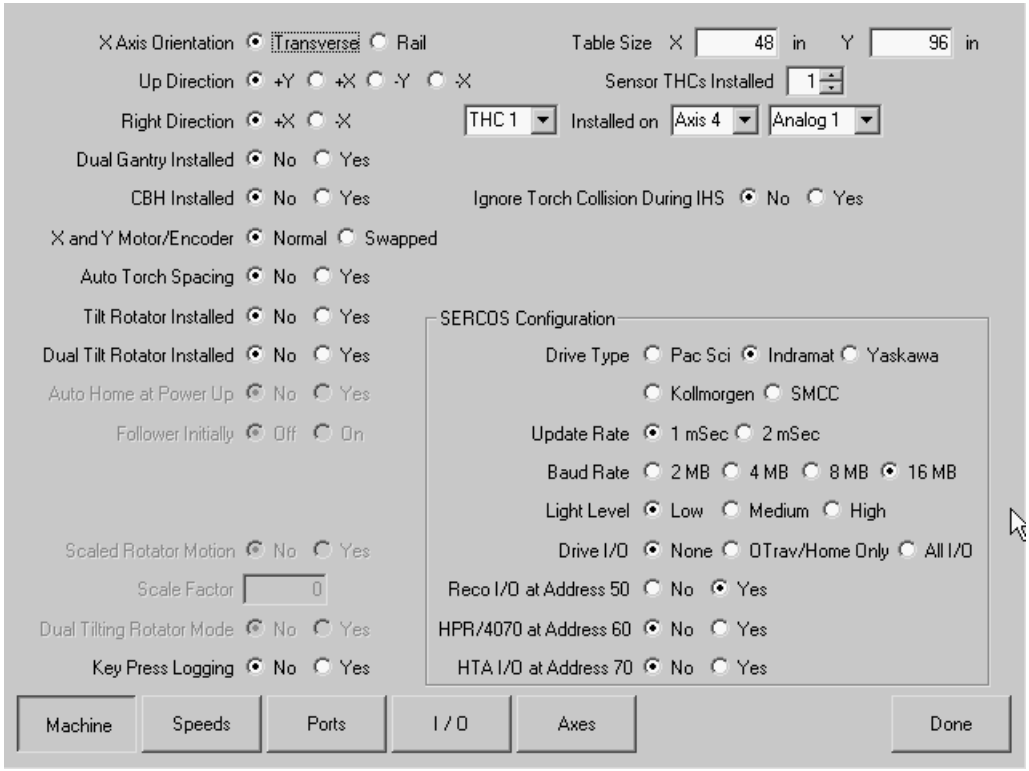
THC On
The THC On parameter is used to indicate which processes are using Sensor™ THCs on the control. This does not assign a process to a specific THC but rather updates the selected process screens to enable any specific Sensor™ THC features. Refer to the Sensor™ THC appendix of this guide for additional information on the setup and use of the Sensor™ THC.

Ignore Torch Collision During IHS
The allows the user to ignore the torch collision input during the initial height sense cycle. This may be advantageous for some THC mechanics.

Command THCs Installed
The Command® THC selection is used to enable the Command THC serial Link. For more information on this feature, please refer to the Command® THC section of this guide.

SERCOS Machine

The SERCOS interface requires configuration to establish communications for motion and I/O.



Drive Type
The manufacturer of the SERCOS style drive being used would be selected. This allows proper operation and tuning parameters to be available.

Update Rate
The update rate for the ring may be selected for motion and I/O. One millisecond is recommended but it is dependent on the capabilities of the hardware being used.

Baud Rate
Communication rate for the ring may be selected. This is determined by the type of drive and I/O being used.

Light Level
The user has the ability to adjust the intensity of the light pulses used on the fiber optic ring. This feature is used to compensate for diminished signal due to issues such as ring distance.

Drive I/O
The user may select to use I/O options directly supported on the Drive Amplifier. Options are None, Overtravel and Home Switches only or All I/O. Note: The Drive I/O will populate the general purpose I/O (both analog and digital) in order from the lowest SERCOS drive axis to the highest SERCOS drive axis.

RECO I/O at Address 50
This parameter is set to Yes if the Indramat RECO I/O module is being used to expand the total number of I/O being used on the fiber optic ring. Note: The RECO I/O will populate the general purpose I/O (both analog and digital) following all drive I/O.

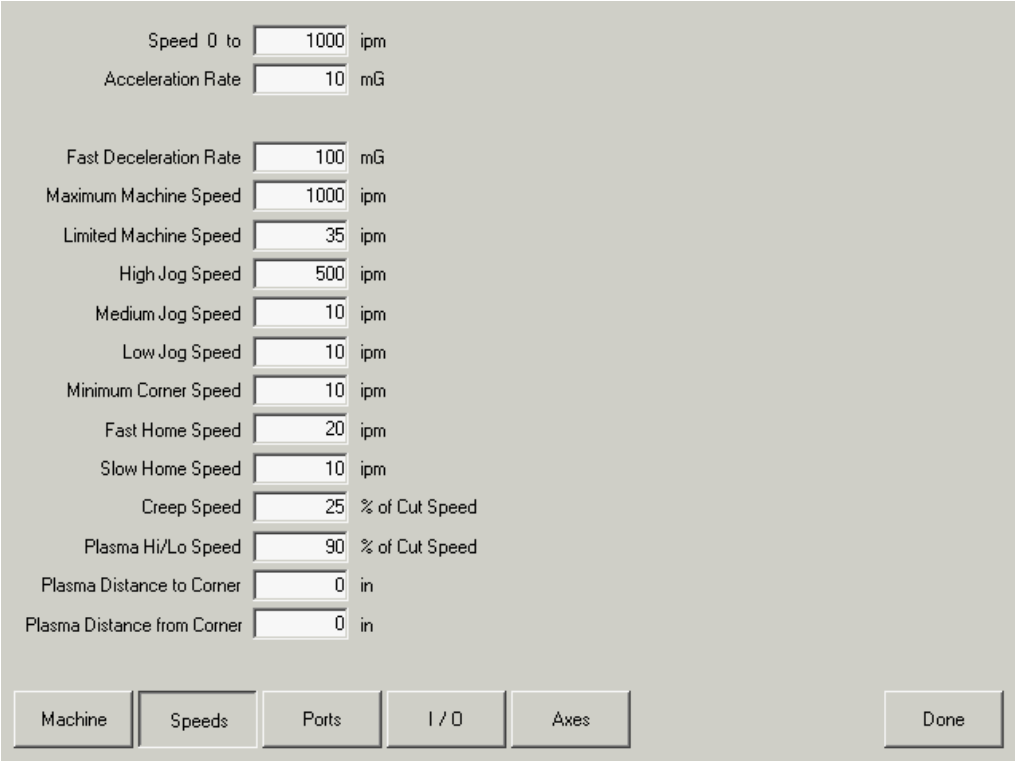
HPR/4070 at address 60
This parameter is set to Yes if the optional SERCOS interface for HPR/4070 is being used.

HTA I/O at Address 70
This parameter is set to Yes if the optional Hypertherm SERCOS interface card is being used.

Speeds

The Speeds setup screen is used for setting the various machine speeds for different operating modes.

Given that the drives, motors, gearboxes and mechanics are capable, the control is capable of operating over a wide range of speeds.



Speed 0 To
This parameter allows the technician to input selected speed ranges to customize the acceleration rates for the various speeds selected. When a speed range lower than the maximum speed is entered, a new range at the maximum machine speed setting will be created, up to a maximum of five. To reduce the number of Speed To ranges, input the maximum machine speed into the range that is to be the highest speed selection and the additional range fields will be removed from the screen.

Acceleration Rate
All mechanical systems have different acceleration and deceleration rates to move the cutting device smoothly. The higher the acceleration rate, the quicker the machine will get up to speed. The lower the acceleration rate the smoother the machine will position the cutting device. This setup parameter is used to determine both the acceleration and deceleration rate for all motion.

Enter a value in milligees for the desired acceleration rate. A milligee (milliG) is 1/1000 of a G, which is the acceleration due to gravity. One milligee is approximately 0.384 inches per second^2. A good starting point for most systems is 10 mgee's.

Fast Stop Deceleration Rate
Activated by the Fast Stop or Torch Collision Input, the Fast Stop Deceleration Rate Parameter specifies in milligees how quickly the system will stop when the Fast Stop Input is active. Generally, this value is much higher then the Acceleration rate.

A milligee (milliG) is 1/1000 of a G, which is the acceleration due to gravity. One milligee is approximately 0.384 inches per second^2.

Maximum Machine Speed
Enter the maximum value at which the system is capable of contouring. This parameter will be used to range limit all subsequent speed entries. In addition, it is used to scale the speedometer widget in the Watch window during runtime operation.

The maximum speed at which the control can contour can be calculated with the following equation.

Maximum Contouring Rate (IPM) =

$$\frac{60 \text{ seconds}}{\text{minute}} * \frac{1 \text{ Inch}}{\text{User edges}} * \frac{100{,}000 \text{ edges}}{\text{second}}$$

For example: the control could command a cutting machine with 4000 edges per inch resolution at 1,500 IPM.

Limited Machine Speed
The Limited Speed feature allows for a user-defined maximum machine speed when the Limited Speed Input is active. This is commonly used to set a reduced machine speed for the purpose of increased safety when testing or maintenance of the machine is being performed.

High Jog Speed
Enter a value for the desired high manual motion speed.

Medium Jog Speed
Enter a value for the desired medium manual motion speed.

Low Jog Speed
Enter a value for the desired low manual motion speed.

Minimum Corner Speed
This is the minimum speed to use when negotiating corners. The control has sophisticated centripetal velocity and acceleration contouring algorithms, which should provide optimal cut quality for most cut operations. In some situations it may be desirable to enter a minimum corner speed to prevent over-burning at corners. In normal operations, this parameter should be set to zero.

Fast Home Speed
Enter the machine speed the control will use during the first phase of the homing sequence. During the first phase, the cutting device will move towards the home limit switches at the fast rate.

Slow Home Speed
Enter the machine speed the control will use during the second phase of the homing sequence. During the second phase, the cutting device will move off the home limit switch and proceed to the marker pulse. Upon detection of the marker pulse, the control will decelerate to a stop and perform a small move in the opposite direction to the marker pulse.

Creep Speed Percentage
The Creep Speed Percentage parameter allows the operator to select what percentage of the machine cut speed will be used when creeping. Generally, this is 25% of the cut speed.

Plasma Hi/Lo Speed Percentage
The Hi/Lo Speed specifies the percentage of the entered Cut Speed below which the control will activate the Torch Height Disable output. The plasma system may use this output to switch from low to high current or to disable the height control. **Note:** The Dual Grid/THC feature must first be enabled at the Plasma Setups Screen.

Plasma Distance To Corner
The Plasma Distance to Corner parameter specifies the distance to the corner at which the plasma system should switch from High current to low current and disable the Automated Height Sensor. Distance to Corner is active whenever the speed drops below the Plasma Hi/Lo Percentage, or segments intersect at an angle greater than the tangent angle. **Note:** The Dual Grid/THC feature must first be enabled at the Plasma Setups Screen.

Plasma Distance From Corner
The Plasma Distance from Corner parameter specifies the distance from the corner when exiting, at which the plasma system should enable the Automated Height Sensor. Distance from Corner is active whenever the speed drops below the Plasma Hi/Lo Percentage, or segments intersect at an angle greater than the tangent angle. **Note:** The Dual Grid/THC feature must first be enabled at the Plasma Setups Screen.

For additional details on how the Torch Height Disable feature of this control operates, please refer to the Cutting Section of this guide.

CBH Speed Setups (Shown only when enabled)

CBH Acceleration Rate
This parameter allows the operator to set the acceleration rate for smooth and stable movement of the contoured bevel head. The higher the acceleration rate the quicker the CBH will get up to speed. The lower the acceleration rate the smoother the machine will position the cutting device. Values are entered in Rev/ Sec^2.

Maximum CBH Speed
Enter the maximum speed for the CBH rotation in Rev/Min.

CBH High Jog / Home Speed
Enter a value for the desired manual CBH jog and fast Home speed.

CBH Low Jog / Home Speed
Enter a value for the desired CBH slow home speed.

THC Speed Setups (Shown only when enabled)

THC Acceleration Rate
This parameter allows the operator to set the acceleration rate for smooth and stable movement of the Sensor™ Torch Height Control. The higher the acceleration rate, the quicker the THC will get up to speed. The lower the acceleration rate, the smoother the machine will position the cutting device. Values are entered in milligees.

Maximum THC Speed
Enter the maximum speed for the Sensor™ THC movement in inches per minute.

THC Jog Speed
Enter a value for the desired THC jog speed.

THC Home/Fast IHS Speed
The THC Home/Fast IHS Speed entered here is used to home the torch at the top of the slide and to move the torch from the selected IHS height towards the plate, looking for the surface of the plate.

THC Slow IHS Speed
The THC IHS Speed is used to retract the torch after the plate has been sensed. The torch will retract at this speed until the contact sense is lost. This determines the exact distance to the plate regardless of any flexing of the plate. A very small speed is recommended for optimal accuracy.

Torch Height Disable Feature

The Torch Height Disable Feature is used to activate the Torch Height Disable output and “freeze” or disable the automatic adjustment of the Automated Torch Height Control system and prevent diving or crashing of the torch in corners. **Note:** The Dual Grid/THC feature must first be enabled in the Plasma Setups screen.

This output is activated by the control based on the values of Plasma Hi/Lo % of Cut Speed, Plasma Distance to Corner and Plasma Distance from Corner setup parameters. When any one of these conditions is met, the Torch Height Disable feature will be implemented. The definition of a corner is based on the tangent angle in the Special Password screen and the value of the Plasma Hi/Lo speed.

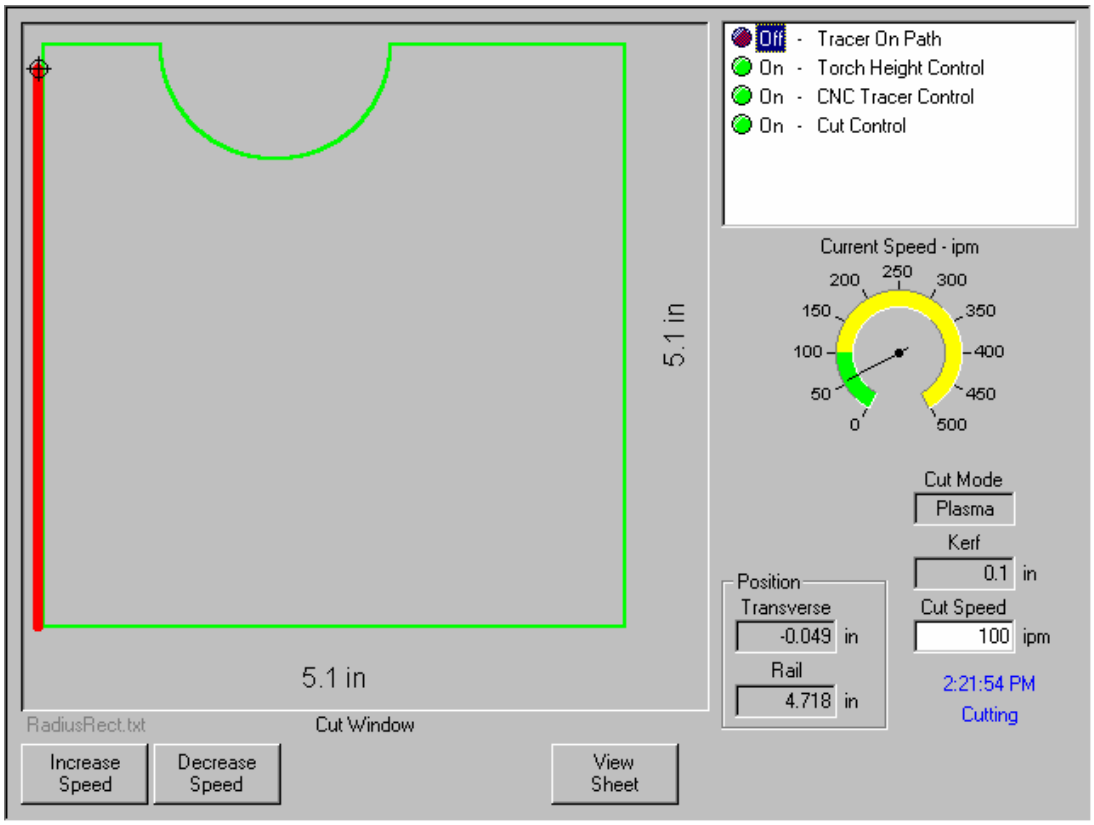
Tangent Angle
This parameter is used to set degree of the tangent angle for control motion. Segments within a part that intersect at angles greater than the selected tangent angle will decel to zero or minimum corner speed. Segments within a part that intersect at angles less than or equal to the selected tangent angle will not decel, unless the next segment is a speed limited arc.

Plasma Hi/Lo Speed Percentage
The Hi/Lo Speed specifies the percentage of the entered Cut Speed below which the control will activate the Torch Height Disable output. The plasma system may use this output to switch from low to high current or to disable the height control.

Plasma Distance To Corner
The Plasma Distance to Corner parameter specifies the distance to the corner at which the plasma system should switch from low current to high current or disable the Automated Height Sensor. Distance to Corner is active whenever the speed drops below the Plasma Hi/Lo Percentage, or segments intersect at an angle greater than the tangent angle.

Plasma Distance From Corner
The Plasma Distance from Corner parameter specifies the distance from the corner when exiting, at which the plasma system should enable the Automated Height Sensor. Distance from Corner is active whenever the speed drops below the Plasma Hi/Lo Percentage, or segments intersect at an angle greater than the tangent angle.

Example:
For the example illustrated below, the Torch Height Disable output will be activated based on the values of the setup parameters.



Plasma Hi/Lo Percentage Value	90%
Distance to Corner Value	.5 inches
Distance from Corner Value	.5 inches
Tangent Angle Value	20 Degrees

For the above listed values, the Torch Height Disable output is active .5 inches before and .5 inches after each 90 degree corner. The THD output is also activated as the torch accelerates away from the pierce and through the arc due to the speed being below the Plasma Hi/Lo value. Finally, because the arc intersects at greater than the 20 degree tangent angle, the THD output is activated for .5 inches before and after the beginning of the arc, and is activated for .5 inches before and after the end of the arc.

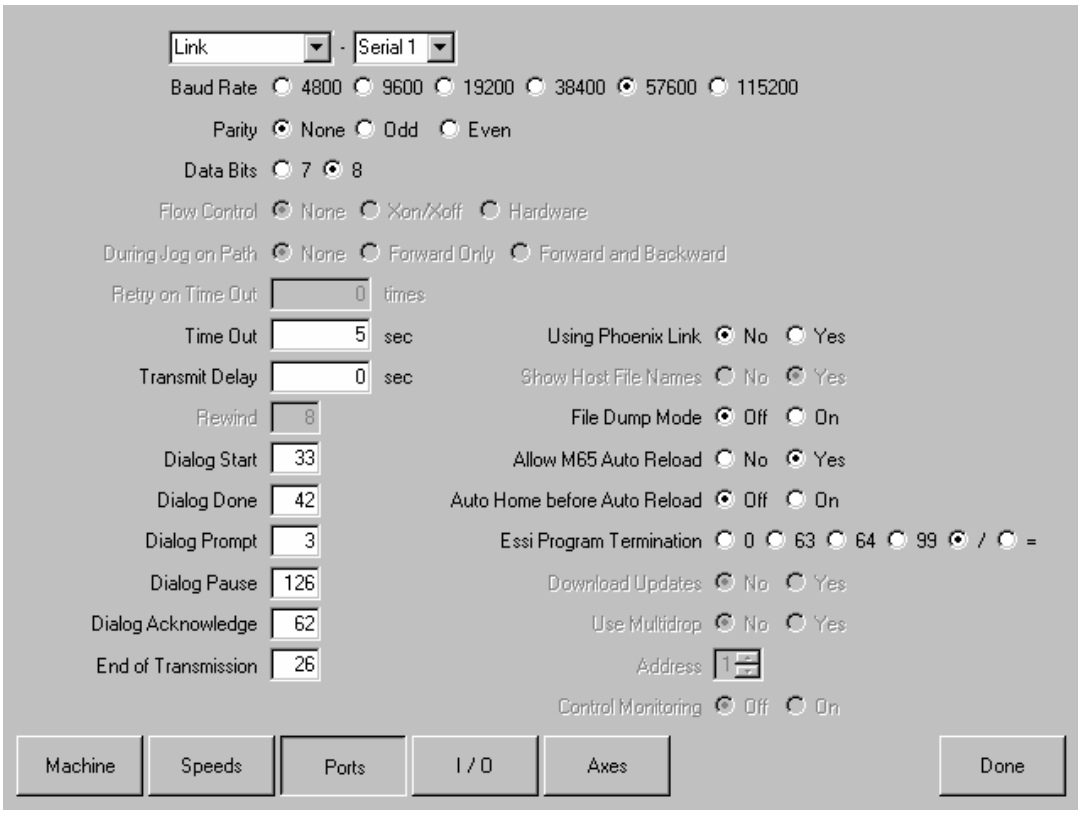
Ports

The control comes standard with two RS-232C serial ports, which may be converted to an RS-422 configuration. For more information on the how to change the serial ports to the RS-422 configuration, please refer to Serial Port Connections. This port has been specially design with opto-isolation and filtering to minimize EMI/RFI noise problems common in many cutting operations. Parameters are enabled and disabled depending on Port feature selections.

The control may be configured to use the communication link provided on the control or the user may enter information to create a custom communication link at the Link Screen to communicate with a host computer. Information on how to access the Phoenix Communication Link Software is provided later in this section.

Up to eight ports may be configured for use in software. Hardware provided with your control may support a smaller number of communication ports.

The following parameters are available to help configure the Serial Ports for your specific communications package and selected communication features.



Port Designation
This parameter allows the user to select which serial port will be configured for link use with the following remote communication settings. Select Link, Messaging, HD4070, FineLine or Command THC (type"V" controls).

Baud Rate
Allows selection of the desired baud rate for the remote Communications Link. The available Baud rates are shown. The control also incorporates a unique compression utility that allows the effective baud rate to be doubled. For example, for links configured to run at 9600 baud, the effective rate will be 19.2K Baud.

Note: For Serial Messaging communication speeds from 1200 Baud to 115200 Baud are available. See Serial Messaging in the Program Code section for more information.

Parity
Enter the desired parity for the remote Communications Link.

Data Bits
Enter the number of data bits the remote link is using. This value is **8** for the link software included with the control.

Time Out Delay
Enter the amount of time the control will wait prior to display communications error should it not be able to establish a link with a remote device.

Transmit Delay
Enter the amount of delay the control will insert between each character that is transmitted over the serial port. Some communications links require a small delay to avoid missing characters that have been sent to them. This parameter should normally be set to zero.

The following parameters allow the user to create a custom communication link on the control by entering the ASCII code equivalent to the character or symbol used by the host computer for dialog start.

For example: The ASCII Decimal Code 33 is equal to the **!** symbol

Rewind
This setup parameter is only enabled when Link File Dump Mode has been enable. Enter the ASCII code equivalent to the character or symbol used by the host computer for tape rewind at the host tape drive system. Enter the number zero to eliminate the rewind command.

Dialog Start
Enter the ASCII code equivalent to the character or symbol used by the host computer for dialog start.

Dialog Done
Enter the ASCII code equivalent to the character or symbol used by the host computer for dialog done.

Dialog Prompt
Enter the ASCII code equivalent to the character or symbol used by the host computer for dialog rompt.

Dialog Pause
Enter the ASCII code equivalent to the character or symbol used by the host computer for dialog pause.

Dialog Acknowledge
Enter the ASCII code equivalent to the character or symbol used by the host computer for dialog acknowledge.

End of Transmission
Enter the ASCII code equivalent to the character or symbol used by the host computer for dialog acknowledge.

Using Phoenix Link
If you are using the Phoenix Communication link program supplied on the control select Yes and the control will automatically enter the appropriate ASCII codes in to the communication link dialog parameters listed above.

Show Host File Names
The Show Host File Names feature allows the user to select whether or not File Names are shown at the Download from Host screen. This is a time saving feature for operators who have very large part folders at the host computer and know the exact file name of the part program to be loaded. The Using Phoenix Link parameter must be set to ON to enable this feature.

File Dump Mode
Select On to configure the link communication protocol to communicate with link programs which operate in File Dump Mode. This will allow the control to accept part programs as one long uninterrupted stream of information as with a tape reader style link.

Allow M65 Auto Reload
Available when a generic link communication has been enabled, this parameter allows the user to select whether the EIA M65 code will be used as an Auto-reload code or ignored.

Auto Home before Auto Reload
When enabled, this feature automatically “homes” the machine before the next Auto reload (EIA M65 code), either serial Link or from Diskette, is executed

ESSI Program Termination
This parameter allows the operator to tell the control which ESSI code (0,63, 64 99, / or =) is to be used as machine stop.

Download Updates
The Download Updates parameter allows the operator to download control software updates through the link communications to the host PC. To use this feature, the “Using Phoenix Link” parameter must be set to yes. The new update file would then be placed in the same folder location as the Link software. When the Update Software softkey is pressed at the Special Password screen, the control will search for the new software update via the link rather than the floppy drive.

Use Multi Drop
Selecting the Use Multi Drop feature will allow the control to be enabled to work with the Phoenix link software Multi Drop feature. The Multi Drop feature allows the Phoenix Link software to communicate with multiple controls to one communications port at the host PC. Up to eight controls may be supported with the Multi Drop feature.

Please note: The “Using Phoenix Link” parameter must be set to YES to enable this feature and specific hardware (serial communications board Rev C or higher) may be required to support this feature. Please contact your control supplier for more details.

Address
The Address Parameter defines the control identification address when using the Multi Drop communications feature. The Phoenix Link software uses this address at the Host PC to know which control it is communicating with.

Control Monitoring
When enabled, the Control Monitoring feature allows the user to view control status at the host PC. Status for File Name, position, cut mode and cut information is displayed. This feature is only available with the Phoenix Link communication software.

Please refer to the Phoenix Link information section of this guide for additional information on the Phoenix link.

The following additional parameters are available when Serial Messaging has been enabled. See Serial Messaging in the Program Code section of this guide for more information.

Flow control
Select to use None, Xon/Xoff or Hardware.

During Jog on Path
The user may select whether messages will be sent when jogging Forward or Backward on Path while at the Pause screen. Note: All messaging will stop when the Stop Key has been pressed or the Remote Pause input becomes active.

Note: The Message Type 21 will not be executed for “Backup on Path”.

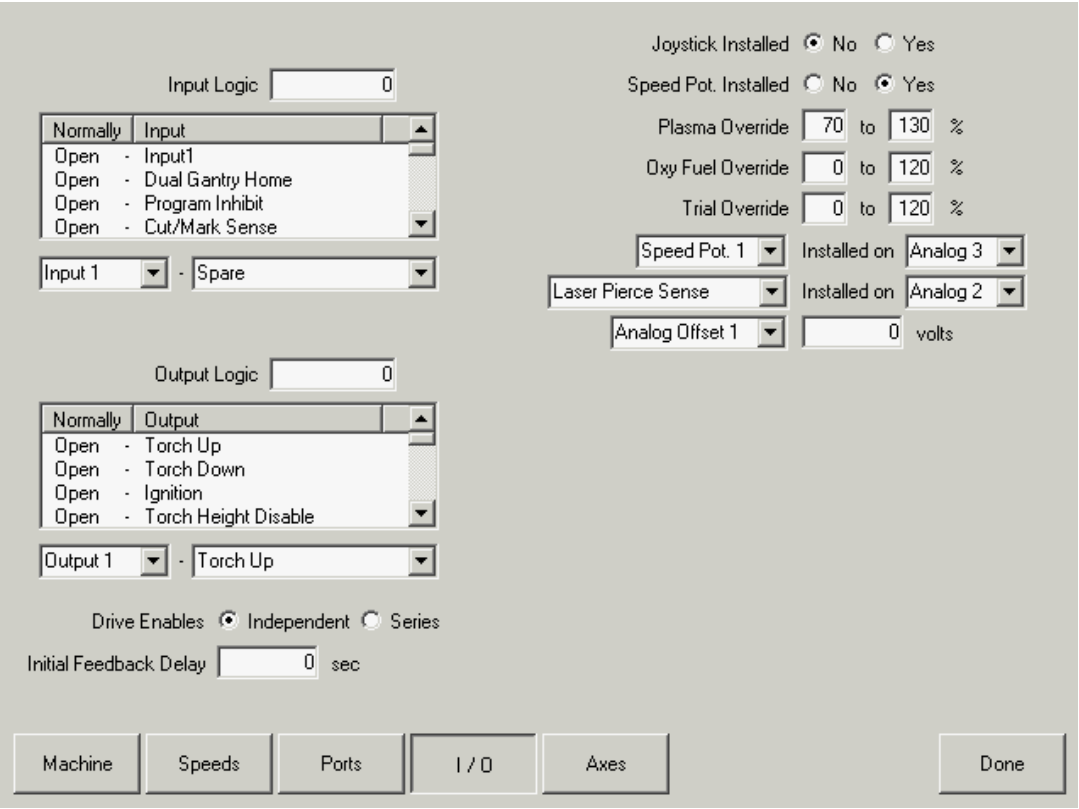
Retry on Time Out
For the Message Type 22 (which requires an acknowledgement from the external device after the message) an automatic retransmit of the message may be sent. The user may select the number of retries allowed before faulting from a lack of response from the external device. The fault prompt “Message Error” will be displayed when in a Time Out condition.

Time Out
The Time Out value may be used for the Message Type 22 (which requires an acknowledgement from the external device after the message) if there is no Time Out value used in the command string of the program code. Refer to the Delay Time / Time Out information for more information.

I/O

Pressing the I/O softkey allows the operator to configure the inputs and outputs for the shape cutting table.

I/O Configuration Type "M", "P" and "V"



Input Logic
The control comes standard with up to 32 discrete inputs. The Input Logic parameter is used as a mask to determine whether or not the input is to be treated as a normally open contact or normally closed contact. Entering a numerical value here will set all the Inputs to a predefined set of logic states for all of the inputs.

With Input Logic set to zero (0), an active input will be displayed as active or On (green lamp) in the input diagnostic screen.

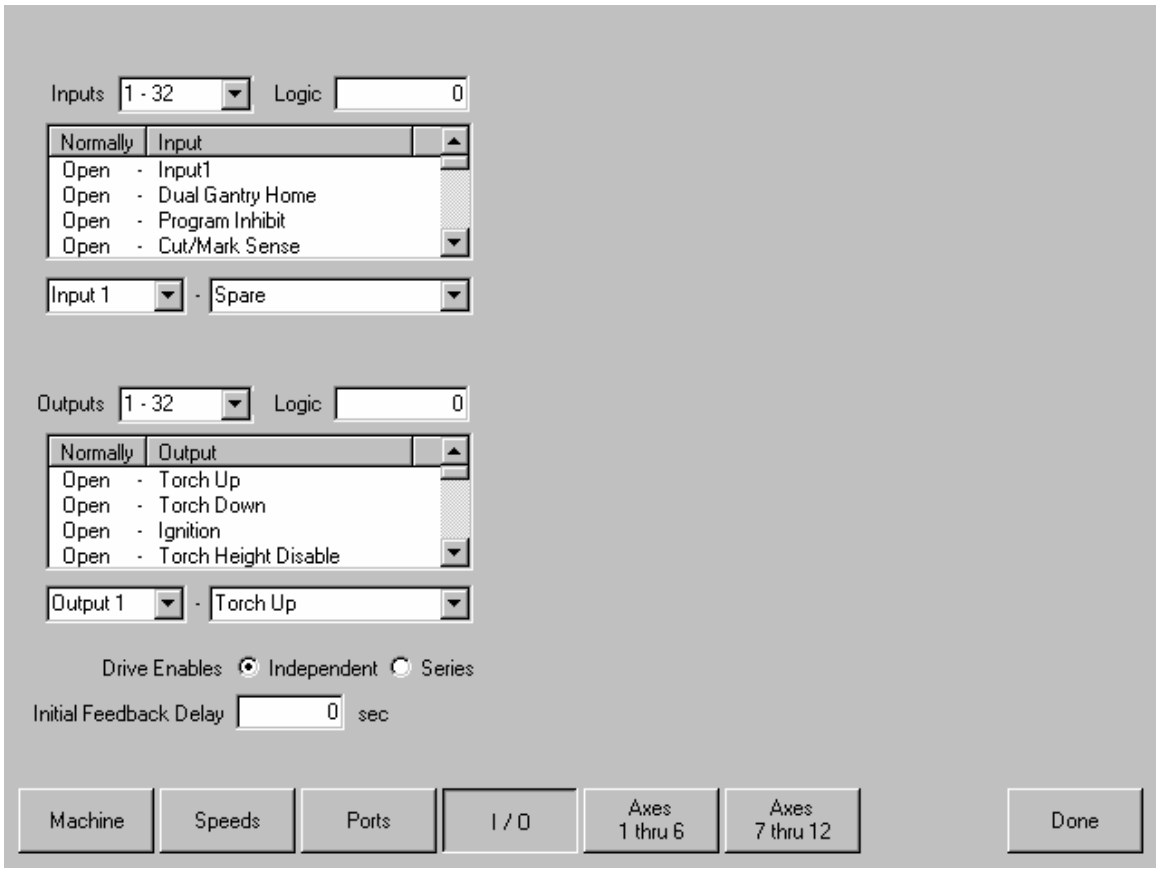
Logic Selection Box
The Logic Selection Box allows the user to select the Logic state for each input to be either normally open or normally closed. The Logic state for the inputs may be switched by selecting the desired input and pressing the space key.

Input Selection
The Input Selection box feature is used to define which inputs will be used by the control and their physical location on the control interface. All controls are shipped with the default selection of Inputs and interface locations for the selected control Interface (I/O) configuration.

Expanded I/O

When more than 64 I/O have been selected a pull down box will be available to assign I/O in the higher I/O ranges.

Note: When the optional USB Front Panel is used the top 128 I/O will be assigned to USB I/O to support the front panel



Input Definitions

Input	Description
Spare	Spare inputs are activated through the part program. If a Spare input is located in the part program, the control will pause the process until the input state is detected. The Spare inputs may be used by use of specific EIA “O” and “M” codes indicating the input number and function. Refer to Appendix A in the operator’s manual for a complete description of these commands.
Torch Up Sense	Confirmation signal indicating that the torch is in the full up position.
Torch Down Sense	Confirmation signal indicating that the torch is in the full down position.
Preheat Sense	Confirmation signal indicating that the Preheat Input from the torch is active.
Cut Sense	Activation of this input indicates that the plasma arc has transferred to the work piece. If the “Arc On Feedback” setup parameter is ON, then machine motion will begin at the activation of this input. Type “M” and “P” controls.
Tracer on Path	Tracer On Path is used with the Teach Trace feature and indicates that the tracing system has detected the template line.
Drive Disabled	If the Drive Disabled input is activated, the control will stop all motion and generate a fault message. Position information will be lost.
Remote Pause	A Remote Pause input, when activated, will stop all control motion and display the Pause screen. No motion will be allowed until this input is deactivated.
Remote Start	When a Remote Start input is detected, it will begin the selected program cycle as if the Start button on the control had been pressed.
Program Inhibit	The Program Inhibit input will force the control to command the motion output to a zero (0) speed. This is generally used as a dwell to pause motion during a tool change or as a pause from a PLC interface.
Raise/ Lower Torch	The type “V” control has the ability to operate multiple Sensor™ THCs which are commanded by the control, as separate axes. The Sensor™ THC Torch Raise and Torch Lower commands may be made through the software softkeys or through the use of these external inputs to the control.
Station Select Input	The type “V” control system has the ability to operate multiple Sensor™ THCs which are commanded by the control as separate axes. The control requires an input to indicate which Sensor™ THCs are active. Is Input is also used for tracking of consumable data for the specified Plasma or Oxy Torch. Station 1-8 are designated for Plasma and stations 9-20 are designated for Oxy Fuel.

X Home Switch	This input indicates that the machine has traveled to its X axis home position. If the X axis “Use Home Limit Switch” parameter is set to YES and a Homing function is performed, the X axis moves in the specified home direction at the Fast Home Speed until the input is activated. The X axis then decelerates to a stop and moves in the opposite direction at the Slow Home Speed until the switch is deactivated. Once the switch is deactivated, the X axis will either decel to a stop or continue on until the encoder marker pulse is detected, if the “Use Marker Pulse” parameter is set to YES.
Y Home Switch	This input indicates that the machine has traveled to its Y axis home position. If the Y axis “Use Home Limit Switch” parameter is set to YES and a Homing function is performed, the Y axis moves in the specified home direction at the Fast Home Speed until the input is activated. The Y axis then decelerates to a stop and moves in the opposite direction at the Slow Home Speed until the switch is deactivated. Once the switch is deactivated, the Y axis will either decel to a stop or continue on until the encoder marker pulse is detected, if the “Use Marker Pulse” parameter is set to YES.
Z Home Switch	Z Axis Home Limit Switch indicates that the machine has traveled to its Z axis home position. If the Z axis “Use Home Limit Switch” parameter is set to YES and a Homing function is performed, the Z axis moves in the specified home direction at the Fast Home Speed until the input is activated. The Z axis then decelerates to a stop and moves in the opposite direction at the Slow Home Speed until the switch is deactivated. Once the switch is deactivated, the Z axis will either decel to a stop or continue on until the encoder marker pulse is detected, if the “Use Marker Pulse” parameter is set to YES.
Y Overtravel Switch	This input indicates that the machine has traveled into its full positive travel of a Y axis. If the hardware overtravels are enabled and this input is activated, the control will stop all motion and generate a fault message. Motion will not be re-enabled until the switch is deactivated.
X Overtravel Switch	This input indicates that the machine has traveled into its full positive travel of a X axis. If the hardware overtravels are enabled and this input is activated, the control will stop all motion and generate a fault message. Motion will not be re-enabled until the switch is deactivated.
Limit Switch	This input indicates that the machine has traveled into its full positive travel of an axis. If the hardware overtravels are enabled and this input is activated, the control will stop all motion and generate a fault message. Motion will not be re-enabled until the switch is deactivated. (Type “M” configuration only)
Ready to Fire PS 1-4	Exclusive to the HD4070® multiple power supply configuration, the Ready to Fire Input is used to ensure that all HD4070® power supplies have completed each individual Initial Height Sense and are ready for use. The torch ignition is held off by the Hold Ignition Input to the power supply from the control.
Raise /Lower 4070 1-2	Exclusive to the HD4070® multiple power supply configuration, the Raise / Lower 4070 Torch Input is used as a manual raise/lower command to the selected HD4070® integrated THC through the control serial – power supply communication link.

X +Overtravel Switch	This input indicates that the machine has traveled into its full positive travel in the X axis. If the hardware overtravels are enabled and this input is activated, the control will stop all motion, generate a fault message and only allow manual motion in the X axis negative direction.
X -Overtravel Switch	This input indicates that the machine has traveled into its full negative travel in the X axis. If the hardware overtravels are enabled and this input is activated, the control will stop all motion, generate a fault message and only allow manual motion in the X axis positive direction.
Y +Overtravel Switch	This input indicates that the machine has traveled into its full positive travel in the Y axis. If the hardware overtravels are enabled and this input is activated, the control will stop all motion, generate a fault message and only allow manual motion in the Y axis negative direction.
Y -Overtravel Switch	This input indicates that the machine has traveled into its full negative travel in the Y axis. If the hardware overtravels are enabled and this input is activated, the control will stop all motion, generate a fault message and only allow manual motion in the Y axis positive direction.
Power Supply OK	This is an input used for the optional Automated Process Controller (APC). It is used to confirm a ready condition from the Plasma Power Supply before beginning the cut process.
Fast Stop	The Fast Stop input is used as an urgent stop input command to the control. When the Fast Stop input becomes active, the control will decelerate motion using a special Fast Stop Decel parameter, and forces the operator to the Pause Screen. One second after the input becomes active, the Drive Enable output from the control will turn off and disable motion. Position information and I/O points will be maintained while the input is active. This will allow the operator to recover the last position after the input has been cleared. *Note:* The Fast Stop Decel parameter is located on the password protected Speeds setup screen.
Torch Collision	The Torch collision input is used on torch systems with “break away” style mounts. In the event that a torch should make contact with the plate or any obstacle which causes the break away mount to release, an input for the mount would be tied back to the control indicating a torch collision has occurred. The operator will then be forced to the Pause screen. While the input is active, the Cut output will be turned off and manual motion will be enabled, allowing the operator to raise, lower and move the torch position to clear the fault. *Note:* Position information, motion command and I/O points are maintained, allowing the operator to return to the cut path and resume cutting. This feature uses the Fast Stop Deceleration rate. Manual raise inputs may be used.
Joystick (Direction)	The Joystick directional inputs (Up, Down, Left and Right) are used to command manual motion when using and external joystick.
Fume Extraction Sense	If selected, the Fume Extraction input is used to confirm that a external Fume Extraction system on the cutting table is operational prior to beginning the cut. An option to override is displayed if the input has not been satisfied at the time of the cut.

Cut/Mark Sense 1& 2	Cut/Mark Sense (arc on feedback) is used to verify that the plasma torch or marker tool has established the Arc for the selected process. This indicates to the control that motion can begin. (Type “V” controls).
THC Cut Sense	THC Cut Sense (arc on feedback) is used to verify that the plasma torch or marker tool has established the Arc for the selected Sensor™ THC . This indicates to the control that motion can begin. (Type “V” controls).
Plasma Select 1 & 2	The Plasma Select 1 & 2 are used to select which Plasma process logic will be used by the control. These inputs are generally run by external switches. (Type “V” controls).
Marker Select 1 & 2	The Marker Select 1 & 2 are used to select which Marker process logic will be used by the control. These inputs are generally run by external switches. (Type “V” controls).
Sensor THC Enable	The type “V” control system has the ability to operate multiple Sensor™ THCs which are commanded by the control, as separate axes. The control requires an input to indicate which Sensor™ THCs are active. This input is now supported by the Station Select input.
THC Homing to Limit	The THC Enable Input is used during Sensor™ THC Homing as the Current Limit input if the “Home to Hard Stop Current Limited” option is selected.
Nozzle Contact Sense	The Nozzle Contact Sense Input is used during Sensor™ THC Initial Height Sense to detect the location of the cut surface. This input is tied back to the control through the external Voltage Divider Card.
THC Homing to Switch	The Nozzle Contact Sense Input is used during Sensor™ THC Homing as the Home Switch input, if the “Home to Switch” option is selected.
THC Automatic	This input is used as an external input to switch the Sensor™ THC between Automatic and Manual operation.
Speed Limit Input	The Speed Limit Input is used to limit the machine speed for saftety during machine testing and maintenance. When active, motion will be limited to the user defined Limited Machine Speed selected in the password protected Speeds screen
Tilt +/– Overtravel Switch	This input indicates that the machine has traveled into its full positive travel in the Tilt axis. If the hardware overtravels are enabled and this input is activated, the control will stop all motion, generate a fault message and only allow manual motion in the Tilt axis opposite direction. The Tilt Overtravel Input is also used for Homing of the Tilt Axis.
Tilt +/–	Tilt +/- inputs are used for manual jog commands for the Tilt Axis.
Tilt Home Feature	This feature uses the Tilt Overtravel Switch input to indicate that the machine has traveled to its Tilt axis home position. When a Homing function is performed, the Tilt axis moves in the specified home direction at the Fast Home Speed until the input is activated. The Tilt axis then decelerates to a stop and moves in the opposite direction at

	the Slow Home Speed until the switch is deactivated. Also see Tilt Overtravel Switch
Rotate +/–	Rotate +/- inputs are used for manual jog commands for the Rotate Axis.
Rotate Home Switch	This input indicates that the machine has traveled to its Rotate axis home position. When a Homing function is performed, the Rotate axis moves in the specified home direction at the Fast Home Speed until the input is activated. The Rotate axis then decelerates to a stop, moves in the opposite direction at the Slow Home Speed until the switch is deactivated.
Pierce Complete	The Pierce Complete input is used for the Laser Cut Process and is used to confirm that the pierce is complete.
Gas Control Read Comp.	The Gas Control Read Complete input is used as part of the HD3070® Automatic Gas Console communications to confirm communications is complete.
Gas Control Error	The Gas Control Error input is used as part of the HD3070® Automatic Gas Console communications to notify of an error from the Auto Gas Console.
Enable Oxy Fuel 1-12	These inputs are used for tracking of consumable data for the specified Oxy Torch. This input is now supported by the Station Select input.
Enable Plasma 1-8	These inputs are used for tracking of consumable data for the specified Plasma Torch. This input is now supported by the Station Select input.
Arc Error Counter 1-8	Used as part of the tracking for consumable data, this input triggers a counter on the Change Consumable Screen. A Plasma Enable Input must be mapped to have this enable available for use.
Test Lifter	This Input is used to perform a test IHS function with a Sensor™ THC.

Output Logic
The control comes standard with up to 32 discrete outputs. The Output Logic parameter is used as a mask to determine whether or not the output is to be treated as a normally open contact or normally closed contact.

Logic Selection Box
The Logic Selection Box allows the user to select the Logic state for each input to be either normally open or normally closed. The logic state for the inputs may be switched by selecting the desired Output and pressing the space key.

Output Selection
The Output Selection box feature is used to define which inputs will be used by the control, and their physical location on the control interface. All controls are shipped with the default selection of Outputs and interface locations for the selected control Interface (I/O) configuration.

Output Definitions

Output	Description
Spare	Spare outputs are activated through the part program. If a Spare output is located in the part, the control will turn on the output as directed. The Spare outputs may be used by use of specific EIA "W" and "M" codes indicating the output number and function. Refer to Appendix A in the operator's manual for a complete description of these commands.
Torch Up	This output is used to raise the cutting torch. It is activated for the "Primary Torch Up Time" and the "Pierce Torch Up Time" in oxy fuel mode. It is activated for the "Torch Up Time" in plasma mode.
Torch Down	This output is used to lower the cutting torch. It is activated for the "Primary Torch Down Time" and the "Pierce Torch Down Time" in oxy fuel mode. It is activated for the "Torch Down Time" in plasma mode.
Ignition Control	This output is used to turn on the igniters in oxy fuel mode or ignite the plasma system in plasma mode.
Torch Height Disable /Dual Grid Control	This output is used to disable the automatic torch height controller in plasma mode. It is activated whenever the current axis position is within the "Plasma Distance To Corner" or the "Plasma Distance From Corner" parameters while cutting a part. It is also active whenever the current cutting speed drops below the result of (Programmed Cut Speed x (Plasma High/Lo Speed/100)). This Output is also used to reduce the plasma current in a switchable current plasma system when the machine speed is less than the Plasma Hi/Lo speed percentage.
Reduce Current	Used with the HD4070®, this output switches the plasma to low current mode.

CNC/Tracer	This output is used to control a CNC relay. The CNC relay determines whether the control, tracing system or joystick is commanding the amplifiers. This output is deactivated whenever the control is off, in Teach Trace mode or is disabled. Otherwise it is always activated.
Marker / Marker Enable	This output is used to activate an external marking device. It can only be activated by the appropriate “M” code in the part program. Refer to Appendix A in the operator’s manual for a complete description of appropriate “M” code commands.
Cut Control	This output is used to enable the cutting oxygen in oxy fuel mode or start the plasma system in plasma mode. This output can also be used to activate a marking device.
Low Preheat Control	The Low Preheat Control output is used to enable the low preheat gas when cutting in oxy fuel mode. It is activated for the “Low Preheat Time” when initiating a cut.
Preheat Control	This output is used to enable the high preheat gas when cutting in oxy fuel mode. It is activated for the “High Preheat Time” when initiating a cut.
Key Press Indicator	The Key Press Indicator output is activated whenever a key is pressed on the control.
Motion Indicator	The Motion Indicator output is activated whenever the control is commanding machine motion.
Plasma Select	The Plasma Select output is activated whenever the control is in the Plasma cutting mode.
Bleed Off Gas	The Bleed Off Gas Output is used by the Oxy fuel cut logic to send an output to the Oxy torch to purge gases at the end of a cut. This Output is on for the duration of the Bleed Off Time selected in setups.
Pierce Control	The Pierce Control Output is used by the Plasma and Oxy fuel cut logic to send an output to the torch during the pierce. This Output is on for the duration of the Pierce Time selected in setups.
Turn ON / Off Supply	The Turn ON OR Turn Off Supply Output is used by the Optional APC (Automated Process Controller) to turn On or Off the plasma supply through the control
N2 Select	The Turn On Supply Output is used by the Optional APC (Automated Process Controller) to enable the use of nitrogen while cutting.
Drive Enable	The Drive Enable Output is used to enable the Drives during normal functions and to disable the Drives during fault conditions.
Shutter Open	The Shutter Open Output is used exclusively with the Laser cut logic and is used to open the Laser Shutter for use.
Assist Gas	The Assist Gas Output is used exclusively with the Laser cut logic and is used to activate the Assist gas.

Digital Beam	The Digital Beam Output is used exclusively with the Laser cut logic and is used to activate the Digital Beam.
Laser Start	The Laser Start Output is used exclusively with the Laser cut logic and is used to activate the Laser System.
Abrasive Control	The Abrasive Control Output is used exclusively with Water Jet cut logic and activates the abrasive control adding abrasive to the cut stream while cutting or for charging the abrasive prior to cutting.
Plasma Enables	These outputs are used for external logic. The appropriate Output(s) is on during plasma cutting, based on the Plasma Select Inputs.
Marker Enables	These outputs are used for external logic. The appropriate Output(s) is on during marking, based on the Marker Select Inputs.
Nozzle Contact Enable	The Nozzle Contact Enable Output is active during Sensor™ THC Initial Height Sense. This input is tied back to the control through the external Voltage Divider Card. This output may also be used to switch an external drive system to low output mode (if equipped) during IHS for stall force plate sensing.
Hold Ignition	The Hold Ignition Output is part of the Sensor™ THC operation and used to hold ignition of the external Plasma Supply. This output may be tied back to the control through the external Voltage Divider Card or direct to the Power Supply depending on configuration.
Gas Flow Set 1 – 100	The Gas flow Set Output is used as part of the HD3070® Automatic Gas Console communications (BCD) to set Gas Flow rates.
Valve Select 1 – 8	The Valve Select Output is used as part of the HD3070® Automatic Gas Console communications to select the appropriate valves for operation.
Gas Control Write	The Gas Control Write Output is used as part of the HD3070® Automatic Gas Console communications to configure the unit for operation.
Remote Test Operate	The Remote Test Operate Output is used as part of the HD3070® Automatic Gas Console communications to Initiate the Remote Test.
Remote Test Preflow	The Remote Test Preflow Output is used as part of the HD3070® Automatic Gas Console communications to test operation of Preflow gases.
Remote Air Plasma	The Remote Air Plasma Output is used as part of the HD3070® Automatic Gas Console communications to signal the Air Plasma Output.
Remote H35/ N2 Plasma	The Remote H35/N2 Plasma Output is used as part of the HD3070® Automatic Gas Console communications to signal the H35/N2 Output.
Remote O2 Plasma	The Remote O2 Plasma Output is used as part of the HD3070® Automatic Gas Console communications to signal the O2 Output.

Change Consumable	This output becomes active when a consumable data value at the Change Consumable Screen has reached it's preset maximum. Generally, this output is tied to an external indicator light or audible alarm to prompt the system operator to change the appropriate consumable (torch tip / electrode). The affected consumable data must be reset at the Change Consumable Screen to clear the output.
Current Set BCD	The Current Set BCD outputs are used to set the current at the plasma power supply or marker supply for use. These outputs are tied to the BCD inputs. Combinations of the current values are used to attain the desired current set point.
Marker Control	The Marker Control Output is used to activate the Marker tool when in the Marking Process. Traditionally, the Marker tool is activated through the combination of Marker Enable and Cut Control Outputs. All the noted options are available and may be configured at the Marker Setup screen for the desired process timing and operational results.
Program Running	The Program Running Output is active any time the control is operating within a part program.
Station Enable 1-20	Station Select outputs are used to activate any function specific to a torch station and are controlled through M37T and M38T codes within a part program. Typically these are used to enable a torch station for use. Stations 1-8 are plasma and stations 9-20 are oxy fuel / other.
Station Lock 1-19	The Station Lock Outputs are used as part of the Automated Torch Spacing feature. The Station lock is used to Lock the unused torch station to the gantry or beam when not in use.
Station Clamp 1-19	The Station Clamp Outputs are used as part of the Automated Torch Spacing feature. The Station Clamp is used to Clamp the selected torch station to the transverse axis for standard cutting.
Station Mirror 1-19	The Station Clamp Outputs are used as part of the Automated Torch Spacing feature. The Station Clamp is used to Clamp the selected torch station to the transverse axis for mirrored cutting.

Drive Enables
This setup parameter allows the user to select how the control responds to drive faults. If the setting is Series, then all axes must complete their individual fault ramp times before the drives are disabled. If the setting is independent, each drive is disabled immediately as soon as its axis fault ramp time is finished.

Initial Feedback Delay
This feature allows the initial feedback from the Drive System to be held off after initial power up. This allows the Drive System to fully enable prior to enabling the position loop.

Joystick Installed
Select “Yes” to enable the optional external Joystick. Not available for all control types and optional control hardware required.

Speed Pot Installed
Select “Yes” to enable the optional external Speed Potentiometer. Not available for all control types and optional control hardware required.

Plasma Override %
The Plasma Override feature is used in conjunction with the Speed Pot feature to set the minimum and maximum range of adjustment of the plasma Speed Pot based on a percentage of the set cut speed. The Speed Pot feature must be enabled for use.

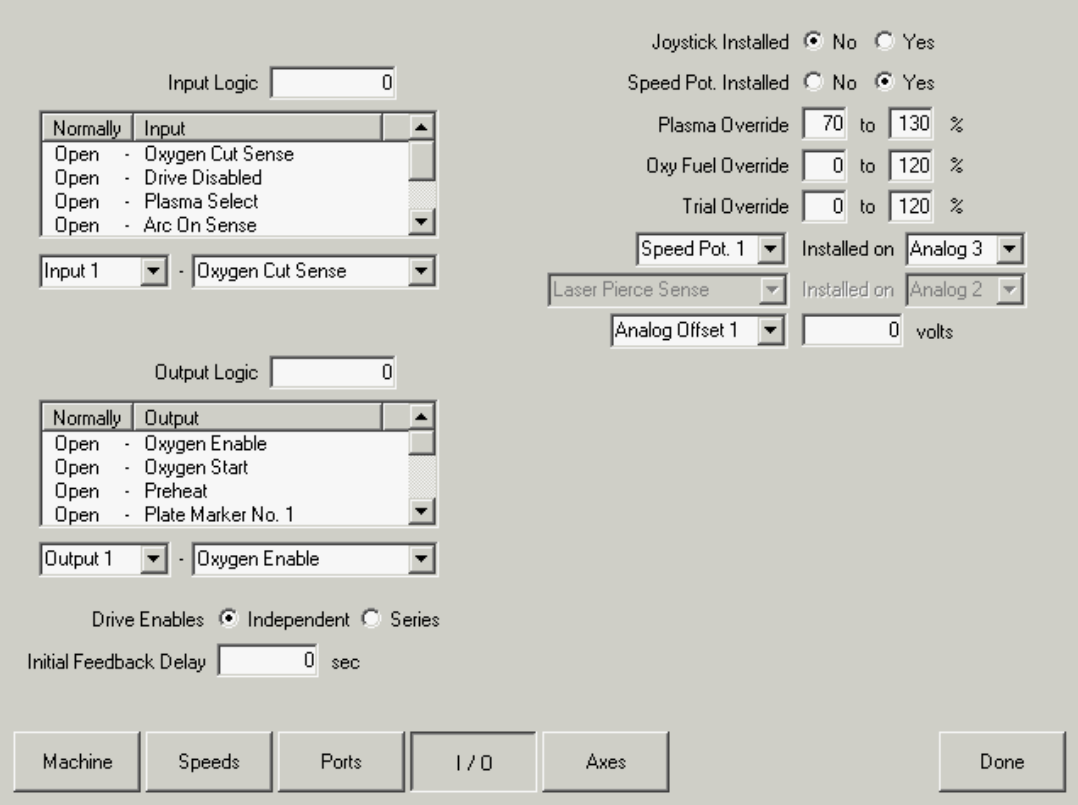
Oxy Fuel Override %
The Oxy Fuel Override feature is used in conjunction with the Speed Pot feature to set the minimum and maximum range of adjustment of the oxy fuel Speed Pot based on a percentage of the set cut speed. The Speed Pot feature must be enabled for use.

Trial Override %
The Trial Override feature is used in conjunction with the Speed Pot feature to set the minimum and maximum range of adjustment of the Trial Speed Pot based on a percentage of the set Trial speed. The Speed Pot feature must be enabled for use.

Speed Pot Installed On
The Speed Pot installed on Parameter is used to assign Speed Pot inputs to the desired Analog Input if a dedicated Speed Pot input is not available on the Analog input card being used.

Analog Offset 1- 12
The Analog Offsets 1 through 12 are used to correct for any imbalance or “Zero” the incoming analog voltage to the Analog Input Card.

I/O Configuration Type "B"



Input Logic
The control comes standard with five discrete inputs. The Input Logic parameter is used as a mask to determine whether or not the input is to be treated as a normally open contact or normally closed contact. Entering a numerical value here will set all the Inputs to a predefined set of logic states for all of the inputs.

With Input Logic set to zero (0), an active input will be displayed as active or On (green lamp) in the input diagnostic screen.

Logic Selection Box
The Logic Selection box allows the user to select the Logic state for each input to be either normally open or normally closed. The logic state for the inputs may be switched by selecting the desired input and pressing the space key.

Input Selection
The Input Selection box feature is used to define which inputs will be used by the control and their physical location on the control interface. All controls are shipped with the default selection of Inputs and interface locations for the selected control Interface (I/O) configuration.

Input Definitions

Input	Description
Spare	Spare inputs are activated through the part program. If a Spare input is located in the part, the control will pause the process until the input state is detected. The Spare inputs may be used by use of specific EIA "W" and "M" codes indicating the input number and function. Refer to Appendix A in the operator's manual for a complete description of these commands.
Oxygen Cut Sense	Activation of this input confirms that Cut Oxygen is on and that motion can begin after any selected preheat or pierce dwells are completed. Note: The control requires a transition on this input before it will command any motion along the cut path. If an Oxygen Cut Sense output is not available on the machine, the control's Oxygen Start output can be wired back into the Oxygen Cut Sense input.
Program Inhibit	The Program Inhibit input will force the control to command the motion output to a zero (0) speed. This is generally used as a dwell to pause motion during a tool change or as a pause from a PLC interface.
Plasma Select	If the Plasma Select input is on, the control will apply Plasma cut logic while cutting. If off, it will assume Oxy Fuel cutting is required and Oxy Fuel cut logic is applied when cutting. This is generally activated by use of an external switch to indicate Plasma mode.
Arc On Sense	Activation of this input indicates that the plasma arc has transferred to the work piece. If the "Arc On Feedback" setup parameter is On, then machine motion will begin at the activation of this input.
Drive Disabled	If the Drive Disabled input is activated, the control will stop all motion and generate a fault message. Position information will be lost.
Remote Pause	A Remote Pause input, when activated, will stop all control motion and display the Pause screen. No motion will be allowed until this input is deactivated.
Limit Switch	This input indicates that the machine has traveled into its full positive travel of an axis. If the hardware overtravels are enabled and this input is activated, the control will stop all motion and generate a fault message. Motion will not be re-enabled until the switch is deactivated. (Type "M" configuration only)
Remote Start	When a Remote Start input is detected, it will begin the selected program cycle as if the Start button on the control had been pressed.
Fast Stop	The Fast Stop input is used as an urgent stop input command to the control. When the Fast Stop input becomes active the control will decelerate motion, using a special Fast Stop Decel parameter, and forces the operator to the Pause Screen. One second after the input becomes active, the Drive Enable output from the control will turn off and disable motion. Position information and I/O points will be maintained while the input is active. This will allow the operator to recover the last

	position after the input has been cleared. *Note:* The Fast Stop Decel parameter is located on the password protected Speeds setup screen.
Torch Collision	The Torch collision input is used on torch systems with “break away” style mounts. In the event that a torch should make contact with the plate or any obstacle which causes the break away mount to release, an input for the mount would be tied back to the control indicating a torch collision has occurred. The operator will then be forced to the Pause Screen. While the input is active, the Cut output will be turned off and manual motion will be enabled allowing the operator to raise, lower and move the torch position to clear the fault. *Note:* Position information, motion command and I/O points are maintained allowing the operator to return to the cut path and resume cutting.

Output Logic
The control comes standard with eight discrete outputs. The Output Logic parameter is used as a mask to determine whether or not the output is to be treated as a normally open contact or normally closed contact.

Logic Selection Box
The Logic Selection box allows the user to select the Logic state for each input to be either normally open or normally closed. The logic state for the inputs may be switched by selecting the desired Output and pressing the space key.

Output Selection
The Output Selection box feature is used to define which inputs will be used by the control and their physical location on the control interface. All controls are shipped with the default selection of Outputs and interface locations for the selected control Interface (I/O) configuration.

Output Definitions

Output	Description
Spare	Spare outputs are activated through the part program. If a Spare output is located in the part, the control will turn on the out put as directed. The Spare outputs may be used by use of specific EIA “O” and “M” codes indicating the output number and function. Refer to Appendix A in the operator’s manual for a complete description of these commands.
Oxygen Enable	The Oxygen Enable Output is used to enable the oxygen circuit prior to the Oxygen Start Output to begin the cut.
Oxygen Start	This output is used to enable the cutting oxygen in oxy fuel mode This output can also be used to activate a marking device.
Preheat	This output is used to enable the high preheat gas when cutting in oxy fuel mode. It is activated for the “High Preheat Time” when initiating a cut.
Plasma Enable	The Plasma Enable Output is used to enable the oxygen circuit prior to the Plasma Start Output to begin the cut.

Plasma Start	This output is used to start the plasma system in plasma mode.
Plasma Height Disable	This output is used to disable the automatic torch height controller in plasma mode. It is activated whenever the current axis position is within the “Plasma Distance To Corner” or the “Plasma Distance From Corner” parameters while cutting a part. It is also active whenever the current cutting speed drops below the result of (Programmed Cut Speed x (Plasma High/Lo Speed/100)).
Plate Marker No. 1	This output is used to activate a marking device. This output is enabled by marking codes within the part program.
Plate Marker No. 2	This output is used to activate a marking device. This output is enabled by marking codes within the part program.
CNC Tracer	This output is used to control a CNC relay. The CNC relay determines whether the control, tracing system or joystick is commanding the amplifiers. This output is deactivated whenever the control is off, in Teach Trace mode or is disabled. Otherwise it is always activated.
Bleed Off Gas	The Bleed Off Gas output is used by the Oxy fuel cut logic to send an output to the Oxy torch to purge gases at the end of a cut. This Output is on for the duration of the Bleed Off Time selected in setups.
Aux Tool Select	The Auxiliary Tool Select Output is used with the type “B” I/O configuration to allow the control to activate multiple tools on the cutting table. The output is activated through use of Marking codes (EIA M10 / M11) within the part program.
Drive Enable	The Drive Enable Output is used to enable the Drives during normal functions and to disable the Drives during fault conditions.

Drive Enables
This setup parameter allows the user to select how the control responds to drive faults. If the setting is Series, then all axes must complete their individual fault ramp times before the drives are disabled. If the setting is independent, each drive is disabled immediately as soon as its axis fault ramp time is finished.

Initial Feedback Delay
This feature allows the initial feedback from the Drive System to be held off after initial power up. This allows the Drive System to fully enable prior to enabling the position loop.

Joystick Installed
Select “Yes” to enable the optional external Joystick. Not available for all control types and optional control hardware required.

Speed Pot Installed
Select “Yes” to enable the optional external Speed Potentiometer. Not available for all control types and optional control hardware required.

Plasma Override %
The Plasma Override feature is used in conjunction with the Speed Pot feature to set the minimum and maximum range of adjustment of the plasma Speed Pot based on a percentage of the set cut speed. The Speed Pot feature must be enabled for use.

Oxy Fuel Override %
The Oxy Fuel Override feature is used in conjunction with the Speed Pot feature to set the minimum and maximum range of adjustment of the oxy fuel Speed Pot based on a percentage of the set cut speed. The Speed Pot feature must be enabled for use.

Trial Override %
The Trial Override feature is used in conjunction with the Speed Pot feature to set the minimum and maximum range of adjustment of the Trial Speed Pot based on a percentage of the set Trial speed. The Speed Pot feature must be enabled for use.

Speed Pot Installed On
The Speed Pot installed on Parameter is used to assign Speed Pot inputs to a desired the Analog Input if a dedicated Speed Pot input is not available on the Analog input card being used.

Analog Offset 1- 12
The Analog Offsets 1 through 12 are used to correct for any imbalance or “Zero” the incoming analog voltage to the Analog Input Card.

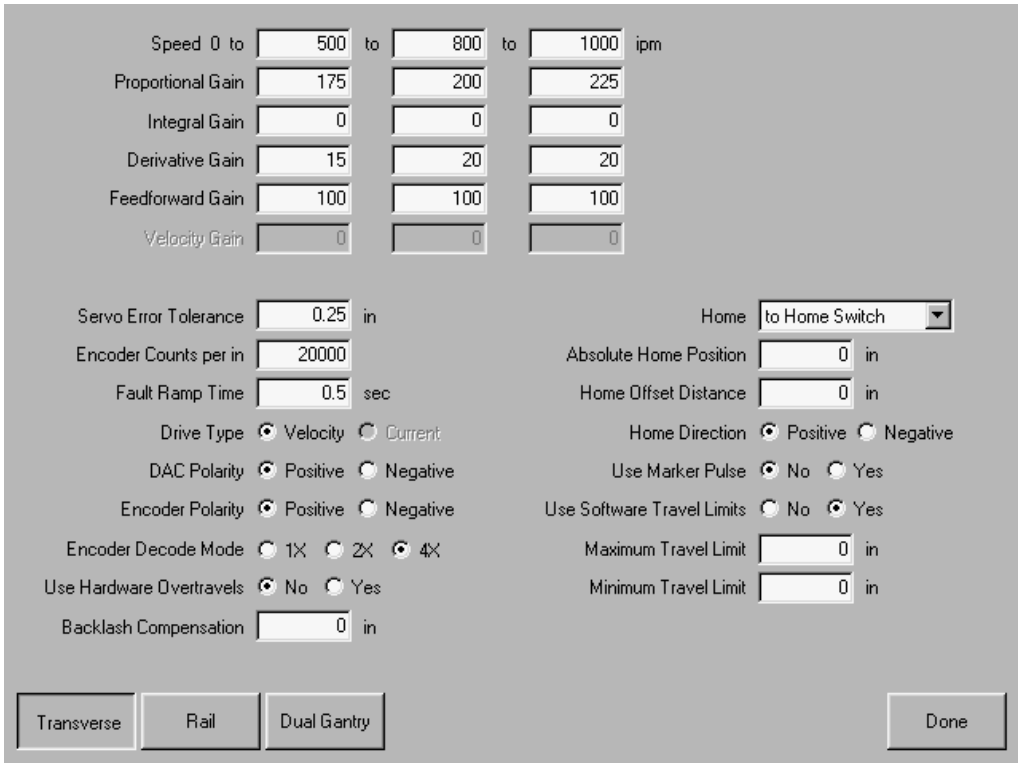
To calibrate the Analog Inputs, jumper the two pins specific to the input together and view the incoming voltage at the Diagnostics Analog I/O screen. The incoming voltage should be zero. If any voltage is displayed at the diagnostic screen, an Offset Voltage equal to the incoming voltage being read can be entered here to “Zero” the incoming voltage. Please refer to the installation instructions later in this section for more details.

Axes

Transverse/Rail

The following screen is identical for both the traverse and rail setup screens.

The control comes with both an advanced position and velocity servo loop. The following parameters are available to help configure the servo loops for your specific drive and mechanical system.



Speed 0 To
This parameter allows the technician to input selected speed ranges to customize the gains for the various speeds selected. ***Note:*** These speed parameters are directly tied to the Speed To field for the acceleration rates previously noted on the Speeds setup screen. Changing these speed parameters will replace the Speed To values entered at the Speeds setup screen.

Proportional Gain
Proportional Gain correlates to Elastic Stiffness in the control loop. Increasing the proportional gain increases the static stiffness, but decreases response of the servo loop.

Under proportional loop control, the drive system will apply a restoring torque to the motor in proportion the position error of the axis.

With a Proportional Gain too high, the system will be unstable which will result in overshoots, and a generally “nervous” and shaky axis. This is also referred to as a “hot” control loop.
With a proportional gain too low, the system will respond in a loose or sloppy manner. This can be seen in the test pattern when the outside corners become rounded and the circle segments do not all meet in the center.

Integral Gain
Integral Gain improves the positioning accuracy of the control loop. Integral Gain can be used to compensate for static friction or gravity. Excessive Integral Gain can result in system instability.

For most shape cutting machines, this parameter should be set to Zero (0).

Derivative Gain
Derivative Gain helps to dampen out sudden changes in velocity. The higher the derivative gain, the slower the response time to the control loop. For most velocity loop drives, this parameter will be set to Zero (0).

Feedforward Gain
Feedforward Gain can be used to drive the following error to zero during machine motion. In all digital control loops there is a finite amount of error that is introduced by the velocity command. Increasing Feedforward Gain can reduce this introduced error.

Velocity Gain
When using a current loop amplifier, the internal velocity loop in the control can be used to provide dampening without an external tachometer.

Using the internal velocity loop with a current loop amplifier can result in higher static stiffness, smoother machine motion, and less overshoot.

Servo Error Tolerance
Allows the user to program the amount of servo loop Following Error to be allowed prior to display an error message. The parameter is limited to a maximum value of five inches.

Encoder Counts per inch
Enter a value that is the number of encoder edges per inch of machine travel. It is possible to enter fractional encoder units and the control will keep track of these fractions automatically. Encoder Counts per inch are equal to the resolution of the encoder, multiplied by the encoder revolutions per inch or mm (based on the machine drive gearing).

For example: The resolution of a 4X - 1000 line encoder counts both edges (lines) of channel A and channel B to equal 4 counts per line multiplied by the 1000 lines per revolution would equal 4000 counts per revolution. If the encoder revolutions per inch to travel are 1:1, we would have 4000 encoder counts per inch of travel.

Encoder Counts/ Inch = 4 Counts/ Line x 1000 Lines/ Rev x 1 Rev/ Inch = 4000

Fault Ramp Time
This parameter sets the motion deceleration time after a fault occurs. At the end of “Fault Ramp Time, The drives will be disabled.

Drive Type
This parameter is used to tell the control what type of control loop to run. If you are running an external velocity loop drive (indicated by having an integrated tachometer in the motor), select Velocity. If you are running in torque mode (no tachometer), select Current.

DAC Polarity
This parameter allows changing of the analog output polarity to establish proper control loop feedback without any wiring changes.

Encoder Polarity
This parameter allows changing of the encoder input polarity to establish proper counting for positive machine motion without any wiring changes.

Encoder Decode Mode
Currently, the control only supports 4X encoder decode mode. This has been done to increase positional accuracy.

Use Hardware Overtravels
Select whether or not the cutting machine will be using Hardware Overtravels. If Hardware Overtravels are used, the control will disable feedback and display an error message if the inputs become active. It is recommended that Hardware Overtravels be installed.

Backlash Compensation
The Backlash Compensation parameter is used to offset or compensate for any backlash in the mechanics of the drive system.

Home
The Home parameter is used to activate use of the Home feature. Depending on control I/O configuration, the table may be Homed to either a designated Home Switch or an Overtravel Switch.

The Home feature is used to set a known absolute physical position location on the cutting table that is used for referencing future manual "Go to Home" and other motion commands. This is generally performed through activation of a home switch positioned on the appropriate axis giving it a known physical location.

When the Homing command is entered at the control, the control will move the axis towards the Home Switches at the Fast Home Speed until the switches have been activated. Once the switches have been activated, motion stops and then the axis moves in the opposite direction off switch at the Slow Home Speed. The moment that the switch is deactivated, the position is recorded at the control, providing an absolute reference point for future motion commands.

Absolute Home Position
Defines the position of the axis when the Home Limit Switch or Marker Pulse is detected.

Home Offset Distance
Allows the user to set an offset distance from the Home Limit Switch.

Home Switch Normally
If a Home Limit Switch is used, the user is prompted for switch polarity.

Home Direction
Determines which direction the axes will travel during phase one of the homing sequence.

Use Marker Pulse
When enabled, the absolute home position will be assigned at the instant the marker pulse is detected. It is recommended that the Marker Pulse be used for optimal homing repeatability.

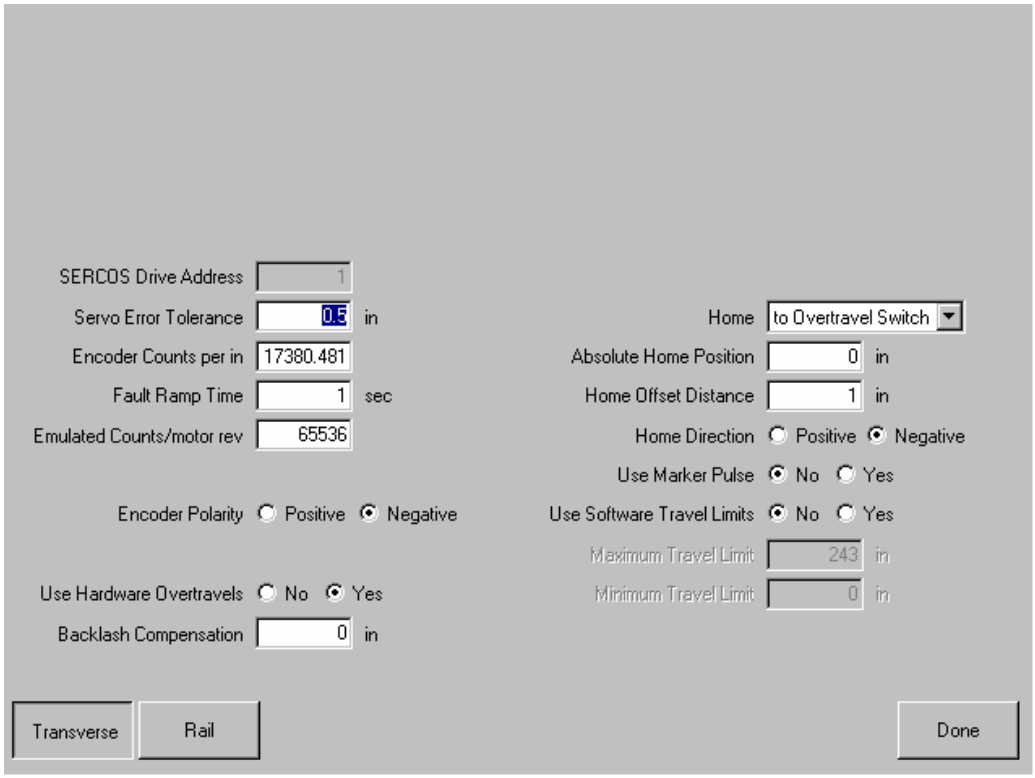
Use Software Travel Limits
The control is capable of running with software Overtravel limit switches. These switches act just like the hardware switches, but require no additional hardware.

Software Overtravels are only practical in cutting machines when Absolute RS-274D programming is used.

Maximum Travel Limit
If Software Overtravels are enabled, the user is prompted for the maximum travel of the cutting machine.

Minimum Travel Limit
If Software Overtravels are enabled, the user is prompted for the minimum travel of the cutting machine.

SERCOS AXES
The SERCOS Interface™ controls the position loop from the amplifier. As a result, limited information for motion is required in the control setups. Tuning is performed through serial port diagnostic software available at the Drives & Motors Diagnostic screen.



The following is a listing of the unique SERCOS parameters. Note: parameters will apply to all SERCOS axes.

SERCOS Drive Address
Each Drive Axes is automatically assigned a Drive Address at the CNC. The appropriate drive amplifier will be coded with the matching Drive Address to provide control motion to the correct amplifier / motor on the SERCOS ring. Note: The drives may be physically located in any order on the ring.

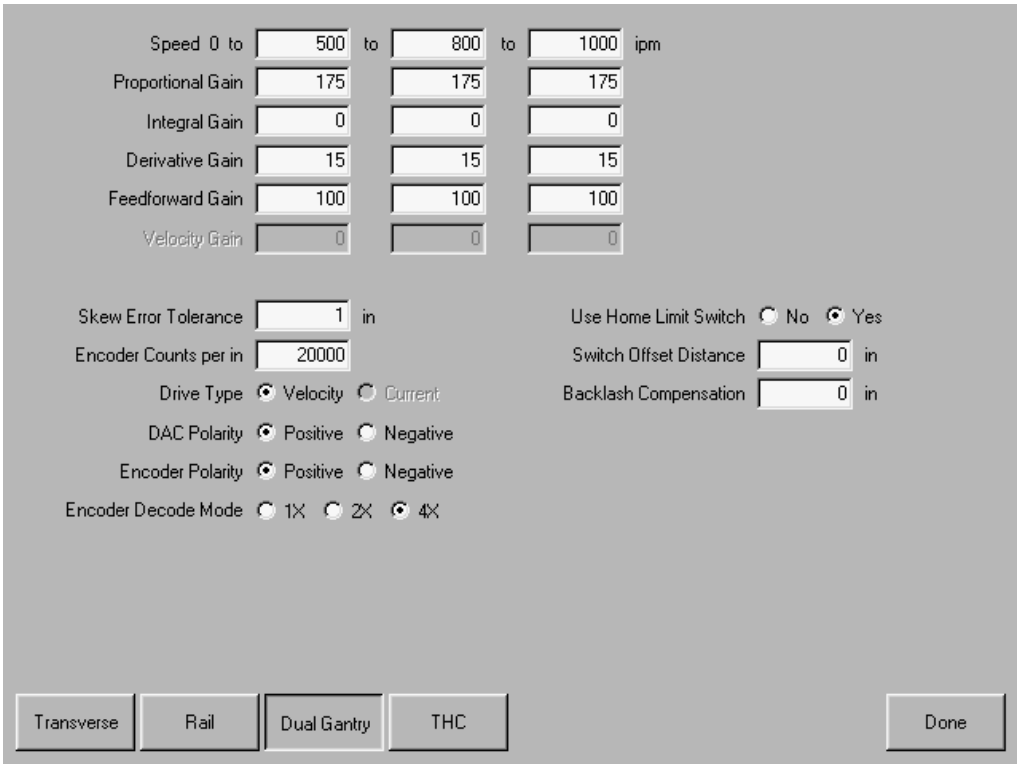
Emulated Encoder Counts/ motor rev
This parameter allows the user to adjust the number of counts per motor rev that the drive generates over the SERCOS ring, to adjust resolution. This parameter is available for Pac Sci drives only. Other drive types allow the emulated Counts /motor rev parameter to be set up in the drive tuning software.

Dual Gantry

The following setup screen is available if the control is configured for a Dual Gantry Axis.

The Dual Gantry Axis is commanded as a separate axis on the control that mirrors the output of the main Rail Axis. Additionally, performance of the Dual Gantry Axis is compared to the main Rail Axis and additional output command is given to keep the axis in position.

The definitions for the setup parameters are the same as for the Transverse/Rail Axes. However, the number of selections are reduced as features for overtravels and homing do not apply.



Speed 0 To
This parameter allows the technician to input selected speed ranges to customize the gains for the various speeds selected. ***Note:*** These speed parameters are directly tied to the Speed To field for the acceleration rates previously noted on the Speeds setup screen. Changing these speed parameters will replace the Speed To values entered at the Speeds setup screen.

Proportional Gain
Proportional Gain correlates to Elastic Stiffness in the control loop. Increasing the proportional gain increases the static stiffness, but decreases response of the servo loop.

Under proportional loop control the drive system will apply a restoring torque to the motor in proportion the position error of the axis.

With a Proportional Gain too high, the system will be unstable which will result in overshoots, and a generally “nervous” and shaky axis. This is also referred to as a “hot” control loop.

With a proportional gain too low, the system will respond in a loose or sloppy manner. This can be seen in the test pattern when the outside corners become rounded and the circle segments do not all meet in the center.

Integral Gain
Integral Gain improves the positioning accuracy of the control loop. Integral gain can be used to compensate for static friction or gravity. Excessive Integral Gain can result in system instability.

For most shape cutting machines this parameter should be set to zero (0).

Derivative Gain
Derivative Gain helps to dampen out sudden changes in velocity. The higher the derivative gain, the slower the response time to the control loop.

For most velocity loop drives this parameter will be set to zero (0).

Feedforward Gain
Feedforward Gain can be used to drive the following error to zero during machine motion. In all digital control loops there is a finite amount of error that is introduced by the velocity command. Increasing Feedforward Gain can reduce this introduced error.

Velocity Gain
When using a current loop amplifier, the internal velocity loop in the control can be used to provide dampening without an external tachometer.

Using the internal velocity loop with a current loop amplifier can result in higher static stiffness, smoother machine motion, and less overshoot.

Skew Error Tolerance
If the Dual Gantry Axis is installed, the user will be prompted for Skew Error Tolerance. This is the amount of position error allowed between the master and slave gantry drive axes prior to an error message being displayed.

Encoder Counts per inch
Enter a value that is the number of encoder edges per inch of machine travel. It is possible to enter fractional encoder units and the control will keep track of these fractions automatically. Encoder Counts per inch are equal to the resolution of the encoder, multiplied by the encoder revolutions per inch (based on the machine drive gearing).

For example: The Resolution of a 4X - 1000 line encoder counts both edges (lines) of channel A and channel B to equal 4 counts per line multiplied by the 1000 lines per revolution would equal 4000 counts per revolution. If the encoder revolutions per inch to travel is 1:1, we would have 4000 encoder counts per inch of travel.

Encoder Counts/Inch = 4 Counts/Line x 1000 Lines/Rev x 1 Rev/Inch = 4000

Drive Type
This parameter is used to tell the control what type of control loop to run. If you are running an external velocity loop drive (indicated by having an integrated tachometer in the motor), select Velocity. If you are running in torque mode (no tachometer), select Current.

DAC Polarity
This parameter allows changing of the analog output polarity to establish proper control loop feedback without any wiring changes.

Encoder Polarity
This parameter allows changing of the encoder input polarity to establish proper counting for positive machine motion without any wiring changes.

Encoder Decode Mode
Currently the control only supports 4X encoder decode mode. This has been done to increase positional accuracy.

Use Home Limit Switch
Selecting “Yes” will enable the Home feature for the Dual Gantry Axis. Note: The Z Home Switch must first be defined and mapped to an input location in the I/O screen to enable this feature.

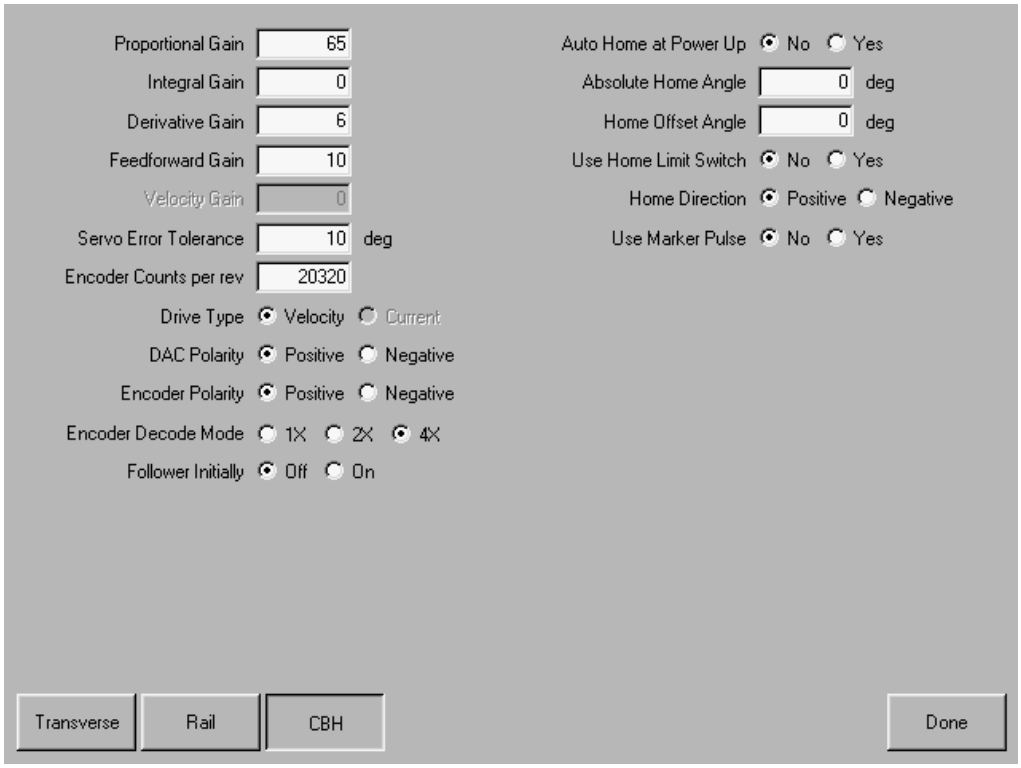
Switch Offset Distance
The Switch Offset Distance is used to specify any physical position offset between the Dual Gantry and Rail Home Switch positions. This allows the control to very accurately position the two axes for operation and remove any skew of the gantry.

Backlash Compensation
The Backlash Compensation parameter is used to offset or compensate for any backlash in the mechanics of the drive system.

CBH

The following setup screen is available if the control is configured for a Contour Bevel Head.

The definitions for the setup parameters are the same as for the Transverse/Rail Axes, with the exception of Absolute Home Angle and Home Offset Angle. These two setup parameters serve the same basic function as previously described but are measured in degrees of rotation rather than inches or millimeters. However, the number of selections are reduced as these parameters are not used with a Contour Bevel Head.



Proportional Gain
Proportional Gain correlates to Elastic Stiffness in the control loop. Increasing the proportional gain increases the static stiffness, but decreases response of the servo loop.

Under proportional loop control, the drive system will apply a restoring torque to the motor in proportion the position error of the axis.

With a Proportional Gain too high, the system will be unstable which will result in overshoots and a generally “nervous” and shaky axis. This is also referred to as a “hot” control loop.

With a proportional gain too low, the system will respond in a loose or sloppy manner. This can be seen in the test pattern when the outside corners become rounded and the circle segments do not all meet in the center.

Integral Gain
Integral Gain improves the positioning accuracy of the control loop. Integral Gain can be used to compensate for static friction or gravity. Excessive Integral Gain can result in system instability.

For most shape cutting machines, this parameter should be set to zero (0).

Derivative Gain
Derivative Gain helps to dampen out sudden changes in velocity. The higher the Derivative Gain, the slower the response time to the control loop.

For most velocity loop drives, this parameter will be set to zero (0).

Feedforward Gain
Feedforward Gain can be used to drive the following error to zero during machine motion. In all digital control loops there is a finite amount of error that is introduced by the velocity command. Increasing Feedforward Gain can reduce this introduced error.

Velocity Gain
When using a current loop amplifier, the internal velocity loop in the control can be used to provide dampening without an external tachometer.

Using the internal velocity loop with a current loop amplifier can result in higher static stiffness, smoother machine motion, and less overshoot.

Servo Error Tolerance
Allows the user to program the amount of servo loop Following Error to be allowed prior to display an error message. The parameter is limited to a maximum value of 90 degrees.

Encoder Counts per rev
Enter a value that is the number of encoder edges per revolution of the Contour Bevel Head axis. It is possible to enter fractional encoder units and the control will keep track of these fractions automatically. Encoder Counts per rev are equal to the resolution of the encoder multiplied by the encoder revolutions per rev.

For example: The Resolution of a 4X - 1000 line encoder counts both edges (lines) of channel A and channel B to equal 4 counts per line time multiplied by the 1000 lines per revolution would equal 4000 counts per revolution.

Encoder Counts/Rev = 4 Counts/Line x 1000 Lines/Rev = 4000

Drive Type
This parameter is used to tell the control what type of control loop to run. If you are running an external velocity loop drive (indicated by having an integrated tachometer in the motor), select Velocity. If you are running in torque mode (no tachometer), select Current.

DAC Polarity
This parameter allows changing of the analog output polarity to establish proper control loop feedback without any wiring changes.

Encoder Polarity
This parameter allows changing of the encoder input polarity to establish proper counting for positive machine motion without any wiring changes.

Encoder Decode Mode
Currently the control only supports 4X encoder decode mode. This has been done to increase positional accuracy.

Follower Initially
This parameter is used to determine if the CBH axis will be On when the control is first powered up.

Auto Home At Power Up
Determines if the Contour Bevel Head will automatically go into the homing routine upon powering up the control.

Absolute Home Angle
Defines the position of the axis when the home limit switch or marker pulse is detected.

Home Offset Angle
Allows the user to set an offset angle from the home limit switch.

Use Home Limit Switch
Tells the control to look for a home limit switch during phase one of the homing sequence.

Home Direction
Determines which direction the axes will travel during phase one of the homing sequence.

Use Marker Pulse
When enabled, the absolute home position will be assigned at the instant the marker pulse is detected. It is recommended that the marker pulse be used for optimal homing repeatability.

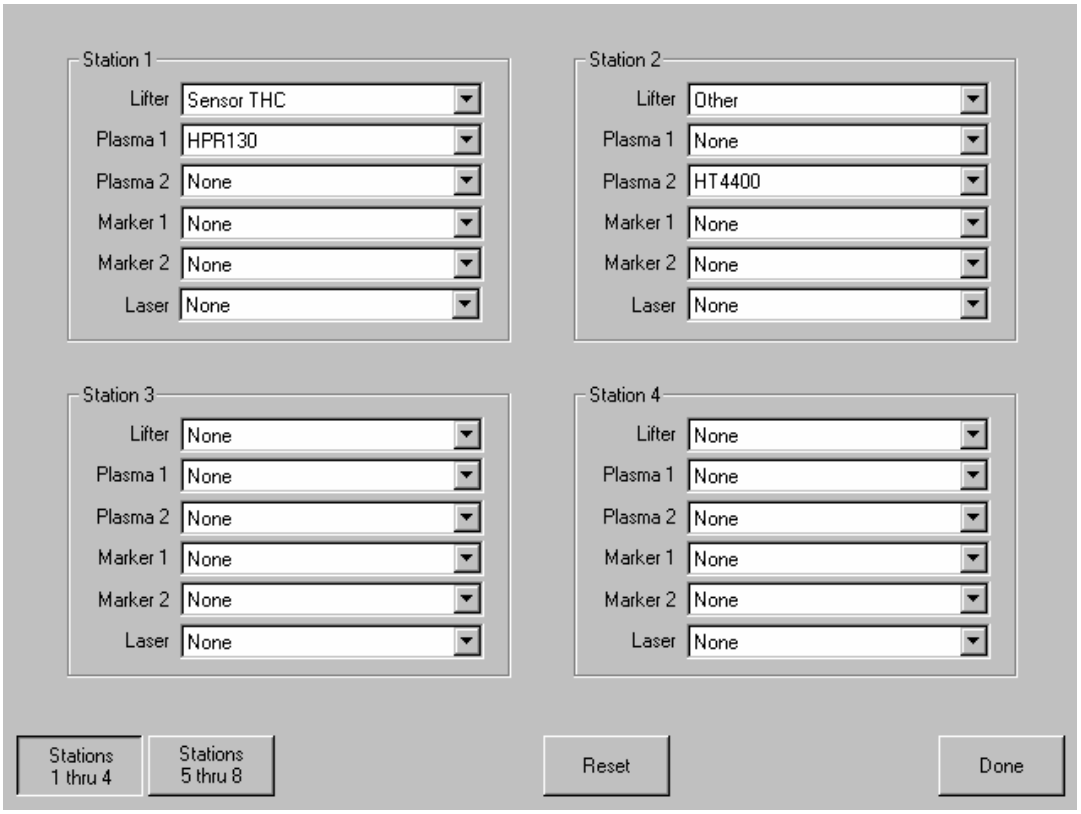
Station Configuration

This password protected screen for the Voyager™ II and Mariner™ controls is used to configure a Plasma, Marker or Laser torch station for use. This provides a single location to assign the Tool Selection, Process Selection and Lifter selection for the station. Up to eight stations for the Plasma 1 & 2 and Marker 1 & 2 process selections may be configured.

The "4532" password is provided for viewing of the Station Configuration setup screen without allowing changes. This password is useful for verify setups without the danger of accidentally changing them or revealing the supervisory password to an unauthorized user.

This Station configuration screen is also used to enable the serial link for the Command® THC as well as serial communication for the HD4070® and HPR130™ Plasma Systems.

Main Screen



These stations may be selected for use through codes within the part program. These codes enable the desired Station (THC) and are used in conjunction with the Process Select codes to configure the desired cut / mark process for use.

When a Station Select has been executed through the program codes the corresponding Station Select Output will be active.

Stations 1-4 / 5-8
The Stations 1-4 / 5-8 Softkey is used to access the desired Station for configuration.

Reset
The Reset Softkey may be used to reset or clear all Station setup parameters setting the values to "None".

Part Program Support
The following program codes are used to enable a station for use. Station Select and Process Select codes should be placed prior to the cut / mark.

Station Selects
Stations (Lifter / THCs) may be selected / de-selected using an EIA-274D program code with the following format.

Code	Description
M19 T*value*	Cancel All Station Selections
M37 T*value*	Select Station 1-20 (Tvalue)
M38 T*value*	De-Select Station 1-20 (Tvalue)

Additionally, these Station Select program codes may be overridden using the user selected THC inputs to the control. The feature to override the part program must be enabled at the Cutting Setup Screen.

Process Selects
Process Selections may be selected using an EIA-274D program code with the following format.

Example: M36 T*value*

Misc. M Code

Valve Identity

T1 = Plasma Process 1
T2 = Plasma Process 2
T3 = Marker Process 1
T4 = Marker Process 2
T5 = Laser Process

Station Configuration Variables
The following options are available for the station configuration

Lifter
None
Sensor THC
Command THC (w/ Serial Link)
HD4070 Integrated THC 1 or 2 (used only with the HD4070® power supply)
Other (any stand alone Lifter Station)

Power Supplies

None	HD4070 Torch 1or 2	Powermax series
Max100/ 100D	HT4001	FineLine 100
Max200	HT4100	FineLine 200
HT2000	HT4400	Other (any other Plasma system)
HD3070	HPR130	

Marker

None	ArcWriter	FineLine 100 & 200
HD4070 Torch 1or 2	HPR130	Other (any stand alone Marker)

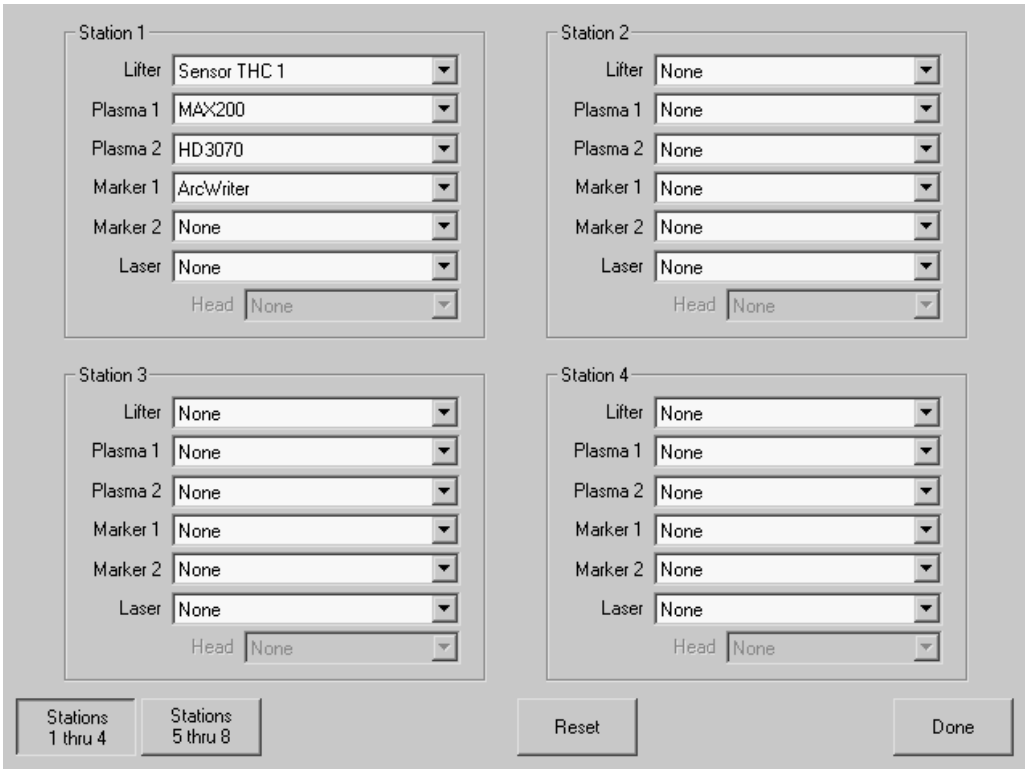
Laser

Rofin RF 40 & 50	Rofin DC 35	Rofin TR 60	Other

Station Selects may be overridden by manual inputs by setting the Station Select Override feature in Cutting Setups to disabled.

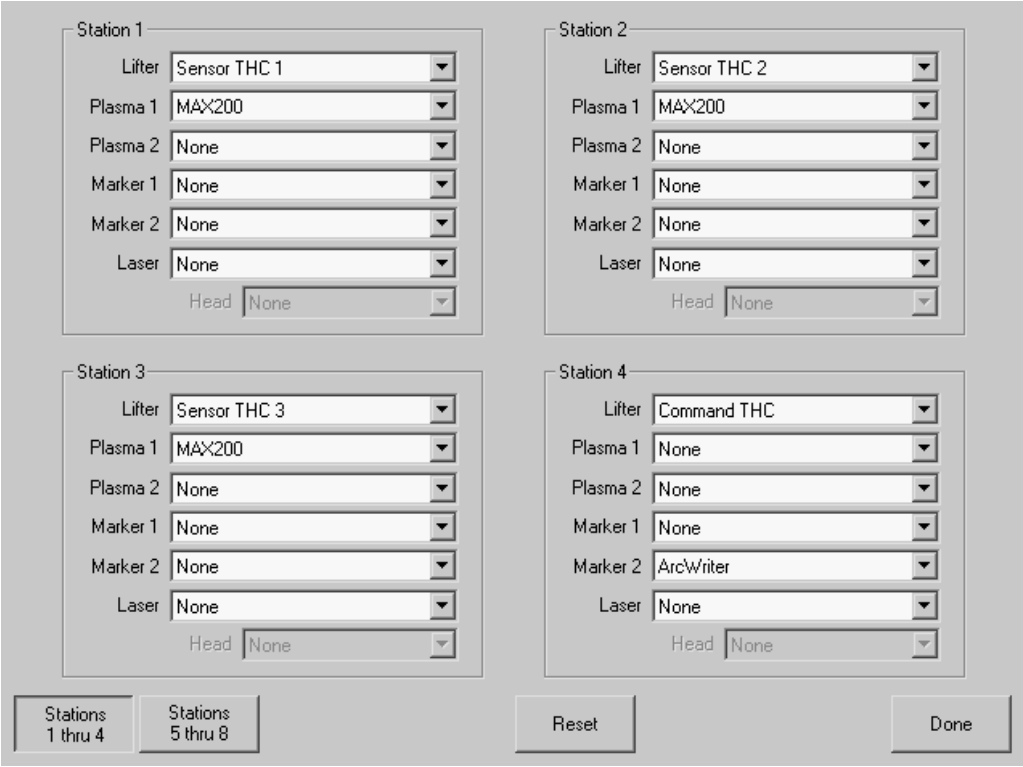
Process Selects may be overridden by manual inputs by setting the Process Select Override feature in Cutting Setups to disabled.

Overview
First press the Stations 1-4 or Station 5-8 Softkey to access the desired station. Select the appropriate Lifter selection for the desired station from the list of available Lifter types. Next select the appropriate tool (Plasma Power Supply / Marker Tool) selection for that station from the list of available tools in the Plasma and Marker Process fields. The tool selection should reflect the actual tools in use for that individual Lifter. The Station may be configured so that all four Plasma and Marker Processes operate on one Station or distributed throughout all 8 stations. If needed, the Reset Softkey may be used to reset or clear all Station setup parameters setting the values to “None”.



Selections made for the four processes and THC designations may limit the overall configuration. Additionally, selection of some of certain power supplies may also limit configuration.

Example: If Station 1 has been defined as having a Sensor™ THC and a MAX200® for Plasma Process 1, no other power supply type can be selected for Plasma Process 1. However, MAX200® for Plasma Process 1 may be select at other stations if a Sensor THC has been selected.

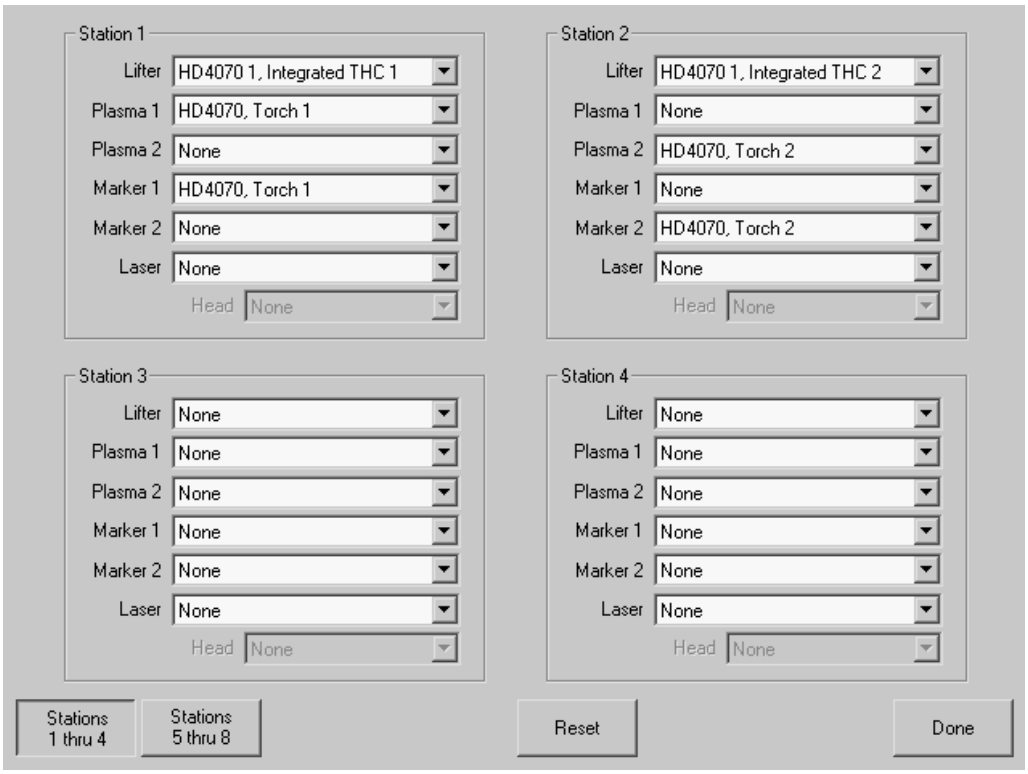


Command® THC Support
Selecting a Command THC as the lifter for a process enables the serial Link to be assigned for a single Command® THC. Note: The actual serial port must be assigned on the Ports setup screen. This also configures the selected Plasma / Marker Cut Types screen to display the Command® THC features. If a Command® THC has been selected for a station but does not use the serial communication feature to the control, then the Lifter type should be set to “Other”.

Please refer to the Command® THC section of this manual for additional information on the operation of the Command® THC

HD4070® Support
The HD4070® feature establishes the Serial Link HD4070® Power Supply communication link and configures the selected Plasma / Marker Cut Types screen to display the HD4070® features. A single HD4070® must be assigned to Stations 1 & 2. A second multi-dropped HD4070 may be assigned on stations 3 & 4.

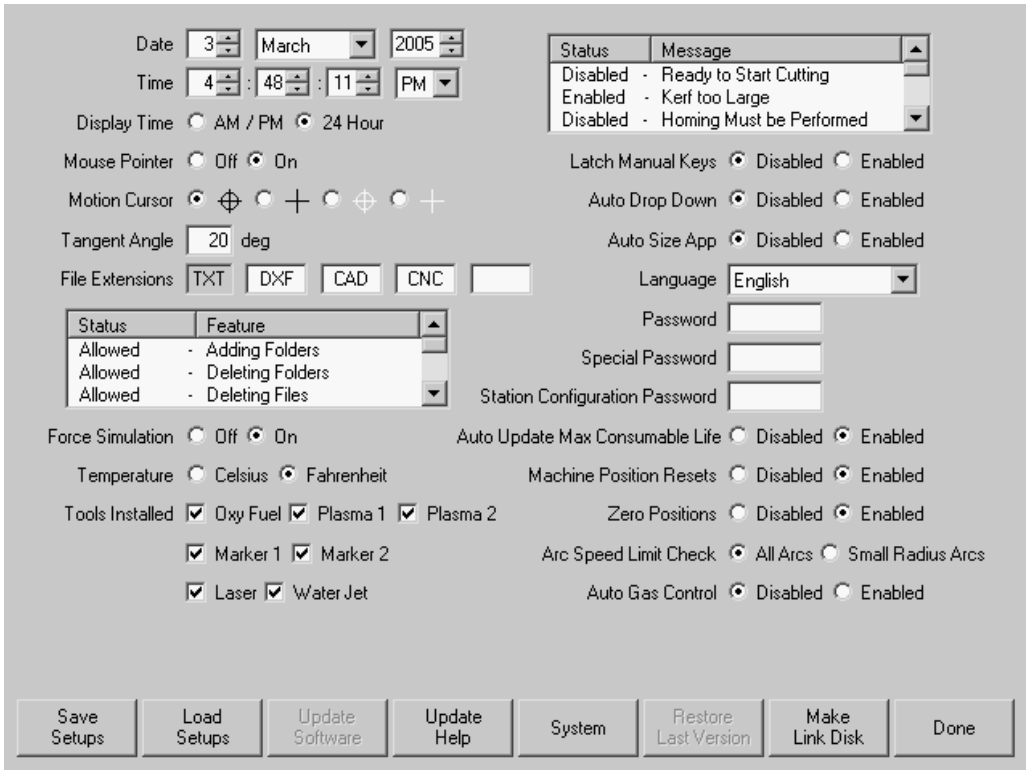
Each HD4070® has the ability to use two Integrated Command® THCs. These are controlled by the HD4070® and as such have designated Station locations.



In the previous example, you can see that the Cutting and Marking with the HD4070® Integrated Torch 1 is limited to Plasma Process 1 / Maker Process 1 on Station 1. Additionally, the Cutting and Marking with HD4070® Integrated Torch 2 is limited to Plasma Process 2 / Maker Process 2 on Station 2. These stations may be configured to Cut or Mark or both. A second multi-dropped HD4070 may be also be assigned on stations 3 & 4.

FineLine 100 / 200 Support
Serial communications to INNERLOGIC's FineLine 100 and FineLine 200 may be enabled and configured for use with selected THCs.

Special



Date
Allows the user to enter the current date.

Time
The value for the current time would be entered at this parameter and displayed at the main screen.

Display Time
The Display Time parameter allows the user to select the display time to be shown in either AM/PM format or 24 hour clock format.

Mouse Pointer
If the control has been equipped with the optional industrial mouse, select On to enable this feature.

Motion Cursor
This parameter allows the user to select the style of Motion Cursor used.

Tangent Angle
This parameter is used to set the degree of the tangent angle for control motion. Segments within a part that intersect at angles greater than the selected tangent angle will decel to zero or minimum corner speed. Segments within a part that intersect at angles less than or equal to the selected tangent angle, will not decel unless the next segment is a speed limited arc.

File Extensions
The parameter allows the user to enter the file extensions of the part files that will accepted at the control.

Adding Folders
This parameter determines whether the control operator has the ability to add Folders from the parts directory on the control or the host computer.

Deleting Folders
This parameter determines whether the control operator has the ability to delete Folders from the parts directory on the control or the host computer.

Deleting Files
This parameter determines whether the control operator has the ability to delete Folders from the parts directory on the control or the host computer.

Mapping Drives
This parameter determines whether the control operator has the ability to map to external drives from the control through the optional Network feature.

Configuring Watch
When enabled, this parameter will allow the control operator to change the selected items in the Watch Window.

Adding Processes
This feature allows to user to add new processes to the Laser cut charts when enabled

Removing Processes
This feature allows to user to remove processes to the Laser cut charts when enabled
.
Force Simulation
When activated, this feature will force the control into a simulation mode that will allow the control to operate with motioned disabled and I/O feedback enabled.

Temperature
The Temperature parameter allows the user to select that the internal control temperature be displayed in Fahrenheit or Celsius in the Watch Window.

Note: Not available for all control types and optional control hardware required.

Tools Installed
This setup parameter is used to select or limit the cut modes available to the control operator.

Message Enables
The following pull down box is used to enable and disable system messages. To change the status of a message, highlight the selected message and press the Space key.

Ready to Start Cutting Message
When enabled, the Ready Message feature will display a ready message when the Start button is pressed.

Kerf Too Large Warning Message
The Kerf Too Large Warning setup parameter allows the user to disable the " Kerf Too Large" warning message. This message is used to notify the user that when a part has been loaded and translated at the control, a conflict with the cut paths has been detected for the given Kerf value and that some detail may be lost when cut. Disabling the "Kerf Too Large" message may lead to unexpected results and allow cutting of invalid parts.

Homing Must Be Performed Message
This message is used to prompt the operator to home the selected axis before motion can begin. The selected axis must have homing enabled on the axes setup screen.

Example:

Values Have been Changed Message
This message is displayed as a confirmation when it has been detected that the values within the current configuration screen have changed. This ensures that changes are not made in error when exiting the screen.

Home Torch Height Control Message
This message is used to prompt the operator to home the Sensor™ THC axis at power up and before motion can begin.

Ready to Final Align Message
This message appears as part of the skew alignment function and is displayed just prior to final motion to position the tool is executed.

Part Larger than Plate Message
This message is displayed when the dimensions of the part that have been loaded exceed the selected plate dimensions.

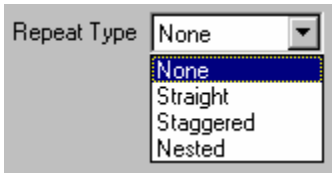
Cut Chart Data Has Changed Message
This message is displayed as a confirmation when it has been detected that the values within the current Cut Chart screen have changed. This ensures that changes are not made in error when exiting the screen.

Save Part for Rush Job
This feature will enable or disable the Resume Part prompt for Rush Job Interrupt.

Latched Manual Keys
This parameter will enable or disable the Latched Manual Key feature which allows the manual motion keys to remain on with a single key press.

Auto Drop Down
When enabled, the Auto Drop Down feature will automatically show the entire list of options at a selection box.

Example:



Zero Positions
This parameter determines whether the control operator has the ability to zero positions. When disabled, the zero positions softkey will be grayed out and will be unavailable to the operator.

Auto Size App.
When enabled, the Auto Size App. feature is used for the demo software to size the application software to full screen display or the standard size of 640x480 (disabled).

Language
The language selection parameter allows the user to select the language displayed on the control from the available languages stored on the control. Languages may be added to the control by performing the standard software update with a language specific update file. Eastern languages may also require the installation of a font viewer to properly display the required characters. To change to a different language, select the desired language and press the DONE softkey. You will then be prompted to cycle power on the control for the new language to be displayed.

Password
The password parameter allows the user to enter a new password for machine setups. Numbers or letters may be used.

Special Password
The password parameter allows the user to enter a new password for special setups. Numbers or letters may be used.

Station Configuration Password
The password parameter allows the user to enter a new password for Station Configuration setups. Numbers or letters may be used.

Auto Update Max Consumable Life
When enabled, this feature will continue to track the consumable life values beyond the user defined set point and assign that maximum values as the new set point. If disabled, the user defined set point for maximum consumable life will not be updated.

Machine Position Resets
When enabled, the Machine Position Resets feature will reset the absolute machine position when the Zero Positions softkey is pressed. When disabled, pressing the Zero Positions softkey will not reset the absolute machine position. Position information based on homing will not be lost. Only the current incremental motion (part) position will be reset to zero.

Auto Gas Control
When enabled, this feature allows the control to communicate with the Auto Gas Console for the HD3070® and allows access to the related setup parameters.

Arc Speed Limit Check
This feature allows the user the ability to turn off the Speed Limit Check performed by *Softmotion* for arcs larger than 10”. This may be used to compensate for abrupt motion commands caused by non-tangent line arc segments, smoothing out motion.

Save Setups
Pressing the Save Setups button will save the current control setting to the floppy disk or hard drive. A window will be displayed to select the drive and enter a file name.

Note: After installation of the control on the cutting table or if any setup parameters are changed, it is important to save the current setup file to both the hard drive and floppy disk for future reference.

Load Setups
Pressing the Load Setups will load the selected control setting from the floppy or hard drive on to the control. A window will be displayed to select the drive and enter the file name.

Update Software
Pressing the Update Software button will update the control operating software from a floppy disk.

Update Help
Pressing the Update Help button will update the control help files from a floppy disk.

System Tools
Pressing the System Tools button will access core Windows® features for system performance. Features include **Update Registry**, **Scan Hard Disk**, **Defrag Hard Disk** and **Format Diskette**. System Tools also accesses features for virus scanning and adding special fonts for some languages.

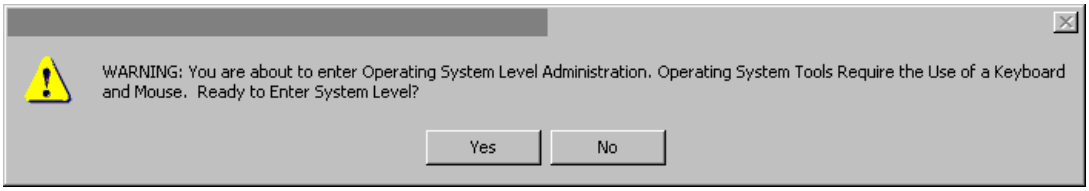
Restore Last Version
Restore Last Version will restore the control to the previous version of system software.

Make Link Disk
The control is shipped with a proprietary Communication Link software used to communicate with a host computer. Pressing this softkey will transfer the Link software to a floppy disk so it may be loaded on to a host computer for use. Included with the software is a text file to instruct the user on setup and use of the link.

System Tools – Windows® XP

The control Systems Tools involves operational knowledge of Windows® XP operating system and should only be performed by qualified personnel.

Note: A reminder will be posted on screen when entering the Systems Tools that a Mouse and Keyboard will be required for proper operation. The Mouse and Keyboard should be connected to the control before entering the System Tools.

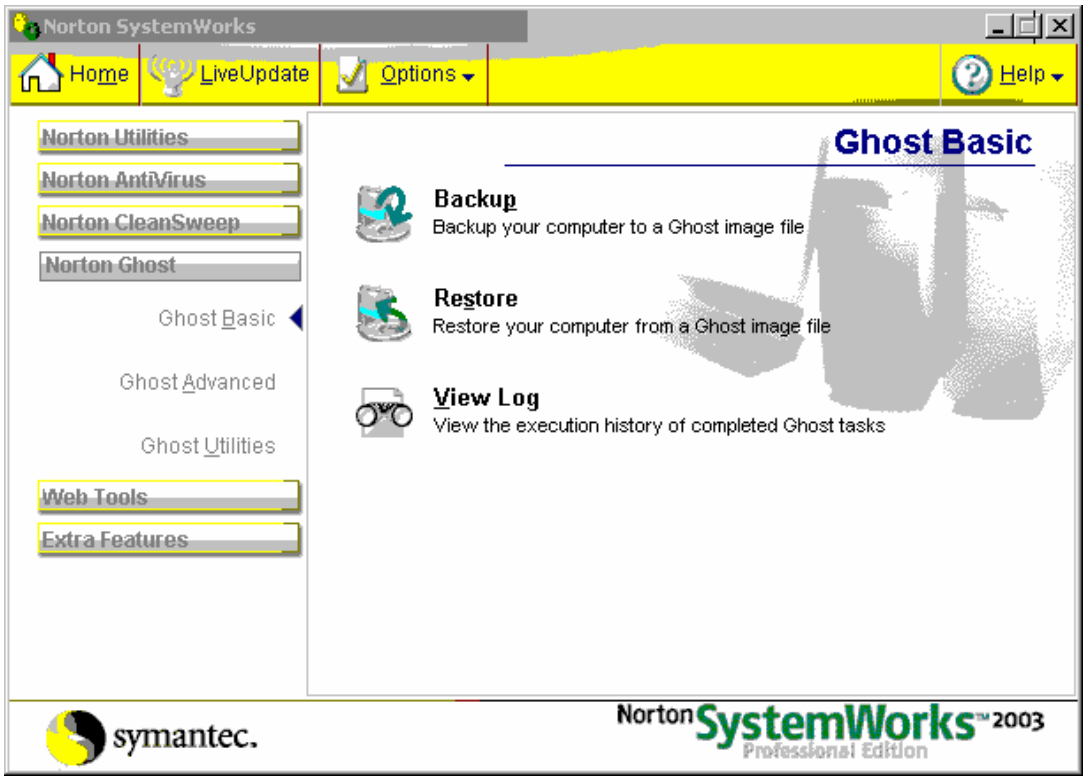


System Tools

Automated Backup
The Automated Backup feature allows the user to select the frequency of the automatic reminder for the backup of main hard drive information. At the selected time, the user will be prompted to backup the system at power up.

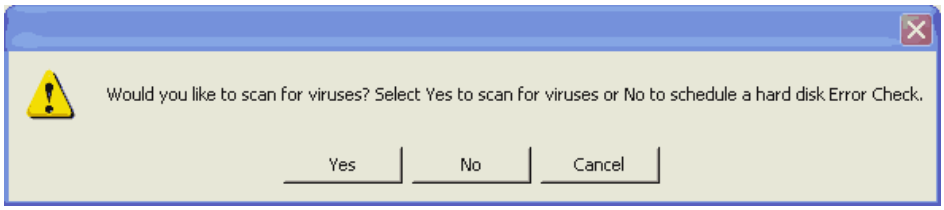
Backup Hard Drive
Pressing the Backup Hard Drive softkey will manually save the contents of the main hard drive to a specified location on the control hard drive or mapped location using the Norton Ghost™ Utility. The information from the backup location may also be restored using a diskette provided with the control.

Example



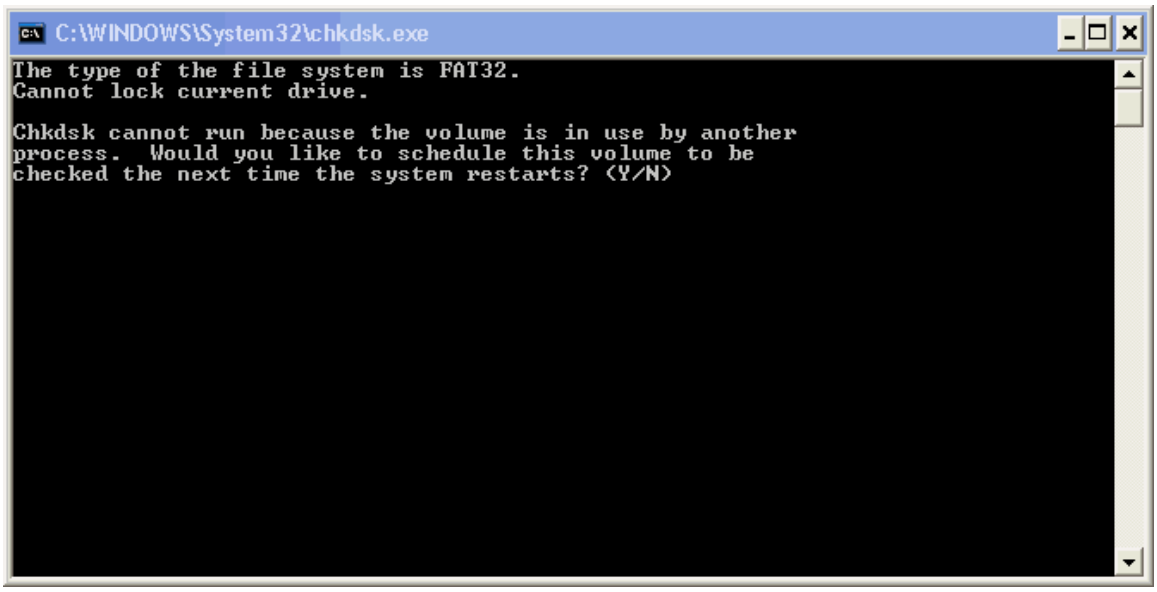
Note: After using Norton Ghost™, all files on Drive C: will be replaced. Control setups will need to be reloaded.

Scan Hard Disk
Pressing the Scan Hard Disk softkey allows the user to scan the Hard Drive for viruses or to Scan the Hard Drive for disk errors.



Scan Hard Disk - Selecting NO will allow the user to scan the Hard Drive for errors and correct them using the Windows® XP CHKDSK (check disk) utility. This task should be performed approximately every three months depending on the number of files loaded to and removed from the control.

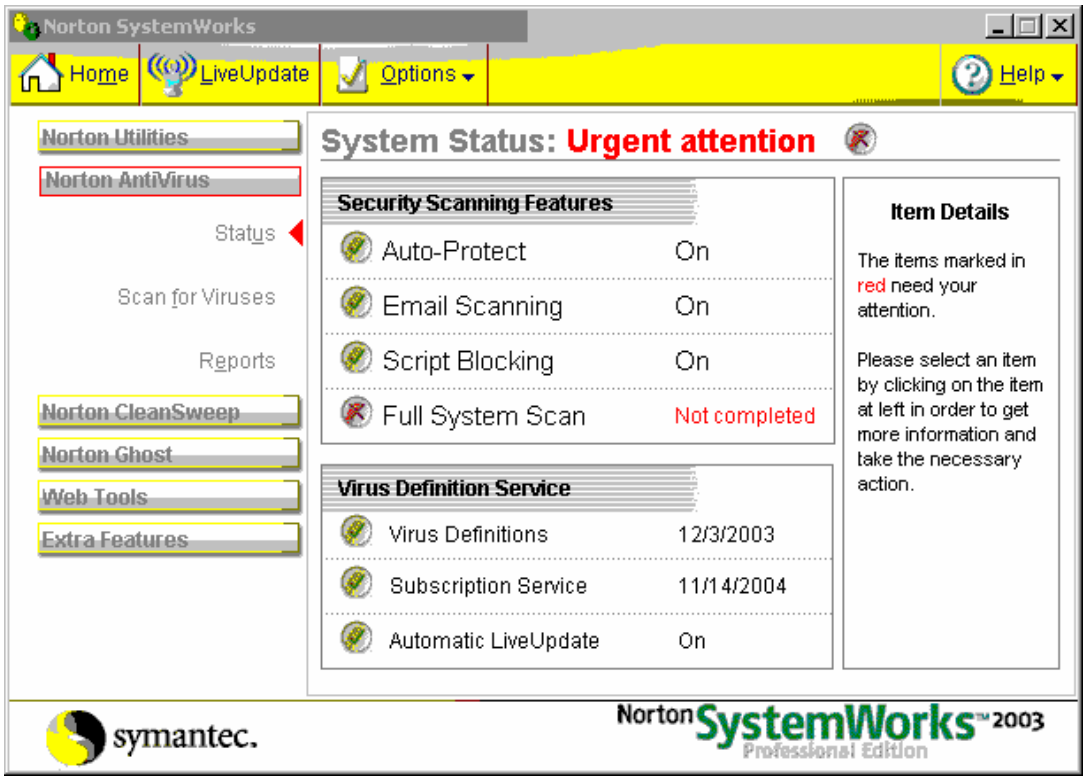
The Check Disk (CHKDSK) function cannot operate while the control software is in operation. You will be prompted to press “Y” for yes to perform the Check Disk at the next boot up of the control.



Scan Hard Disk - Selecting YES will allow the user to scan the Hard Drive for viruses using Norton's Anti-virus software.

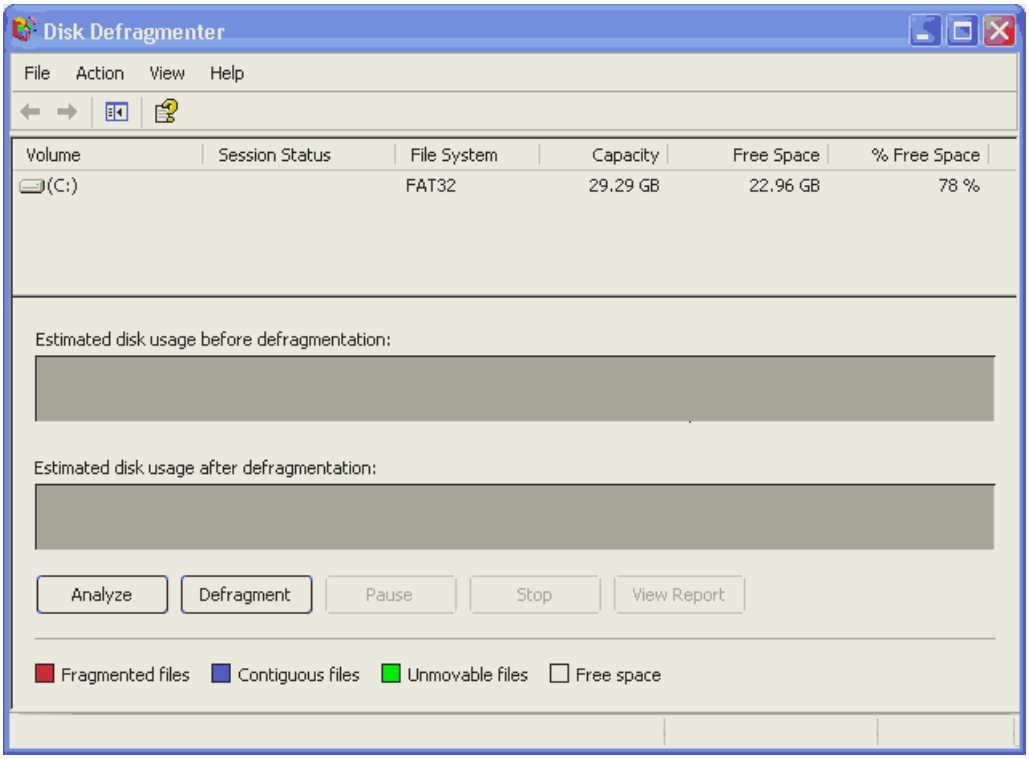
Antivirus™

The AntiVirus™ feature allows the operator to search files being loaded on to the control for known viruses. Norton AntiVirus™ is a trademark of Symantec™ Corporation. Please contact your control vendor for information on how to obtain the AntiVirus™ software for use on your control.

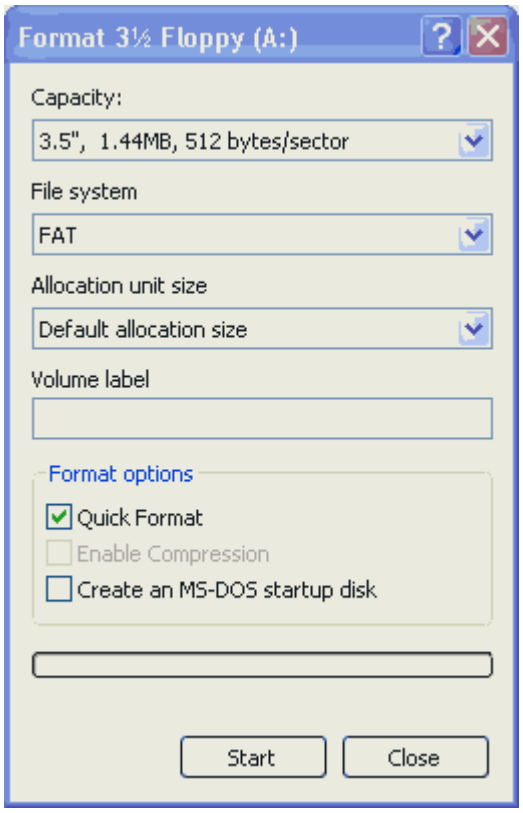


Defragment Hard Disk

The Defragment Hard Disk feature will scan the control hard disk for file locations and rearranges them for optimum performance. This task should be performed approximately every three months.



Format Floppy Disk
Pressing the Format Floppy Disk softkey will format a floppy disk placed into the floppy drive. This is advantageous in the event that the control has difficulty reading a floppy disk formatted by a computer. **Note:** Formatting the diskette will remove any files that are stored on the diskette.



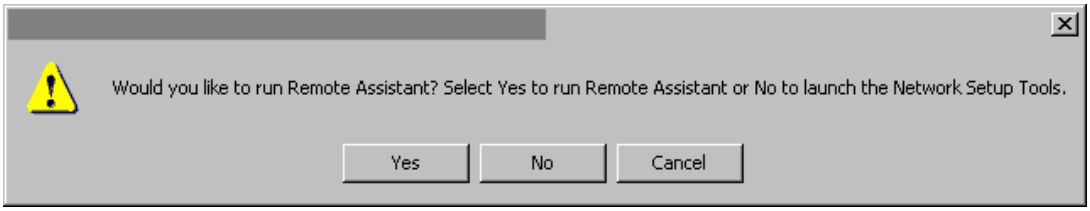
Reset Setups
Reset Setups will delete the current setup file, forcing default values to be loaded. A new setup file can then be loaded on the control through the Special Password screen.

If the control supplier has installed a customized setup file containing information specific to the cutting table, the Reset Setups Softkey is renamed Restore Setups. This custom setup file then becomes the new default setup file and pressing the Restore Setup Key will return the control to the original factory settings, as configured by the control supplier.

Network and Remote Tools

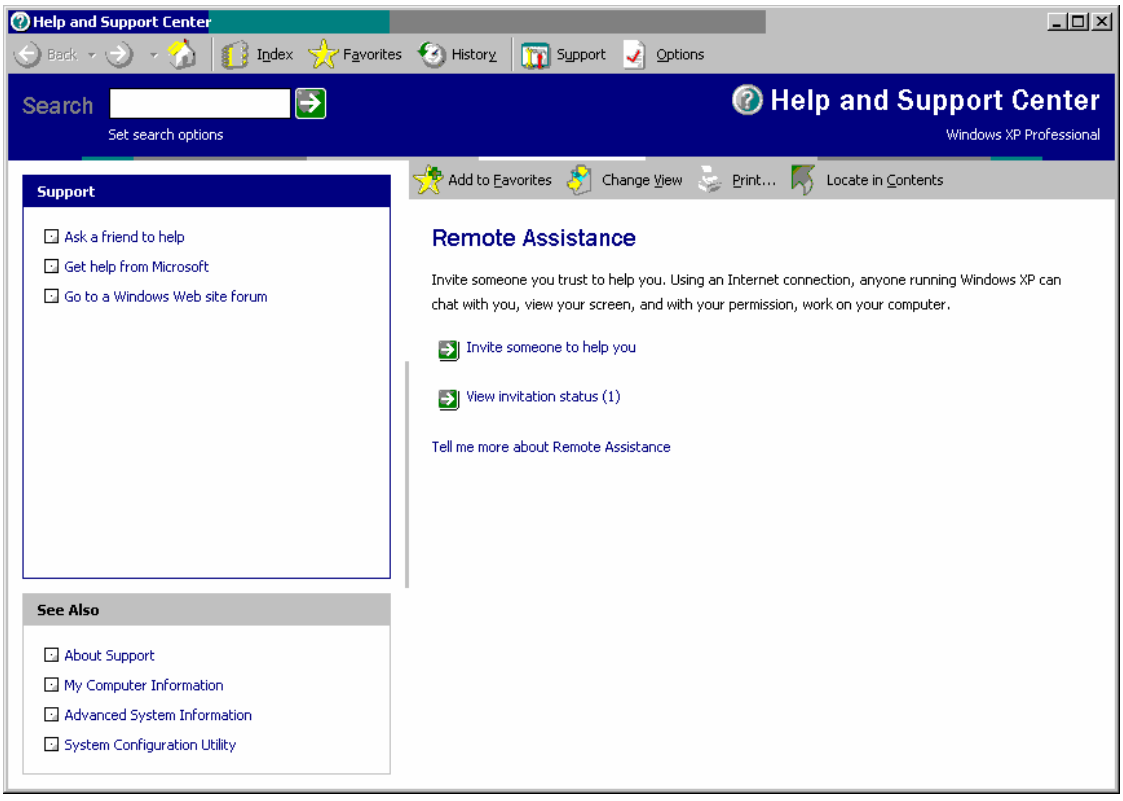
The Network and Remote Tools functions involves operational knowledge of Windows® XP operating system and should only be performed by qualified personnel.

Pressing the Network Tools softkey accesses the Windows® XP Network Connection Utility and Remote Assistant Utility.



Windows XP® Remote Assistant

Remote Assistance is a feature within Windows XP® and allows a Remote Helper to view and chat over a TCP/IP connection with a control running the Windows XP® Embedded operating system. The Remote Helper can also request to share control of the keyboard and mouse.



Some applications for Remote Assistance are:
1. Remote demonstrations of CNC software.
2. Show an operator certain features he may not be familiar with.
3. Online chat feature allows direct communication
4. Send or retrieve Software Updates, Database Files or other files with a Remote User.
5. Debug certain customer issues using Log Files.
6. Allow an operator to demonstrate a problem remotely.

Basic Instructions for use of Remote Assistance:
1. Operator connects control to network/internet.
2. Operator launches Remote Assistance Wizard and creates a Remote Assistance Invitation File with password and saves it to floppy disk.
3. Operator E-mails the Remote Assistance Invitation File and password to the Remote Helper.
4. Remote Helper connects to network/internet and launches Remote Assistance Invitation File.
5. Operator accepts Remote Assistance dialog.
6. Chat windows are available to both the operator and Remote Helper to allow them to discuss the feature or issue that is being reviewed remotely.

Requirements for the use of Remote Assistance on the Control:
Windows XP Embedded and Phoenix version 4.5 or 5.0 or higher.
Keyboard, mouse and internet connection (network, dial-up, DSL or other TCP/IP compatible network) is required for Remote Assistance. High speed connections preferred.

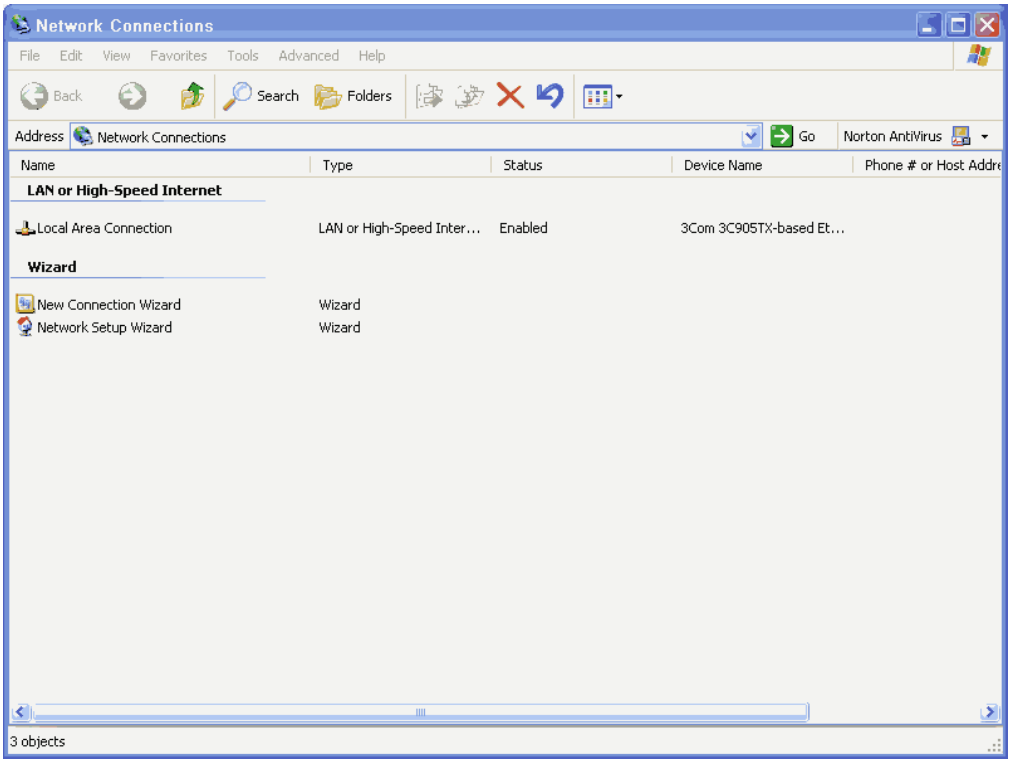
Note: The Remote Helper is not allowed to perform motion unless the control is in forced simulation mode or is a demo version of software running on a desktop. Audio feature is not used.

This feature would only be used with the assistance of and external technician. Please contact your control vendor if you require additional details on the use of this feature.

Network Connection
The optional Network feature allows the control to be incorporated directly into an office PC Network for part allocation. This feature is available on controls Windows XP® operating systems and requires a factory supplied Network card to be installed. Please see your control vendor for additional details on adding this feature.

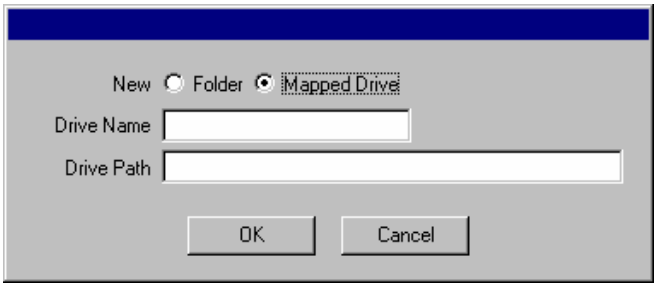
Network System Requirements:
The Optional Networking feature is approved to work with

Window NT® Servers
Window NT® Workgroups
Window 98® Workgroups



To Map the control for loading files

Enable the Mapped Network Drive feature at the Special Password Screen.
At the files Screen, press the + Key. Enter the desired mapped drive location.

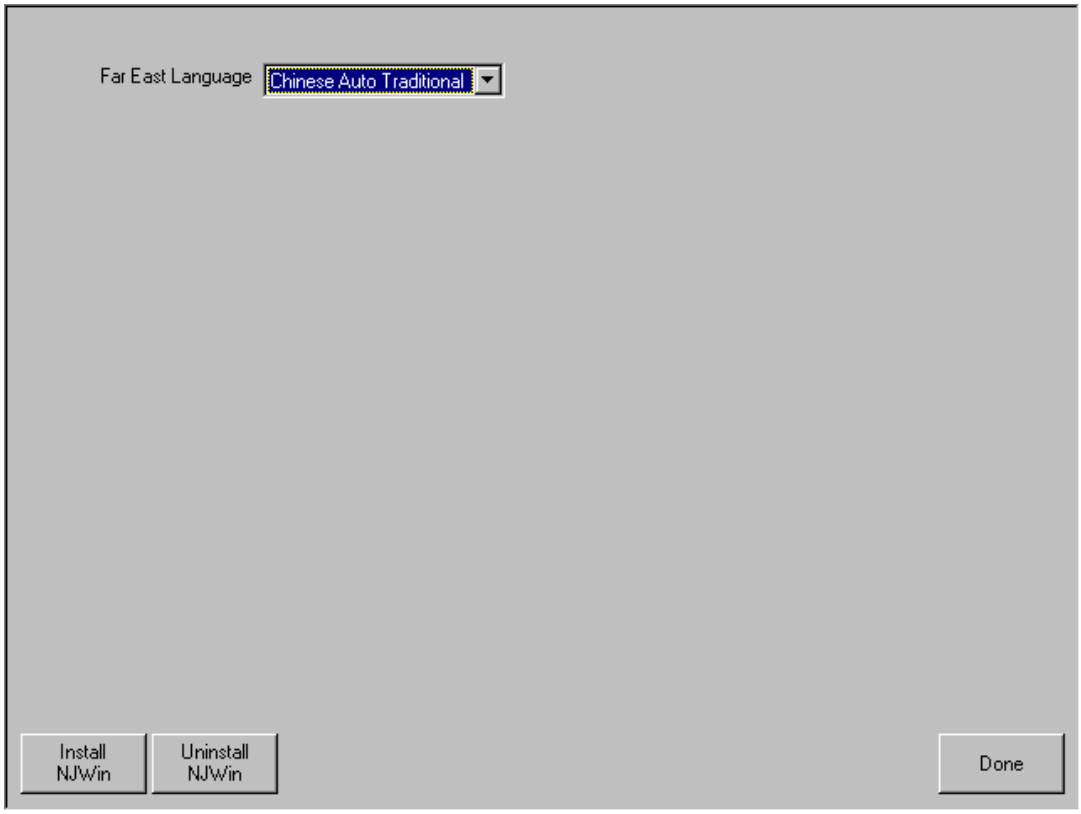


The control will automatically log on to the system at boot up.

NJWin® Tools
The NJWin® softkey will access the NJWin® font viewer set up screen.

NJWIN® is a font viewing software program that is used to display the proper characters for eastern languages. To view eastern languages, NJWIN® must be loaded on the control and the required eastern language selected at the NJWIN® screen. The translated update/operating software must be loaded onto the control and the required language selected at the special password screen.

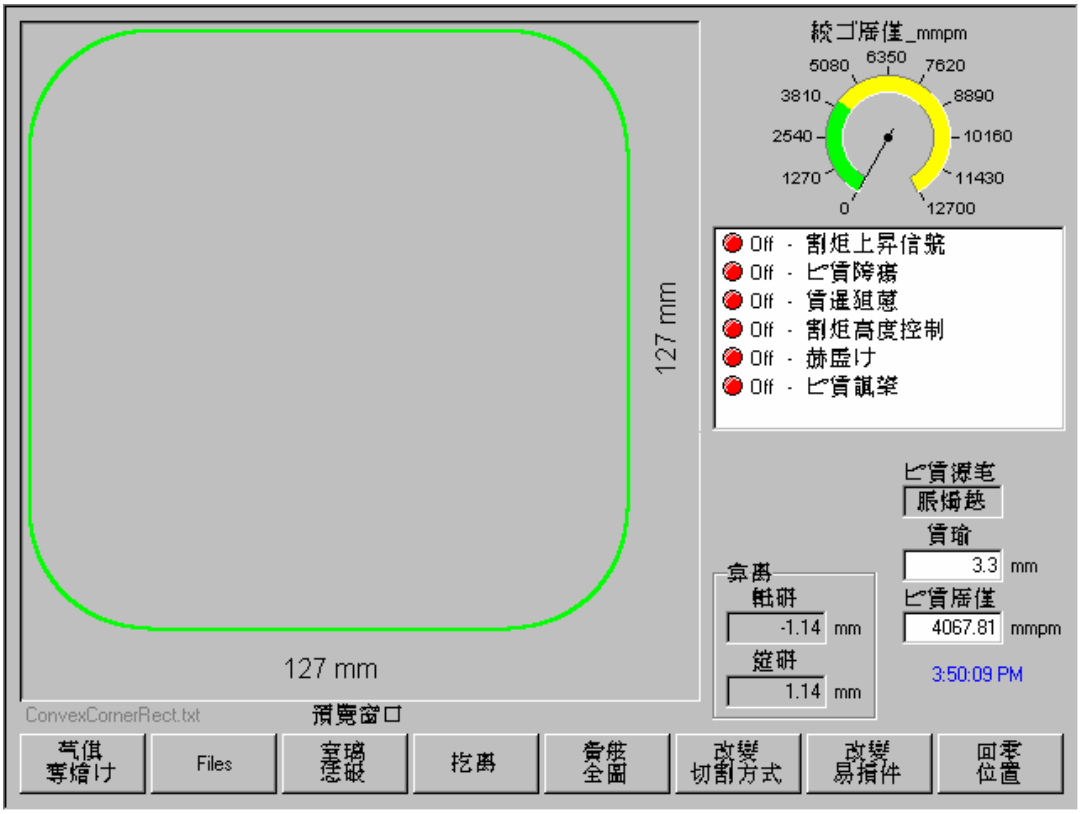
Please contact your control vendor for software and information on languages available. NJWIN® is a registered trademark of NJStar Software Corporation.



Install NJWin®
Press the Install NJWIN® softkey to install the NJWIN® font viewer software onto the control.

Uninstall NJWin®
Press the Uninstall NJWIN® softkey to remove the NJWIN® font viewer software from the control.

Example:

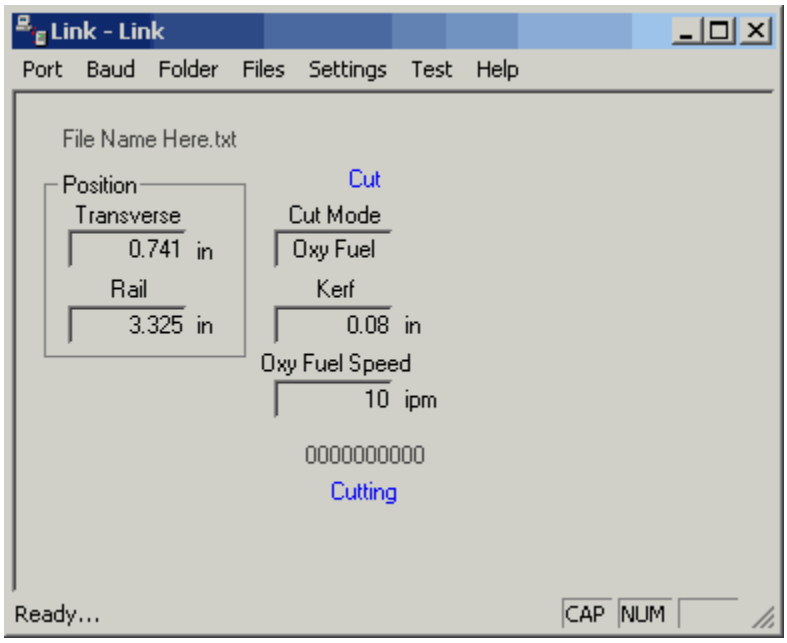


Section 5: Phoenix Link

Phoenix Link Overview

The Phoenix Link Communication Software is a proprietary communication package supplied with the control for optimal communication of part files and consumable database files between the control and the host computer. The program uses a 2X compression feature that allows the communications system to operate at speeds up to 230K Baud.

Phoenix Link
When the Phoenix Link Communication Software is operating, the following window will be displayed at the host computer for configuration. Once the software is running, the window may be minimized.



The following is a brief description of the available setup parameters for the Phoenix Link. Simply left click with the computer mouse on the selected feature in the drop down box to select, enable or execute that feature.

Port
This setup parameter allows the user to select the communication port to be used on the host computer.

Baud
This setup parameter allows the user to select the Baud rate used for communication on the host computer. Baud Rates: Min 9600 bps – Max 115,200 bps

Folder
The Folder setup parameter allows the operator to change the path of the Master Folder (Parts Folder). Sub folders and the part files within this Folder will be viewed at the control.

Files
The files setup parameter allows the user to indicate which file extensions will be recognized as acceptable part program files for download by the link software and will be viewed at the control.

Settings
The Settings setup parameter allows the user to configure the link to allow the Auto Reload (M65) feature to be enabled and recognized during communication. Additionally, the user may also select to communicate to multiple controls using the Multi Drop feature and configure it for use.

Test
The Test feature is used to test the operation of the selected communications port. To test, simply connect the transmit and receive signals on the selected communications port by inserting a paper clip and click on the desired port to test. The status of the test will be displayed in the lower left corner of the window.

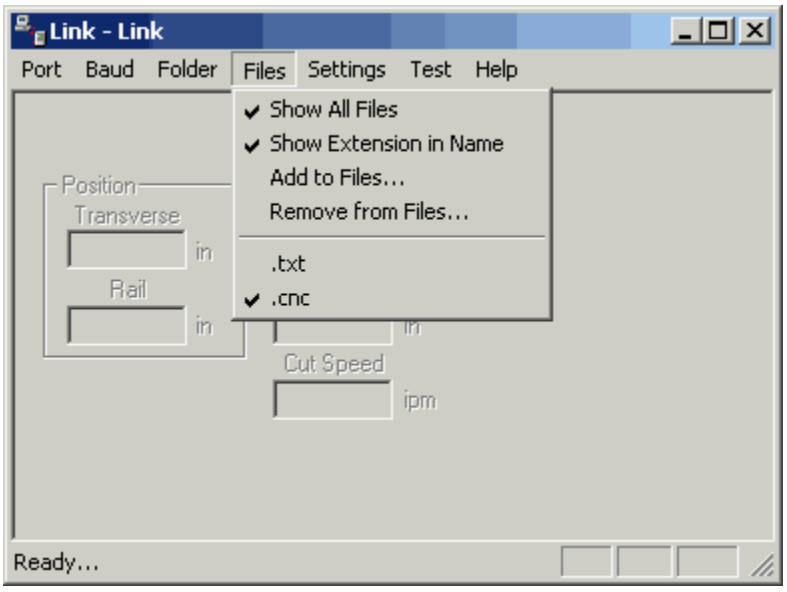
Help
Selecting Help will display the current version of link software being used.

Files

The Files setup parameter allows the user to indicate which file extensions will be recognized as acceptable part program files for download by the link software and will be viewed at the control.

Once a file has been successfully saved on the control, it is assigned the “txt” file extension for use internally on the control. The operator must be aware of this as **part programs with the same name, but different file extensions, will be overwritten during multiple file downloads**. A warning will be displayed at the control prior to a file being overwritten. Care must be taken when downloading.

The list of acceptable part program types is listed in the lower half of the of the Files option box. The checkmark (√) before the file extension indicates which selected file type will be displayed at the control. Please note that the checkmark (√) in the file extension listing also indicates the file extension which will be placed on a part program when uploading a file to the host.



The following options are available to define what part programs may be viewed at the control.

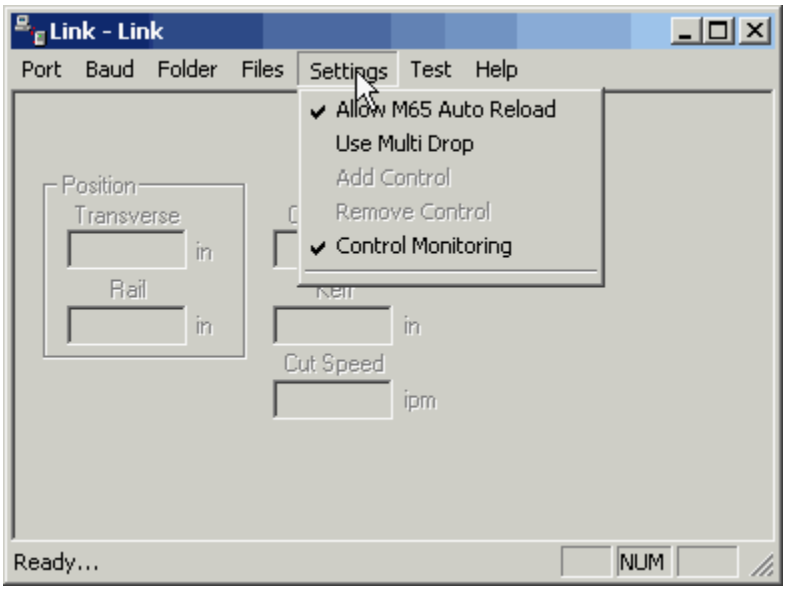
Show All Files
Enabling this feature allows all file types in the selected parts folder to be viewed at the control. A checkmark (√) located before this feature indicates that it has been enabled.

Show Extension in Name
This feature allows the user to view the file extension as part of the name at the control. For the file name “Job123.CNC”, the control would only display “Job123_CNC” in the filename location of the download screen. The control would display “Job 123” if this feature was not enabled. This feature is advantageous if more than one file has the same file name with different file extensions is being used. A checkmark (√) located before this feature indicates that it has been enabled.

Add to Files
The Add to Files feature allows the user to add to the list of acceptable part program types to be viewed at the control. Up to four file types (extensions) may be added to the default .txt extension. A checkmark (√) located before a file extension will indicate which file extension will be placed onto any part file being uploaded to the host.

Remove from Files
The Remove from Files feature allows the user to remove file extensions from the list of acceptable part program types.

Settings



Allow M65 Auto Reload
Selecting the M65 Auto Reload Feature allows part programs to be partitioned into smaller part programs separated by the M65 code. During the download, the control will download the individual sections of the part program and allow the operator to execute that section of the part. When that section of the program has been completed, the next section of the program will be automatically downloaded for execution. The downloads will continue until an end of program (M02) code is detected.

Use Multi Drop
The Use Multi Drop feature allows the Link to be configured to communicate with multiple controls through one communication port on the host PC. Up to eight controls may be supported with the Multi Drop feature.

Please note: The "Using Phoenix Link" parameter must be set to yes at the control to enable this feature and specific hardware for the control (serial communications board Rev D or higher) and host PC may be required to support this feature. Please contact your control supplier for more details.

Add Control
The Add Control feature is used to add a new control to the list of controls to communicate with. The corresponding control number must then be assigned to the new control in the link set up screen.

Remove Control
The Remove Control feature is used to remove a control from the list of controls that the host PC will communicate with.

Control Monitoring
When enabled, the Control Monitoring feature allows the user to view control status the host PC. Status for File Name, position, cut mode and cut information is displayed. This feature is only available with the Phoenix Link Communication Software.

Installation

Below is an item list to outline the step by step procedure for the communication setup of the control and installation of the Phoenix Link Communication software:

Disclaimer of Warranty: This link software and accompanying written material (including instructions for use) are provided “as is” without warranty of any kind.

Minimum System Requirements

Processor:	Pentium® 100MHZ
Hard Drive Space	0.5 MB
Memory:	4MB
Display:	VGA
Floppy Drive:	3.5”
Operating System:	MS Windows® 95, 98, NT, 2000, ME or XP
Serial Port:	One RS-232 or RS422 serial port will be required per control.

Software

1) At the control, access the Special Password screen, place a diskette into the floppy drive and press the Make Link Disk softkey. Three files will be transferred to the floppy disk. The Link software (Link.exe), a Setup file (Setup.exe) and a Readme file (Readme.txt). The Setup file will create a Link folder on the root directory of the host PC and will copy the Link software into it. The “Readme” file contains additional information about installation and setup of the Link software on to the host computer.

2) When the light goes out on the floppy drive, transfer the floppy disk to the host computer and place the disk into the floppy (A) drive. From the Windows® Start button, select Run. At the opening prompt type A:\Setup.bat and select OK. The setup file will expand the files and create a “Link” directory on the root directory. Placed in this directory will be the Link.exe file. **Please note**: The Link software must be located and run on the PC that is connected to the communication cable coming from the control.

3) From the Windows® Start button, select Run. At the opening prompt, type A:\Link\Link.exe and select OK. After the link software has been launched, two other files will be created. A link.ini file, which contains the Link software configuration information, and a Parts folder, which is the default Master parts folder. It is recommended that a shortcut to the Link.exe be placed on the desktop of the host PC for ease of use.

4) At the host computer, create one or more folders under the “Parts” directory. Place in to these folders any part programs to be accessed by the control.

   For example, if you wish to add the folders ”Workfile 1” and “Workfile 2” to the parts directory, the structure of the files would look as below:

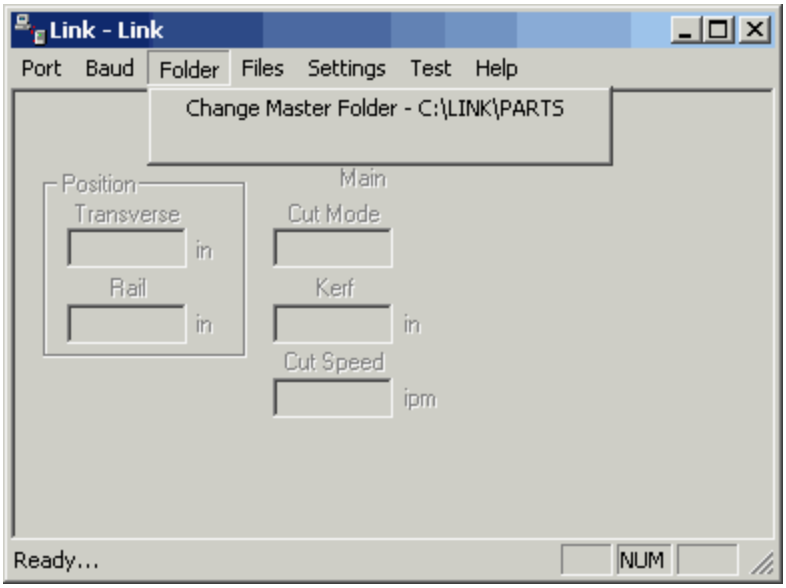
Path C:\Link\Parts\Workfile 1 and C:\Link\Parts\Workfile 2

Any part programs to be viewed and downloaded at the control would be placed here. Only the sub folders Workfile 1 and Workfile 2 and the program files located within them will be viewed at the control.

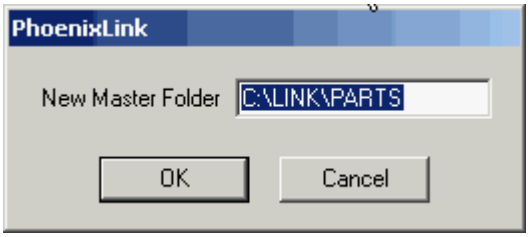
Change Master Folder
If the host computer currently has existing part programs and folders, the Link software may be configured to operate with the current folder names. This master parts folder may be located on the host PC or another PC that is networked to the host PC. **Please note**: The Link software must be located and run on the PC that is connected to the communication cable coming from the control.

This is accomplished by configuring the Link software through the "Change Master Folder" feature to point the Link to the folder that contains the required part programs.

Launch the Link Software at the host computer and Link window will be displayed.



Select Files\Change Master Folder.

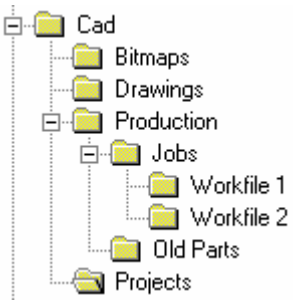


The Master file may now be changed from the current folder to the selected folder by typing in the selected path. Select OK to accept the change.

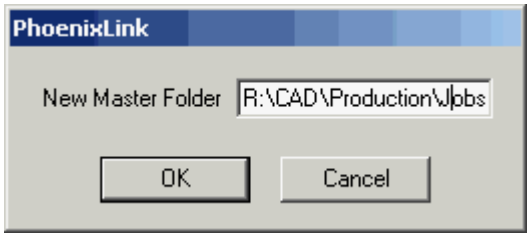
The same procedure would also apply when selecting a master folder located on a network.

For example, if the folders which contain the part programs are currently located in a folder named “Jobs” located on the PC named “R” drive, the Link.exe could be configured to the Change Master folder option to access these files.

Example path: R:\Cad\Production\Jobs



Again, start by launching the Link Software at the host computer. Select Files\Change Master Folder.



The Master file may now be changed from the current folder to the selected “Jobs” folder by typing in the path R:\Cad\Production\Jobs. Select OK to accept the change.

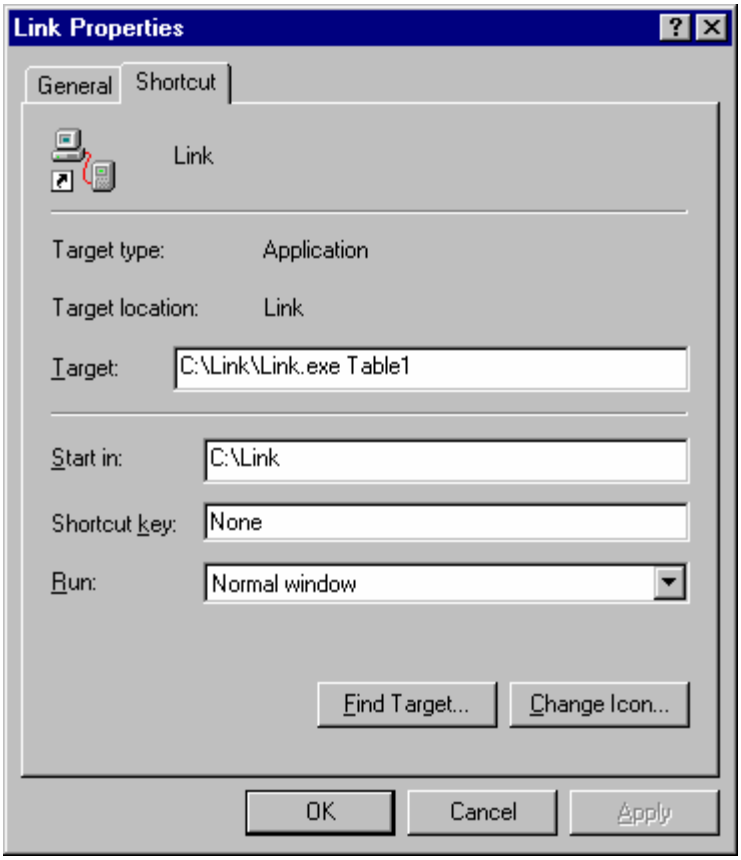
The final step to setup the Link software is to configure the Link software for Port, Baud, Files and Settings to match those being used at the control. It is recommended that a shortcut to the Link.exe be placed on the desktop of the host PC for ease of use.

Operating Multiple Links

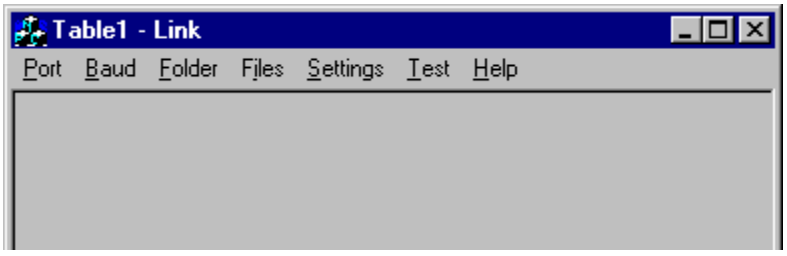
To connect more than one control to the host PC without the use of the Multi Drop feature, a Link software specific to each control may be installed. Each version of Link being operated will require its own dedicated communications port on the host PC.

Start by creating individual folders for each cutting table and placing a copy of the Link.exe into each folder. Create a shortcut for each Link.exe and place the shortcut on the desktop. Using a mouse, right click on the shortcut to open the shortcut properties dialog box. Add to the shortcut target command line information to indicate which table the Link will be in communication with.

In the target command line example below, “Table1” has been added to the end of the command line to indicate the Link will be specific to communications with Table 1.



This “table” information, added to the Target command line, will then be noted in the title bar of the Link window. The Link may now be launched from the shortcut and configured specific to this table. When the Link is closed, a “Table1.ini” with the specific Link setup file will be saved in the folder.



Continue to configure each additional Link for communication to each control. The separate Link files may be configured to point to the same or different master parts folders.

Hardware

Note: It is suggested for the purpose of establishing the proper setup of communications, that the control be placed next to the host computer and connected via a short communication cable. Once communications have been successfully established, the control can then be located on the cutting table and connected to the host computer via the appropriate cable or short haul modem system.

1) Configure the selected RS232/RS422 serial port on the control for operation, as described in the Serial Port information of this guide.

2) Test the control's communication port in the Diagnostic Screen to confirm proper operation of the serial port. Directions for testing of the serial port are described in the Diagnostic section of this guide.

3) Enter the control's Link setup screen to select the use of the desired communication port, select the Baud rate and select to use Phoenix Link. It is suggested to start at the lowest baud rate and increase until the maximum is achieved. Communicating at too high a speed may cause error messages to be displayed due to lost characters or information.

4) Enter the control's Special Password screen to add the file extension of the part programs being used to the current list of acceptable file extensions.

5) Load and configure the Link software at the host computer as previously described in this section.

6) Test the host computer's selected serial port through the "Test Port" feature of the Link software as outlined in the Phoenix Link software overview.

7) Connect the control to the host computer's selected communications port with the appropriate cable or modem system.

Operating Phoenix Link

1) The Phoenix Link software must be running at the host computer to communicate with your shape cutting control. Start the Link software at the host PC from the desktop shortcut or select the Windows Start Button, then select Run. From the opening prompt, type C:\Link\Parts\Link.exe (or appropriate path to the Link.exe) and select OK. The Phoenix Link window will appear. The Link software window may be minimized during operation if desired.

2) At the control, press the Files softkey and select to Upload or Download to Host. As the control is connecting to the host computer, a status display in blue text for the communication can be viewed in the lower right corner of the screen.

3) The control will initialize the port, open the port, and then try to contact the host. If this attempt at communication fails, an error message will be displayed in red. If successful, the control will download the available folder and part file names to be viewed on screen. **Note:** If the "Show Host File Names" parameter at the control has been set to "No", only folder names will be viewed.

Common Errors

Below is a listing of common errors encountered when installing a communications system.

1) The port selected at the host computer has already been assigned to another software program.

2) The host and control have been configured to different setup values.

3) The cable has been connected to the incorrect port or software has been configured to the incorrect port.

4) The selected modem or cabling system being used has swapped the transit and received signals, causing a communications failure.

5) Trying to transmit over too long a cable without a modem or using incorrect wire for the distance being traveled.

6) Trying to communicate at too high a baud rate for the modem system selected.

7) The correct file extension has not been entered at the control's Special Password screen, preventing part programs from being displayed at the control.

Error Messages

Below is a listing of common error messages and some possible causes.

Unable to Open Port (control)
The selected communications port could not be opened. The wrong port has been selected or the communications port has failed.

Unable to Open Port (host)
The selected communications port could be opened. The wrong port has been selected, the communications port has failed or another software application is using the port.

Unable to Initialize Port
The selected communications port was unable to be initialized. The wrong port has been selected, the communications port has failed or another software application is using the port.

Port Failed
The Port Failed error message will be displayed if the communications port test has failed for the selected port. This may be due to a fault with the test wire connection, incorrectly connecting to the proper transmit and receive pins location, or failure of the communications port.

Host Not Responding
This message will be displayed if the communications port has been successfully opened the port, but has failed to establish communication with the Link software. This may be due to a fault with the cable connection, cable configuration or the host computer's communications port.

Communication Failed
This message will be displayed if after establishing communication with the host, an expected message from the host is not correct.

Communications Time Out
This message will be displayed if the specified amount of time allowed for a response from the host computer expires. This amount of time can be configured in the Link setup screen. This may be due to a fault with the cable connection, cable configuration or the host computer's communications port.

Checksum Error
The Checksum Error message will be displayed at the control if after a part has been uploaded or downloaded, the checksum calculated by the host and the control do not match. The Checksum calculation is performed by adding the numeric values of the ASCII codes used. This error may be due to incorrect cabling or transmitting at too high a speed for the communications system selected.

Warning: The Master Folder Selected does Not Contain any Folders
This error message will be displayed at the host computer if the selected master folder does not contain any subfolders. You may choose to add subfolders if they do not exist. If subfolders do exist, the path to the master folder may be incorrect.

For additional assistance in trouble shooting the Phoenix Link in the event of a failure, please contact our control vendor or representative.

Appendix A: Motion Overview

General Motion Theory - Servo Loop Control

The following is intended to assist customers / control system users in better understanding motion theory. Note: It is highly recommended that any system tuning be performed by qualified service technician as incorrect tuning may cause damage to the system or personal injury.

Outline of Information

1) What is closed loop servo control?
   a) What is an Encoder?
   b) What is Following Error?
   c) What is a Position / Servo Error?
2) Determining Edge per Inch Parameter
3) Gain Term Definitions
4) Recommended Tuning Procedures

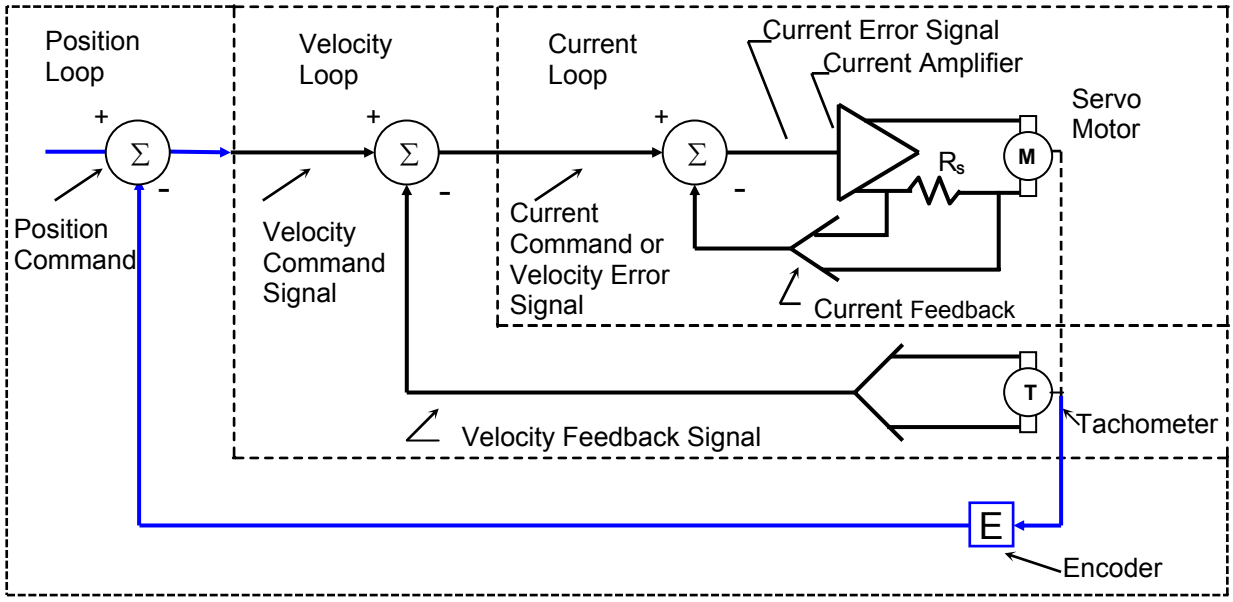
1) What is Closed Loop Servo control?

A Servo System is the means of accurately controlling electrical motors to create force. The motor output is generally connected to a gearing system to translate the rotational force of the motor into linear motion. Additionally this gearing system is used to modify the strength and speed of the motion.

Closed Loop Servo control is the continuous process of monitoring position and/or velocity commands compared to actual position and velocity and adjusting the output accordingly. A servo system without feedback devices and automatic adjustment capabilities would be referred to as Open Loop Servo control.

The drawing below outlines a typical Velocity and Position Loop System. The most important aspect of this for our motion control is the Position Loop. The process starts with the motion control providing a motion command (voltage) to the motor to move at a specific speed to a desired position. Position is tracked during the motion by means of a feedback device (Encoder) that provides both directional and distance information. Based on that feedback, the control adjusts it's motion command (voltage) to the motor to ensure that the motor is accurately positioning on the designated motion path at the correct speed.

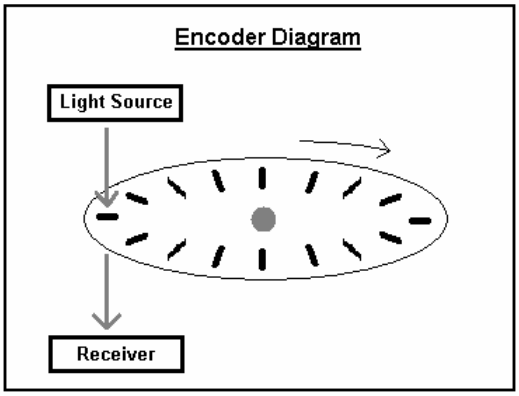
Typical Velocity and Position Loop System



The Motion Command starts as Digital Output within the control and then is converted to a +/- 10VDC Analog Output for use by the motors. This conversion of the Motion Command within the control is referred to as the DAC (Digital to Analog Converter) Output and is performed by the Motion Control Card. The Analog Output when it comes out of the control is sent to a drive amplifier that then steps up the voltage output to the motor and creates motion. Also, there is usually a linear relationship between the voltage sent and the machine speed (i.e. 10 volts = maximum machine speed, 5 volts = half max machine speed). Additionally, the polarity of the output (DAC Polarity +/-) to the amplifier will dictate the direction of the motor rotation. In most applications and in the following application description the feedback device is an Encoder.

1a) What is an Encoder?

Essentially, an Encoder is a feedback device that provides signal pulses as the motor turns. The diagram at the right illustrates the basic concept of an Encoder. Although this does not represent all Encoder / feedback device technology, this illustration provides a visual aid to help understand the process.

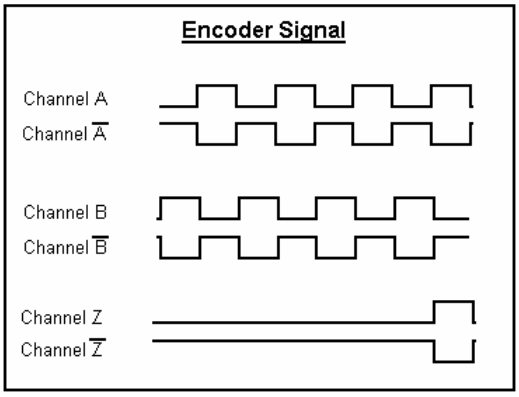


The illustration shows a disk with small holes cut out along the outer edge. The light source provides a beam of light projected downward through the holes in the disk. As the disk turns on the end of the motor shaft, the light passes through the disk creating pulses. The Receiver below the disk picks up the pulsed light source and sends that feedback to the control.

As there is a direct relationship between the rotation of the motor shaft, the Encoder Pulses and the distance of motion traveled (when the motor shaft turns) the control is able to calculate distance by counting the encoder pulses received, thus closing the Position loop. So this relationship shown as a simplified formula would be:

Encoder Pulses x Motor Revs = Distance

The Encoder generates a Square Wave type signal as illustrated at the diagram to the right. Generally, most encoders provide two main signals (A & B) and the complements (A/ & B/). These signals are also referred to as channels. The Compliment channels are not always used but can provide increased noise immunity when used. The rotational direction (Encoder Polarity) can be determined by the signal received (e.g. ABABA or BABAB).



The Z signal shown here is produced only once per revolution and is often referred to as the Marker Pulse. This marker pulse is quite often used for accuracy in “Homing” routines.

The pulses generated are generally referred to as counts. The holes in the disk are also commonly referred to as lines. You may hear someone mention that they have a 1000 line encoder. The pulses picked up by the receiver may actual be the beginning and end of each light pulse per line for each the two channels (A&B) resulting in a 4x mode encoder. Thus a 1000 line Encoder in 4x mode would produce 4000 pulses or counts per revolution of the disk/ motor. The more pulses/ counts produce by the Encoder for a given distance the greater the accuracy the motion will be.

1b) What is Following Error?

Following Error or Servo Error is the distance between the ideal commanded position from the control and the actual position of motion. Some Following Error is to be expected as the response of the motor can rarely ever reach the ideal command of the system due to the resistance of load being moved. It is easiest to think of this latent response as being very much like driving a car away from a stop light. For the car, it takes time for the engine to produce the force required to move the weight of the car up to the desired speed. Following Error for each axis can be selected to be viewed in the Watch Window / Status Window of the control. This is a quick reference tool for monitoring the performance of the actual machine motion as compared to the control command.

The important consideration for X/Y coordinate motion is that the response for the X and Y motion is similar. If the response is dissimilar, poor results for commanded motion will result. An example of a dissimilar tuned response would that when a circular motion is commanded, a oval or elliptical motion will result as one axis out performs the other.

1c) What is a Position / Servo Error?
A Position Error or Servo Error occurs when the distance between the ideal motion position and the actual motion position exceeds a pre-defined Servo Error tolerance value. A Position Error indicates that the response from the motion command was not executed, executed too slowly or executed incorrectly. The Servo Error Tolerance is user definable value within the control and is usually set to be a value twice the noted following error during normal operation. This allows the system to operate without nuisance faults caused by temporary resistance to the motion, such as dirt on motion rails or temporary tension from motor cabling, etc.

Note: It is important to remember that in the Closed Position Loop, the output command will adjust to try and maintain the desired speed and positioning. As a result, a loss of Encoder Feedback would result in the control sending out it's maximum motion command to the motor causing it to "run away" without control. Conversely, failure of the motor to turn while feedback is enabled, will result in a position error and the command output will stop when the fault occurs.

2) Determining the Encoder Counts per Inch Parameter and Maximum Machine Speed
Remembering that the position loop uses the pulses/ counts from the encoder to calculate distance, it is important to determine how many encoder pulses are equal to a specific distance of machine motion. The control uses the Encoder Counts Per Inch/mm value as the constant to calculate distance and speed.

The Encoder Counts per Inch/mm is a calculation based on the number of pulses generated by the encoder for one revolution of the motor and how much distance is traveled from that motor motion through the gearing being used.

So this relationship shown as a formula would be:

Counts / Line x	**Counts / Rev x**	**1 Rev / Inch =**	**Encoder Counts/ Inch**
encoder mode e.g 4x	*Pulses per Rev*	*gear box ratio & rack /pinion ratios*	

For example: The resolution of a 4X - 1000 line encoder counts both edges (lines) of channel A and channel B to equal 4 counts per line multiplied by the 1000 lines per revolution equaling 4000 counts per revolution. If the encoder revolutions per inch of travel are 1:1, we would have 4000 encoder counts per inch of travel.

4 Counts/ Line x 1000 Lines/ Rev x 1 Rev/ Inch = 4000 Encoder Counts/ Inch

Determining Maximum Machine Speed
The following information is used to establish the proper value for determining max machine speed. Multiply the max RPM of the motor by the number of inches of travel per revolution to get the resulting Maximum Machine Speed in Inches per Minute.

For example*

4000 RPM Motors x .125 inches per rev = 500 inches per minute

*Note: Through test or calculation it is determined that the table moves 1/8 inches per revolution of the encoder.

With the Maximum Speed, Encoder Counts per Inch, DAC and Encoder polarities determined and entered into control setups, a simple test of machine motion can be made in the control Drive Diagnostics screen. This test should be made with the motors disengaged for saftey. This is a basic

motion test of the system and does not use gain terms or the position loop for motion. Please refer to the Installation Guide provide with your control for more information on this feature.

3) Gain Term Definitions

Proportional Gain
In a feedback control system the error term is acted on by the control system and it in turn alters the output. Proportional Gain is pure amplification of the error term. In a closed loop control system this is proportional to the error signal. Simply put, the output is Proportional Gain times error.

In most systems Proportional Gain this is the primary tuning parameter to improve the response of the position loop.

Integral Gain
Perhaps the best understanding comes from realizing that the limit of Proportional Gain is that it cannot completely eliminate error. The system can become unstable if only Proportional Gain is used to try and eliminate all the error in a system. When the response of a system is considered satisfactory, but steady state error is excessive, the error can be further reduced by increasing system gain only for long term accumulations of error over time. Integral gain is sometimes used to compensate for static load disturbances like torque loading, gravity bias, and offset.

NOTE: This term can cause instability in a system as it has a more instant effect at the beginning of a move profile. Therefore. it is rarely used in the types of control systems presented here. Only small adjustments to Integral Gain should be made if indications of steady state error exist. In almost all applications this value is set to zero. We recommend using the Feed Forward Gain for closing following error occurring during a move profile.

Derivative Gain
Derivative Gain responds to the rate of change of the signal and can produce corrections before the error term becomes large, therefore it is useful in improving the transient response of a system. Since it opposes change in the controlled output, it can produce a stabilizing effect by damping a tendency toward oscillation. This is the reason we promote tuning by following error to the maximum Proportional Gain then setting Derivative Gain at 10% of Proportional Gain as a rule of thumb. Do not overdo Derivative Gain as it can have a detrimental effect on the overall response of the system.

Feed Forward
Acts to “push” the commanded output ahead to reduce or eliminate dynamic following error. Where dynamic following error is defined as the difference in actual position to commanded position that exists during motion. It is a more pure term than integral gain. It could be defined as the ability to correct for a “lag” in the system with an effect similar to Proportional Gain. Do not increase feed forward gain to the extreme as it can result in positive following error and excessive overshoot.

4) Recommended Tuning Procedures for Hypertherm Automation Motion Controls

Using the information previously provided as a core understanding of the position loop process we can now look at tuning motion for the desired motion performance. Due to potential safety hazards and the potential possibility for machine damage from incorrect tuning it is recommended that this operation be performed by trained and experienced personnel.

Prior to performing motion tuning, values for DAC Polarity, Encoder Polarity for each axis and maximum machine speed should be calculated and entered into control setups. Servo Error Tolerance for the axes should be set to maximum (5 inch max for X/Y motion).

Initially, it is recommended that basic tuning start with the motors disengaged from the machine to allow the user to confirm controlled motion and response of the motion axes. An initial Acceleration Rate of 10 Mg's can be used to begin the motion tuning. It is important to remember that after the motors are engaged to the machine for motion, the load requirements for each axis will change requiring additional tuning. Additionally if the acceleration rate in increased after the initial tuning, additional adjustments to Gain tuning may be required for proper machine motion.

Procedure

We recommend tuning the system by performing manual moves at a slow speed with all gains set to zero with the exception of Proportional Gain. Proportional Gain should start with a small value of 10. Engage the motors to the machine frame and beginning raising the Proportional Gain to allow movement. If the axes starts to vibrate or oscillate this indicate the selected gain value is too high and should be lowered. It may also require de-tuning the response of the Drive amplifier.

Now that you have some basic control of the system set up the Watch Window to display Position and Following Error for the selected Axes. Load and automatically "trial" the Test Pattern simple shape from the shape library. You will be able to follow response of the system by watching the performance of the Motor /Encoder feedback and its ability to maintain path on the control preview screen.

Systematically increase Proportional gain until it has little or no effect on the following error or until instability becomes noticeable. Then reduce proportional gain to eliminate instability. Adjust Derivative gain to 10% of the proportional gain value. For a Velocity Loop Servo Drive, Integral gain should be set to zero. After tuning for the best response, increase Feed Forward gain systematically to further reduce following error if necessary. It is not required that you eliminate following error but it is wise to ensure that Following Error for each axis is similar. Please Note: Feed Forward Gain will reduce steady state following error, but may cause overshoot.

It is important to note that some following error is desirable, following error terms should be nearly the same from one axis to another, and the polarity of the following error term must be the same as the direction of travel.

Finally, check the system tuning by placing a pen on the system. "Draw" the test pattern provided in the simple shape library and observe the cornering capability, arc/ circle contouring and the ability to position at the center crossings. When troubleshooting tuning issues, varying the size and trial speed can often provide valuable information through observations of the pen tracing.

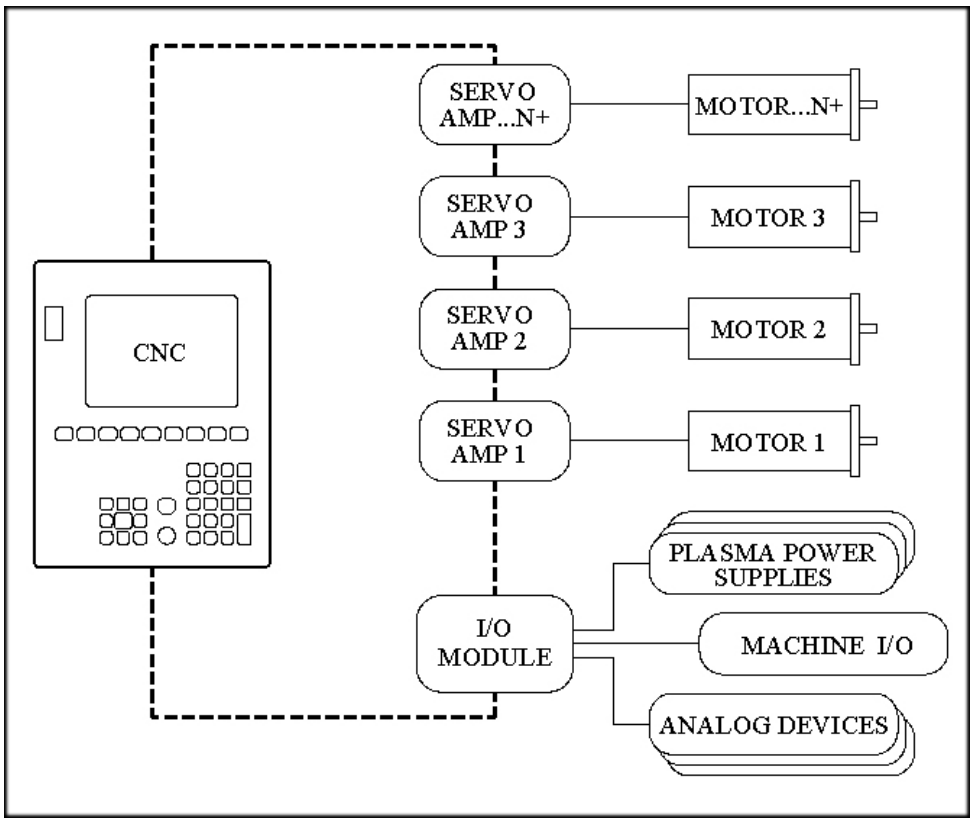
After the system has been successfully tuned, adjust the Servo Error Tolerance to equal twice the normal Following Error for the axes (note: This is a common approach to setting the Servo Error Tolerance but is up to the discretion of the service agent) . This is allows the system to operate without nuisance faults caused by temporary resistance to the motion, such as dirt on motion rails or temporary tension from motor cabling, etc.

SERCOS Interface™ Overview

The acronym "SERCOS" refers to **SE**rial **R**eal time **CO**mmunication **S**ystem servo drive interface. This approach to communication with the drive amplifiers is performed through use of a fiber optic ring and would replace the traditional +/- 10VDC analog output motion control card with a new fiber optic driver card. Motion commands from the amplifier to the motor are the same as in a traditional servo loop.

Developed in Europe in 1991 by a group of machine control vendors, SERCOS has been widely accepted and is approved by International standard (IEC 61491 in 1995) and European standard (EN 61491 in 1998).

Due to the expandable nature of the SERCOS interface, Mariner can support up to 12 axes of motion currently available in control software. Additional I/O modules may be added to expand the total number of digital and analog I/O.



The SERCOS Drive Interface has a number of unique advantages.

1. Reduced CNC - machine interface wiring by use of a single fiber optic connector.
2. Fast 32 bit communications between the drive an CNC.
3. Improved noise immunity due to the fiber optic communication.
4. Long fiber optic cable lengths supported.
5. SERCOS is an open standard that is cross vendor compatible.

For more information on SERCOS, contact SERCOS North America at http://www.sercos.com/

SERCOS™ Interface is a registered Trademark of SERCOS North America.

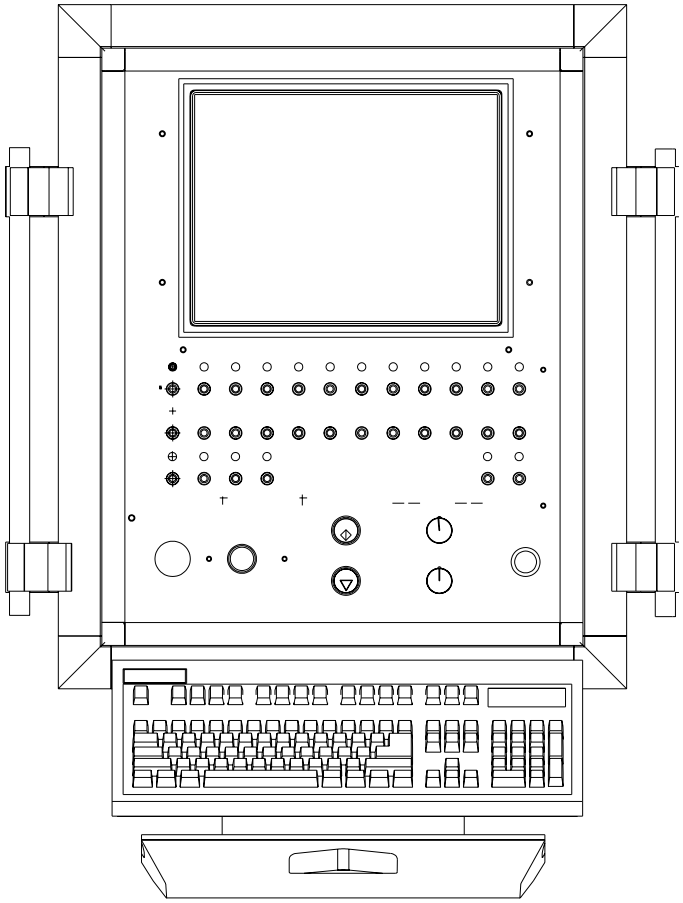
Appendix B: Mariner™ & Voyager II™

The Voyager II™ and Mariner™ are Hypertherm's premier PC-based CNC Controls for the metal cutting industry utilizing our proprietary Graphical User Interface (GUI) and *SoftMotion*™ Technology. These products set the standard for operational features, ease of use and increased productivity in the shape cutting industry.

This Appendix is intended to note additional product features, highlight modified view screens and to familiarize the operator with the screen structure for these controls. Many view screens will change only slightly and this section will only reference the new features for that view screen. ***Note:*** The controls have the ability to control several cutting processes. View screens which simply duplicate the set up parameters or features for the additional process, have not been included.

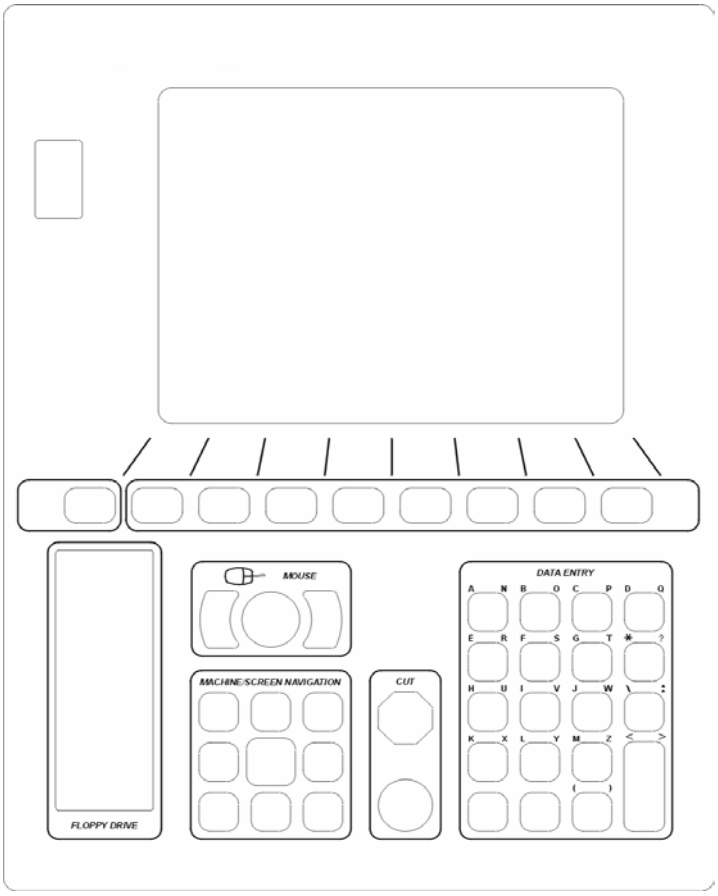
Mariner™ Overview

Mariner ™ offers motion control operation of up to 12 axes with 1024 I/O signals with SERCOS™ Interface, providing a high degree of flexibility in operation and table configurations. This control system supports Multiple Sensor™ Torch Height Controls, Tilt / Rotate, Dual tilt / Rotate and Dual Transverse motion axes along with direct communication to Hypertherm's HD3070® HyDefinition® Autogas Console, HD4070® HyDefinition® and HPR 130™ Plasma systems. A unique Laser process screen directly integrates to Hypertherm's *FAST*Laser head. This product uses type "V" software.



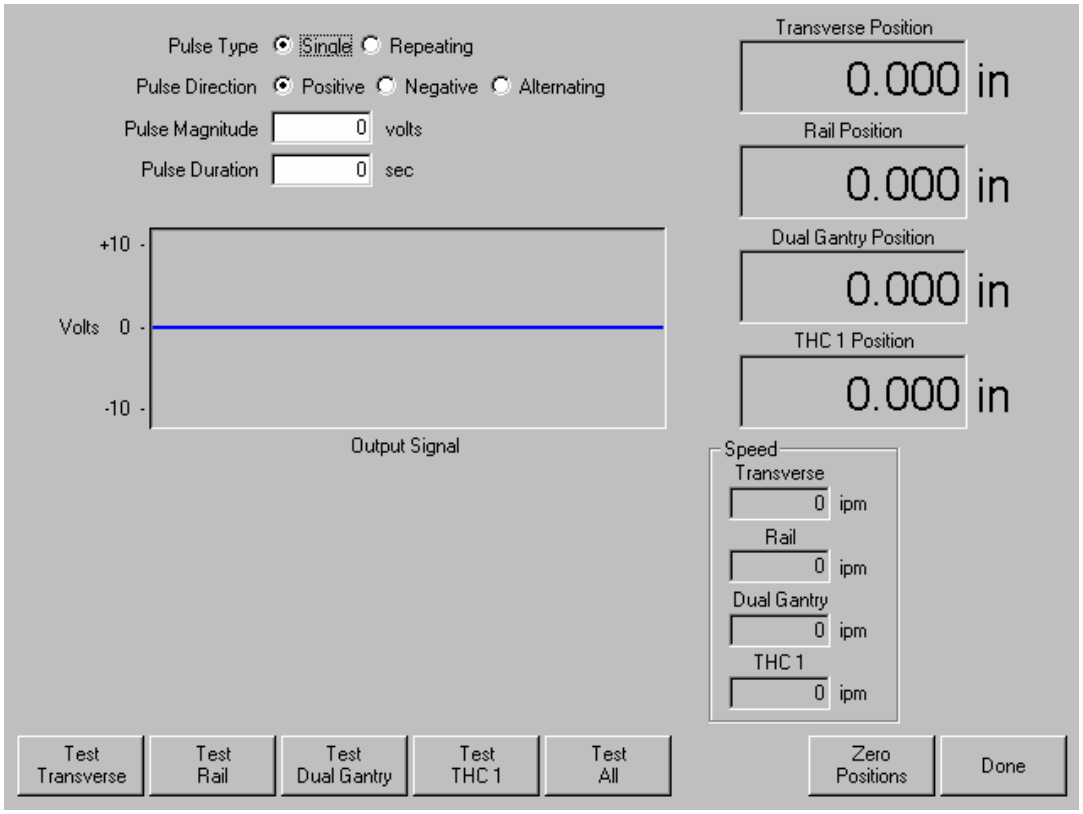
Voyager II™ Overview

Voyager II™ offers motion control operation of up to six axes with 64 I/O signals, providing a high degree of flexibility in operation and table configurations. This control system supports Multiple Sensor™ Torch Height Controls, Tilt / Rotate axes and direct communication to Hypertherm's HD3070® HyDefinition® Autogas Console, HD4070® HyDefinition® and HPR 130™ Plasma systems.

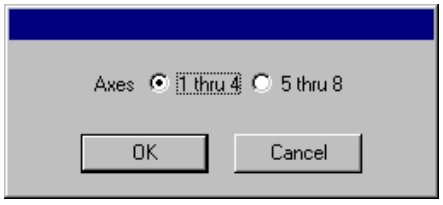


Diagnostics

Drives & Motors



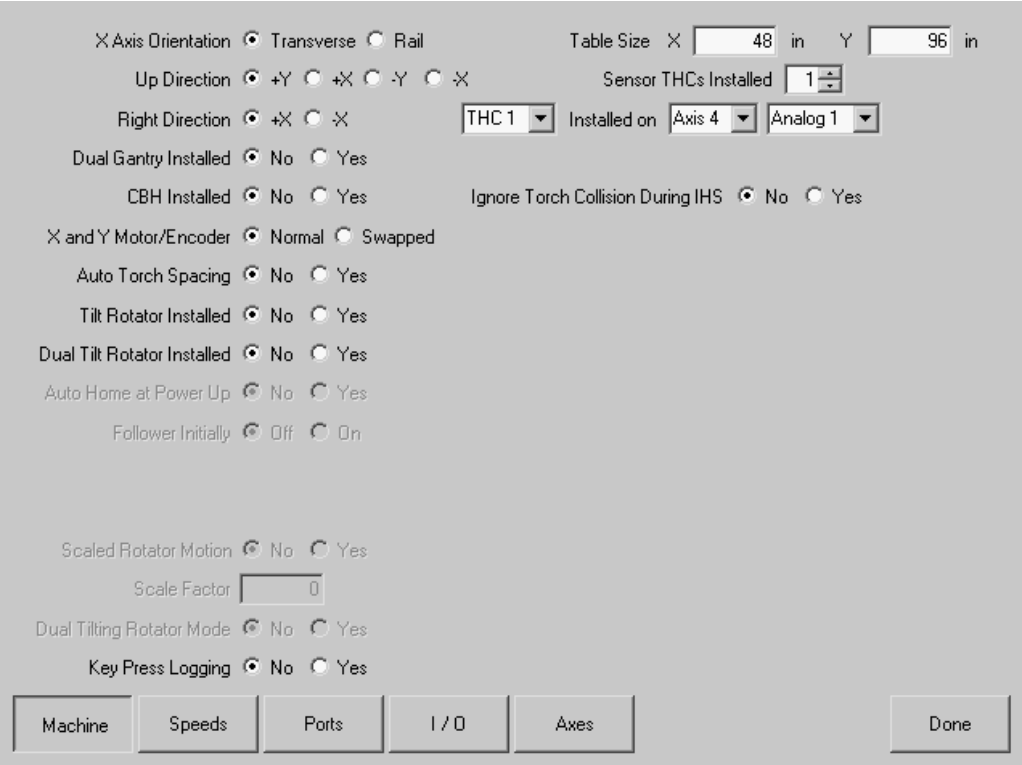
The Voyager II™ control has the ability to control up to six axes of motion. When entering the Drives & Motors Diagnostic screen, the user will prompted to select which group of axes will be available for testing.



Please refer to the Diagnostics Section of this guide for additional information on the Drives & Motors Diagnostic features.

Password Setups

Machine



Tilt Rotator Installed
The Tilt Rotator Installed parameter is used to enable use of the Tilt Rotator feature. Tilt Rotator is a unique rotational cutting tool which combines a rotational axis with a Tilt (bevel) axis allowing for compound cutting. Note: The Tilt Rotator feature will execute the commanded Tilt Angle motion over the length of the line segment (linear interpolation).

Dual Tilt Rotator Installed
This parameter enables use of a second Tilt Rotator feature. Additionally a second Transverse Axis is enabled for use allowing individual, parallel and Mirror cutting.

Auto Home at Power Up
Determines if the Contour Bevel Head (CBH) and Tilt / Rotate axes will automatically go into the homing routine upon powering up the control.

Follower Initially
This parameter is used to determine if the CBH and Rotate features will always be enabled after power up or would be enabled through the part program.

Dual Tilting Rotator Mode
The Dual Tilting Rotator Mode defines the Tilt Rotator to use two Tilt Axes rather than a Rotation Axis and Tilt Axis for Rotational Bevel Cutting. Tilt Rotator parameter must be active for this feature.

Key Logging
The Key Logging feature is used to record key press and other related information in a daily log file. This is intended for use by Service Technicians when a fault occurs to help review events prior to the fault experienced. When enabled, the file will be saved to the hard drive then may be retrieved through the Files feature by transferring the file to floppy diskette. Generally, this parameter is set to NO unless instructed by a technician to be enabled.

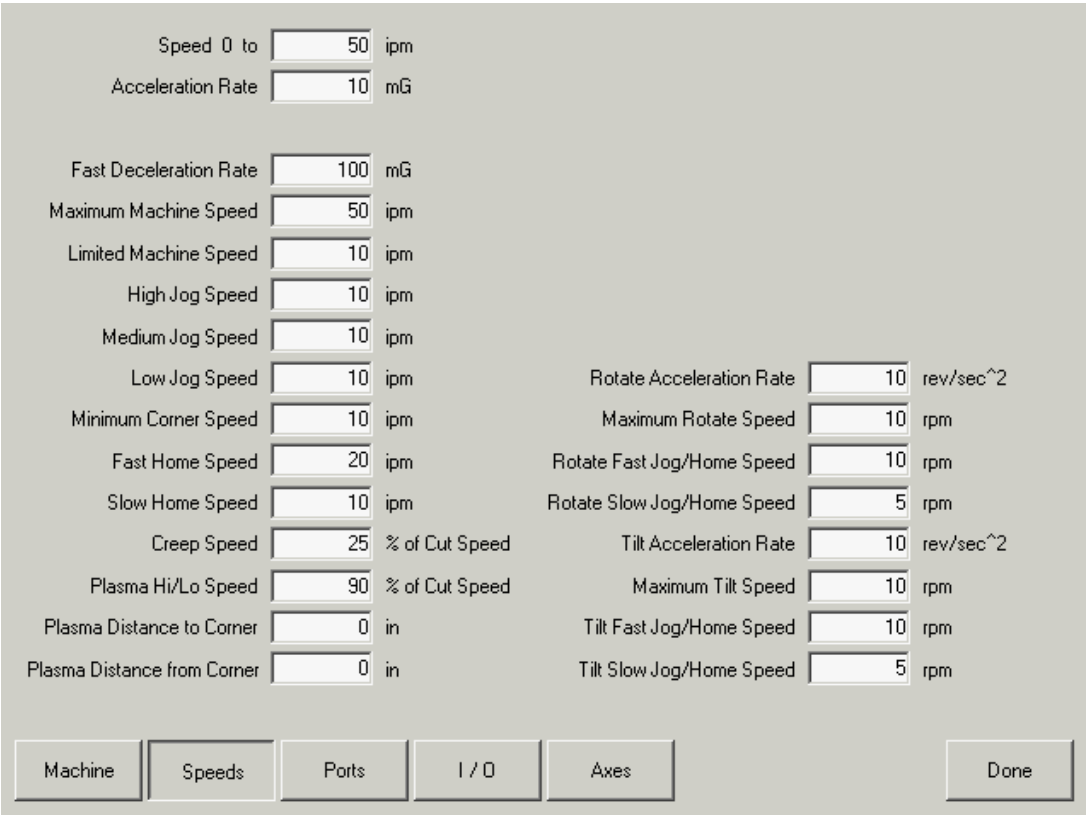
THCs Installed
The THC Installed parameter defines the total number of Sensor™ THC axes assigned for operation at the control.

THC Installed On Axis / Analog
This setup parameter is used to define the THC axis for use. The user can select which axis the THC is to be commanded on, the analog input to use (arc voltage feedback) and which plasma.

Note: Refer to the Station Configuration and Sensor™ THC sections of this guide for additional information on the setup and use of the Sensor™ THC.

Speeds

The following Speeds setup parameter will be available when Tilt Rotator has been enabled.



Rotate Acceleration Rate
This parameter allows the operator to set the acceleration rate for smooth and stable movement of the contoured bevel head. The higher the acceleration rate, the quicker the Rotate Axis will get up to speed. The lower the acceleration rate, the smoother the machine will position the cutting device. Values are entered in Rev/ Sec^2.

Maximum Rotate Speed
Enter the maximum speed for the Rotate Axis rotation in RPM.

Rotate High Jog Speed
Enter a value for the desired Rotate Axis High Jog Speed.

Rotate Low Jog Speed
Enter a value for the desired Rotate Axis Low Jog Speed.

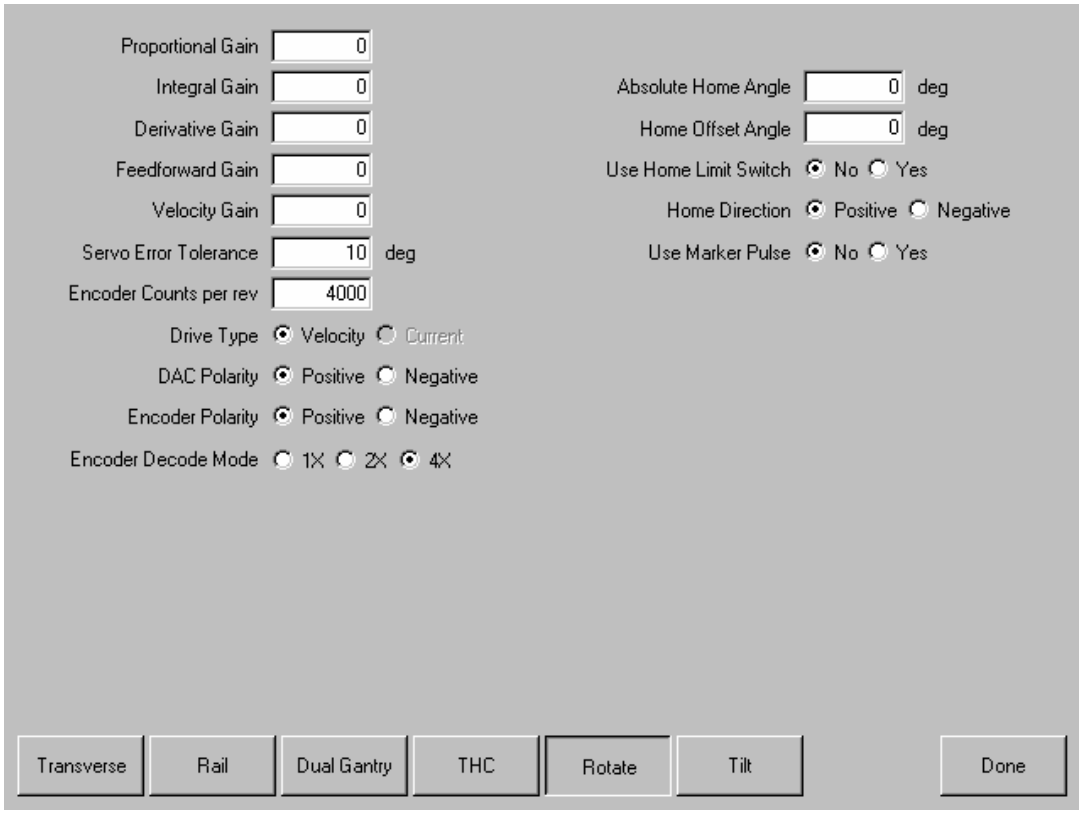
Tilt Acceleration Rate
This parameter allows the operator to set the acceleration rate for smooth and stable movement of the contoured bevel head. The higher the acceleration rate the quicker the Tilt Axis will get up to speed. The lower the acceleration rate the smoother the machine will position the cutting device. Values are entered in Rev/ Sec^2.

Maximum Tilt Speed
Enter the maximum speed for the Tilt Axis in RPM.

Tilt High Jog Speed
Enter a value for the desired Tilt Axis High Jog Speed.

Tilt Low Jog Speed
Enter a value for the desired Tilt Axis Low Jog Speed.

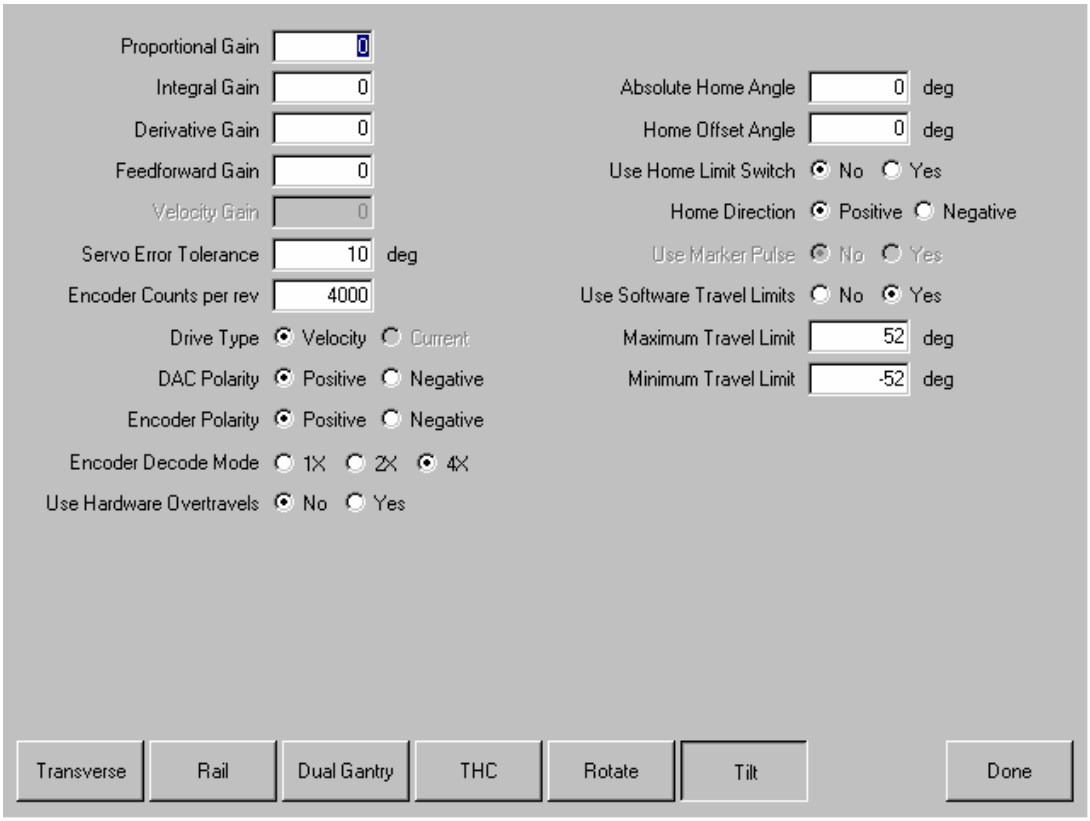
Rotate 1 & 2 Axes



Absolute Home Angle
Defines the position of the axis when the home limit switch or marker pulse is detected.

Home Offset Angle
Allows the user to set an offset angle from the home limit switch.

Tilt 1 & 2 Axes

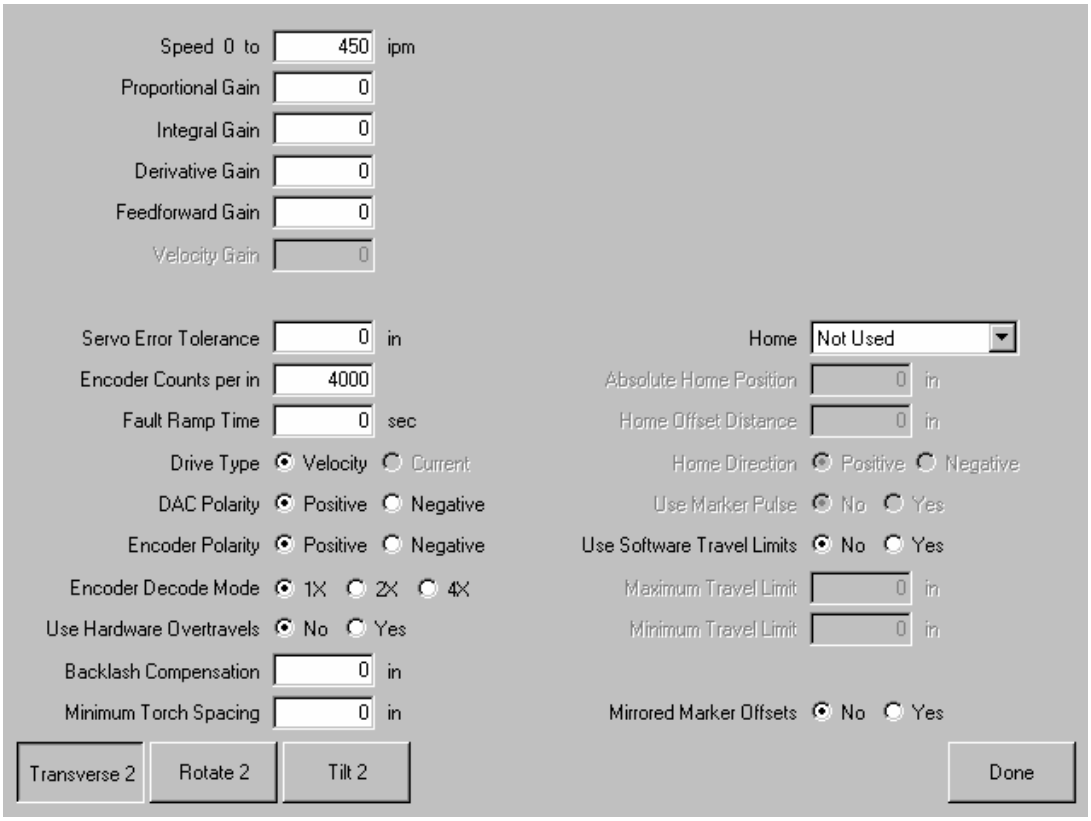


Absolute Home Angle
Defines the position of the axis when the home limit switch or marker pulse is detected.

Home Offset Angle
Allows the user to set an offset angle from the home limit switch.

Note: Homing to a limit switch uses the Tilt Overtravel Switch (+/ –) input.

Transverse 2 Axis



Minimum Torch Spacing
This value set a minimum distance allowed between Transverse 1 and Transverse 2 axes.

Mirrored Marker Offsets
This feature allows preset tool offsets to be performed as mirrored motion for the Transverse 2 axis.

Tilt Rotator Part Codes

Kerf Table

Code	Description
G59 D1-200Xvalue	Sets kerf table variable from 1-200
G41 D1-200	Enables Left Kerf using a Kerf Table variable
G42 D1-200	Enables Right Kerf using a Kerf Table variable
G43 D1-200	Changes current kerf value via Kerf Table using previously set Left or Right kerf

Tilt/Rotator

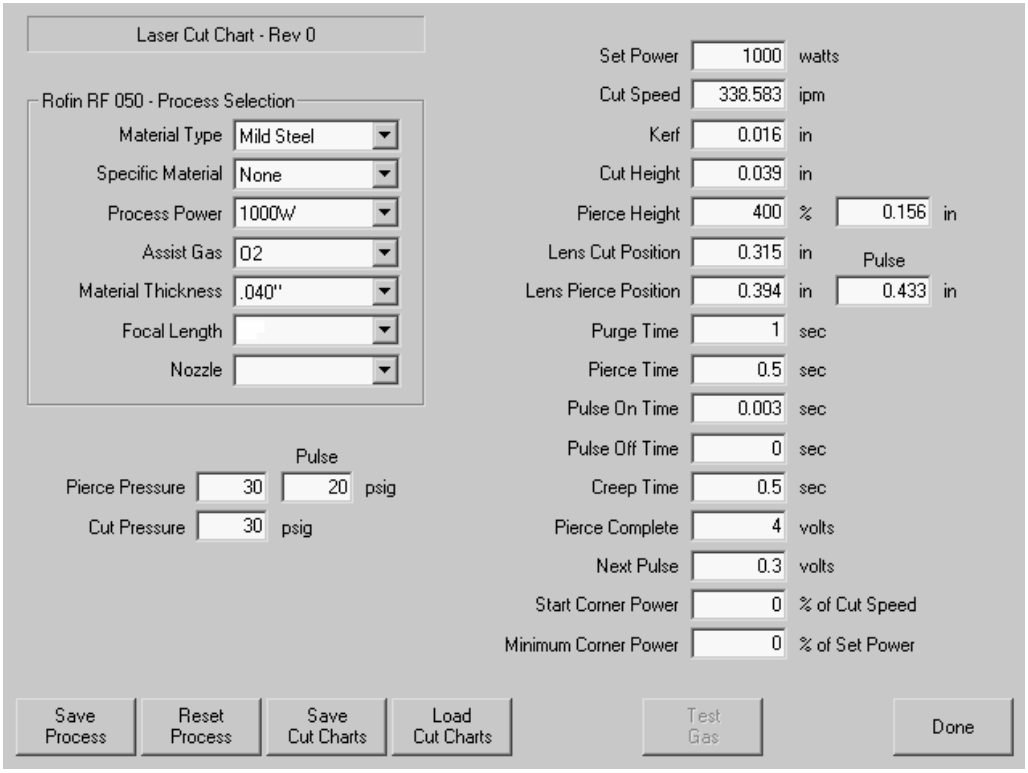
Code	Description
G00 A*value*	Sets Tilt angle – A is the angle value in degrees
G00 X*value* Y*value* A*value*	Performs Linear Interpolation of Tilt angle along line segment.
G00 A*value* F*value*	Sets Tilt angle – Angle value in degrees with a speed command in RPM
M28	Disables Follower
M29	Enables Follower
M90	Preparatory Cmd - Aligns Rotator to Tangent angle of next cut segment
M75	A axis/Tilt Goto Home Cmd - Rapid Index

Laser

Cut Chart

A cut chart database allows the user to select factory recommended settings or amend the database for personalized settings. The Cut Chart information may be saved or loaded via the hard drive or floppy drive. The Cut Chart files containing the factory recommended settings are available from Hypertherm®.

Access to the Cut Chart data is available from the Laser Cut Types screen using the shift key, as indicated below. The laser parameters must first be enabled in the password protected Station Configuration setups to allow the Cut Chart Information for the Laser to be available for use.

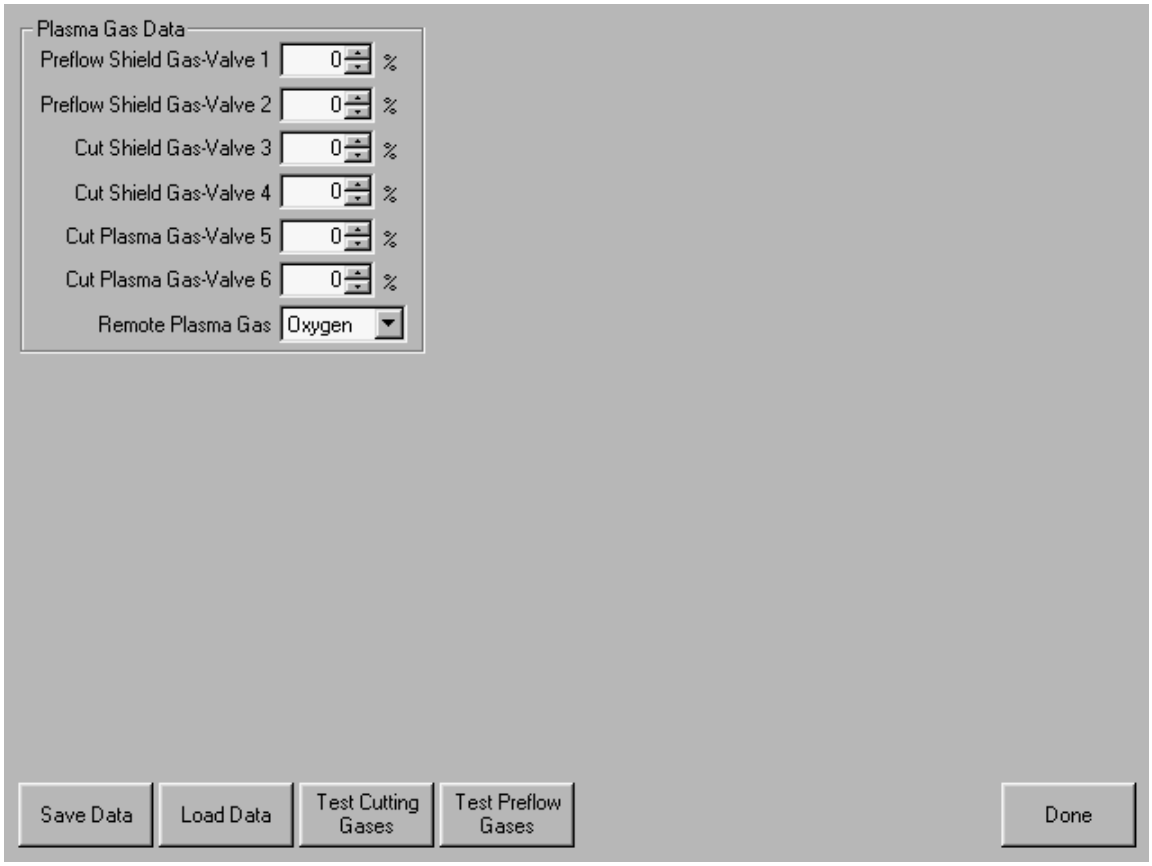


Please refer to the control Operator's Guide for additional information on setup and use of the Laser Cut Chart.

HD3070® Auto Gas Interface

This section outlines information specific to the HD3070® Auto Gas Interface. The Auto Gas screen is available from the Cut Types screen.

Note: The Auto Gas feature must first be enabled at the Special Password screen.



The top of the Auto Gas screen lists the valve parameter settings for the HD3070®. Valve settings for the 3070® Auto Gas console are documented in the HD3070® manual. When the values are set, these become the current setting and the operator can choose to save the file to the diskette or hard drive.

The settings at the supply are updated at control power up, whenever the settings are changed at this screen or through commands in a part program. Supply settings are also updated if power is lost and re-enabled at the power supply. There may be a brief delay as these power supply settings are communicated from the control to the power supply.

Save Data
Pressing the Save Data softkey will allow the operator to save the current Autogases setting to diskette or hard drive for future use.

Load Data
Pressing the Load Data softkey will allow the operator to Load stored Autogases setting from diskette or hard drive for use.

If you save the data, a file is created with G59 codes with the selected valve settings. Here is an example of the data file where all percentages are set to zero.

G59 V65 B0
G59 V66 B0
G59 V67 B0
G59 V68 B0
G59 V69 B0
G59 V70 B0
G59 V71 B0

Test Cutting Gases
Pressing the Test Cutting Gases softkey allows the operator to test the HD3070® Cut Gases.

Test Preflow Gases
Pressing the Test Preflow Gases softkey allows the operator to test the HD3070® Preflow Gases.

HD3070® Auto Gas I/O

The Interface to the HD3070® Auto Gas console is made through of Single Ended and BCD (Binary Coded Decimal) inputs. The BCD style of interface allows for exact settings by use of multiple inputs being active at any time. The active BCD input values are summed together to obtain the exact set point.

These I/O points are wired in the same fashion as our other Single Ended I/O points. The following I/O points are supplied for use of the HD3070® Auto Gas Console

Inputs

Gas Control Read Complete
Gas Control Error

Outputs

Gas Control Write	Remote Test Operate
Remote Test Preflow	Remote Air Plasma
Remote H35/ N2 Plasma	Remote O2 Plasma
Gas Flow Set 1-100 (BCD)	Valve Select 1-8 (BCD)

Cut Chart Setup through part program codes is supported. Refer to Part Programming section of the Installation Guide.

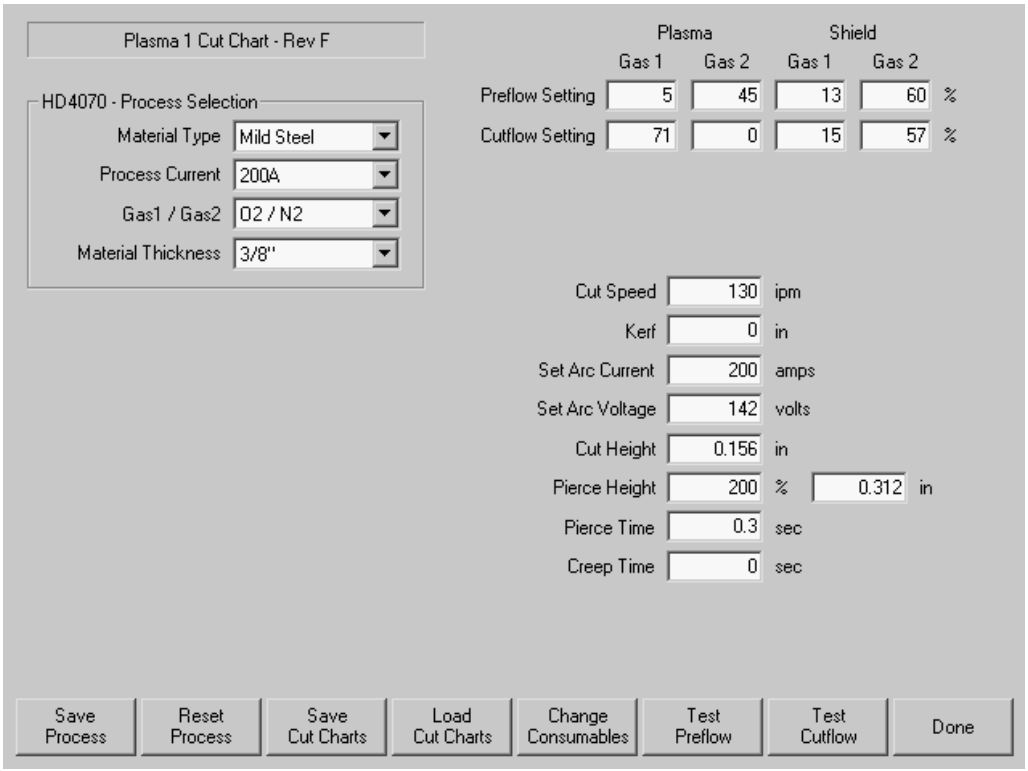
HD4070® and HPR130™ Interface

The Voyager II™ and Mariner™ controls offer the additional option of interfacing directly to Hypertherm's HD4070® HyDefinition® and HPR130 Power Supplies for setup. Note: MicroEdge and Edge II controls can be operated in Voyager mode to add this feature. This feature has the ability to improve the ease of power supply setup and operational accuracy, while having the flexibility to fine tune the process specific to the operator's needs.

Using this advanced feature, all necessary power supply settings are transmitted from the control directly to the power supply configuring it for use via serial communications. The power supply setup is performed through the use of a Cut Chart (cut process parameter database) which is based on eight process selections. The combination of these eight process selections are used as key reference settings to transmit all necessary cut process parameters (e.g. arc voltage, pierce delay, etc.) to the supply.

This database allows the user to select factory recommended settings or amend the database for personalized settings. The Cut Chart information may be saved or loaded via the hard drive or floppy drive. The Cut Chart files containing the factory recommended settings are available from Hypertherm®. Similar screens and features are available for the HPR130.

Cut Chart

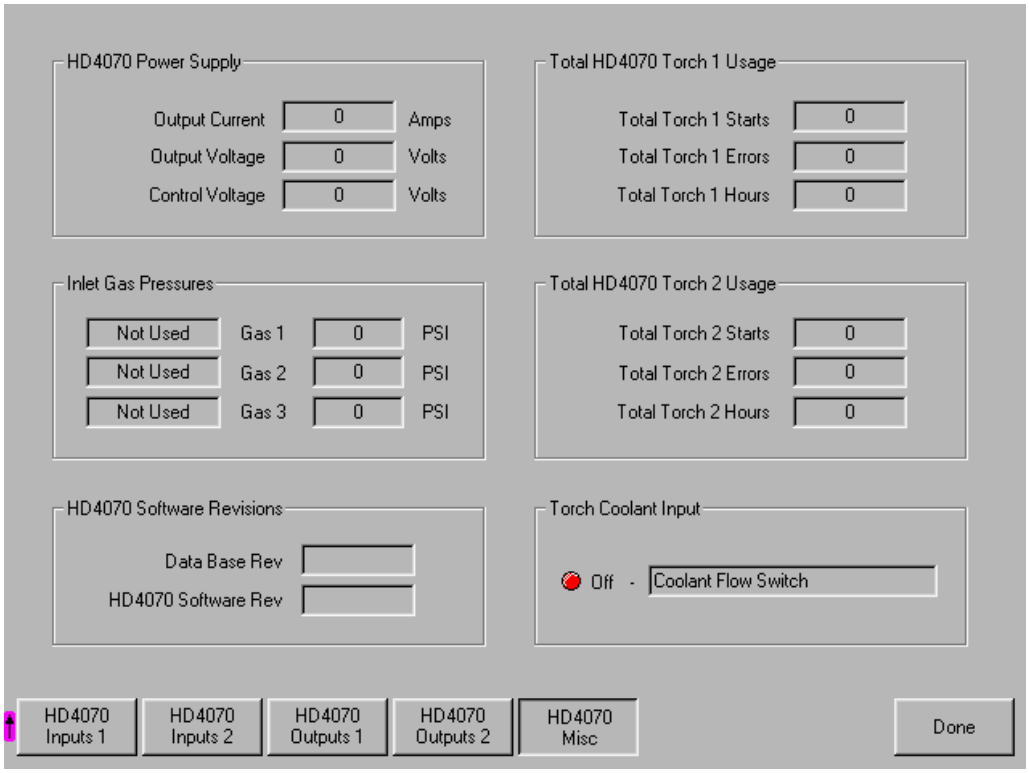


Please refer to the control Operator's Guide for additional information on setup and use of the Cut Chart. Cut Chart Setup through part program codes is supported. Refer to Part Programming section of the Installation Guide.

I/O and Diagnostics
Power Suppy I/O and remote diagnostics screens are accessed through the standard Diagnostic screen after serial link communications has been established. Status for the supply Software Revisions, Gas Pressure, Usage, I/O and Remote tools will be available.

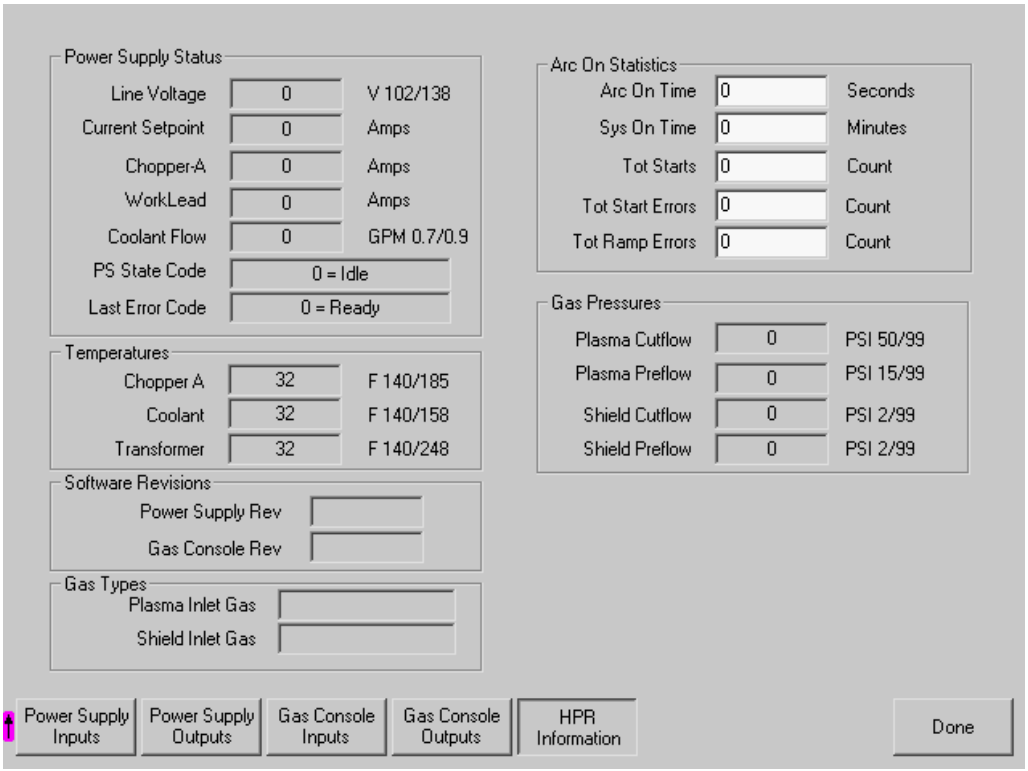
Miscellaneous
Status items for the supply are available at the Misc. Screen.

HD4070 Diagnostics



Remote Tools
While in the Diagnostics screen, you may press the Purple Shift Key to access the following remote tools.

HPR130 Diagnostics



Remote Tools
While in the Diagnostics screen, you may press the Purple Shift Key to access remote tools.

Test Preflow
Pressing the Test Preflow Softkey performs the Test Preflow Gases feature at the power supply. This feature is used to set the inlet gas pressures under normal flow conditions to the recommended level.

Test Cutflow
Pressing the Test Cutflow softkey performs the Test Cutflow Gases feature at the power supply. This feature is used to set the inlet gas pressures under normal flow conditions to the recommended level.

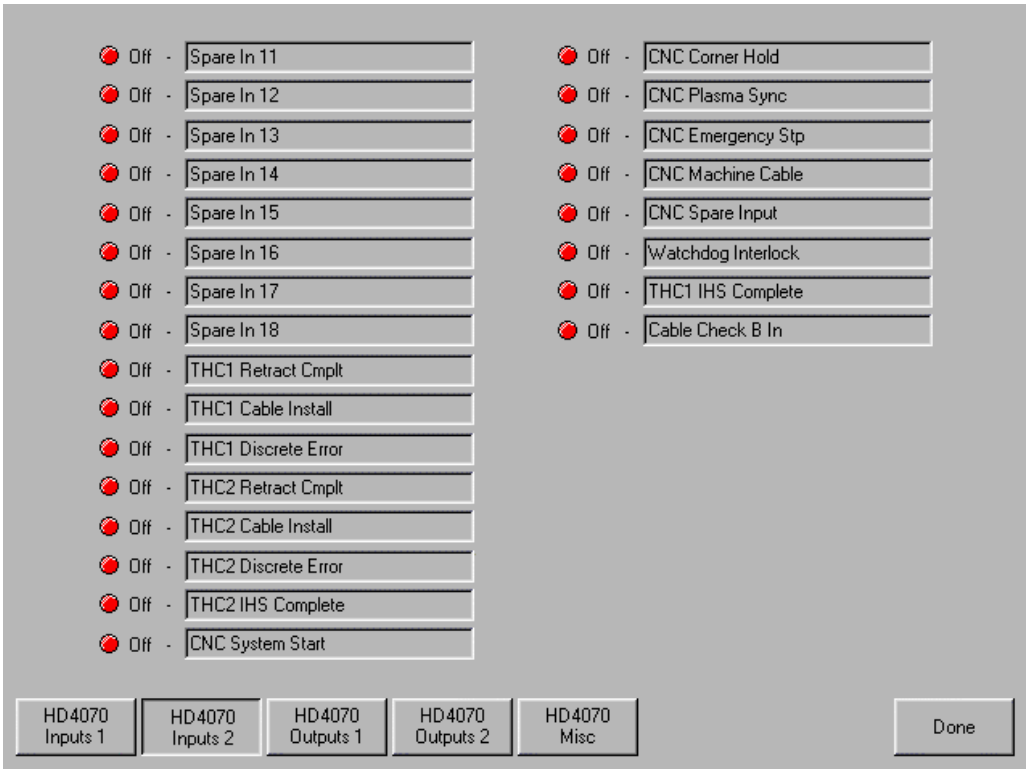
Test HPR Gas Console
This feature provides automated test features for the HPR AutoGas console. Please contact an authorized service agent for use of these tests.

Test Pump
Pressing the Test Pump softkey performs the Test Coolant Pump feature at the power supply. This feature is useful in purging the air bubbles from the coolant loop after installation or repair.

Update Software
Pressing the Update Software softkey will initiate the process of the Software Update at the power supply. Step by step instructions will be displayed on screen to guide the user through the update process.

Inputs
The Input screen shows the current status of the supply inputs.

Inputs (cont.)


Off - Spare In 11
Off - Spare In 12
Off - Spare In 13
Off - Spare In 14
Off - Spare In 15
Off - Spare In 16
Off - Spare In 17
Off - Spare In 18
Off - THC1 Retract Cmplt
Off - THC1 Cable Install
Off - THC1 Discrete Error
Off - THC2 Retract Cmplt
Off - THC2 Cable Install
Off - THC2 Discrete Error
Off - THC2 IHS Complete
Off - CNC System Start
Off - CNC Corner Hold
Off - CNC Plasma Sync
Off - CNC Emergency Stp
Off - CNC Machine Cable
Off - CNC Spare Input
Off - Watchdog Interlock
Off - THC1 IHS Complete
Off - Cable Check B In
HD4070 Inputs 1
HD4070 Inputs 2
HD4070 Outputs 1
HD4070 Outputs 2
HD4070 Misc
Done

Outputs

Similar to the standard Output Diagnostic screen, the output screen shows the current status of the listed supply outputs. Note: Outputs for the supply cannot be activated through the diagnostic screen.

Outputs (cont.)

Serial Communication Interface

RS-422C Connections to HD4070® CNC Interface

Control (male)		Supply (male)	
Signal Name	**DB-9 Pin**	**Signal Name**	**DB-37 Pin**
TxD-	2	RxD-	2
RxD-	3	TxD-	1
TxD+	4	RxD+	21
RxD+	7	TxD+	20

RS-422C Connections to HPR130™ CNC Interface

Control (male)		Supply (male)	
Signal Name	**DB-9 Pin**	**Signal Name**	**DB-37 Pin**
TxD-	2	RxD-	1
RxD-	3	TxD-	2
TxD+	4	RxD+	20
RxD+	7	TxD+	21

Multiple Supplies
The Serial Communication Link supported by the CNC can also be extended to multiple power supplies.

This unique feature is implemented through the use of the serial link and I/O points. It is assumed that the all systems are configured similarly and will be used simultaneously. If any of the selected power supplies has a fault, the fault must be cleared before the cut can begin.

Specific hardware and software versions for both the control and the power supply are required. Please refer to the power supply manual for additional information on operation and installation.

Inputs and Outputs

Raise 1-4 and Lower 1-4
The Raise / Lower inputs will be used to control the Integrated Command™ THC lifters on multi-dropped suppliess for the selected process.

Note: When using this feature with the Sensor™ THCs rather than the Integrated Command™ THCs, the Sensor™ THC Torch Raise and Torch Lower commands for the selected process may be made through the software softkeys or through the use of these external inputs to the control.

Cut Sense 1-4
THC Cut Sense Input (arc on feedback) is used to verify that the plasma torch or marker tool has established the arc for the selected torch. This indicates to the control that motion can begin.

Ready to Fire PS 1-4
This signal is an output from each supply and is used in multiple plasma systems. It notifies the CNC that the THC has completed the IHS cycle and Preflow is complete. This indicates that the torch is ready to fire. On the supply, this signal is used along with the CNC Plasma Sync Input. The CNC Hold Ignition output is connected to the supply CNC Plasma Sync" inputs. When all configured supplies return active "Ready to Fire" signals, the Hold Ignition signals are removed.

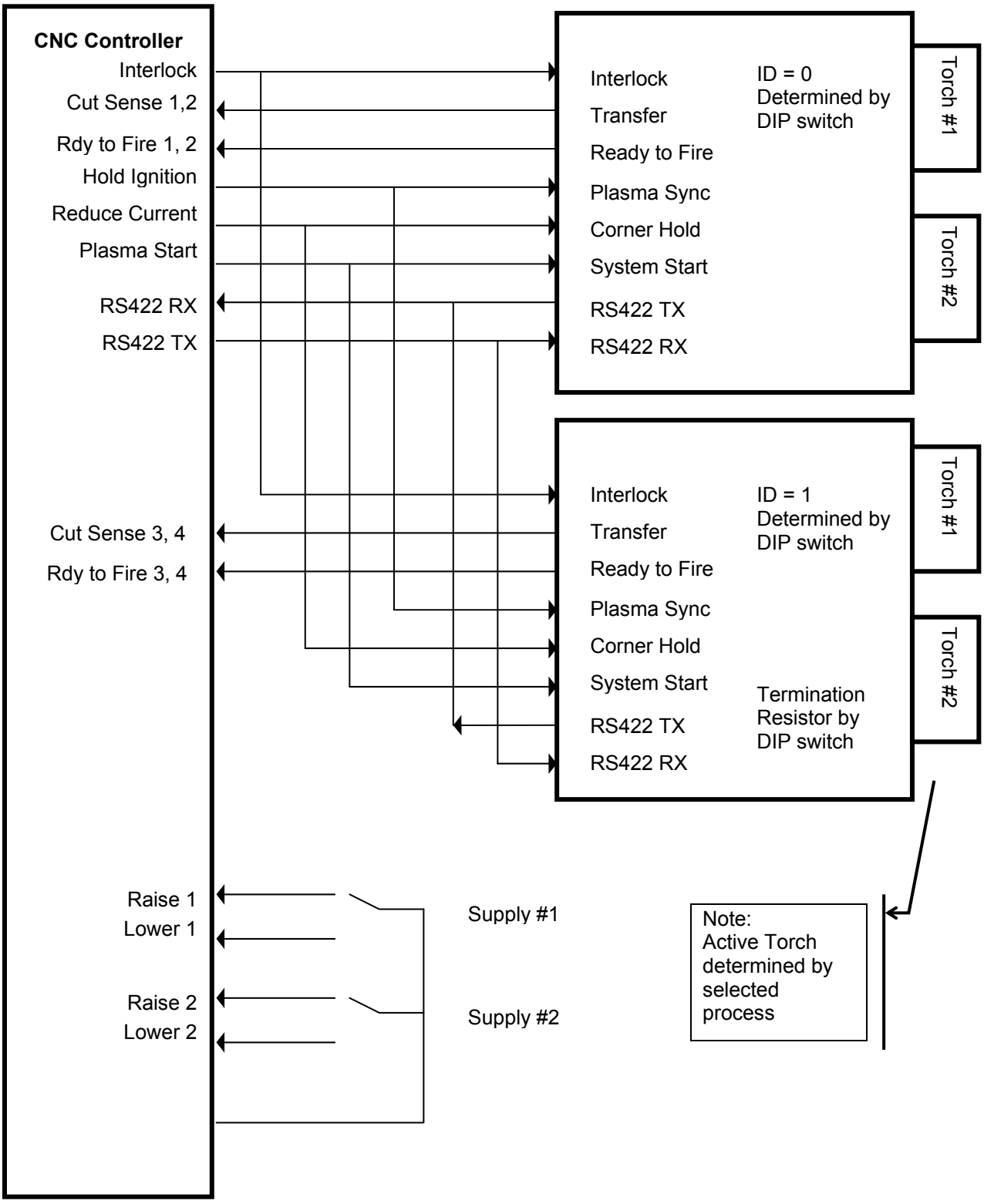
Hold Ignition
The Hold Ignition Output is used to delay ignition of the external plasma supply and allow the individual supplies to complete Preflow and IHS before torch ignition. For this application, the Hold Ignition would be tied to the Plasma Sync Inputs for multi-dropped supplies.

Reduce Current
Used with the supply to switch the plasma to low current mode. This signal is functionally different from the Torch Height Disable Output in that it is not active during the initial torch ignition, pierce, and accelerate to speed after Plasma Start. For this application, the Reduced Current output would be tied to the Corner Hold Inputs for multi-dropped power supplies.

The Corner Current Parameter located on the Plasma Setup Screen, is a user defined value for setting the percentage of the corner current.

NOTE HD4070®: Proper mult-drop operation requires a Rev C or higher Breakout board in the HD4070® as well as Rev K or higher control software in the HD4070®.

RS-422 Multidrop Interface to Multiple power supplies



FineLine® Overview

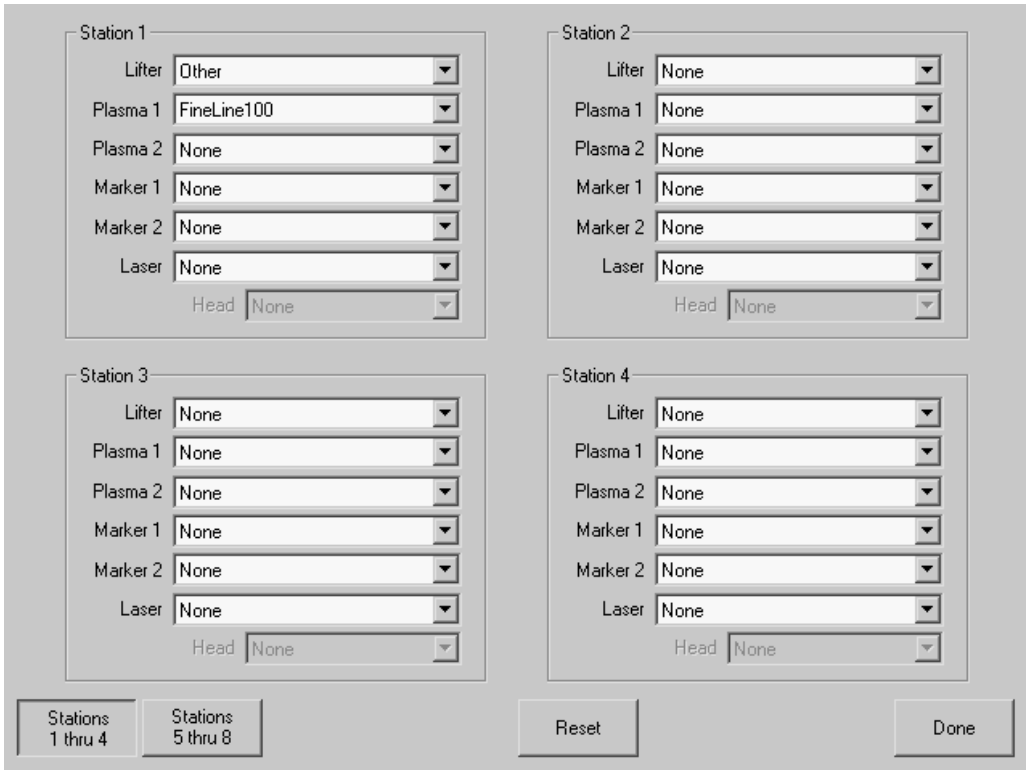
The “Type V” control offers the additional option of interfacing directly to INNERLOGIC’s FineLine Power Supply for setup via a user selected RS-422 serial port. This advanced feature transmits all necessary power supply settings from the control directly to the FineLine power supply configuring it for use.

The power supply setup is performed through the use of a Cut Chart (cut process parameter database) which is based on eight process variables. The combination of these eight process variables are tied to the settings for the cut process parameters (e.g. arc voltage, pierce delay, etc.) that are transmitted to the supply. For additional convenience, consumable part numbers for the FineLine are displayed at the Change Consumable screen.

This database allows the user to select factory recommended settings or amend the database for personalized settings. The Cut Chart information may be saved or loaded via the hard drive or floppy drive. Specialized Cut Chart files containing the factory recommended settings are available from the control vendor.

The Power Supply parameter must first be enabled in the password protected Station Configuration setups to allow the Cut Chart Information for the feature to be enabled for use. Once selected at the Station Configurations screen, the port must then be selected for communications on the Ports setup screen and the selected port must then be configured as RS-422. For more information on configuration of the port, refer to the Ports information section of this guide.

Station Configuration (example)



Notes:

- Please refer to the power supply operators manual for complete information on the operation and setup of the FineLine Power Supply.
- The FineLine Power Supply parameters must first be enabled in the password protected Station Configuration Screen to allow the Cut Chart Information for the FineLine to be available for use.
- Serial communications for the FineLine Power supply are established on the user selected communication port. The port must be configured for RS-422 operation.
- Cut Chart Setup through part program codes is supported. Refer to Part Programming section of the Installation Guide.

Automatic Torch Spacing

The Automatic Torch Spacing feature uses codes within the part program, and designated outputs, to perform precise positioning of individual torch stations for multi-torch cutting processes.

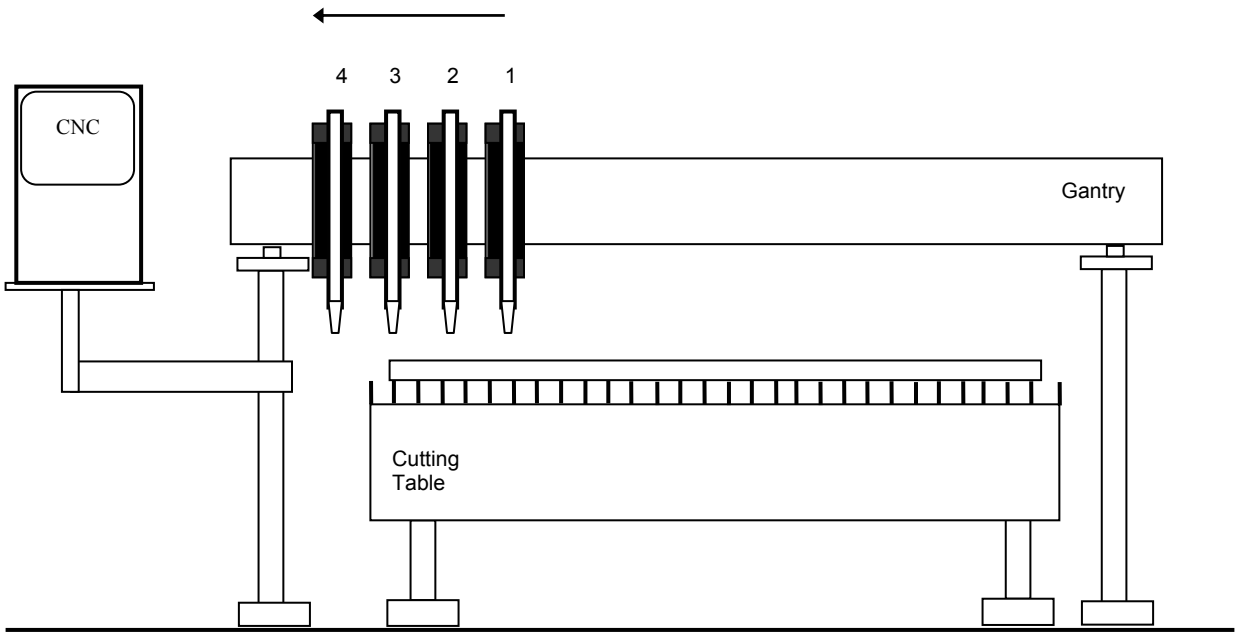
This Feature must be enabled in Machine Setups for use. The Auto Torch Spacing Override feature in Cutting Setups must also be enabled.

In this process, the master torch station has a fixed mount to the transverse axis and the other slave torch stations have the ability to clamp to the mechanics of the transverse axis during use or lock to the gantry or beam when not in use.

For the example, below Torch 1 is the master station and Torch 2-4 are the slave stations.

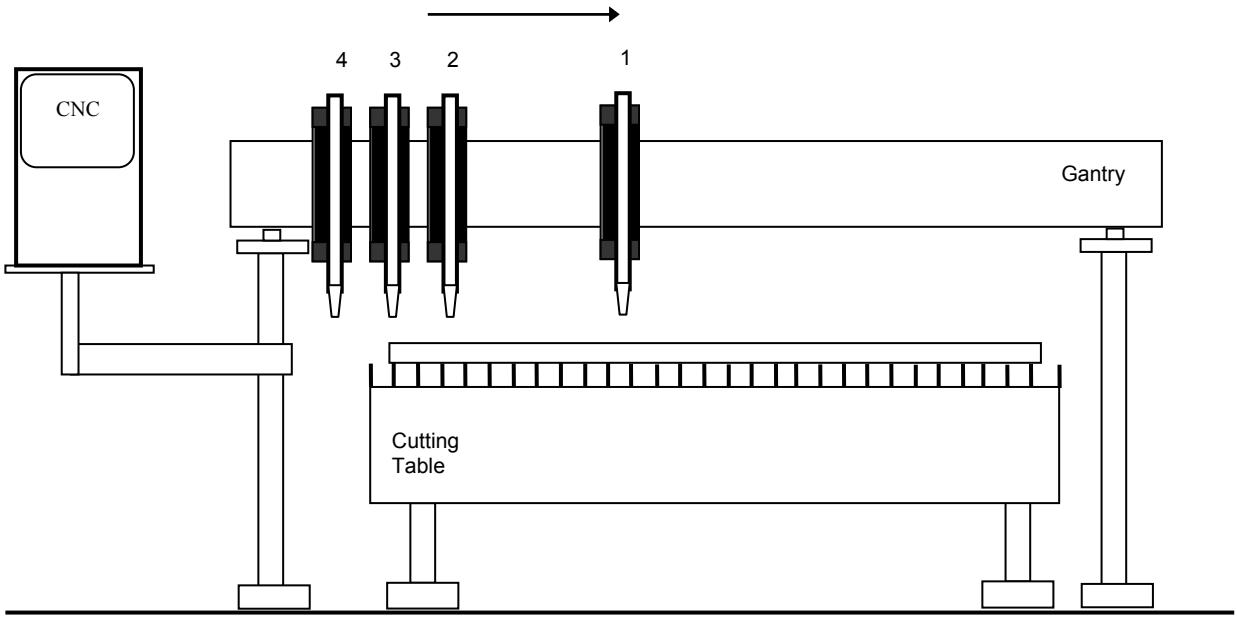
Typical use is as follows:

1) Unclamp and Unlock all stations (except the first which is fixed and slides the others)
2) Go to Home Command on Transverse Axis (M77 or M78 depending on orientation)

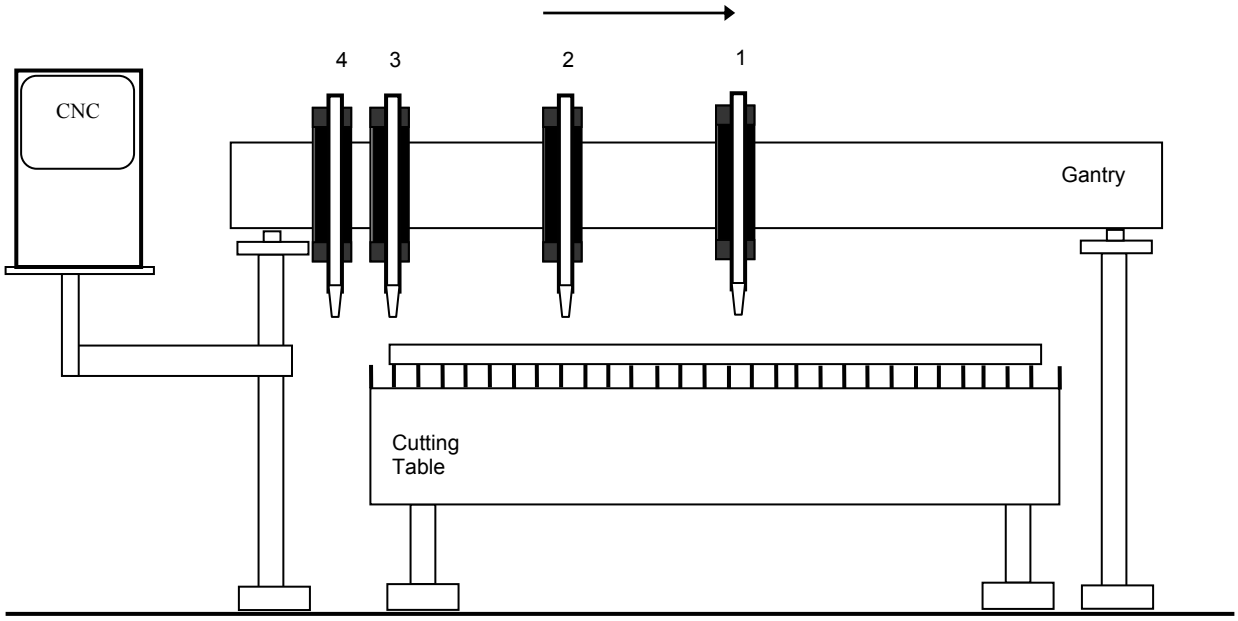


3) Clamp and Unlock all carriages and G00 index inward on transverse
(optional command - may used to space all stations away from edge / OT switch of machine)

4) Lock and Unclamp all and G00 index to space first station (remember-first station has no clamping/locking on board)



5) Unlock and Clamp next station and G00 index to space next station.



6) Repeat 5 above until as many stations as needed are spaced.

Note: Homing will also automatically include the commands necessary to push the stations to the side and lock / clamp them whenever the transverse is homed, if Auto Torch Spacing is enabled. Unclamp/ Clamp and Unlock / lock commands execute a one second delay before moving.

Automatic Torch Spacing Program Codes

Code	Description
M32	Unclamp / Unlock All Stations
M33	Unclamp / Lock All Stations
M34	Clamp / Unlock All Stations
M34T*value*	Clamp / Unlock 'T" Station, where T = 1 through 19
M35	Clamp / Unlock All Stations Mirror
M35T*value*	Clamp / Unlock Mirror "T" Station, where T = 1 through 19
M77	Go to Home position Y Axis
M78	Go to Home position X Axis
G00 Xn Yn	Traverse command where n = value to move the desired axes a distance.

Automatic Torch Spacing I/O

Station Lock 1-19	The Station lock is used to Lock the unused torch station to the gantry or beam when not in use.
Station Clamp 1-19	The Station Clamp is used to Clamp the selected torch station to the transverse axis for standard cutting.
Station Mirror 1-19	Station Clamp is used to Clamp the selected torch station to the transverse axis for mirrored cutting.

Example Part Program

Transverse axis defined as X axis
Three station cut of 20 inch vertical rip.

Code	Description
G70	English Units
G91	Incremental Mode
G99 X1 Y0 I0 J0	Axes Preset zero Scaling
M32	Unclamp / Unlock All Stations
M78	Home X Axis (move all stations to Home position)
M34	Clamp All / Unlock All
G00X2Y0	Traverse X axis 2 inches (to move off edge/ switch)
M33	Unclamp All / Lock All
G00X10Y0	Traverse X axis 10 inches (to set 10 inch space – station 1)
M34 T1	Clamp Station 1 / Unlock Station 1
G00X10Y0	Traverse X axis 10 inches (to set 10 inch space– station 2)
M34 T2	Clamp Station 2 / Unlock Station 2
G41	Left Kerf
M07	Cut On
G01 X0 Y20	Line segment (Y axis 20 inches)
M08	Cut Off
G40	Kerf Off
M02	End of Program

Appendix C: Program Codes

EIA RS-274D

The control supports EIA RS-274D part programs. An EIA RS-274D program lists the sequence of Lines, Arcs, Speeds, Kerf and I/O functions used to create a part. While the user is free to program in EIA using the standard text editor, it is recommended that the *ShapeWizard*® Graphical Programming environment be used instead.

Following is a list of the EIA codes that are directly supported, mapped, or currently unsupported by the control. Mapped EIA codes are automatically converted upon program load into directly supported EIA codes. Unsupported EIA codes are ignored. All other EIA codes will generate an error.

Directly Supported EIA Codes

EIA CODE	DESCRIPTION
F*value*	Machine Speed (if Speed Override enabled)
N*value*	Line Number
(*text*)	Comments
X*value*	X Axis Endpoint or other Data
Y*value*	Y Axis Endpoint or other Data
I*value*	I Axis Integrand or Part Option Data
J*value*	J Axis Integrand or Part Option Data
O*value* S*value*	Output (1-64), State (0-Off or 1-On)
W*value* S*value*	Wait for Input (1-64), State (0-Off or 1-On)
G00	Rapid Traverse Linear Interpolation
G00 A*value*	Sets Tilt angle – A is the angle value in degrees
G00 XY*value* A*value*	Performs Linear Interpolation of Tilt angle along line segment.
G00 A*value* F*value*	Sets Tilt angle – Angle value in degrees with a speed command in RPM
G00 Xn Yn	Traverse command where n = value to move the desired axes a distance.
G01	Linear Interpolation (at Cut Speed)
G02	Clockwise Circular Interpolation
G03	Counterclockwise Circular Interpolation
G04	Preset Dwell (uses Setup Dwell Time)
G04 X*value*	Program Dwell in Seconds
G08 X*value*	Repeat Subroutine X Times
G20	Select English Units (inches)
G21	Select Metric Units (mm)
G40	Disable Kerf Compensation
G41	Enable Left Kerf Compensation
G42	Enable Right Kerf Compensation
G43 X*value*	Kerf Value
G41 D1-200	Enables Left Kerf using a Kerf Table variable
G42 D1-200	Enables Right Kerf using a Kerf Table variable
G43 D1-200	Sets the current Kerf value via the Kerf Table using prior set Left or Right Kerf
G59 D1-200Xvalue	Sets Kerf table variable from 1-200

EIA CODE	DESCRIPTION
G59 V*value* F*value*	Sets the Plasma Supply current through Outputs or Serial Link for Vprocess (504,514,524,534) at Fcurrent value V504 – Current Setting Plasma 1 V514 – Current Setting Plasma 2 V524 – Current Setting Marker 1 V534 – Current Setting Marker 2
G82	Oxy-Fuel Cut Mode
G83	Oxy-Fuel Cut Mode Contour Bevel Head
G84	Plasma Cut Mode
G85	Plasma Cut Mode Contour Bevel Head
G90	Absolute Programming Mode
G91	Incremental Programming Mode
G92	Set Axis Presets
G97	Program Repeat Pointer
G97 T*value*	Program Repeat Pointer. Executes the repeat T times
G98	Repeat at G97, or start of program if no G97
G99	Part Options
M00	Program Stop
M01	Optional Program Stop (uses Setup Parameter)
M02	End of Program
M07	Cutting Device On
M08	Cutting Device Off
M09	Enable Marker 1
M10	Disable Marker 1
M11	Marker Offset 1 On
M12	Marker Offset 1 Off
M13	Enable Marker 2
M14	Disable Marker 2
M15	Cut On
M16	Cut Off
M17	Oxy Gas On
M18	Oxy Gas Off
M19	Cancel All Stations
M26	Station Select On
M27	Station Select Off
M28	CBH / Rotator Disable
M29	CBH Rotator Enable
M30	End of Program (same as M02)
M31	Reset Functions (Cut Off, Marker Off, Kerf Off)
M32	Unclamp / Unlock All Stations
M33	Unclamp / Lock All Stations
M34	Clamp / Unlock All Stations
M34T*value*	Clamp / Unlock ‘T” Station, where T = 1 through 19
M35	Clamp / Unlock All Stations Mirror
M35T*value*	Clamp / Unlock Mirror “T” Station, where T = 1 through 19
M36 T*value*	Process Select “T” where T value selects the process 1- Plasma 1 2- Plasma 2 3- Marker 1 4- Marker 2 5- Laser
M37 T*value (1-20)*	Select Station “T” where T = 1 through 20

EIA CODE	DESCRIPTION
M38 T*value (1-20)*	Deselect Station “T” where T = 1 through 20
M40	Start of Subroutine
M40 X*value*	Start of Subroutine. Executes the repeat X times
M41	End of Subroutine
M50	Height Sensor Disable
M51	Height Sensor Enable
M52	Height Sensor Disable and Raise Torch
M53	Height Sensor Enable and Lower Torch
M65	End of Program (same as M02)
M72	Marker Offset 2 Off
M73	Marker Offset 2 On
M75	A Axis/Tilt Go to Home Command - Rapid Index
M76	C Axis/Rotate Go to Home Command - Rapid Index
M77	Go to Home position Y Axis
M78	Go to Home position X Axis
M79 T*value (1-4)*	Go To Home Position (1-4)
M90	Aligns CBH / Rotator to Tangent angle of next cut segment
M274	Marker Offset 3 Off
M275	Marker Offset 3 On
M276	Marker Offset 4 Off
M277	Marker Offset 4 On
M278	Marker Offset 5 Off
M279	Marker Offset 5 On
M280	Marker Offset 6 Off
M281	Marker Offset 6 On
M282	Marker Offset 7 Off
M283	Marker Offset 7 On
M284	Marker Offset 8 Off
M285	Marker Offset 8 On
M286	Marker Offset 9 Off
M287	Marker Offset 9 On
M288	Marker Offset 10 Off
M289	Marker Offset 10 On
M290	Marker Offset 11 Off
M291	Marker Offset 11 On
M292	Marker Offset 12 On
M293	Marker Offset 12 On
M301	Assigns the current X/Y position to Home Position 1
M302	Assigns the current X/Y position to Home Position 2
M303	Assigns the current X/Y position to Home Position 3
M304	Assigns the current X/Y position to Home Position 4

Mapped EIA Codes

EIA CODE	DESCRIPTION	MAPPED TO
G04 F*value*	Program Dwell	G04 X*value*
G05	Set Axis Presets	G92
G21	Linear Interpolation (at cut speed)	G01
G22	CW Circular Interpolation	G02
G23	CCW Circular Interpolation	G03
G41 K*value*	Left Kerf with Value	G41 with Kerf Value
G42 K*value*	Right Kerf with Value	G42 with Kerf Value
G97 T*Value*	Subroutine Loop	G08 X*value* and M40

EIA CODE	DESCRIPTION	MAPPED TO
G45	Lead In to Kerfed Part	G01, G02, or G03
G70	Select English Units	G20
G71	Select Metric Units	G21
G98	End of Subroutine Loop	M41
M03	Cutting Device On/Off	M07 (Oxy Fuel) or M08 as appropriate
M04	Cutting Device On	M07
M05	Cutting Device Off	M08 (Oxy Fuel)
M06	Cutting Device Off	M08
M06	Enable Marker 2	M13
M07	Disable Marker 1 or 2	M10 or M14 as appropriate
M08	Enable Marker 1	M09
M09	Disable Marker 1 or 2	M10 or M14 as appropriate
M10	Enable Marker 2	M13
M14	Height Sensor Disable	M50
M15	Height Sensor Enable	M51
M20	Cutting Device On/Off	M07 or M08 as appropriate (Plasma)
M21	Cutting Device On/Off	M07 or M08 as appropriate (Plasma)
M20	Output 9 On	O9 S1
M21	Output 9 Off	O9 S0
M22	Output 12 On	O12 S1
M23	Output 12 Off	O12 S0
M24	Wait for Input 7 On	W7 S1
M25	Wait for Input 8 On	W8 S1
M25	CBH Enable	M29
M26	Wait for Input 7 Off	W7 S0
M26	CBH Disable	M28
M27	Wait for Input 8 Off	W8 S0
M67, M02	Kerf Left	G41
M68, M03	Kerf Right	G42
M69, M04	Kerf Off	G40
M65, M70	Cutting Device On	M07
M66, M71, M73	Cutting Device Off	M08
M70	Marker Offset 1 Off	M12
M71	Marker Offset 1 On	M11
M70T01	Marker Offset 1 Off	M12
M71T01	Marker Offset 1 On	M11
M70T02	Marker Offset 2 Off	M72
M71T02	Marker Offset 2 On	M73
M70T03	Marker Offset 3 Off	M274
M71T03	Marker Offset 3 On	M275
M70T04	Marker Offset 4 Off	M276
M71T04	Marker Offset 4 On	M277
M70T05	Marker Offset 5 Off	M278
M71T05	Marker Offset 5 On	M279
M70T06	Marker Offset 6 Off	M280
M71T06	Marker Offset 6 On	M281
M70T07	Marker Offset 7 Off	M282
M71T07	Marker Offset 7 On	M283
M70T08	Marker Offset 8 Off	M284
M71T08	Marker Offset 8 On	M285
M98	End Comment	)

EIA CODE	DESCRIPTION	MAPPED TO
M99	Start Comment	(
M221	No Mirror, No Rotate	G99 X1 Y0 I0 J0
M222	Mirror Y, No Rotate	G99 X1 Y0 I0 J1
M223	Mirror X and Y	G99 X1 Y0 I1 J1
M224	Mirror X, No Rotate	G99 X1 Y0 I1 J0
M225	Mirror X/Y on -45 Deg	G99 X1 Y270 I1 J0
M226	Rotate 90 Deg CCW	G99 X1 Y90 I0 J0
M227	Mirror X/Y on +45 Deg	G99 X1 Y270 I0 J1
M228	Rotate 90 Deg CW	G99 X1 Y270 I0 J0
M245	Output 1 On	O1 S1
M246	Output 1 Off	O1 S0
M247	Output 2 On	O2 S1
M248	Output 2 Off	O2 S0
M249	Output 3 On	O3 S1
M250	Output 3 Off	O3 S0
M251	Output 4 On	O4 S1
M252	Output 4 Off	O4 S0
M253	Wait for Input 1 On	W1 S1
M254	Wait for Input 1 Off	W1 S0
M255	Wait for Input 2 On	W2 S1
M256	Wait for Input 2 Off	W2 S0
M257	Wait for Input 3 On	W3 S1
M258	Wait for Input 3 Off	W3 S0
M259	Wait for Input 4 On	W4 S1
M260	Wait for Input 4 Off	W4 S0

Unsupported EIA Codes

EIA CODE	DESCRIPTION
G46	Table 0 Select
G99	Freestanding G99
G103 Q*name*	Stop Current Program/ Load New Program
G201	Incremental Line In2
G202	Incremental CW Arc In2
G203	Incremental CCW Arc In2
G211	Incremental Line In3
G212	Incremental CW Arc In3
G213	Incremental CCW Arc In3
G221	Absolute Line In2
G222	Absolute CW Arc In2
G223	Absolute CCW Arc In2
G231	Absolute Line In3
G232	Absolute CW Arc In3
G233	Absolute CCW Arc In3
G240	Programmable Kerf
G247	Table 1 Select
G248	Table 2 Select
G249	Table 3 Select
G250	Table 4 Select
G276	Internal Variable Load

Unsupported EIA Codes (cont.)

EIA CODE	DESCRIPTION
G277	External Variable Load
G278	X Axis Home
G279	Y Axis Home
G280	X Home Return
G281	Y Home Return
M22	PLC Control Code
M75	PLC Control Code
M210	X Sign Toggle
M211	Y Sign Toggle
M212	X and Y Swap and Toggle
M231	Aux. State Reset
M261	Aux. Torch Master On
M262	Aux. Torch Master Off

The unsupported EIA codes previously noted are ignored when read. Some of these codes may be supported in the future. Any EIA codes that are not listed above will result in a translator error upon loading the EIA program. Known EIA codes that will not be accepted include, but are not limited to:

P*value*	Program Number
D*value*	Indexed Kerf Operations
V*value*	Internal Variable Load

EIA Comments
Comments may be placed into the part program to be displayed on screen and viewed by the operator. The comment line must first be preceded by a program stop command (EIA M00 code or ESSI 0 code).

EIA Example:

M00 – Pauses Program
(Comment) – Text to be displayed

ESSI

The control supports ESSI part programs as defined by the International Standards Organization in ISO 6582. An ESSI program lists the sequence of Lines, Arcs, Speeds, Kerf and I/O Functions used to create a part. While the user is free to program in ESSI using a standard text editor, it is recommended that the *ShapeWizard*® Graphical Programming environment be used instead.

While the user is free to download ESSI programs to the control, it is important to note that all Part Programs will be internally converted to EIA for execution in the control. Following is a list of the ESSI codes that are mapped into the control, or currently unsupported by the control. Mapped ESSI codes are automatically converted upon program load into directly supported EIA codes. Unsupported ESSI codes are ignored. All other ESSI codes will generate an error.

Mapped ESSI Codes

ESSI CODE	DESCRIPTION	MAPPED TO EIA
%	Start of Program	Not Used-Automatic
+/-*value*…	Line or Arc	G00, G01, G02 or G03 as appropriate
0	End Program or Stop	M02 or M00 (if 64 is End Program)
3	Start Comment	(
4	End Comment	)
5	Enable Rapid Traverse	Not Used-Automatic
6	Disable Rapid Traverse	Not Used-Automatic
7	Cutting Device On	M07
8	Cutting Device Off	M08
9	Enable Marker 1	M09
10	Disable Marker 1	M10
11	Marker Offset 1 On	M11
12	Marker Offset 1 Off	M12
11+1	Marker Offset 1 On	M11
12+1	Marker Offset 1 Off	M12
11+2	Marker Offset 2 On	M73
12+2	Marker Offset 2 Off	M72
11+3	Marker Offset 3 On	M275
12+3	Marker Offset 3 Off	M274
11+4	Marker Offset 4 On	M277
12+4	Marker Offset 4 Off	M276
11+5	Marker Offset 5 On	M279
12+5	Marker Offset 5 Off	M278
11+6	Marker Offset 6 On	M281
12+6	Marker Offset 6 Off	M280

ESSI CODE	DESCRIPTION	MAPPED TO EIA
11+7	Marker Offset 7 On	M283
12+7	Marker Offset 7 Off	M282
11+8	Marker Offset 8 On	M285
12+8	Marker Offset 8 Off	M284
13	Enable Marker 2	M13
14	Disable Marker 2	M14
15	Marker Offset 2 On	M73
16	Marker Offset 2 Off	M72
21	No Mirror, No Rotate	G99 X1 Y0 I0 J0
22	Mirror Y, No Rotate	G99 X1 Y0 I0 J1
23	Mirror X and Y	G99 X1 Y0 I1 J1
24	Mirror X, No Rotate	G99 X1 Y0 I1 J0
25	Mirror X/Y on -45 Deg	G99 X1 Y270 I1 J0
26	Rotate 90 Deg CCW	G99 X1 Y90 I0 J0
27	Mirror X/Y on +45 Deg	G99 X1 Y270 I0 J1
28	Rotate 90 Deg CW	G99 X1 Y270 I0 J0
29	Enable Left Kerf Comp	G41
30	Enable Right Kerf Comp	G42
38	Disable Kerf	G40
39+*value*	Machine Speed	F*value*
40+*value*	Programmable Kerf	G43 X*value*
41	Preset Dwell	G04
41+*value*	Program Dwell in mSec	G04 X*value*
45	Ht Sensor Enable/Lower	M53
46	Ht Sensor Disable/Raise	M52
47	Ht Sensor Enable	M51
48	Ht Sensor Disable	M50
51	CBH Enable	M29
52	CBH Disable	M28
53	Cutting Device On	M07
54	Cutting Device Off	M08
63	Reset Functions	M31
64	End Program	M02
65	End of Program/ Reload	M65
67	Ht Sensor Disable	M50
68	Ht Sensor Enable	M51
70	Select English Units (in)	G20
71	Select Metric Units (mm)	G21
79+1	Go To Home Position 1	M79 T1
79+2	Go To Home Position 2	M79 T2
79+3	Go To Home Position 3	M79 T3
79+4	Go To Home Position 4	M79 T4
81	Incremental Mode	G91
82	Absolute Mode	G90
83	Set Axis Presets	G92
90	End of Program	M02
97	Program Repeat Pointer	G97
97+*value*	Subroutine Loop	M40 X*value*
98	Repeat at 97, Subroutine loop or start of program if no 97	G97, G98 or M41 as appropriate
99	End of Program	M02

ESSI CODE	DESCRIPTION	MAPPED TO EIA
245	Output 1 On	O1 S1
246	Output 1 Off	O1 S0
247	Output 2 On	O2 S1
248	Output 2 Off	O2 S0
249	Output 3 On	O3 S1
250	Output 3 Off	O3 S0
251	Output 4 On	O4 S1
252	Output 4 Off	O4 S0
253	Wait for Input 1 On	W1 S1
254	Wait for Input 1 Off	W1 S0
255	Wait for Input 2 On	W2 S1
256	Wait for Input 2 Off	W2 S0
257	Wait for Input 3 On	W3 S1
258	Wait for Input 3 Off	W3 S0
259	Wait for Input 4 On	W4 S1
260	Wait for Input 4 Off	W4 S0
282	Marker Offset 3 On	M275
283	Marker Offset 3 Off	M274
284	Marker Offset 4 On	M277
285	Marker Offset 4 Off	M276
286	Marker Offset 5 On	M279
287	Marker Offset 5 Off	M278
288	Marker Offset 6 On	M281
289	Marker Offset 6 Off	M280
290	Marker Offset 7 On	M283
291	Marker Offset 7 Off	M282
292	Marker Offset 8 On	M285
293	Marker Offset 8 Off	M284

Unsupported ESSI Codes

ESSI CODE	DESCRIPTION
103+Name	Stop Current Program/ Load New Program
237	X Sign Toggle
238	Y Sign Toggle
239	X and Y Swap and Toggle
266	Table 1 Select
267	Table 2 Select
268	Table 3 Select
269	Table 4 Select
276	Internal Variable Load
277	External Variable Load
278	X Axis Home
279	Y Axis Home
280	X Home Return
281	Y Home Return

The unsupported ESSI codes above are ignored when read. Some of these codes may be supported in the future. Any ESSI codes that are not listed above will result in a translator error upon loading the ESSI program.

ESSI Comments
Comments may be placed in to the part program to be displayed on screen and viewed by the operator. The comment line must first be preceded by a program stop command (EIA M00 code or ESSI 0 code).

ESSI Example:

0 – Pauses Program
3 – Start Comment
Comment – Text to be displayed
4 – End Comment

Unique Feature Codes

Kerf Table

Code	Description
G59 D1-200Xvalue	Sets kerf table variable from 1-200
G41 D1-200	Enables Left Kerf using a Kerf Table variable
G42 D1-200	Enables Right Kerf using a Kerf Table variable
G43 D1-200	Changes current kerf value via Kerf Table using previously set Left or Right kerf

Tilt / Rotator Part Codes

Code	Description
G00 A*value*	Sets Tilt angle as a preparatory command – A is the angle value in degrees
G00 XY*value* A*value*	Performs Linear Interpolation of Tilt angle along line segment.
G00 A*value* F*value*	Sets Tilt angle – Angle value in degrees with a speed command in RPM
M28	Disables Follower
M29	Enables Follower
M90	Preparatory Cmd - Aligns Rotator to Tangent angle of next cut segment
M75	A axis/Tilt Goto Home Cmd - Rapid Index

Automatic Torch Spacing Program Codes

Code	Description
M32	Unclamp / Unlock All Stations
M33	Unclamp / Lock All Stations
M34	Clamp / Unlock All Stations
M34T*value*	Clamp / Unlock ‘T” Station, where T = 1 through 19
M35	Clamp / Unlock All Stations Mirror
M35T*value*	Clamp / Unlock Mirror “T” Station, where T = 1 through 19
M77	Go to Home position Y Axis
M78	Go to Home position X Axis

Station Selects
Stations (Lifter / THCs) may be selected / de-selected using a EIA-274D program code with the following format.

Code	Description
M19 T*value*	Cancel All Station Selections
M37 T*value*	Select Station 1-20 (Tvalue)
M38 T*value*	De-Select Station 1-20 (Tvalue)

Additionally, these Station Select program codes may be overridden using the user selected THC inputs to the control. The feature to override the part program must be enabled at the Cutting Setup screen.

Process Selects
Process Selections may be selected using a EIA-274D program code with the following format.

Example: M36 T*value*

Misc. M Code — M36

Valve Identity — T*value*

T1 = Plasma Process 1
T2 = Plasma Process 2
T3 = Marker Process 1
T4 = Marker Process 2
T5 = Laser Process

Station Configuration Variables
The following options are available for the station configuration

Lifter
None
Sensor THC
Command THC (w/ Serial Link)
HD4070 Integrated THC 1 or 2 (used only with the HD4070® power supply)
Other (any stand alone Lifter Station)

Power Supplies

None	HD4070 Torch 1or 2	Powermax series
Max100/ 100D	HT4001	FineLine 100
Max200	HT4100	FineLine 200
HT2000	HT4400	Other (any other Plasma system)
HD3070	HPR130	

Marker

None	ArcWriter	FineLine 100 & 200
HD4070 Torch 1or 2	HPR130	Other (any stand alone Marker)

Laser

Rofin RF 40 & 50	Rofin DC 35	Rofin TR 60	Other

HD3070® Auto Gas Overview

The Interface to the HD3070® Auto Gas console is made through of Single Ended and BCD (Binary Coded Decimal) inputs. The BCD style of interface allows for exact settings by use of multiple inputs being active at any time. The active BCD input values are summed together to obtain the exact set point.

These I/O points are wired in the same fashion as our other Single Ended I/O points. The following I/O points are supplied for use of the HD3070® Auto Gas Console

Inputs
Gas Control Read Complete
Gas Control Error

Outputs

Gas Control Write	Remote Test Operate
Remote Test Preflow	Remote Air Plasma
Remote H35/ N2 Plasma	Remote O2 Plasma
Gas Flow Set 1-100 (BCD)	Valve Select 1-8 (BCD)

HD3070® Part Program Support
The same valve setting data which is used at the Auto Gas setup screen may also be used within a part program to configure the HD3070® for use. This code is used to select the valve and indicate the valve set point.

Using a EIA-274D G59 code with the following format.

Example: G59 V65 B5

Misc. G Code

Valve Identity
V65 = Preflow Shield Gas - Valve 1
V66 = Preflow Shield Gas - Valve 2
V67 = Cut Shield Gas - Valve 3
V68 = Cut Shield Gas - Valve 4
V69 = Cut Plasma Gas - Valve 5
V70 = Cut Plasma Gas - Valve 6
V71 = Remote Plasma Gas Type

Valve Value
For Valves V65 – V70
A whole integer is used to set the desired percentage value.
For Valve 71
0 = Oxygen
1 = H35/N2
2 = O2

For the example given, the part program code (G59 V65 B5) would set the Autogas Preflow Shield Gas valve to 5%. Multiple G59 codes can be used to set and adjust the all desired valves.

HD4070® and HPR Part Program Support

The same Cut Chart data which is used at the Cut Chart setup screen may also be used within a part program to configure the power supply for use. This code is used to select the set point for each variable.

It is not necessary to have a line of code for each Cut Chart variable within a part program. Only those variables which are changing need be inserted into the part program (e.g. Material Thickness or Material Type).

Part program codes for the power supply should be grouped together at the beginning of the program. The three variables which may be set through the part program are Material Type, Current Setting and Material Thickness.

Cut parameters for the power supply may be configured using the EIA-274D G59 code with the following format.

Example: G59 V503 F5

Misc. G Code

Variable Identity

V503 – Material Type Plasma 1
V513 – Material Type Plasma 2
V523 – Material Type Marker 1
V533 – Material Type Marker 2

V504 – Current Setting Plasma 1
V514 – Current Setting Plasma 2
V524 – Current Setting Marker 1
V534 – Current Setting Marker 2

V507 – Material Thickness Plasma 1
V517 – Material Thickness Plasma 2
V527 – Material Thickness Marker 1
V537 – Material Thickness Marker 2

Variable Value

V503, V513, V523, V533 – Material Type

1 = Mild Steel
2 = Stainless Steel
3 = Aluminum

V504, V514, V524, 534 – Current Setting

7 = 7A	70 = 70A
10 = 10A	80 = 80A
15 = 15A	100 = 100A
18 = 18A	130 = 130A
30 = 30A	200 = 200A
45 = 45A	

Variable Value *(continued)*

V507, 517, 527, 537 – Material Thickness

1 = None	12 = 10GA	23 = 9/16” & 14mm
2 = 28GA	13 = 1/16” & 1.5mm	24 = 5/8” & 15mm
3 = 27GA	14 = .075” & 2mm	25 = 3/4” & 20mm
4 = 26GA	15 = 3/32” & 2.5mm	26 = 7/8” & 22mm
5 = 24GA	16 = 1/8” & 3mm	27 = 1” & 25mm
6 = 22GA	17 = 3/16” & 5mm	28 = 1 1/8” & 29mm
7 = 20GA	18 = 1/4” & 6mm	29 = 1 1/4” & 32mm
8 = 18GA	19 = 5/16” & 8mm	30 = 1 3/8” & 35mm
9 = 16GA	20 = 3/8” & 10mm	31 = 1 1/2” & 38mm
10 = 14GA	21 = 7/16” & 11mm	32 = 1 3/4” & 44mm
11 = 12GA	22 = 1/2”& 12mm	33 = 2” & 50mm

FineLine Part Program Support

The same Cut Chart data which is used at the Cut Chart setup screen may also be used within a part program to configure the FineLine for use. This code is used to select the set point for each variable.

It is not necessary to have a line of code for each Cut Chart variable within a part program. Only those variables which are changing need be inserted into the part program (e.g. Material Thickness or Material Type).

Part program codes for the FineLine should be grouped together at the beginning of the program. The three variables which may be set through the part program are Material Type, Current Setting and Material Thickness.

Cut parameters for the FineLine may be configured using a EIA-274D G59 code with the following format.

Example: G59 V503 F5

Misc. G Code

Variable Identity

V503 – Material Type Plasma 1
V513 – Material Type Plasma 2
V523 – Material Type Marker 1
V533 – Material Type Marker 2

V504 – Current Setting Plasma 1
V514 – Current Setting Plasma 2
V524 – Current Setting Marker 1
V534 – Current Setting Marker 2

V507 – Material Thickness Plasma 1
V517 – Material Thickness Plasma 2
V527 – Material Thickness Marker 1
V537 – Material Thickness Marker 2

Variable Value

V503, V513, V523, V533 – Material Type

1 = Mild Steel
2 = Stainless Steel
3 = Aluminum

V504, V514, V524, 534 – Current Setting

8 = 8A	50 = 50A
9 = 9A	70 = 70A
10 = 10A	100 = 100A
30 = 30A	200 = 200A

Variable Value *(continued)*

V506 – Cutting Surface
1 = Above Water
2 = 3” Below Water
3 = Mild Steel Cold Rolled (50 AMP)

V507 – Material Thickness

1 = None	12 = 10GA	23 = 9/16” & 14mm
2 = 28GA	13 = 1/16” & 1.5mm	24 = 5/8” & 15mm
3 = 27GA	14 = .075” & 2mm	25 = 3/4” & 20mm
4 = 26GA	15 = 3/32” & 2.5mm	26 = 7/8” & 22mm
5 = 24GA	16 = 1/8” & 3mm	27 = 1” & 25mm
6 = 22GA	17 = 3/16” & 5mm	28 = 1 1/8” & 29mm
7 = 20GA	18 = 1/4” & 6mm	29 = 1 1/4” & 32mm
8 = 18GA	19 = 5/16” & 8mm	30 = 1 3/8” & 35mm
9 = 16GA	20 = 3/8” & 10mm	31 = 1 1/2” & 38mm
10 = 14GA	21 = 7/16” & 11mm	32 = 1 3/4” & 44mm
11 = 12GA	22 = 1/2”& 12mm	33 = 2” & 50mm

Sensor™ THC Part Program Support

Sensor™ THC offers the ability to configure THC setup parameters through part program codes.

The following parameters are available for use using EIA-274D G59 codes:

Arc Voltage
Pierce / Start Time
Pierce/ Start Height Factor
Cut / Mark Height

Setup is obtained using the following format.

Example: G59 V601 F*value*

Misc. G Code

Variable Identity

V600 = Plasma 1 Arc Voltage
V601 = Plasma 1 Pierce Time
V602 = Plasma 1 Pierce Height Factor
V603 = Plasma 1 Cut Height

V625 = Plasma 2 Arc Voltage
V626 = Plasma 2 Pierce Time
V627 = Plasma 2 Pierce Height Factor
V628 = Plasma 2 Cut Height

V650 = Marker 1 Arc Voltage
V651 = Marker 1 Start Time
V652 = Marker 1 Start Height Factor
V653 = Marker 1 Mark Height

V675 = Marker 2 Arc Voltage
V676 = Marker 2 Start Time
V677 = Marker 2 Start Height Factor
V678 = Marker 2 Mark Height

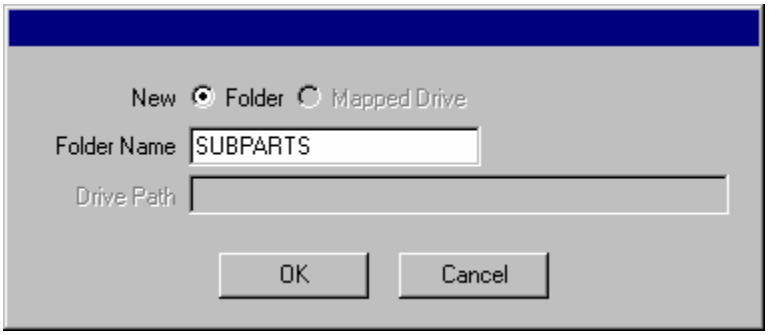
Variable Value

The selected value for the variable

Sub Parts

The Sub Parts feature allows the user to call and execute a separate part file within a part program using a simple line of text.

To configure a subroutine part for use, the user must first create a folder on the control hard drive named “SUBPARTS”. To create a folder on the hard drive, select to Load From Disk”. With the folder location highlighted, press the “+” key to create a new folder.



Save the desired part program in the SUBPARTS folder.

To execute the part, insert a line of code at the desire location within the part with the following format.

PFILENAME

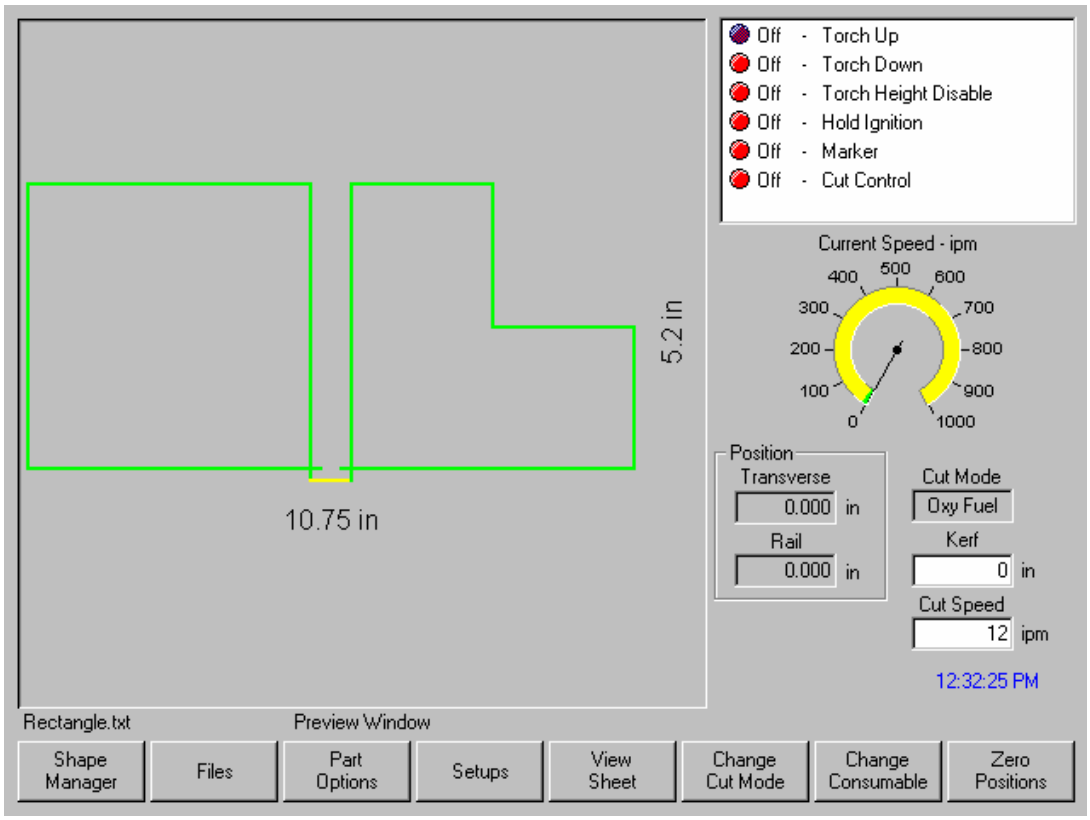
Start the line of code with the letter P to indicate that a Sub Part is to be executed, followed by the filename for the desired part program.

Example:

If the user were to add the Sub Part “L-Bracket” to be executed after completing a simple 5” x 5” square with a commanded traverse, the part program would appear similar to this example.

```
( Rectangle - Piece )
G20
G91
G99 X1 Y0 I0 J0
G41
M07
G01 X-5.2 Y0
G01 X0 Y5
G01 X5 Y0
G01 X0 Y-5.2
M08
G00 X.75 Y0
PL-BRACKET
G40
M02
```

When executed, the example program provided above would be represented as the original part plus the additional Sub Part, including the programmed traverse.



Note: Sub Parts may also contain other Sub Parts. After being translated by the control, the final text of the part will contain the complete text of the original part and Sub Part.

Marker Font Generator

The Marker Font Generator feature may be used to label or identify parts with a marking devise prior to cutting. This is accomplished by use of a simple command string within the part program code to call existing text characters (fonts) and execute marking of the selected text.

The program code uses a specific format and is structured to provide information to be used when marking. Information on the Font source location, Scale Factor, Angle, Marker Tool, Tool Offset and Text are entered as information blocks in the command string. Each section or information block in the command string is separated by a space. The format of this command code is outlined as follows:

Note: If a value is not present for a specific information block, the default values will be used. The default values are:

Font (F):	Internal	**Angle (A):**	0°	**Offset (O):**	#1
Scale (S):	One	**Marker (M):**	#1		

Example of a simple command string: **<F2 S1 A45 M2 O2 <TEST 123>**

< The program command must begin with the "<" symbol to indicate the Marker Font Generator feature is being used.

F The first block of information is the Font Source location. The "F" indicates "Font" and is followed by a digit to indicate the location. Number 1 indicates the internal font in the control software, number 2 indicates to use a font located on the control hard drive, and number 3 indicates to source the font to be used from diskette. If no font is found at the selected location, the default internal font will be used. For the example given, the font location would be from the hard drive.

S The second information block determines the scale of the text. The "S" is used to indicate "Scale" and is followed by a digit to indicate a numeric scale factor. For the example given, the Scale factor would be two or twice as large as the original font dimensions.

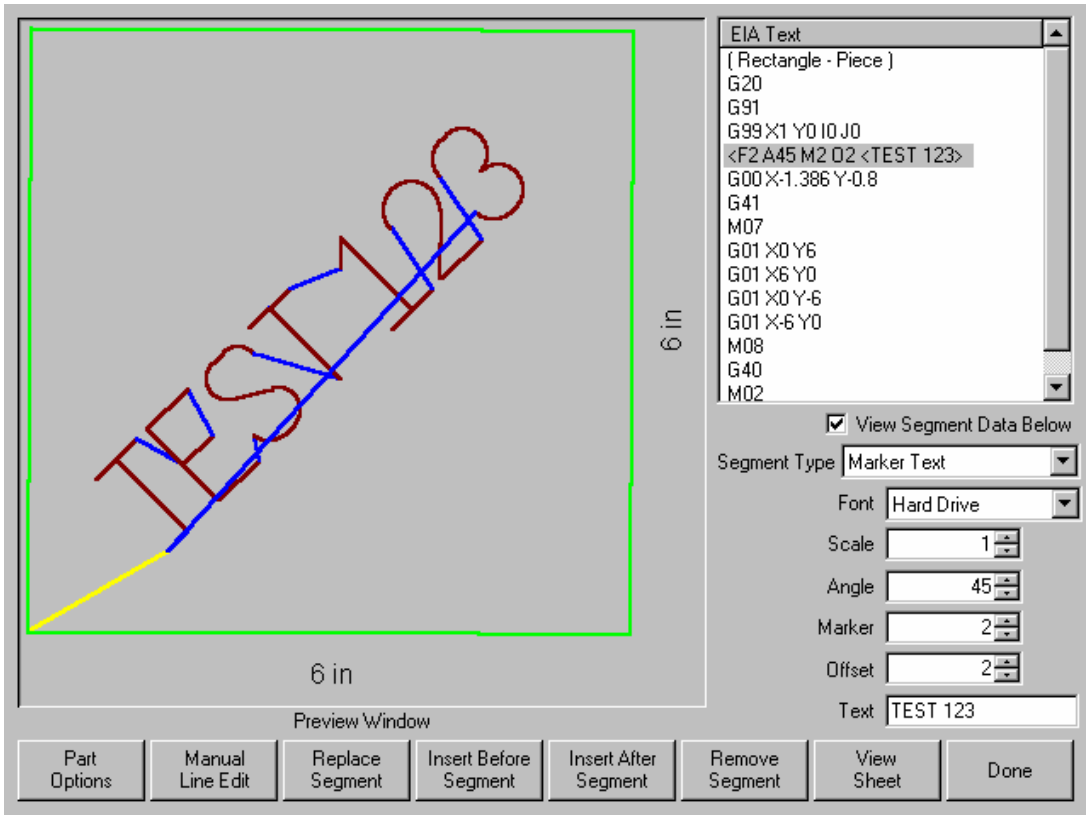
A The third information block determines the angle of the text. The "A" is used to indicate "Angle" and is followed by a numeric value for the degree of angle. For the example given, the angle would be 45°.

M The fourth information block determines the Marker Tool to be used. The "M" is used to indicate "Marker" followed by the number of the Marker Tool (Marker Enable Output) to be used. Up to two marker enables are supported.

O The fifth information block determines which tool Offset to be used. The "O" indicates offset followed by a number indicating one of the nine different tool offsets previously configured in control setups is to be used. The example shown indicates that tool offset number two should be used.

< > The final information block is used to specify the marker text to be executed. The text must be enclosed in the "<" and ">" marks to be valid and understood as the selected text. For the example given, the marker text executed would be "TEST 123"

Translated by the control, the example command string given above would generate the Marker Text "TEST 123" onto the plate as shown here in Shape Wizard.



To improve the ease of use for the part program designer and control operator, the Marker Font Generator feature will always insert a traverse segment to return to the original start point at the beginning of the marking text.

Internal Fonts
The internal fonts located within the control software are 1" high and are limited to characters available on the control keypad. Alphabetical characters are limited to upper case letters only.

External Fonts
External Fonts may be loaded from a floppy disk or from the control hard drive. When generating the text, the control searches for part files to correspond to the selected character. The part file names must be based on their ASCII numeric equivalent and have a .txt file extension.

Example: For the marker text "Ab 12", the control will search for the following files to generate the text.

Text	ASCII No.	File Name
Capital A	65	Ascii65.txt
Lower Case b	98	Ascii98.txt
Space	32	Ascii32.txt
No 1	49	Ascii49.txt
No 2	50	Ascii50.txt

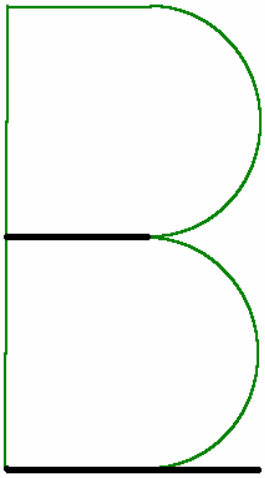
Please refer to the ASCII Codes section of this guide for additional ASCII code information.
Font programs may be saved on the control hard drive by creating a folder labeled "Fonts" through the "Save to Disk" feature and saving the font programs within this folder. Remember, if a corresponding part file to text requested is not found at the selected source location, the internal font file will be used.

Custom Fonts
As previously noted, customer selected custom fonts may be used when using the Marker Font Generator feature. To construct these font files, certain guidelines should be adhered to.

1) Programming format must be EIA
2) Only M09 and M10 maybe used to enable and disable the marker.
3) Only G00, G01, G02 and G03 codes may be used.
4) The program must end in an M02.
5) The proper file name must be assigned to the font program.
6) The font program must begin in the lower left and end in the lower right.
7) Font programs should have the consistent dimensional limits (i.e. 1' high, etc.).

Example: The letter "B" – File Name Ascii66.txt

```
M09
G01 X0 Y1
G01 X0.321429 Y0
G02 X0 Y-0.5 I0 J-0.25
G01 X-0.321429 Y0
M10
G00 X0.321429 Y0
M09
G02 X0 Y-0.5 I0 J-0.25
G01 X-0.321429 Y0
M10
G00 X0.571 Y0
M02
```



The darker lines in the drawing represent the Traverse segment and the lighter lines represent the Marking lines. You can see by this illustration that at the end of the font program, a traverse is used to continue motion to the bottom right corner.

Note: The Burny 3/5 style of programming for the Marker Font Generator feature is also supported for the default internal font source.

Serial Messaging

The Serial Messaging feature may be used to pass commands embedded within a part program through a selected serial port to an external device. Both RS-232 and RS-422 are supported. TCP/IP protocol is not supported at this time.

Overview

Serial Messaging has a fairly basic communication protocol that has three simple formats to send ASCII codes as command strings. During the messaging function, a status indicator for “Message Transmit”, “Message Delay” or “Message Verify” will be displayed in the Watch window.

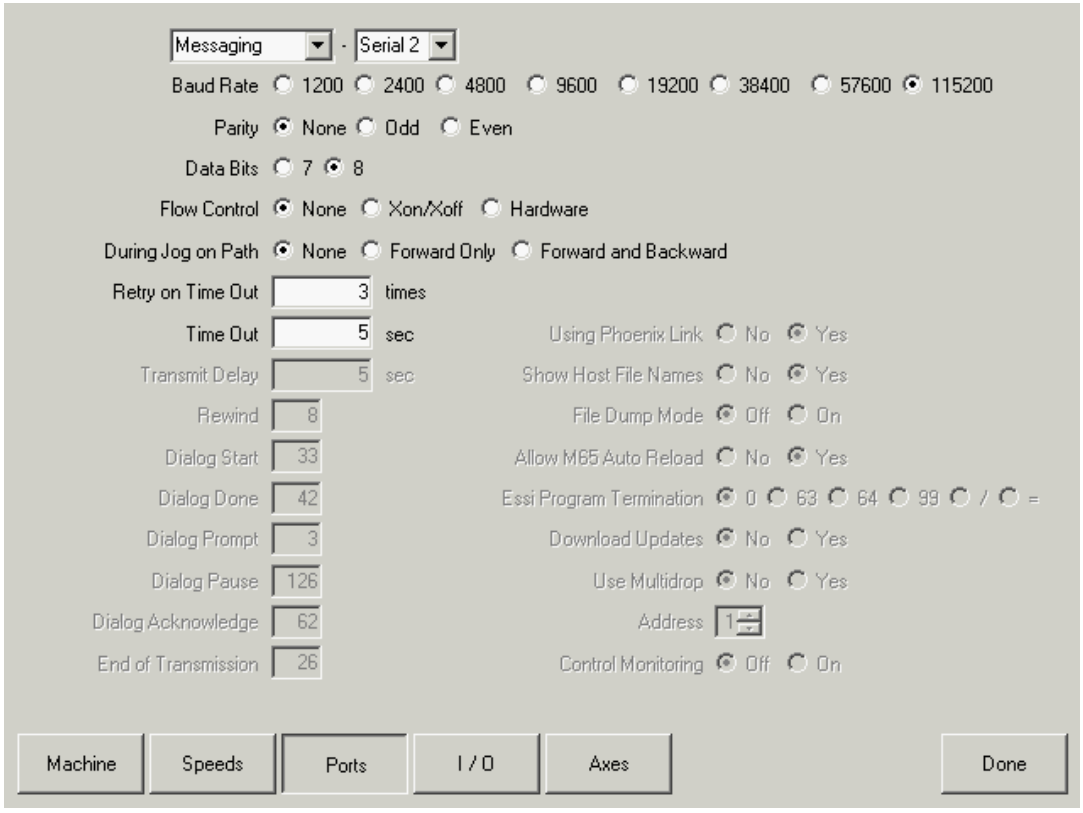
Options

1) While the selected message is sent to the external device, the part program will be temporarily suspended. After completion of the transmission, the part program will then automatically resume. No acknowledgement from the external device is required. An additional Time Delay may also be added.

2) A message is sent concurrent to execution of the part program and no delay is encountered. No acknowledge is required. No Delay Time is allowed.

3) The message is sent with a suspension of the program during transmission as in option one, but an Acknowledge from the external device (ACK) is required before the part program can continue. A Non-Acknowledge (NAK) response from the external device will prompt a retransmit of the message from the control. An optional Time Out value may be added to the program code. If no Time Out code is used in the program code the Default time out value at the Ports setup screen will be used. Additionally, an optional automatic retry feature may be enabled at the Ports setup screen.

To enable use of this feature, assign Messaging to the select port at the Ports setup screen.



After enabling Messaging, the flow control parameters to communicate with the external device will then need to be selected. The user may also select how messaging is handled for the Jogging Forward/Backward on Path. Additionally, the Retry on Time Out and Time Out parameters are available .

The following parameters must be configured for use. Hardware and flow control configuration information must match the external device.

Baud Rate
Select a communication speed from 1200 Baud to 115200 Baud

Parity
Select None, Odd or Even.

Data Bits
Select 7 or 8 Data Bits.

Flow Control
Select to use None, Xon/Xoff or Hardware.

During Jog on Path
The user may select whether messages will be sent when jogging Forward or Backward on Path while at the Pause screen. Note: All messaging will stop when the Stop Key has been pressed or the Remote Pause input becomes active.

Note: The Message Type 21 will transmit the message concurrent to the associated motion segment during “Backup on Path”.

Retry on Time Out
For the Message Type 22 (which requires an acknowledgement from the external device after the message) an automatic retransmit of the message may be sent. The user may select the number of retries allowed before faulting from a lack of response from the external device. The fault prompt “Message Error” will be displayed when in a Time Out condition.

Time Out
The Time Out value may be used for the Message Type 22 (which requires an acknowledgement from the external device after the message) if there is no Time Out value used in the command string of the program code. Refer to the Delay Time / Time Out information for more information.

Programming Code
The ASCII message string follows a unique program message format. Each command begins with a ">" character and ends with a "<" character. These characters are used as delimiters to frame the command (Message Type, Optional Format and Optional Delay Time/ Time Out) instructions for the message.

Message Information
The format of this command code is outlined as follows:

EIA Example: (>20+Format+Delay Time/Time Out<Message)

Message Command Type
>20< Direct message with Delay
>21< Direct message without Delay
>22< Message that requires Acknowledge
(see Message Command Type below)

Optional Format Value
This optional Format value allows the user to add Line Feed and Carriage Return commands, etc., message string. 0,1,16,17,32,33,48,49,64,65,80,81, 96,97,112,113 are supported (see Format Value below).

Optional Delay Time/Time Out Value
Time in seconds (see Time Out Value below)

Message Text
The message content (see Message Text below)

Note: Message format is always within comment characters and the Command portion of the program code is between the ">" Character and the "<" Character.

ESSI Example:	EIA Example:
3	(>20,1,1<Message)
>20,1,1<Message	
4	

See below for format and delay Code information.

Note: For the example provided, the plus sign (+) character was used as delimiter between fields for the command instruction. In addition to the plus sign (+), the hyphen (**-**), comma (**,**) or space may be used as delimiters.

Example:
Using spaces, the EIA command would look like this: (>20 Format Timeout<Message Text)

Message Command Type

>20< This command delays the part program until all bytes have been transmitted, then optionally waits the Delay Time, if specified.

>21< A message is sent concurrent to execution of the part program and no delay is encountered. No acknowledge is required.

>22< The message is sent with a suspension of the program during transmission as in option one, but an Acknowledge from the external device (ACK = Hexadecimal 06) is required before the part program can continue. A Non-Acknowledge (NAK = Hexadecimal 15) response from the external device will prompt a retransmit of the message from the control.

An optional Time Out value may be added to the program code. If no Time Out code is used in the program code the Default time out value at the Ports setup screen will be used. Additionally, an optional automatic retry feature may be enabled at the Ports setup screen.

With the automatic retry feature the message will automatically be retransmitted if no response is detected. The retry is executed after the Time Out value has elapsed. The number of retries can be defined on the Ports configuration screen.

Optional Format Value

Specialty characters for the format may be sent in addition to command string.

Specialty Characters Supported

HEX	Name	Description
01	SOH	Start of Header
02	STX	Start of Text
03	ETX	End of Text
04	EOT	End of Transmission
0A	LF	Line Feed
0D	CR	Carriage Return
	BCC	“Exclusive Or” Check Byte

Note: Checksum is always an 'Exclusive OR' of the Data ONLY as it does not include any of the 'Format' chars including the CR/LF option.

Optional Format Character Assignments

Value	Assignment
0	No Special Assignment (Must be used in the format location is a Delay is required but no Format options are required).
1	Append a Carriage Return (<CR> = Hex value OD) and a Line Feed (<LF> = Hex Value0A)
16	Append an "Exclusive OR" (<BCC>) to the end of the message.
17	Appends a combination of 16 and 1.
32	Encloses the message with Start of Text (<STX> = Hex Value 02) and End of Text (<ETX> = Hex Value 03). The <ETX> follows the message and the optional <CR><LF>> append codes but precedes the Check Byte <BCC>.
33	Appends a combination of 1 and 32.
48	Appends a combination of 16 and 32.
49	Appends a combination of 1, 16 and 32.
64	Append a Start of Header(<SOH> = Hex value 01) and a End of Transmission (<EOT> = Hex Value04) to the Message.
65	Appends a combination of 1and 64.
80	Appends a combination of 16 and 64.
81	Appends a combination of 1, 16 and 64.
96	Appends a combination of 32 and 64.
97	Appends a combination of 1, 32, and 64.
112	Appends a combination of 16, 32 and 64.
113	Appends a combination of 1, 16, 32 and 64.

Optional Delay Time/Time Out Value
The Delay Value will issue a delay in seconds at the end of the message for Message Type 20.

No delay is supported for Message Type 21.

This value also works as a Time Out value for Message Type 22. An error will be displayed if the message is not Acknowledged (ACK Hexadecimal 06) with in the specified time. If no Time Out Delay is defined in the command, the Time Out parameter on the Ports screen will be used.

The value is in a 3.2 format where a value of 5 is equal to 5.00 seconds. Accepted limits for the value is range of 0.00 to 999.99 seconds.

Message Text Content
Up to 300 data characters in each command string may be sent. The Command characters (information between and including the ">" and "<" signs) are included in this maximum.

Printable and Non- Printing ASCII codes can be used in the message string. Refer to the ASCII Code appendix of this manual for more information on ASCII codes and the Hexidecimal value.

Non-printing characters are supported by use of a two-character command and can send a Binary Code in the Range from 0-255. Double byte character to support combinations will affect the maximum length count with each pair reducing the maximum data characters by 1. Refer to the Non-printing Character information later in this section for information on these values.

Non – Printing Characters
Non Printing Characters are supported through use of a pair of two printing codes to equal the non-printing code. This pair of characters is retained in the program code but sent as single 8-bit code when transmitted.

There are three types of character pairs and each performs a different operation based on the first character of the pair. This produces a single modified character for transmission.

Character Options

1) The "&" two-character pair clears the 0x40 bit from the 2nd character code value.
2) The "!" two-character pair clears the 0x40 bit and sets the 0x80 bit set in the 2nd character code.
3) The "$" two-character pair clears the 0xC0 bit in the 2nd character.

To transmit the single character with a value 0x01, use the two character sequence "&A". This converts the "A" value of 0x41 to 0x01 by clearing the 0x40 bit. To transmit 0x81, use "!A" or to transmit)xC1 use "$A".

Exceptions / Additions
As the "&", "!" and "$" are used as key indicators for the Non-print characters, there is a special format used when these characters are used as a print character in the message text. Simply use the character twice. "&&" = "&"

The ESSI style part program uses several unique characters which requires special two character codes to be used. For example, the message code "&K" in the part program will transmit the code value of 0x2B which is the ASCII code for the plus sign (+). In order to send the + character the code "&K" must be used.

The following are unique codes used in WORD ADDRESS and ESSI programs

Code	Code Value	Description
&'	0x20=space	At end of ESSI program
&h	0x28 = "("	To transmit "(" from WORD ADDRESS program
&i	0x29 = ")"	To transmit ")" from WORD ADDRESS program
&?	0x7F = DEL	Non-printable DELETE code
&K	0x2B = "+"	To transmit "+" from ESSI program

Non Printing Character Table

ASCII codes less than Hexidecimal 20

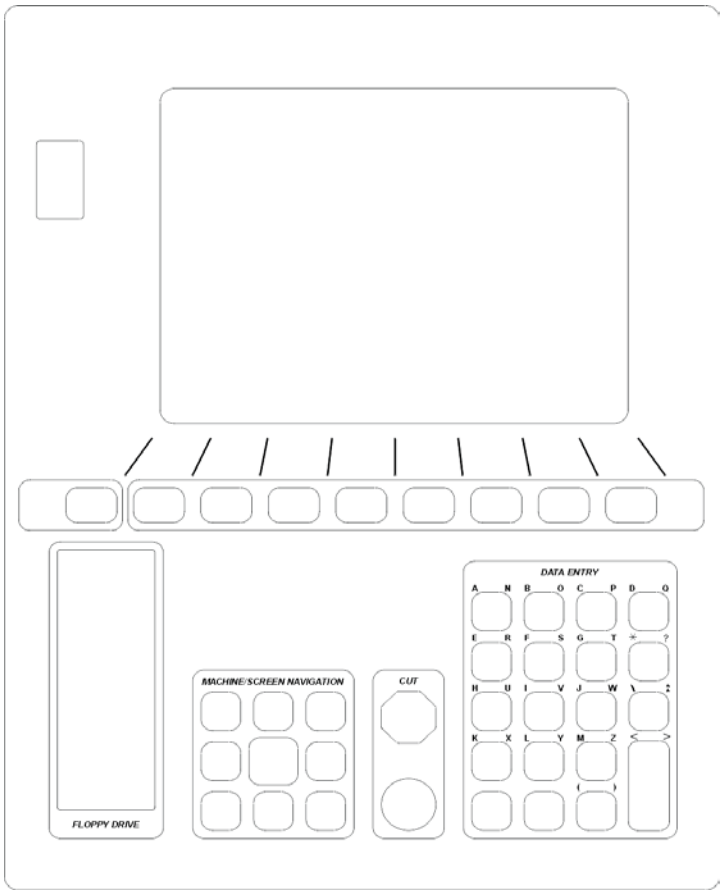
Code	Hex	Code	Hex	Code	Hex	Code	Hex
&A	00	&H	08	&P	10	&X	18
&A	01	&I	09	&Q	11	&Y	19
&B	02	&J	0A	&R	12	&Z	1A
&C	03	&K	0B	&S	13	&[	1B
&D	04	&L	0C	&T	14	&\	1C
&E	05	&M	0D	&U	15	&]	1D
&F	06	&N	0E	&V	16	&^	1E
&G	07	&O	0F	&W	17	&_	1F

8 bit character codes greater than Hexidecimal 80

Code	Hex	Code	Hex	Code	Hex	Code	Hex
!@	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	!_	9D
!`	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	DD
$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

Appendix D: Edge II™ Machine Interface

The Edge II™ shape cutting control is an extremely versatile product, offering up to four configurable axes of motion, configurable I/O locations and three different styles of external table interface for ease of installation. The control features may also be expanded through use of optional analog and network interface cards.



Rear Panel Layout
The rear panel of the control has several cable connectors to connect the control to power, I/O and communication ports. These connectors are clearly labeled as to their function, as shown below.

The AC power cable is inserted into the AC power connector and plugged into a standard 3-way 110 or 220 volt outlet. The control has a universal AC input power module that allows the user to plug into either voltage without changing additional jumpers. In addition, the AC Power connector contains an integral fuse receptacle and line filter.

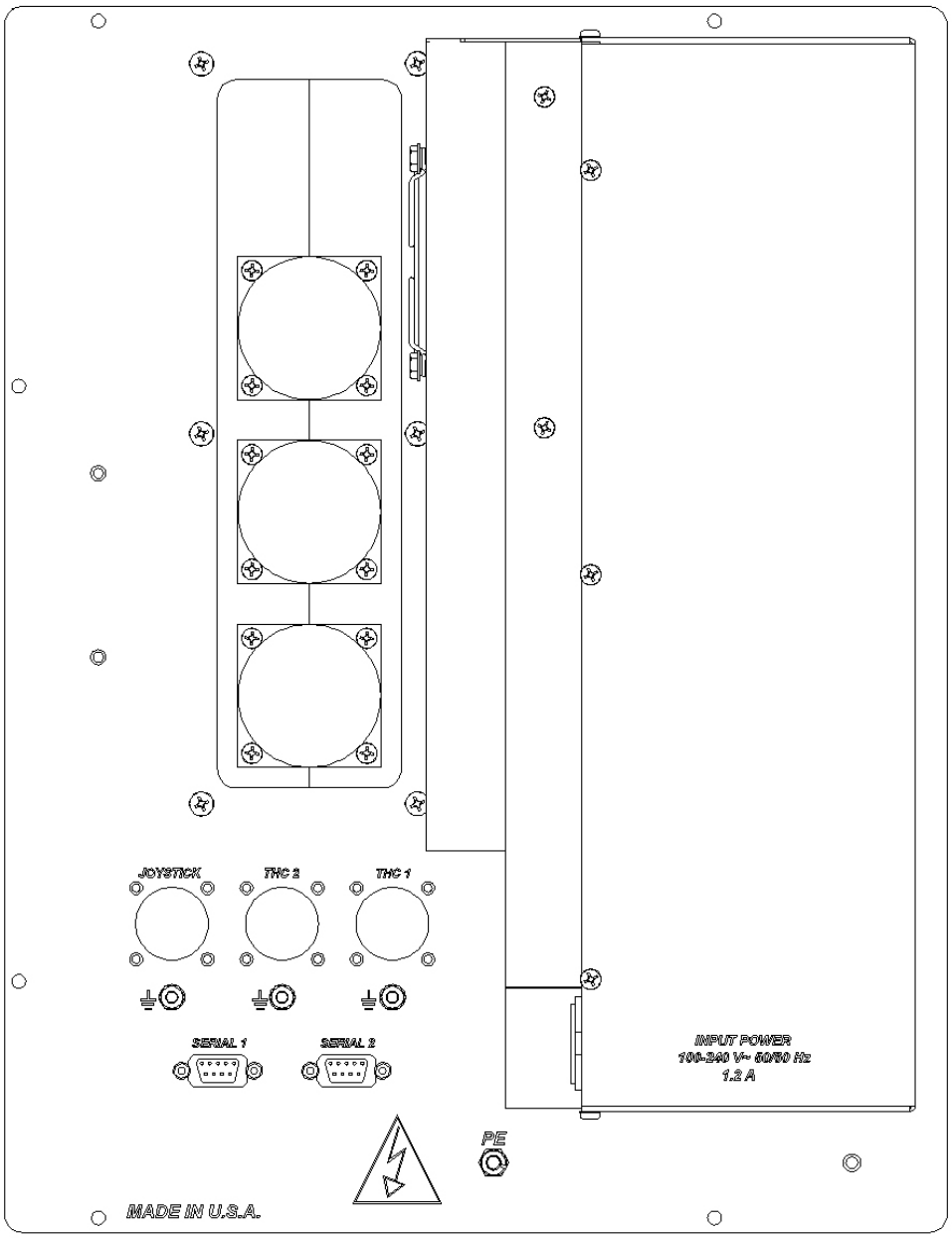
The rear panel has an integrated hinged door to assist in servicing the unit. A remote communications link can be connected to one of the two serial ports and an external ground (PE) lug is also provided.

Single Ended or Double Ended I/O Configuration

The following illustration shows the back panel for the single ended/doubled ended I/O configuration. The cables that connect the control to the cutting machine are attached to the I/O (Input/Output), and the DRIVE/ENCODER connectors.

For the purposes of this guide, Double Ended I/O is referred to as Type “M” configuration and Single Ended I/O is referred to as Type “P” configuration.

Rear Panel



Machine Interface

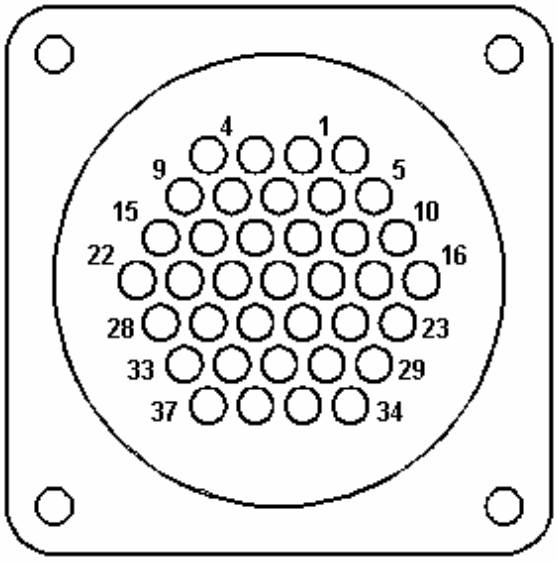
The information contained in the Machine Interface Appendix is intended to provide the basic information for connection of the shape cutting control to the cutting table. Each machine interface will vary slightly based on the cutting table configuration and features. Additionally, I/O pinout information may vary slightly based on the configuration of the selected I/O and their locations. Changes to the I/O configuration may be made in the password protected I/O screen. All controls are shipped with the default selection of Inputs and interface locations for the selected control Interface (I/O) configuration. Installation and service should only be performed by a qualified service technician.

I/O Configuration Type “P” and “M”

I/O Connector
The I/O connector is a standard sex circular CPC connector from AMP. This connector was specifically chosen for its rugged industrial design and its metal insulation characteristics for EMI/RFI noise immunity. The control can ship with two different versions of I/O in this one connector style. One style is single ended I/O (Type “P” configuration) and the other is double-ended I/O (Type “M” configuration).

In the single ended I/O scheme, a ground is provided on the I/O pin. In the double-ended approach, both the positive and negative pins for the I/O point are provided to the user. The advantage to single ended I/O is that it takes one pin for each point versus two for the double-ended I/O scheme increasing the total number of I/O points available to the user.

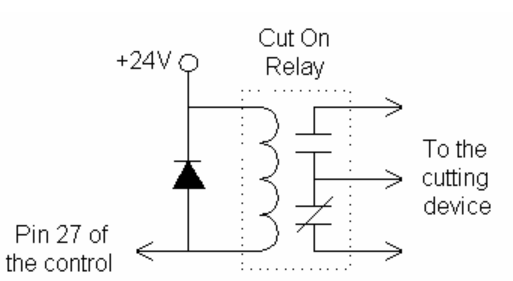
I/O Mating Connector
Connector AMP #208470-1
Backshell AMP #208945-8
Sockets (16-18 ga) AMP #66101-3
Sockets (20-24 ga) AMP #66105-3



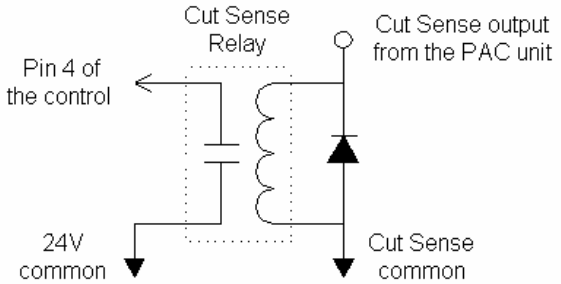
I/O Configuration Type "P" (Single Ended I/O)

Connecting single ended I/O to the control. These examples assume a +24V power supply has been connected across pins 34 and 36 of the control, or that the optional internal +24V power supply has been installed.

Output tied to external Cut On

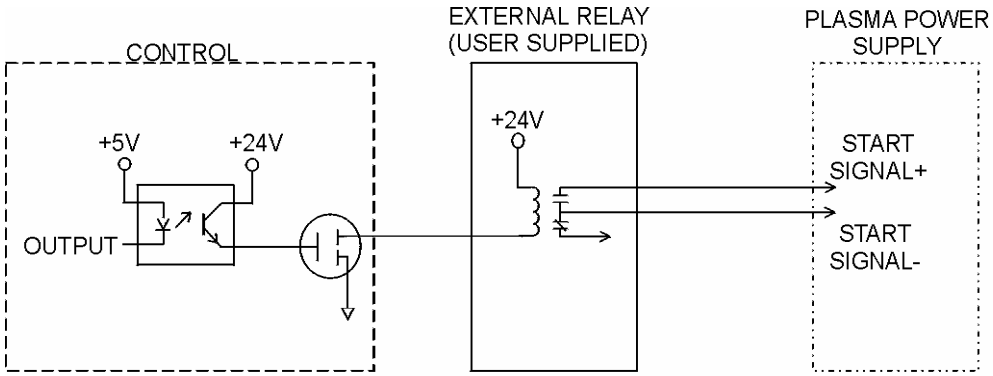


Input tied to Cut Sense Relay

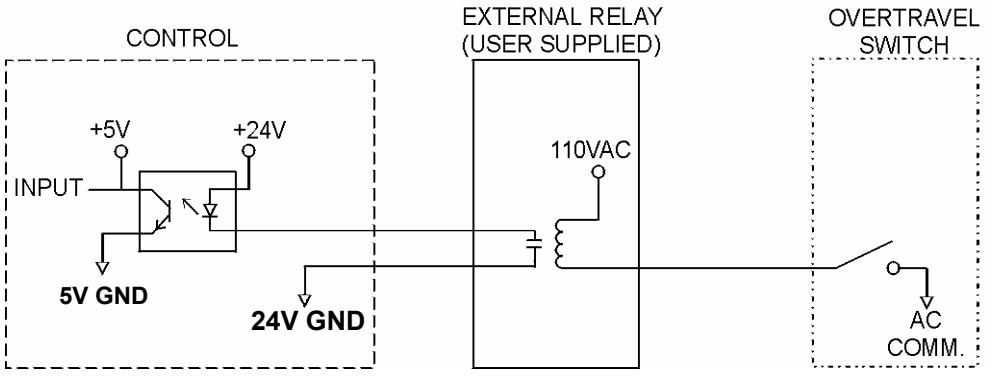


Examples of possible circuits

Output



Input



Single Ended I/O Pinout
The Single Ended I/O offers 12 outputs which are rated at 24VDC for up to 1-amp loads and 12 inputs rated for 24VDC.

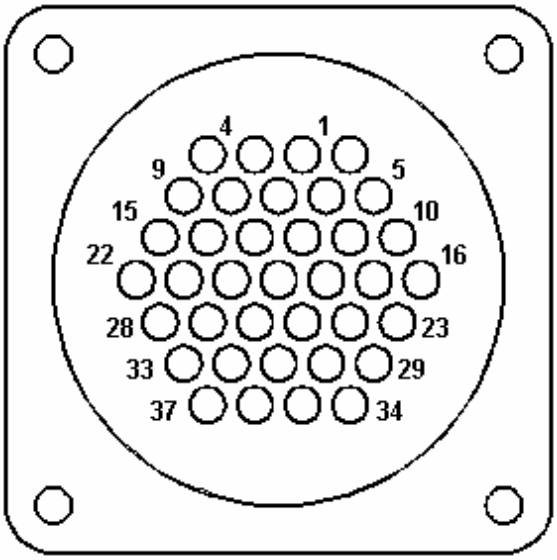
Pin	I/O	Description
1	Input 1	Torch Up Sense
2	Input 2	Torch Down Sense
3	Input 3	Preheat Sense or X -Overtravel Switch
4	Input 4	Cut Sense
5	Input 5	Tracer on Path or Z Home Switch
6	Input 6	Spare or Y -Overtravel Switch
7	Input 7	Spare
8	Input 8	Spare or Remote Pause
9	Input 9	X Home Switch
10	Input 10	X Overtravel Switch or X +Overtravel Switch
11	Input 11	Y Home Switch
12	Input 12	Y Overtravel Switch or Y +Overtravel Switch
13	N/C	No Connection
14	+24 VDC	+ I/O Power Supply
15	+24 VDC	+ I/O Power Supply
16	N/C	No Connection
17	24V Common	I/O Power Supply Common
18	24V Common	I/O Power Supply Common
19	N/C	No Connection
20	N/C	No Connection
21	Output 1	Torch Up
22	Output 2	Torch Down
23	Output 3	Ignition Control
24	Output 4	Torch Height Disable/Dual Grid Control
25	Output 5	CNC/Tracer
26	Output 6	Marker Enable
27	Output 7	Cut Control
28	Output 8	Spare
29	Output 9	Spare or Low Preheat
30	Output 10	Preheat Control
31	Output 11	Key Press Indicator or Motion Indicator
32	Output 12	Spare or Plasma Select
33	I/O Shield	Chassis Ground
34	+24 VDC	+I/O Power Supply
35	+24 VDC	+I/O Power Supply
36	24 V Common	I/O Power Supply Common
37	24 V Common	I/O Power Supply Common

Drive/Encoder Connector
The Drive/Encoder connector is a reverse sex circular CPC connector from AMP. This connector was specifically chosen for its rugged industrial design and its metal insulation characteristics for EMI/RFI noise immunity.

NOTE: For optimum noise immunity, cable shields may be tied externally to the control enclosure or to the metal AMP connectors.

Drive/Encoder Mating Connector and Cable

Connector AMP #208472-1
Backshell AMP #208945-8
Pins (16-18 ga) AMP #66099-3
Pins (20-24 ga) AMP #66103-3
Cabling: Use Belden # 9504 or equivalent for encoder signals
Cabling: Use Belden # 9501 or equivalent for drive signals



Axes Assignments

Axes	Axes Assignment
1 (X)	Transverse or Rail
2 (Y)	Transverse or Rail
3 (Z)	Dual Gantry, CBH or THC
4 (W)	CBH or THC

Drive/Encoder Pinout

Pin	Description
2	Encoder Power Supply Input (+5V)
3	Encoder Power Supply Common
7	Encoder Power Supply Shield
8	

X Axis	Y Axis	Description
4	1	Encoder Power Output
8	6	Encoder Power Common
9	5	Encoder Channel A input
14	11	Encoder Channel /A Input
15	10	Encoder Channel B Input
21	17	Encoder Channel /B Input
22	16	Encoder Channel Z Input
28	23	Encoder Channel /Z Input
13	12	Encoder Shields
24	26	Drive Enable In (relay contact)
25	27	Drive Enable Out (relay contact)
37	34	Drive Power Input (+12 or +15)
33	29	Servo Output (± 10V)
32	30	Drive Power Common
36	35	Drive Power Input (-12 or –15)
20	18	Servo Output Common
19	31	Drive/Servo Shield

Drive/Encoder Pinout (For 3 and 4 Axes units)

Pin	Description
2	Encoder Power Supply Input (+5V)
3	Encoder Power Supply Common
7	Encoder Power Supply Shield

Z Axis	W Axis	Description
4	1	Encoder Power Output
8	6	Encoder Power Common
9	5	Encoder Channel A input
14	11	Encoder Channel /A Input
15	10	Encoder Channel B Input
21	17	Encoder Channel /B Input
22	16	Encoder Channel Z Input
28	23	Encoder Channel /Z Input
13	12	Encoder Shields
24	26	Drive Enable In (relay contact)
25	27	Drive Enable Out (relay contact)
37	34	Drive Power Input (+12 or +15)
33	29	Servo Output (± 10V)
32	30	Drive Power Common
36	35	Drive Power Input (-12 or –15)
20	18	Servo Output Common
19	31	Drive/Servo Shield

Note: Use of individual Drives Enables for each axes is recommend for proper operation.

I/O Configuration Type "M" (Double Ended I/O)

The double ended I/O configuration of the control provides additional flexibility in connecting to external devices. These I/O points allow the user to separate the control voltages for each I/O point. Meaning, there is no common tie between each point as with the single ended I/O scheme. No power is required to be brought into the control. Pins 34-37 are provided for the optional internal +24V supply should the user want the power supply integrated into the control.

Double Ended I/O Pinout

The Single Ended I/O offers eight outputs which are rated at 24VDC for up to 1-amp loads and eight inputs rated for 24VDC.

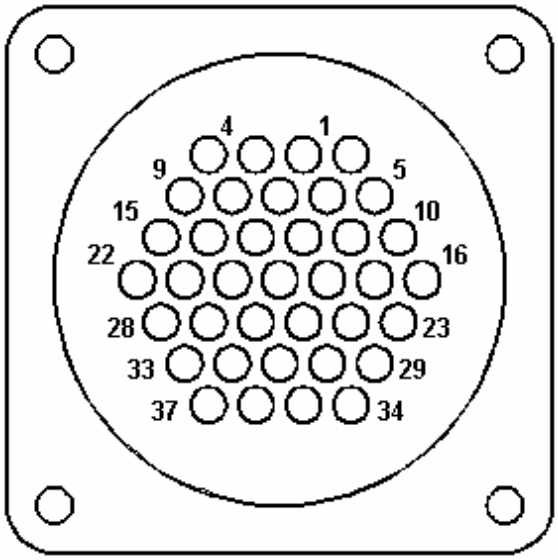
Pin	I/O	Description
1	Input 1 +	Torch Up Sense
2	Input 1 -	Torch Up Sense
3	Input 2 +	Spare
4	Input 2 -	Spare
5	Input 3 +	Preheat Sense
6	Input 3 -	Preheat Sense
7	Input 4 +	Cut Sense
8	Input 4 -	Cut Sense
9	Input 5 +	Spare
10	Input 5 -	Spare
11	Input 6 +	Limit Switch
12	Input 6 -	Limit Switch
13	Input 7 +	Torch Down Sense
14	Input 7 -	Torch Down Sense
15	Input 8 +	Spare or Remote Pause
16	Input 8 -	Spare or Remote Pause
17	Output 1 +	Torch Up
18	Output 1 -	Torch Up
19	Output 2 +	Torch Down
20	Output 2 -	Torch Down
21	Output 3 +	Ignition Control
22	Output 3 -	Ignition Control
23	Output 4 +	Torch Height Disable/Dual Grid Control
24	Output 4 -	Torch Height Disable/Dual Grid Control
25	Output 5 +	CNC
26	Output 5 -	CNC
27	Output 6 +	Marker Enable or Beeper or Motion Indicator
28	Output 6 -	Marker Enable or Beeper or Motion Indicator
29	Output 7 +	Preheat Control
30	Output 7 -	Preheat Control
31	Output 8 +	Cut Control
32	Output 8 -	Cut Control
33	I/O Shield	Chassis Ground
34	+24 VDC	+I/O Power Supply
35	+24 VDC	+I/O Power Supply
36	24 V Common	I/O Power Supply Common
37	24 V Common	I/O Power Supply Common

Drive/Encoder Connector
The Drive/Encoder connector is a reverse sex circular CPC connector from AMP. This connector was specifically chosen for its rugged industrial design and its metal insulation characteristics for EMI/RFI noise immunity.

NOTE: For optimum noise immunity, cable shields may be tied externally to the control enclosure or to the metal AMP connectors.

Drive/Encoder Mating Connector and Cable

Connector AMP #208472-1
Backshell AMP #208945-8
Pins (16-18 ga) AMP #66099-3
Pins (20-24 ga) AMP #66103-3
Cabling: Use Belden # 9504 or equivalent for encoder signals
Cabling: Use Belden # 9501 or equivalent for drive signals



Axes Assignments

Axes	Axes Assignment
1 (X)	Transverse or Rail
2 (Y)	Transverse or Rail

Drive/Encoder Pinout

Pin	Description
2	Encoder Power Supply Input (+5V or +12V*)
3	Encoder Power Supply Common
7	Encoder Power Supply Shield
24	Watchdog Normally Open Contacts
25	Watchdog Common

*__NOTE__: For Rev A + B MCC's +12V Encoders require a switch to be set on the interface board.

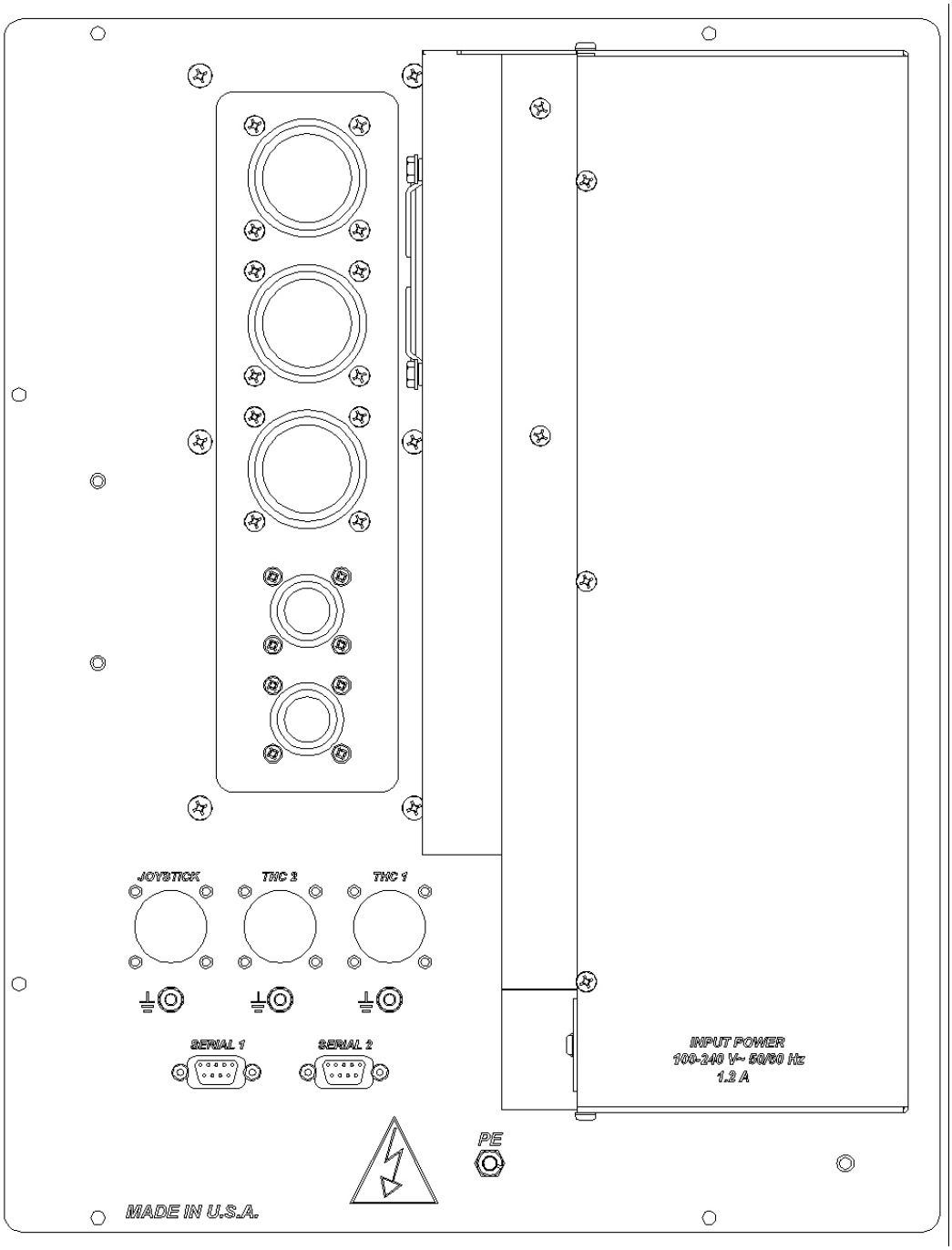
X Axis	Y Axis	Description
4	1	Encoder Power Output
8	6	Encoder Power Common
9	5	Encoder Channel A input
14	11	Encoder Channel /A Input
15	10	Encoder Channel B Input
21	17	Encoder Channel /B Input
22	16	Encoder Channel Z Input
28	23	Encoder Channel /Z Input
13	12	Encoder Shields
37	34	Drive Power Input (+12 or +15)
33	29	Servo Output (± 10V)
32	30	Drive Power Common
36	35	Drive Power Input (-12 or –15)
20	18	Servo Output Common
19	31	Drive/Servo Shield

Note: Use of individual Drives Enables for each axis is recommend for proper operation.

I/O Configuration Type “B”

The illustration below shows the control back panel in a Type “B” I/O configuration. The cables that connect the control to the cutting machine are attached to the OXY FUEL and PLASMA (Input/Output), DRIVE connector, X ENCODER and Y ENCODER interface connectors.

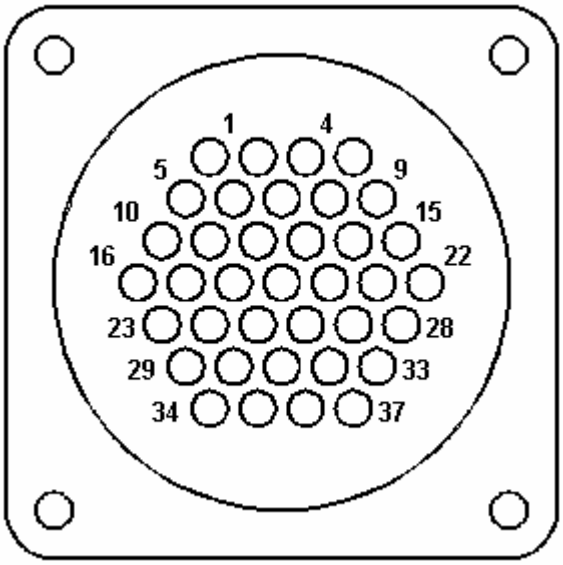
Back Panel



I/O Configuration Type “B”

This shape cutting control has been specifically designed and configured to connect to a Burny 3 or Burny 5 style wire harness system without modification. Outputs are relay contact rated at 1 amp at 120 VAC. Inputs are optically isolated and can operate at 24 – 120 VAC/DC.

Oxy Fuel and Plasma Connectors
The Oxy Fuel and Plasma connectors are standard sex circular CPC connectors from AMP.



I/O Mating Connectors
Connector AMP #206150-1
BackShell AMP #206138-1
Sockets (16-18 ga) AMP #66101-3
Sockets (20-24 ga) AMP #66105-3

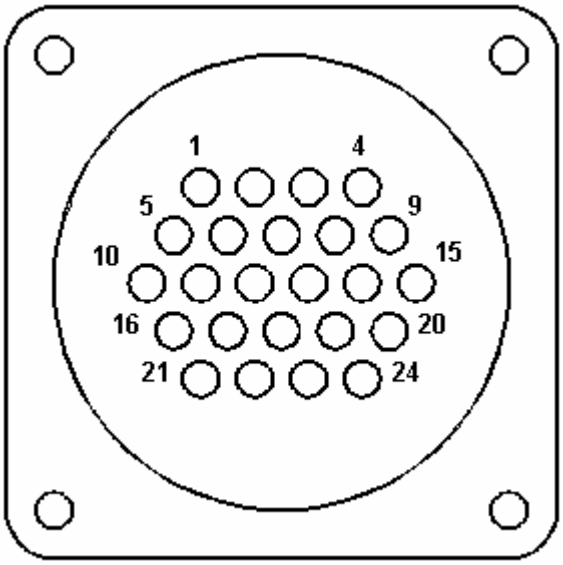
Oxy Fuel Pinout

Pin	I/O	Description
10	Input	Oxygen Cut Sense
23	Input	Oxygen Cut Sense
11	Input	Program Inhibit
24	Input	Program Inhibit
3	Output NO	Oxygen Enable
4	Output COM	Oxygen Enable
8	Output NC	Oxygen Enable
32	Output NO	Oxygen Start
37	Output COM	Oxygen Start
36	Output NC	Oxygen Start
21	Output NO	Preheat
22	Output COM	Preheat
28	Output NC	Preheat
9	Output NO	Plate Marker No. 1
15	Output COM	Plate Marker No. 1
14	Output NC	Plate Marker No. 1
1	115 V Hot	I/O Power Supply
18	I/O Shield	Chassis Ground
19	I/O Shield	Chassis Ground
34	115V Neutral	I/O Power Supply Common

Plasma Pinout

Pin	I/O	Description
5	Input	Plasma Select
18	Input	Plasma Select
16	Input	Arc On Sense
29	Input	Arc On Sense
2	Output NO	Plasma Enable
3	Output COM	Plasma Enable
4	Output NC	Plasma Enable
22	Output NO	Plasma Start
21	Output COM	Plasma Start
15	Output NC	Plasma Start
37	Output NO	Plasma Height
36	Output COM	Plasma Height
35	Output NC	Plasma Height
26	Output NO	Plate Marker No. 2 or CNC Tracer
20	Output COM	Plate Marker No. 2 or CNC Tracer
13	Output NC	Plate Marker No. 2 or CNC Tracer

Drive Connector
The Drive connector is a standard sex circular CPC connector from AMP.



NOTE: For optimum noise immunity, cable shields may be tied externally to the control enclosure.

Drive Mating Connector and Cable
Connector AMP #206837-1
Backshell AMP #206138-1
Sockets (16-18 ga) AMP #66101-3
Cabling: Use Belden # 9501 or equivalent for drive signals

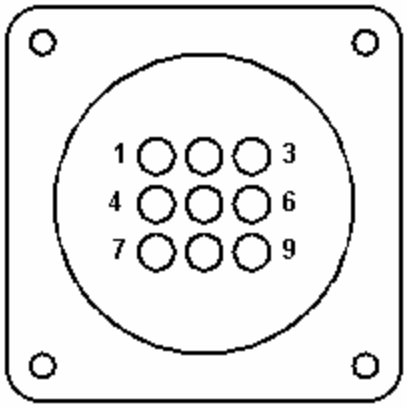
Axes Assignments

Axes	Axes Assignment
1 (X)	Transverse or Rail
2 (Y)	Transverse or Rail

Drive Pinout

Pin	Description
7	X Reference +
6	Y Reference +
9	Reference Common
12	Reference Shield
20	Remote Pause
8	Watchdog Normally Open Contacts
13	Watchdog Common

Encoder Connectors
The Encoder connectors are a standard sex circular CPC connector from AMP.



NOTE: For optimum noise immunity, cable shields may be tied externally to the control enclosure.

Encoder Mating Connectors and Cables
Connector AMP #206708-1
Backshell AMP #206966-1
Sockets (20-24 ga) AMP #66105-3
Cabling: Use Belden # 9504 or equivalent for encoder signals

Encoder Pinout

Pin	Description
7	Power Output
1	Power Common
8	Channel A input
3	Channel /A Input
9	Channel B Input
5	Channel /B Input
6	Channel Z Input
2	Channel /Z Input
4	Shields

THC and Joystick Interface

I/O Configuration Type “P” controls have dedicated connectors for THC 1, THC and Joystick / Speedpots.

Series 1 PCI Analog Card

Note: The Analog Card will be designated as PCI-AIC Rev A in the Control Information Diagnostic screen.

Board Marking PCI Analog 1 Part # PCBS-0074

THC 1

Pin #	Designation	Description
1	Common	Common
2	Input 5 +	Nozzle Contact Sense + (Relay Contact)
3	Input 5 –	Nozzle Contact Sense - (Relay Contact)
4	Output 1 +	Nozzle Contact Enable + (Relay Contact)
5	Output 1 –	Nozzle Contact Enable - (Relay Contact)
6	Analog Input 1 +	THC +
7	Analog Input 1 –	THC –
8	Output 2 +	Hold Ignition (Relay Contact)
9	Output 2 –	Hold Ignition (Relay Contact)
Ground Stud		Shield

Mating Connector
Connector AMP #206708-1
Backshell AMP #206966-1
Sockets (20-24 ga) AMP #66105-3
Cabling: Use Belden # 9504 or equivalent

THC 2

Pin #	Designation	Description
1	Common	Common
2	Input 6 +	Nozzle Contact Sense + (Relay Contact)
3	Input 6 –	Nozzle Contact Sense – (Relay Contact)
4	Output 3 +	Nozzle Contact Enable + (Relay Contact)
5	Output 3 –	Nozzle Contact Enable – (Relay Contact)
6	Analog Input 2 +	THC +
7	Analog Input 2 –	THC –
8	Output 4 +	Hold Ignition (Relay Contact)
9	Output 4 –	Hold Ignition (Relay Contact)
Ground Stud		Shield

Mating Connector
Connector AMP #206708-1
Backshell AMP #206966-1
Sockets (20-24 ga) AMP #66105-3
Cabling: Use Belden # 9504 or equivalent

Joystick

Pin #	Designation	Description
1	Input 1	Joystick UP
2	Input 2	Joystick DWN
3	Input 3	Joystick LT
4	Input 4	Joystick RT
5	Common	Common
6	Analog Input 3 +	Speed Pot 1
7	Analog Input 3 –	Speed Pot 1
8	Analog Input 4 +	Speed Pot 2
9	Analog Input 4 –	Speed Pot 2
Ground Stud		Shield

Note: Joystick inputs are activated by passing the Common signal (pin 5) to the desired input. Analog inputs for the speedpots are rated at 0 - +10VDC

Mating Connector
Connector AMP #206708-1
Backshell AMP #206966-1
Sockets (20-24 ga) AMP #66105-3
Cabling: Use Belden # 9504 or equivalent

THC and Joystick Cable Grounding
Cable shields should be tied to the external PE studs for optimum noise immunity.

Appendix E: Voyager II™ Machine Interface

The Voyager II™ Shape Cutting Control is designed with all machine interface connections internal to the enclosure. No external machine interface is provided. All Interface cabling enters and exits through an opening in the bottom of the enclosure. Extreme caution should be taken to ensure that the opening at the base of this unit is appropriately sealed so that no contamination enters the unit.

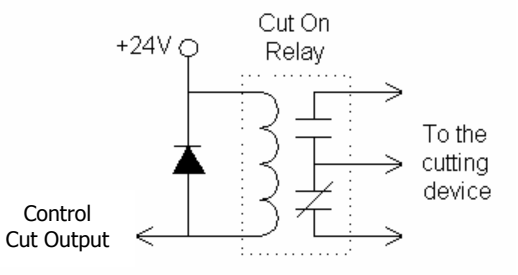
The information contained in this section is intended to provide the basic information for connection of the Voyager II™ Shape Cutting Control to the cutting table. Each machine interface will vary slightly based on the cutting table configuration and features. Additionally, I/O pinout information may vary slightly based on the configuration of the selected I/O and their locations. Changes to the I/O configuration may be made in the password protected I/O screen. All controls are shipped with the default selection of Inputs and interface locations for the selected control Interface (I/O) configuration. Installation and service should only be performed by a qualified service technician. For more information regarding the I/O process definitions please refer to the Setups section of this guide.

Operation and maintenance of automated equipment involves potential hazards. Personnel should take precautions to avoid injury. This equipment should only be opened by trained service personnel.

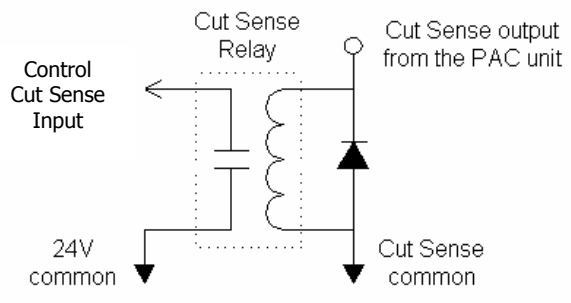
I/O Configuration Type "V" (Single Ended I/O)

Connecting single ended I/O to the control. The control provides +24V power on pins 17 & 18 (+24 VDC) and pins 36 & 37 (24 VDC Common).

Output tied to external Cut On

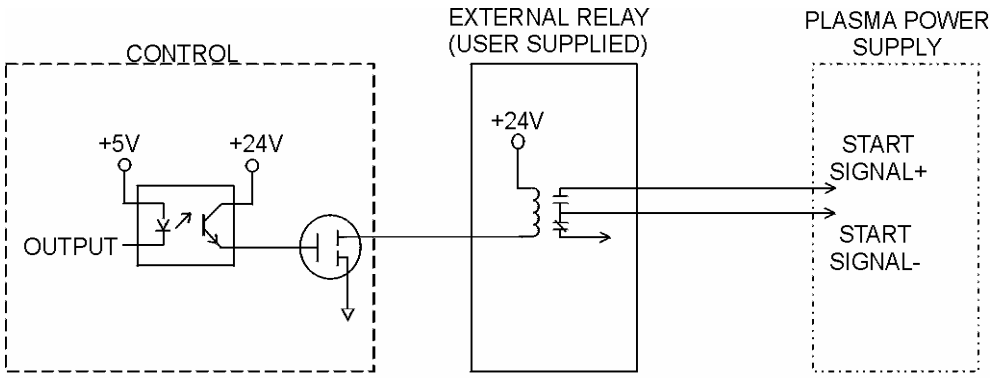


Input tied to Cut Sense Relay

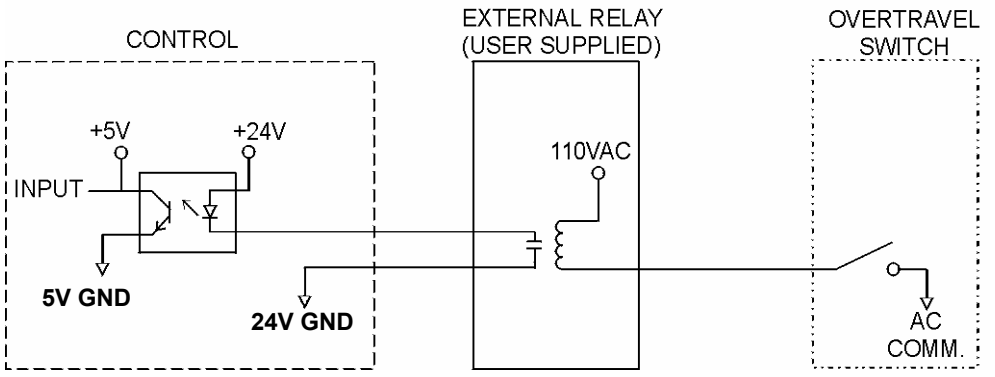


Examples of possible circuits

Output



Input



Single Ended I/O Pinout
The Single Ended I/O offers 32 outputs which are rated at 24VDC for up to 1-amp loads and 32 inputs rated for 24VDC as standard

I/O Connector J5

Pin	Description	Default I/O Description
1	Input 1	Spare
2	Input 2	Z Home Switch
3	Input 3	Program Inhibit
4	Input 4	Cut/ Mark Sense 1
5	Input 5	Cut/ Mark Sense 2
6	Input 6	Remote Pause
7	Input 7	Drive Disabled
8	Input 8	Spare
9	Input 9	X Home Switch
10	Input 10	X+ Overtravel
11	Input 11	Y Home Switch
12	Input 12	Y+ Overtravel
13	Input 13	Plasma I Select
14	Input 14	Plasma 2 Select
15	Input 15	Marker 1 Select
16	Input 16	Marker 2 Select
17	+24 VDC	N/A
18	+24 VDC	N/A
19	Chassis Ground	N/A
20	Output 1	Torch Up
21	Output 2	Torch Down
22	Output 3	Ignition
23	Output 4	Torch Height Disable
24	Output 5	Hold Ignition
25	Output 6	Marker
26	Output 7	Cut Control
27	Output 8	Plasma 1 Enable
28	Output 9	Plasma 2 Enable
29	Output 10	High Preheat Control
30	Output 11	Low Preheat Control
31	Output 12	Marker 1 Enable
32	Output 13	Marker 2 Enable
33	Output 14	Gas Control Write
34	Output 15	Remote Test Operate
35	Output 16	Remote Test Preflow
36	+24 VDC Common	N/A
37	+24 VDC Common	N/A

Mating Connector
Connector: 37C D-Sub Amp # 205210-3 or equivalent
Backshell: Amp #748676-4 or equivalent
Pins: Amp #5-66507-9 (24-28 AWG) or equivalent

I/O Connector J6

Pin	Description	Default I/O Description
1	Input 17	Gas Control Read Complete
2	Input 18	Gas Control Error
3	Input 19	Raise Torch 1
4	Input 20	Lower Torch 1
5	Input 21	Enable THC 1
6	Input 22	Raise Torch 2
7	Input 23	Lower Torch 2
8	Input 24	Enable THC 2
9	Input 25	Spare
10	Input 26	Spare
11	Input 27	Spare
12	Input 28	Spare
13	Input 29	Spare
14	Input 30	Spare
15	Input 31	Spare
16	Input 32	Spare
17	+24 VDC	N/A
18	+24 VDC	N/A
19	Chassis Ground	N/A
20	Output 17	Remote Air Plasma
21	Output 18	Remote H35/N2 Plasma
22	Output 19	Remote O2 Plasma
23	Output 20	Gas Flow Set 1
24	Output 21	Gas Flow Set 2
25	Output 22	Gas Flow Set 4
26	Output 23	Gas Flow Set 8
27	Output 24	Gas Flow Set 10
28	Output 25	Gas Flow Set 20
29	Output 26	Gas Flow Set 40
30	Output 27	Gas Flow Set 80
31	Output 28	Gas Flow Set 100
32	Output 29	Valve Select 1
33	Output 30	Valve Select 2
34	Output 31	Valve Select 4
35	Output 32	Valve Select 8
36	+24 VDC Common	
37	+24 VDC Common	

Mating Connector
Connector: 37C D-Sub Amp # 205210-3 or equivalent
Backshell: Amp #748676-4 or equivalent
Pins: Amp #5-66507-9 (24-28 AWG) or equivalent

Note: Additional I/O for the Voyager II™ will be available through use of optional Analog Input cards. Additional information on the Optional Analog Input Cards is available in the Sensor™ THC section of this guide.

Please contact your control vendor for more information on how the Analog Input Card may be configured in your control.

AC Input Pinout

Pin	Description
1	110VAC or 220VAC Input (Hot)
2	110VAC or 220VAC Input (Neutral)
6	AC Power Ground
7	Watchdog (relay contact)
8	+24 VDC common
11	Watchdog (relay contact)
14	+24 VDC Output

AC Input Mating Connector
Connector: 16CAmp # 206037-1 or equivalent
Backshell: Amp #206070-1 or equivalent
Sockets: Amp #66101-3 (16-18 AWG) or equivalent

Axes	Conn. Location	Axes Assignment
1	J5	Transverse or Rail
2	J6	Transverse or Rail
3	J7	Dual Gantry, CBH or THC
4	J8	CBH or THC
5	J9	Rotate or THC
6	J10	Tilt or THC

Drive/ Encoder Pinout (J5- J10)

Pin	Description
1	Channel A Input
2	Channel B Input
3	Channel Z Input
4	Encoder Power Output (5 VDC supplied as standard)
5	Chassis Ground / E Ground
6	Servo Output (± 10V)
7	Drive Enable In (relay contact)
8	Encoder Shield
9	Channel /A Input
10	Channel /B Input
11	Channel /Z Input
12	E Ground
13	Drive/ Servo Shield
14	Servo Output Common
15	Drive Enable Out (relay contact)

Drive/ Encoder Input Mating Connector
Connector: 15C D-Sub Amp # 25206-3 or equivalent
Backshell: Amp #748676-2 or equivalent
Pins: Amp #5-66506-9 (20-24 AWG) or equivalent

Warning! This control is equipped with an internal power supply for providing analog, encoder and I/O voltage. A wiring modification to bring the proper voltage to the Drive Encoder Connector for the use of 12 Volt encoders may be required.

Optional Analog / PWM Interface

Analog Card Options

The Analog Card Interface option provides connection for operation of the Joystick, Speed Pot and Sensor™ THC features

Series 1 ISA Analog Card

Note: The Analog Card will be designated as Rev 0 in the Control Information Diagnostic screen.

Board Marking PC-012-1098 Rev. B Part # PCBS-0010-B

J1 - Power

Pin #	Designation	Description
1	VA+	+ 12VDC
2	A Ground	Common
3	VA–	- 12VDC
4	VE+	+5VDC
5	E Ground	Ground

TB1 - I/O

Pin #	Designation	Description
1	Analog 3 +	Speed Pot 1 +
2	Analog 3 -	Speed Pot 1 –
3	Analog 4 +	Speed Pot 2 +
4	Analog 4 -	Speed Pot 2 –
5	Input 1	Joystick Up (single ended – active by E-ground)
6	Input 2	Joystick Down (single ended – active by E-ground)
7	Input 3	Joystick Left (single ended – active by E-ground)
8	Input 4	Joystick Right (single ended – active by E-ground)

Mating Connector
8C Phoenix Connector – Phoenix Part # 1803633

TB2 - I/O

Pin #	Designation	Description
1	Analog 2 +	THC +
2	Analog 2 -	THC –
3	Input 6 +	Nozzle Contact Sense + (Relay Contact)
4	Input 6 -	Nozzle Contact Sense - (Relay Contact)
5	Output 3 +	Nozzle Contact Enable + (Relay Contact)
6	Output 3 -	Nozzle Contact Enable - (Relay Contact)
7	Output 4 +	Hold Ignition + (Relay Contact)
8	Output 4 -	Hold Ignition - (Relay Contact)

Mating Connector
8C Phoenix Connector – Phoenix Part # 1803633

TB3 - I/O

Pin #	Designation	Description
1	Analog 1 +	THC +
2	Analog 1 -	THC –
3	Input 5 +	Nozzle Contact Sense + (Relay Contact)
4	Input 5 -	Nozzle Contact Sense - (Relay Contact)
5	Output 1+	Nozzle Contact Enable + (Relay Contact)
6	Output 1-	Nozzle Contact Enable - (Relay Contact)
7	Output 2+	Hold Ignition + (Relay Contact)
8	Output 2-	Hold Ignition - (Relay Contact)

Mating Connector

8C Phoenix Connector – Phoenix Part # 1803633

Series 2 Analog/ PWM Interface Card

Note: The Analog Card will be designated as Rev A in the Control Information Diagnostic screen.

Board Marking PC-026-500 Rev. Part # PCBS-0040

J5 - I/O

Pin #	Designation	Description
1	Joystick IN1	Joystick Up (single ended – active by E-ground)
2	Joystick IN2	Joystick Down (single ended – active by E-ground)
3	Joystick IN3	Joystick Left (single ended – active by E-ground)
4	Joystick IN4	Joystick Right (single ended – active by E-ground)
5	E Ground	Joystick Common
6	Chassis Ground	Shield
7	Analog In 6 +	Speed Pot 1 +
8	Analog In 6 -	Speed Pot 1 –
9	Chassis ground	Shield
10	Analog In 12 +	Speed Pot 2 +
11	Analog In 12 -	Speed Pot 2 –
12	Chassis Ground	Shield

Mating Connector
12C Phoenix Connector – Phoenix Part # 1803675

J6 - APC 2

Pin #	Description
1	Analog In 8 +
2	Analog In 8 -
3	Shield
4	Analog In 9 +
5	Analog In 9 -
6	Shield
7	+24VDC
8	Analog In 10 +
9	Analog In 10 -
10	Shield
11	Analog In 11 +
12	Analog In 11 -
13	Shield
14	+24VDC
15	Output 16
16	+24VDC
17	PWM 4 +
18	PWM 4 -
19	Shield
20	PWM 5 +
21	PWM 5 -
22	Shield
23	PWM 6 +
24	PWM 6 -
25	Shield

J7 - Plasma 2

Pin #	Description
1	Analog 7 In +
2	Analog 7 In -
3	Shield
4	Output 41
5	No Connection
6	Input 9
7	+24VDC
8	No Connection
9	Analog Out 2 +
10	Analog Out 2 -
11	Chassis Ground
12	Output 42
13	Output 43
14	Output 44
15	Output 45
16	Output 46
17	Output 47
18	Input 41
19	Input 42
20	Input 43
21	Input 44
22	+24 VDC
23	+24 VDC
24	+24 V Common
25	+24 V Common

J8 - APC 1

Pin #	Description
1	Analog In 2 +
2	Analog In 2 -
3	Shield
4	Analog In 3 +
5	Analog In 3 -
6	Shield
7	+24VDC
8	Analog In 4 +
9	Analog In 4 -
10	Shield
11	Analog In 5 +
12	Analog In 5 -
13	Shield
14	+24VDC
15	Output 8
16	+24VDC
17	PWM 1 +
18	PWM 1 -
19	Shield
20	PWM 2 +
21	PWM 2 -
22	Shield
23	PWM 3 +
24	PWM 3 -
25	Shield

J9 - Plasma 1

Pin #	Description
1	Analog 1 +
2	Analog 1 –
3	Shield
4	Output 1
5	No Connection
6	Input 33
7	+24VDC
8	No Connection
9	Analog Out 1 +
10	Analog Out 1 –
11	Chassis Ground
12	Output 34
13	Output 35
14	Output 36
15	Output 37
16	Output 38
17	Output 39
18	Input 34
19	Input 35
20	Input 36
21	Input 37
22	+24 VDC
23	+24 VDC
24	+24 V Common
25	+24 V Common

APC Mating Connector (J6 & J8)
Connector: 25C D-Sub Amp # 207464-2 or equivalent
Backshell: Amp #748676-3 or equivalent
Pins: Amp #5-66506-9 (20-24 AWG) or equivalent

Plasma Mating Connector (J7 & J9)
Connector: 37C D-Sub Amp # 205207-1 or equivalent
Backshell: Amp #748676-3 or equivalent
Pins: Amp #5-66504-7 (20-24 AWG) or equivalent

Appendix F: Mariner™ Machine Interface

The Mariner™ Shape Cutting Control is designed with all machine interface connections passing through the pedestal mount at the base of the enclosure. Motion and I/O are supported via the fiber optic communication ring of the SERCOS Interface™.

The information contained in this section is intended to provide the basic information for connection of the Mariner™ Shape Cutting Control to the cutting table. Each machine interface will vary slightly based on the cutting table configuration and features.

Operation and maintenance of automated equipment involves potential hazards. Personnel should take precautions to avoid injury. This equipment should only be opened by trained service personnel.

AC Input Pinout

TB connector	Description
101	110VAC or 220VAC Input (Hot)
102	110VAC or 220VAC Input (Neutral)
	AC Power Ground

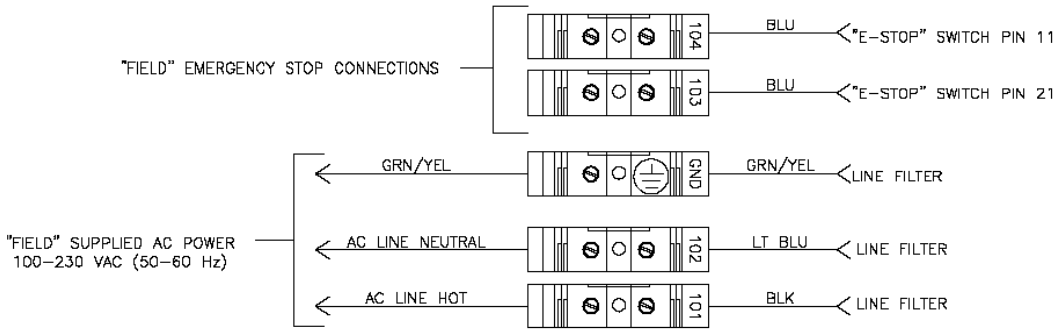
Recommended Wire
14 AWG or greater

E-Stop

The E-stop Switch provides normally open contacts rated at 20VAC/500mA minimum to 250VAC/6A maximum.

TB connector	Description
103	Contact Closure
104	Contact Closure

Diagram Location Din-02



SERCOS Motion and I/O

As noted previously, Motion and I/O are supported via the fiber optic communication ring of the SERCOS Interface™. Digital and Analog I/O are supported.

Motion is controlled through address assignments for the axes. Inputs and Outputs work on a similar assignment in SERCOS and may be mapped at the I/O configuration screen.

Details for wiring the motion and /O are specific to the specific SERCOS hardware being used. Please refer to the appropriate supplier for interfacing information.

Appendix F: Serial Ports

Both serial ports provided are shipped in the RS-232C wiring configuration. To change either port to an RS-422 configuration requires changing a jumper setting on the Serial Isolation Board located inside the control on the back panel. Simply locate the appropriate jumper for the desired port at the bottom of the board and move the jumper from the RS-232C position to the RS-422 position, which is clearly marked on the board.

Warning! Configure the port for RS-422 Operation before connecting RS-422 compatible devises.

The serial ports in the control are specifically designed to operate with a standard nine pin serial port connector. Specifications for these ports are as follows:

Channel Type	Optically Isolated RS-232C or RS-422.
Information Code	ASCII (American Standard Code for Information Interchange).
Baud Rate	User selectable up to 115.2K baud.
Number of Start Bits	1
Number or Stop Bits	1
Word Length	User selectable 7 or 8 bits.
Parity	User selectable None, Even or Odd.
Data Synchronization	XON (Control-Q) / XOFF (Control-S).
Time Out	User selectable in one-second increments.
Transmit Delay	User selectable in one one/hundredths of a second increments.
Rear Panel Connector	IBM-PC/AT compatible 9-pin D-type female.

Control RS-232C DB-9 Pinout

Pin	Signal Name	Description
1	Shield	Chassis Ground
2	TxD	Transmit Data to External Device
3	RxD	Receive data from External Device
4		No Connection
5	Common	Ground
6		No Connection
7		No Connection
8		No Connection
9		No Connection

RS-232C Connections to Host PC with 9-pin D-type connector

Host PC		Control	
Signal Name	DB-9 Pin	Signal Name	DB-9 Pin
Shield	1	Shield	1
RxD	2	TxD	2
TxD	3	RxD	3
Common	5	Common	5

RS-232C Connections to Host PC with 25-pin D-type connector

Host PC		Control	
Signal Name	**DB-25 Pin**	**Signal Name**	**DB-9 Pin**
Shield	1	Shield	N/C
RxD	3	TxD	2
TxD	2	RxD	3
Common	7	Common	5

Control RS-422 DB-9 Pinout

Pin	Signal Name	Description
1	Shield	Chassis Ground
2	TxD-	Transmit Data - to External Device
3	RxD-	Receive Data - from External Device
4	TxD+	Transmit Data + to External Device
5	Common	Ground
6		No Connection
7	RxD+	Receive Data + from External Device
8		No Connection
9		No Connection

RS-422C Connections to Host PC with 9-pin D-type connector

Host PC		Control	
Signal Name	**DB-9 Pin**	**Signal Name**	**DB-9 Pin**
Shield	1	Shield	N/C
RxD-	3	TxD-	2
TxD-	2	RxD-	3
RxD+	7	TxD+	4
TxD+	4	RxD+	7
Common	5	Common	5

RS-422 Connections to Host PC with 25-pin D-type connector

Host PC		Control	
Signal Name	**DB-25 Pin**	**Signal Name**	**DB-9 Pin**
Shield	1	Shield	N/C
RxD -	3	TxD -	2
TxD -	2	RxD -	3
RxD +	14	TxD +	4
TxD +	16	RxD +	7
Common	7	Common	5

Serial Port Jumpers

The following Jumper selections for proper operation of the Rev D serial communication card.

Jumper Settings

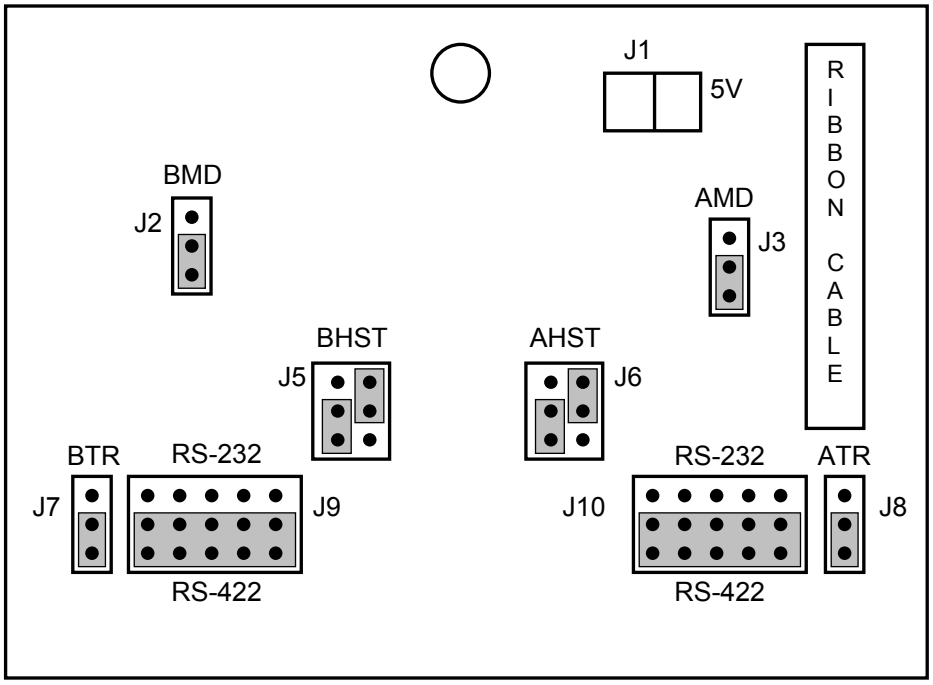
Location	Designation	Description
J3	AMD	Port A Multidrop .
J2	BMD	Port B Multidrop
J6	AHST	Port A Host
J5	BHST	Port B Host
J8	ATR	Port A Termination Resistor
J7	BTR	Port B Termination Resistor
J9	RS-232 / RS-422	RS-232 / RS-422 selection jumper
J10	RS-232 / RS-422	RS-232 / RS-422 selection jumper

Definitions

Multi-drop	Used to enable / disable the multi-drop feature for communication to multiple controls through one link program..
Host	Used to configure the card as a host serial card for multi-drop. Requires additional Hardware.
Termination Resistor	The Termination Resistor is used to add resistance to the communications system for the end controls in a multi-drop system.

RS- 232 / 422 Configuration

The jumpers on J9 and J10 would be placed in position for RS-232 or RS-422 for operation on the appropriate port. Selection may very slightly depending on control type.



Appendix G: ASCII Codes

This appendix provides the 128 ASCII codes (American Standard Code for Information Interchange) as defined by ANSI (American National Standards Institute) Standard X3.4-1977.

Control Codes

Hex	Dec	Character	Name	Description
00	0	^ @	NUL	Null
01	1	^A	SOH	Start of Header
02	2	^B	STX	Start of Text
03	3	^C	ETX	End of Text
04	4	^D	EOT	End of Transmission
05	5	^E	ENQ	Enquiry
06	6	^F	ACK	Acknowledge
07	7	^G	BEL	Bell
08	8	^H	BS	Backspace
09	9	^I	HT	Horizontal Tab
0A	10	^J	LF	Line Feed
0B	11	^K	VT	Vertical Tab
0C	12	^L	FF	Form Feed
0D	13	^M	CR	Carriage Return
0E	14	^N	SO	Shift Out
0F	15	^O	SI	Shift In
10	16	^P	DLE	Data Link Escape
11	17	^Q	DCI	Device Control 1
12	18	^R	DC2	Device Control 2
13	19	^S	DC3	Device Control 3
14	20	^T	DC4	Device Control 4
15	21	^U	NAK	Negative Acknowledge
16	22	^V	SYN	Synchronous Idle
17	23	^W	ETB	End Transmission Block
18	24	^X	CAN	Cancel
19	25	^Y	EM	End of Medium
1A	26	^Z	Sub	Substitute
1B	27	^[	ESC	Escape
1C	28	^\	FS	File Separator
1D	29	^]	GS	Group Separator
1E	30	^^	RS	Record Separator
1F	31	^_	US	Unit Separator
20	32		SP	Space

All Codes

Hex	Dec	Symbol	Hex	Dec	Symbol	Hex	Dec	Symbol
00	0	^ @	2B	43	+	56	86	V
01	1	^A	2C	44	,	57	87	W
02	2	^B	2D	45	-	58	88	X
03	3	^C	2E	46	.	59	89	Y
04	4	^D	2F	47	/	5A	90	Z
05	5	^E	30	48	0	5B	91	[
06	6	^F	31	49	1	5C	92	\
07	7	^G	32	50	2	5D	93	]
08	8	^H	33	51	3	5E	94	^
09	9	^I	34	52	4	5F	95	_
0A	10	^J	35	53	5	60	96	`
0B	11	^K	36	54	6	61	97	a
0C	12	^L	37	55	7	62	98	b
0D	13	^M	38	56	8	63	99	c
0E	14	^N	39	57	9	64	100	d
0F	15	^O	3A	58	:	65	101	e
10	16	^P	3B	59	;	66	102	f
11	17	^Q	3C	60	<	67	103	g
12	18	^R	3D	61	=	68	104	h
13	19	^S	3E	62	>	69	105	i
14	20	^T	3F	63	?	6A	106	j
15	21	^U	40	64	@	6B	107	k
16	22	^V	41	65	A	6C	108	l
17	23	^W	42	66	B	6D	109	m
18	24	^X	43	67	C	6E	110	n
19	25	^Y	44	68	D	6D	111	o
1A	26	^Z	45	69	E	70	112	p
1B	27	^[	46	70	F	71	113	q
1C	28	^\	47	71	G	72	114	r
1D	29	^]	48	72	H	73	115	s
1E	30	^^	49	73	I	74	116	t
1F	31	^_	4A	74	J	75	117	u
20	32		4B	75	K	76	118	v
21	33	!	4C	76	L	77	119	w
22	34	“	4D	77	M	78	120	x
23	35	#	4E	78	N	79	121	y
24	36	$	4F	79	O	7A	122	z
25	37	%	50	80	P	7B	123	{
26	38	&	51	81	Q	7C	124	|
27	39	‘	52	82	R	7D	125	}
28	40	(	53	83	S	7E	126	~
29	41	)	54	84	T	7F	127	←
2A	42	‘	55	85	U			

Appendix H: Sensor™ THC

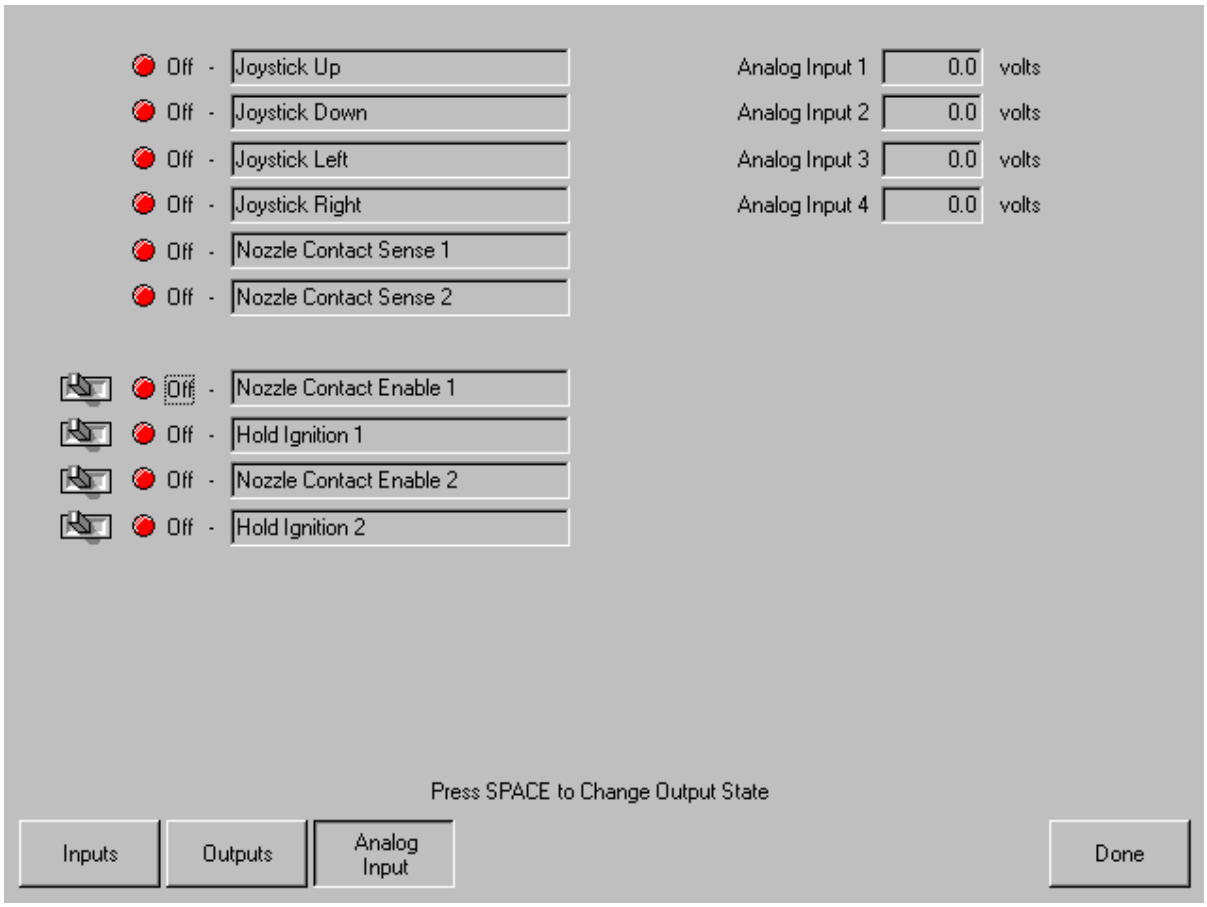
Diagnostics

Analog Input

The Sensor™ THC requires that additional inputs, outputs and analog voltage be brought in to the control to monitor the process. These signals are communicated to the control through an analog input card that has been installed into the control. In addition to THC operations, this analog input card may also be used for operation of an optional Joystick feature and external speed pots.

Note: View screens will vary depending upon the Analog Input Card being used.

Analog Input Series 1



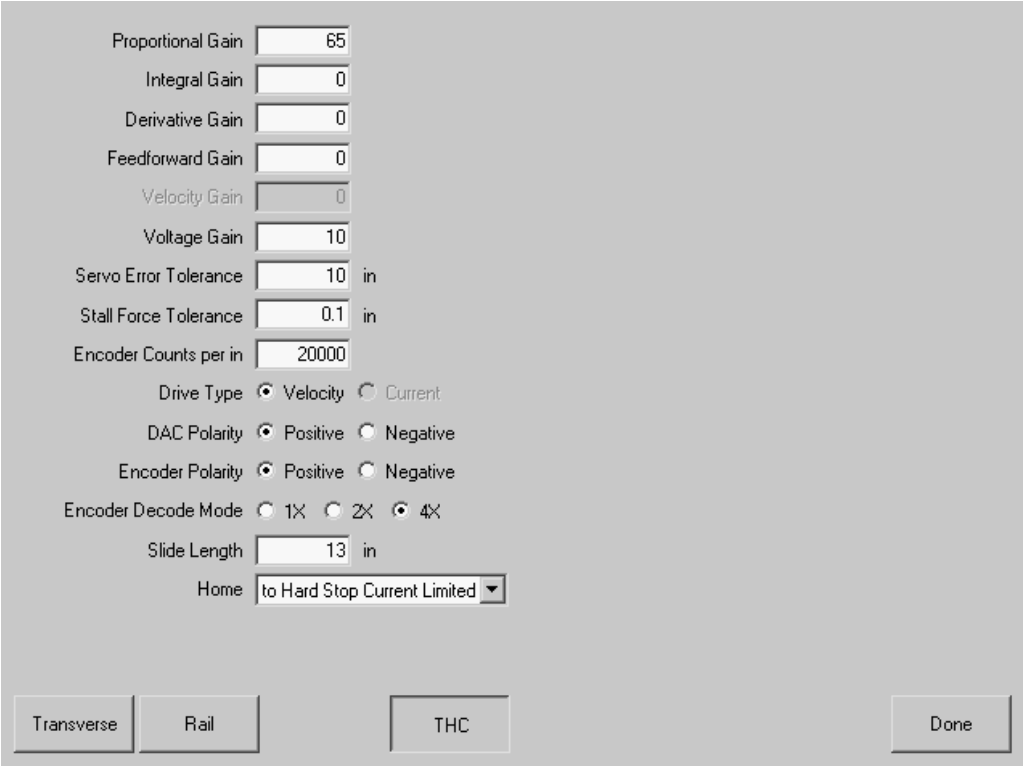
Analog Input Series 2

Inputs / Outputs
Single Ended inputs and outputs located on the Analog Input Card are displayed.

Analog Inputs
The Analog Input values shown in the upper right hand of the screen are the actual voltages coming into the analog card. Analog inputs are assigned to the THC Axis and the Analog input for the appropriate THC may be viewed here.

Sensor™ THC Axis Setups

The THC Axis screen is designed specifically for use with the Sensor™ THC.



Stall Force
The Stall Force Parameter allows the user to select the amount of Following Error (inches / mm) to be used as the motion limit when Homing or performing manual IHS / plate sensing. Example: If the value is set to .1 inches, the THC Axis will continue to move the axis until .1 inches of following error has been reached. The will indicate the Plate location during IHS and will indicate the top of the slide during homing.

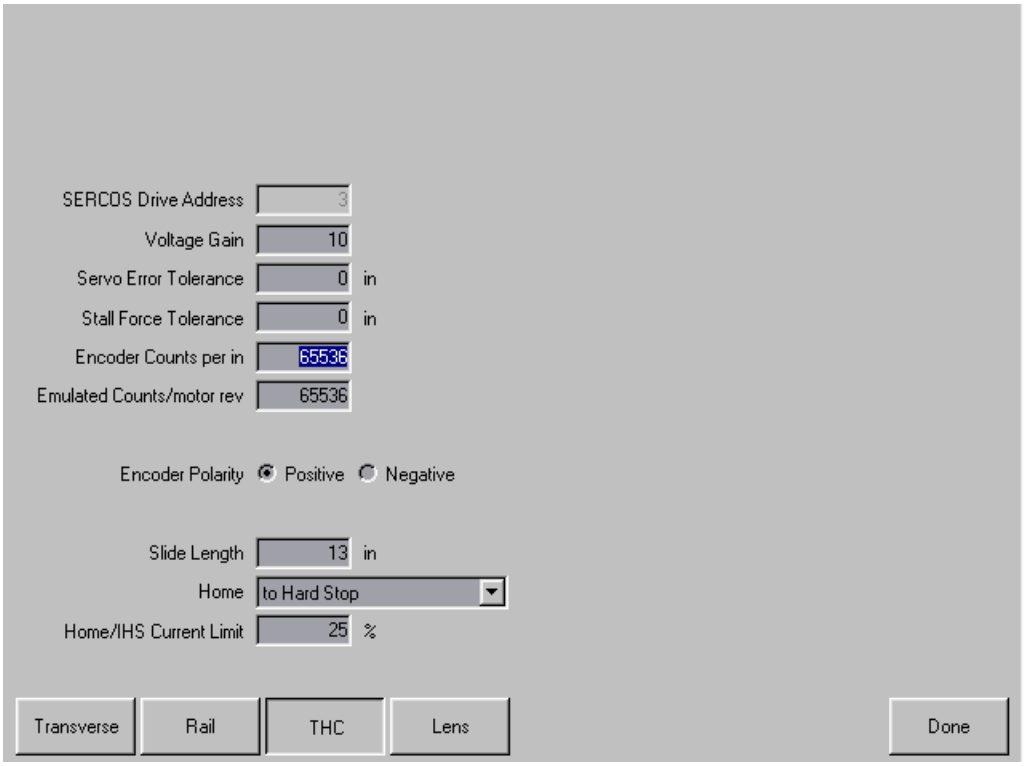
Slide Length
This parameter is used to specify the overall motion length of the Slide mechanism being used for the THC. This information is used to set the travel limits of the slide after homing.

Home
The Home parameter is used to activate use of the Home feature for the THC Axis. Depending on the Slide mechanism used, the THC may be Homed to Hard Stop, Hard Stop w/ Current Limit or Home Switch.

Note:
If the “Home to Hard Stop Current Limited” option is selected, the CNC Nozzle Contact Enable Output should be connected to the Current Limit Input of the amplifier to reduce torque during homing.

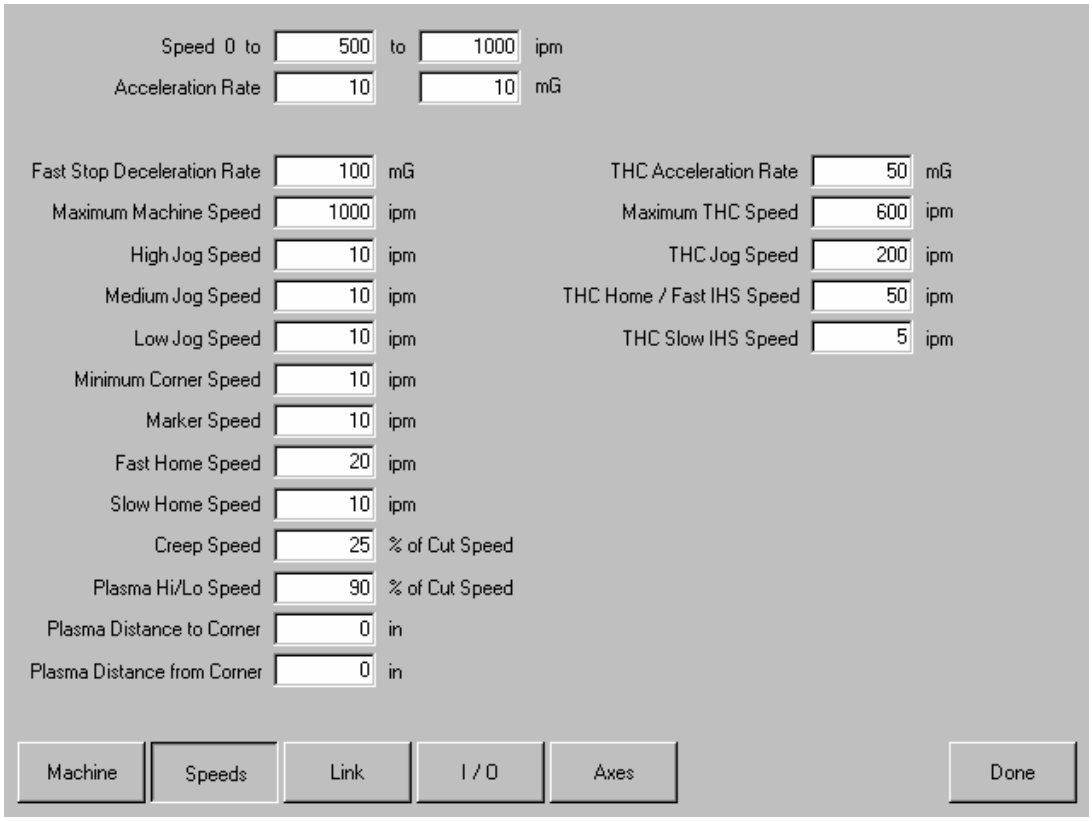
The CNC Nozzle Contact Sense Input is used during Sensor™ THC Homing as the Home Switch Input if the “Home to Switch” option is selected.

SERCOS Sensor THC Axis



Home/ IHS Current Limit
The Home / IHS Current limit parameter allows the user to select a percentage of current limit to be used during homing and IHS functions.

THC Speeds



THC Acceleration Rate
This parameter allows the operator to set the acceleration rate for smooth and stable movement of the Sensor™ Torch Height Control. The higher the acceleration rate, the quicker the THC will get up to speed. The lower the acceleration rate, the smoother the machine will position the cutting device. Values are entered in Milligees.

Maximum THC Speed
Enter the maximum speed for the Sensor™ THC movement in inches/millimeters per minute.

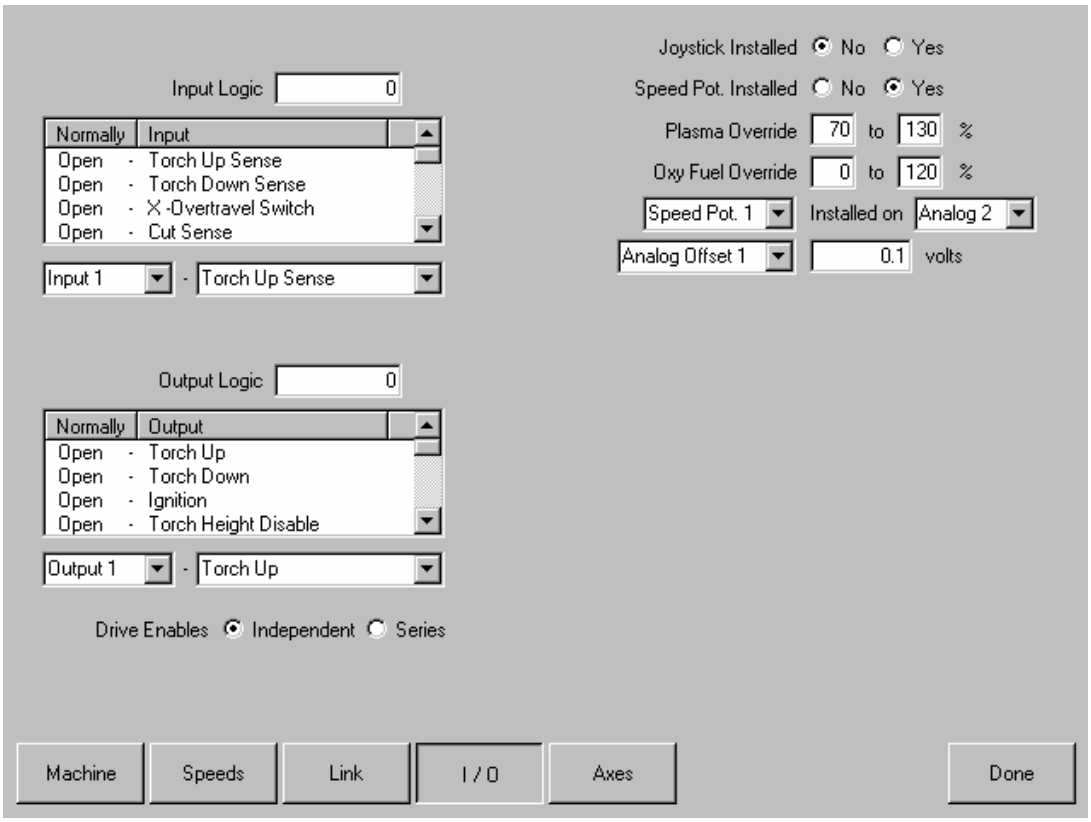
THC Jog Speed
Enter a value for the desired THC jog speed.

THC Home/Fast IHS Speed
The THC Home/Fast IHS Speed entered here is used to home the torch at the top of the slide and to quickly maneuver the torch from the selected IHS height to the plate.

THC Slow IHS Speed
The THC IHS Speed is used to retract the torch after the plate has been sensed. The torch will retract at this speed until the contact sense is lost. This determines the exact distance to the plate, regardless of any flexing of the plate. A very small speed is recommended for optimal accuracy.

Note: Due to the quick response time of the Sensor™ THC, generally there is no need for a value to be entered at the "Distance to Corner" parameter to lock or "freeze" the position of the torch. It is, however, suggested that a value be entered for the "Distance from Corner" to stabilize the torch during acceleration.

THC I/O



Analog Offset 1 - 12
The Analog Offsets 1 through 12 are used to correct for any imbalance or “zero” the incoming analog voltage to the Analog Input Card. Analog inputs are assigned to the THC Axis and the Analog Offsets for the appropriate THC Analog input may be adjusted here.

To calibrate the Analog Inputs, jumper the two pins specific to the input together and view the incoming voltage at the Diagnostics Analog I/O screen. The incoming voltage should be zero. If any voltage is displayed at the diagnostic screen, an Offset Voltage equal to the incoming voltage being read can be entered here to “zero” the incoming voltage. Please refer to the installation instructions later in this section for more details.

Sensor™ THC Part Program Support
Sensor™ THC offers the ability to configure THC setup parameters through part program codes.

The following parameters are available for use using EIA-274D G59 codes:

Arc Voltage
Pierce / Start Time
Pierce/ Start Height Factor
Cut / Mark Height

Setup is obtained using the following format.

Example: G59 V601 F*value*

Misc. G Code

Variable Identity
V600 = Plasma 1 Arc Voltage
V601 = Plasma 1 Pierce Time
V602 = Plasma 1 Pierce Height Factor
V603 = Plasma 1 Cut Height

V625 = Plasma 2 Arc Voltage
V626 = Plasma 2 Pierce Time
V627 = Plasma 2 Pierce Height Factor
V628 = Plasma 2 Cut Height

V650 = Marker 1 Arc Voltage
V651 = Marker 1 Start Time
V652 = Marker 1 Start Height Factor
V653 = Marker 1 Mark Height

V675 = Marker 2 Arc Voltage
V676 = Marker 2 Start Time
V677 = Marker 2 Start Height Factor
V678 = Marker 2 Mark Height

Variable Value
The selected value for the variable

Installation and THC Interface

The Sensor ™ THC is supported through various hardware configurations to offer single and multiple Sensor™ THC operation. Please refer top you exact hardware configuration when installing the Sensor™ THC.

Warning! Due to potentially high voltages, extreme care should be taken when working inside the plasma power supply. Work should only be performed by trained service personnel. Please refer to Power Supply manufacturer instructions.

Sensor™ THC w/ Series 1 ISA Analog Card and Series 2 Voltage Divider Card

This section refers to the following hardware configuration. *Note*: The Analog Card will be designated as Rev 0 in the Control Information Diagnostic screen.

Series 1 ISA Analog Card (Board Marking PC-012-1098 Rev. B)	Part # PCBS-0010-B
Series 2 Voltage Divider Card (Board Marking PC-026-500 Rev.)	Part # PCBS-0047

Instructions
If the voltage divider card has not been installed in the plasma power supply, mount the card in an accessible location away from high electrical noise areas. Wire the VDC to the appropriate signal inside the power supply as outlined in the following pinout information

Voltage Divider Card Pinout (Series 2)

Divider PCB - 2C Connector J1
(**Note:** +24VDC supply to be provided from inside the power supply)

Pin #	Description
1	+24 VDC Power Input
2	+24 VDC Common Input

Mating Connector
2C Phoenix Connector – Phoenix Part # 1840366

Divider PCB - 6C Connector J2 To Control

Pin #	Description
1	Nozzle Contact Sense
2	+24 Common
3	Nozzle Contact Enable
4	Analog In 1+
5	Analog In 1–
6	E Ground

Mating Connector
6C Phoenix Connector – Phoenix Part # 1840405

Divider PCB - 5C Connector J3 to Power Supply / Table

Pin Number	Description
1	Ground (Chassis Ground)
2	Electrode (Plasma DC –)
3	Work (Plasma DC +)
4	NC
5	Shield (Nozzle Contact)

Mating Connector
Terminal Connections

Control & Cable Pinout for Sensor™ THC

I/O Configuration Type "V"

Control 8C Analog Pin #	Description	Divider J2 Pin #
1	Analog +	J2 - 4
2	Analog –	J2 - 5
3	Nozzle Contact Sense +	J1 - 1
4	Nozzle Contact Sense –	J2 - 1
5	Nozzle Contact Enable +	J2 - 3
6	Nozzle Contact Enable –	J2 - 2
7	Hold Ignition +	N/A (direct to power supply)*
8	Hold Ignition –	N/A (direct to power supply)*

Mating Connector
8C Phoenix Connector – Phoenix Part # 1803633

* **Note**: It is recommended that the Hold ignition input be wired to the Power Supply through an external relay for noise immunity. Please refer to Instructions from supply manufacturer for details on connection to the Hold Ignition Input.

Sensor™ THC w/ Series 1 ISA Analog Card and Series 3 Voltage Divider Card

This section refers to the following hardware configuration. *Note*: The Analog Card will be designated as Rev 0 in the Control Information Diagnostic screen.

Series 1 ISA Analog Card (Board Marking PC-012-1098 Rev. B)	Part # PCBS-0010-B
Series 3 Voltage Divider Card	Part # PCBS-0061

Instructions
If the voltage divider card has not been installed in the plasma power supply, mount the card in an accessible location away from high electrical noise areas. Wire the VDC to the appropriate signal inside the power supply as outlined in the following pinout information

Voltage Divider Card Pinout (Series 3)

Divider PCB - 2C Connector J1

Pin #	Description
1	85 -265 VAC Power Input (47-63Hz)
2	85 -265 VAC Neutral Input

Mating Connector
2C Phoenix Connector – Phoenix Part # 1840366

Divider PCB - 8C Connector J2 To Control

Pin #	Description
1	+24 VDC Common
2	+24 VDC
3	Nozzle Contact Sense
4	Nozzle Contact Enable
5	+24 VDC Common
6	Analog Out +
7	Analog Out –
8	E Ground

Mating Connector
8C Phoenix Connector – Phoenix Part # 1803633

Divider PCB - 5C Connector J3 to Power Supply / Table

Pin Number	Description
1	Ground (Chassis Ground)
2	Electrode (Plasma DC –)
3	Work (Plasma DC +)
4	NC
5	Shield (Nozzle Contact)

Mating Connector
Terminal Connections

Control & Cable Pinout for Sensor™ THC

I/O Configuration Type "V"

Control 8C Analog Pin #	Description	Divider J2 Pin #
1	Analog +	J2 - 6
2	Analog –	J2 - 7
3	Nozzle Contact Sense +	J2 - 2
4	Nozzle Contact Sense –	J2 - 3
5	Nozzle Contact Enable +	J2 - 4
6	Nozzle Contact Enable –	J2 - 5
7	Hold Ignition +	N/A (direct to power supply)*
8	Hold Ignition –	N/A (direct to power supply)*
N/C	Shield	J2 - 8

Mating Connector
8C Phoenix Connector – Phoenix Part # 1803633

* **Note**: It is recommended that the Hold ignition input be wired to the Power Supply through an external relay for noise immunity. Please refer to Instructions from supply manufacturer for details on connection to the Hold Ignition Input.

Sensor™ THC w/ Series 2 Analog Card and Series 2 Voltage Divider Card
This section refers to following hardware configuration. *Note*: The Analog Card will be designated as Rev A in the Control Information Diagnostic screen.

Series 2 Analog Card / PWM Interface (Board Marking PC-023-0100 Rev.)	Part # PCBS-0040
Series 2 Voltage Divider Card (Board Marking PC-026-500 Rev.)	Part # PCBS-0047

Instructions
If the voltage divider card has not been installed in the plasma power supply, mount the card in an accessible location away from high electrical noise areas. Wire the VDC to the appropriate signal inside the power supply as outlined in the following pinout information

Voltage Divider Card Pinout

Divider PCB - 2C Connector J1
(**Note:** +24VDC supply to be provided from inside the power supply)

Pin #	Description
1	+24 VDC Power Input
2	+24 VDC Common Input

Mating Connector
2C Phoenix Connector – Phoenix Part # 1840366

Divider PCB - 6C Connector J2 To Control

Pin #	Description
1	Nozzle Contact Sense
2	+24 Common
3	Nozzle Contact Enable
4	Analog In 1+
5	Analog In 1–
6	E Ground

Mating Connector
6C Phoenix Connector – Phoenix Part # 1840405

Divider PCB - 5C Connector J3 to Power Supply / Table

Pin Number	Description
1	Ground (Chassis Ground)
2	Electrode (Plasma DC –)
3	Work (Plasma DC +)
4	NC
5	Shield (Nozzle Contact)

Mating Connector
Terminal Connections

Sensor™ THC w/ Series 2 Analog Card and Series 3 Voltage Divider Card

Series 2 Analog Card / PWM Interface (Board Marking PC-023-0100 Rev.)	Part # PCBS-0040
Series 3 Voltage Divider Card	Part # PCBS-0061

Instructions
If the voltage divider card has not been installed in the plasma power supply, mount the card in an accessible location away from high electrical noise areas. Wire the VDC to the appropriate signal inside the power supply as outlined in the following pinout information

Voltage Divider Card Pinout (Series 3)

Divider PCB - 2C Connector J1

Pin #	Description
1	85 -265 VAC Power Input (47-63Hz)
2	85 -265 VAC Neutral Input

Mating Connector
2C Phoenix Connector – Phoenix Part # 1840366

Divider PCB - 8C Connector J2 To Control

Pin #	Description
1	+24 VDC Common
2	+24 VDC
3	Nozzle Contact Sense
4	Nozzle Contact Enable
5	+24 VDC Common
6	Analog Out +
7	Analog Out –
8	E Ground

Mating Connector
8C Phoenix Connector – Phoenix Part # 1803633

Divider PCB - 5C Connector J3 to Power Supply / Table

Pin Number	Description
1	Ground (Chassis Ground)
2	Electrode (Plasma DC –)
3	Work (Plasma DC +)
4	NC
5	Shield (Nozzle Contact)

Mating Connector
Terminal Connections

I/O Configuration Type "V"

Due to the ability to select the Analog Input being used for a selected THC and the ability to configure the Input and Output locations, no exact or standard Pinout for the THC connections is available. Connections would be made by selecting the Analog Input for the desired THC and connecting the Analog signals from the Voltage Divider Card. In much the same manner, the required Nozzle Contact Sense, Nozzle Contact Enable and Hold Ignition I/O points would be selected and connected to the corresponding appropriate pins on the Voltage Divider Card.

Description	**Divider J2 Pin #**
Analog +	J2 - 6
Analog –	J2 - 7
Nozzle Contact Sense +	J2 - 2
Nozzle Contact Sense –	J2 - 3
Nozzle Contact Enable +	J2 - 4
Nozzle Contact Enable –	J2 - 5
Hold Ignition +	N/A (direct to power supply)*
Hold Ignition –	N/A (direct to power supply)*
Shield	J2 - 8

* **Note**: It is recommended that the Hold Ignition input be wired to the Power Supply through an external relay for noise immunity. Please refer to Instructions from the supply manufacturer for details on connection to the Hold Ignition Input.

Sensor™ THC w/ Series 1 PCI Analog Card and Series 2 Voltage Divider Card

This section refers to following hardware configuration. *Note*: The Analog Card will be designated as Rev 0 in the Control Information Diagnostic screen.

Series 1 PCI Analog Card (Board Marking PCBS-0073)	Part # PCBS-0074
Series 2 Voltage Divider Card (Board Marking PC-026-500 Rev.)	Part # PCBS-0047

Instructions
If the voltage divider card has not been installed in the plasma power supply, mount the card in an accessible location away from high electrical noise areas. Wire the VDC to the appropriate signal inside the power supply as outlined in the following pinout information

Voltage Divider Card Pinout (Series 2)

Divider PCB - 2C Connector J1
(**Note:** +24VDC supply to be provided from inside the power supply)

Pin #	Description
1	+24 VDC Power Input
2	+24 VDC Common Input

Mating Connector
2C Phoenix Connector – Phoenix Part # 1840366

Divider PCB - 6C Connector J2 To Control

Pin #	Description
1	Nozzle Contact Sense
2	+24 Common
3	Nozzle Contact Enable
4	Analog In 1+
5	Analog In 1–
6	E Ground

Mating Connector
6C Phoenix Connector – Phoenix Part # 1840405

Divider PCB - 5C Connector J3 to Power Supply / Table

Pin Number	Description
1	Ground (Chassis Ground)
2	Electrode (Plasma DC –)
3	Work (Plasma DC +)
4	NC
5	Shield (Nozzle Contact)

Mating Connector
Terminal Connections

Control & Cable Pinout for Sensor™ THC

I/O Configuration Type "P"

Note: A 9C Amp connector is provided on the back of the control (I/O Type "P") for interfacing.

Control 9C Analog Pin #	Description	Divider Pin #
1	24V Common	J2-2
2	Nozzle Contact Sense +	J1-1
3	Nozzle Contact Sense –	J2-1
4	Nozzle Contact Enable +	J2-3
5	Nozzle Contact Enable –	J2-2
6	Analog +	J2-4
7	Analog –	J2-5
8	Hold Ignition +	N/A (direct to power supply)*
9	Hold Ignition –	N/A (direct to power supply)*
Ground Stud	Shield	No Connection

Analog Mating Connector
Connector AMP # 206708-1
Backshell AMP #206966-1
Sockets #66105-3 (20-24 ga)

VDC Mating Connector
8C Phoenix Connector – Phoenix Part # 1803633

Cable
Belden #9505 or equivalent

Note: It is recommended that the Hold Ignition input be wired to the Power Supply through an external relay for noise immunity. Please refer to instructions from supply manufacturer for details on connection to the Hold Ignition Input.

Sensor™ THC w/ Series 1 Analog Card and Series 3 Voltage Divider Card

This section refers to following hardware configuration. *Note*: The Analog Card will be designated as Rev 0 in the Control Information Diagnostic screen.

Series 1 PCI Analog Card (Board Marking PCBS-0073)	Part # PCBS-0074
Series 3 Voltage Divider Card	Part # PCBS-0061

Instructions
If the voltage divider card has not been installed in the plasma power supply, mount the card in an accessible location away from high electrical noise areas. Wire the VDC to the appropriate signal inside the power supply as outlined in the following pinout information

Voltage Divider Card Pinout (Series 3)

Divider PCB - 2C Connector J1

Pin #	Description
1	85 -265 VAC Power Input (47-63Hz)
2	285 -265 VAC Neutral Input

Mating Connector
2C Phoenix Connector – Phoenix Part # 1840366

Divider PCB - 8C Connector J2 To Control

Pin #	Description
1	+24 VDC Common
2	+24 VDC
3	Nozzle Contact Sense
4	Nozzle Contact Enable
5	+24 VDC Common
6	Analog Out +
7	Analog Out –
8	E Ground

Mating Connector
8C Phoenix Connector – Phoenix Part # 1803633

Divider PCB - 5C Connector J3 to Power Supply / Table

Pin Number	Description
1	Ground (Chassis Ground)
2	Electrode (Plasma DC –)
3	Work (Plasma DC +)
4	NC
5	Shield (Nozzle Contact)

Mating Connector
Terminal Connections

Control & Cable Pinout for Sensor™ THC

I/O Configuration Type "P"

Note: A 9C Amp connector is provided on the back of the control (I/O Type "P") for interfacing.

Control 9C Analog Pin #	Description	Divider J2 Pin #
1	24V Common	1
2	Nozzle Contact Sense +	2
3	Nozzle Contact Sense –	3
4	Nozzle Contact Enable +	4
5	Nozzle Contact Enable –	5
6	Analog +	6
7	Analog –	7
8	Hold Ignition +	N/A (direct to power supply)*
9	Hold Ignition –	N/A (direct to power supply)*
Ground Stud	Shield	No Connection

Analog Mating Connector
Connector AMP # 206708-1
Backshell AMP #206966-1
Sockets #66105-3 (20-24 ga)

VDC Mating Connector
8C Phoenix Connector – Phoenix Part # 1803633

Cable
Belden #9505 or equivalent

* **Note**: It is recommended that the Hold Ignition input be wired to the Power Supply through an external relay for noise immunity. Please refer to Instructions from the supply manufacturer for details on connection to the Hold Ignition Input.

Calibration

Series 1 Analog Card

Note: The Series 1 Analog Card will be designated as Rev 0 in the Control Information Diagnostic screen.

Board Marking PC-012-1098 Rev. B Part # PCBS-0010-B

After the voltage divider card and control cabling have been connected, the system is ready to be calibrated for use.

Analog Offset: To adjust the Analog Offset, place a jumper on the Analog In signals on the Analog input card or at the 9C connection for the Analog Input Card located at the back of the control. The analog input voltage would then be viewed at the I/O Diagnostics screen to read any incoming voltage for the THC. If any voltage is displayed at the diagnostic screen, an Offset Voltage equal to the incoming voltage being read can be entered at the Password protected Analog I/O screen to correct for any imbalance and “zero” the incoming voltage

Example: If an incoming Analog Input Voltage is reading .1 volts, simply enter .1 at the Analog Offset and correct the imbalance.

Series 2 Analog Card

Note: The Analog Card will be designated as Rev A in the Control Information Diagnostic screen.

Board Marking PC-023-0100 Rev. Part # PCBS-0040

After the voltage divider card and control cabling have been connected, the system is ready to be calibrated for use.

Analog Offset: To adjust the Analog Offset, place a jumper on the Analog In signals on the Analog Input Card. The analog input voltage would then be viewed at the I/O Diagnostics screen to read any incoming voltage for the THC. If any voltage is displayed at the diagnostic screen, an Offset Voltage equal to the incoming voltage being read can be entered at the Password protected Analog I/O screen to correct for any imbalance and "zero" the incoming voltage

Example: If an incoming Analog Input Voltage is reading .1 volts, simply enter .1 at the Analog Offset and correct the imbalance.

Series 2 and 3 Voltage Divider Card

Note: No Calibration is required for the Series 2 or 3 Voltage Divider Card.

Warning! The Series 2 Analog card is not compatible with the Series 1 Voltage divider card.

Appendix I: Command® THC

Machine Interface

Warning! Configure the port for RS-422 operation before connecting to the Command® THC. The Command THC Link must first be enabled in Machine Setups for Type “P” controls and at the Station configuration for type “V” controls. Refer to the Serial Port section of this guide for additional information on configuring the serial port for RS-422 communication.

Port Designation
Serial communications for the Command® THC would automatically be set to the serial port which is not selected for serial communications. Example: If Serial Port 1 is designated for use as the link to the Host PC for Downloading of part programs, the HD4070® communications would be established on Serial Port 2.

Type “V” control may select the serial port designation at the Ports configuration screen.

RS-422 Connections to Command® THC with 25-pin D-type connector

Command® THC		Control	
Signal Name	**DB-9 Pin**	**Signal Name**	**DB-9 Pin**
RxD -	1	TxD -	2
TxD -	2	RxD -	3
RxD +	20	TxD +	4
TxD +	21	RxD +	7

For improved noise immunity, it is recommended that the cable shields for communication be tied to ground. Ferrite bead with several wraps on the cable may also be used.

Appendix J: Speed Pot and Joystick

Speed Pot and Joystick Overview

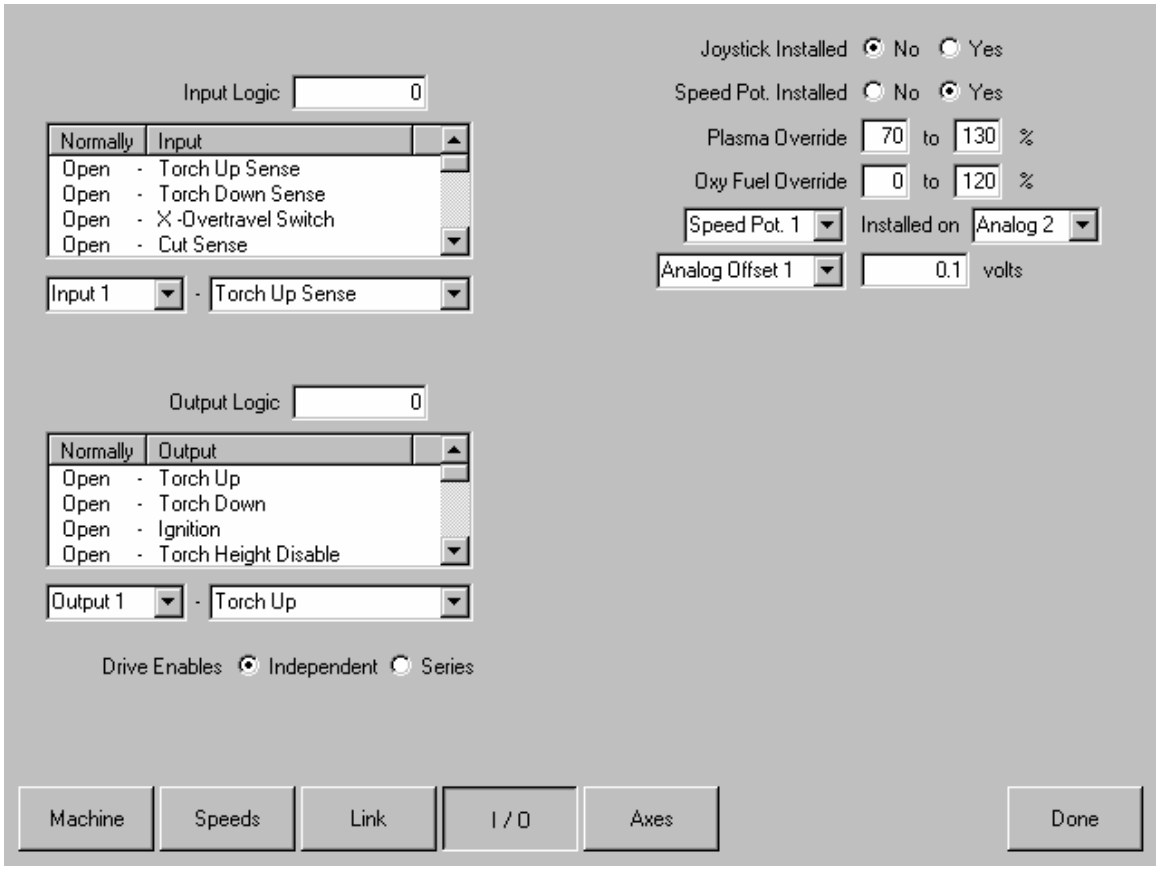
Through the use of Single Ended Inputs to an optional Analog Input Card installed in the control, your shape cutting control may be configured to support an external Joystick or Two Speed Potentiometers. Note: These features are not available for all control types and optional control hardware is required.

The external Joystick is used as a directional command signal when in manual motion.

The optional Speed Pot may be used to adjust the current motion speed.

These features must first be enabled at the password protected I/O screen for use.

Analog Card I/O



Joystick Installed
Select “Yes” to enable the optional external Joystick.

Speed Pot Installed
Select “Yes” to enable the optional external Speed Potentiometer.

Plasma Override %
The Plasma Override feature is used in conjunction with the Speed Pot feature to set the minimum and maximum range of adjustment of the plasma Speed Pot based on a percentage of the set cut speed. The Speed Pot feature must be enabled for use.

Oxy Fuel Override %
The Oxy Fuel Override feature is used in conjunction with the Speed Pot feature to set the minimum and maximum range of adjustment of the oxy fuel Speed Pot based on a percentage of the set cut speed. The Speed Pot feature must be enabled for use.

Speed Pot Installed On
The Speed Pot Installed On Parameter is used to assign Speed Pot inputs to a desired the Analog Input, if a dedicated Speed Pot input is not available on the Analog Input Card being used.

Analog Offset 1- 12
The Analog Offsets 1 through 12 are used to correct for any imbalance or “Zero” the incoming analog voltage to the Analog Input Card. Analog Offsets 1 and 2 are used for the THC 1 and THC 2 feature. Analog Offsets 3 & 4 are used for Speed Pot 1 and Speed Pot 2.

To calibrate the Analog Inputs, jumper the two pins specific to the input together and view the incoming voltage at the Diagnostics Analog I/O screen. The incoming voltage should be zero. If any voltage is displayed at the diagnostic screen, an Offset Voltage equal to the incoming voltage being read can be entered here to “Zero” the incoming voltage. Please refer to the installation instructions later in this section for more details.

Analog Input Diagnostics

Note: View screen may vary depending on the Analog Input Card installed.

Inputs
The Analog Input Card required to operate the optional Joy Stick and Speed Pots is equipped with six low voltage Inputs that are optically isolated and can operate at 24 – 120 VAC/DC. The first four inputs are used for the optional Joystick feature and inputs five and six are used to support THC One and THC Two Nozzle Contact Sense respectively. The Input Logic for these inputs is normally open.

Analog Inputs
The Analog Input values shown in the upper right hand of the screen are the actual voltages coming into the analog card. Analog Inputs one and two are used for THC One and Two. Analog inputs three and four are used for optional external speed pot referencing.

I/O Interface

Series 1 ISA Analog Card

Pin #	Description
1	Joystick Up
2	Joystick Down
3	Joystick Left
4	Joystick Right
5	E-Ground
6	No Connection
7	No Connection
8	No Connection
9	No Connection

Note: Joystick inputs are activated by passing the Common signal (pin 5) to the desired input. Analog inputs for the speedpots are rated at 0 - +10VDC

Joystick Mating Connectors
Connector AMP #206708-1
Backshell AMP #206966-1
Sockets (20-24 ga) AMP #66105-3
Cabling: Use CAROL #C0603 or equivalent

Series 1 PCI Analog Card

Pin #	Designation	Description
1	Input 1	Joystick UP
2	Input 2	Joystick DWN
3	Input 3	Joystick LT
4	Input 4	Joystick RT
5	Common	Common
6	Analog Input 3 +	Speed Pot 1
7	Analog Input 3 –	Speed Pot 1
8	Analog Input 4 +	Speed Pot 2
9	Analog Input 4 –	Speed Pot 2
Ground Stud		Shield

Note: Joystick inputs are activated by passing the Common signal (pin 5) to the desired input. Analog inputs for the speedpots are rated at 0 - +10VDC

Mating Connector
Connector AMP #206708-1
Backshell AMP #206966-1
Sockets (20-24 ga) AMP #66105-3
Cabling: Use Belden # 9504 or equivalent

THC and Joystick Cable Grounding
Cable shields should be tied to the external PE studs for optimum noise immunity.

Series 2 Analog Interface Card

J5 - I/O

Pin #	Designation	Description
1	Joystick IN1	Joystick Up (single ended – active by E-ground)
2	Joystick IN2	Joystick Down (single ended – active by E-ground)
3	Joystick IN3	Joystick Left (single ended – active by E-ground)
4	Joystick IN4	Joystick Right (single ended – active by E-ground)
5	E Ground	Joystick Common
6	Chassis Ground	Shield
7	Analog In 6 +	Speed Pot 1 +
8	Analog In 6 -	Speed Pot 1 –
9	Chassis ground	Shield
10	Analog In 12 +	Speed Pot 2 +
11	Analog In 12 -	Speed Pot 2 –
12	Chassis Ground	Shield

Mating Connector

12C Phoenix Connector – Phoenix Part # 1803675