Phoenix® Software V9.5

Programmer's Reference

for Hypertherm Touchscreen Shape Cutting Controls

806420 – Revision 1

Hypertherm®

Hypertherm, Inc.
Etna Road, PO Box 5010
Hanover, NH 03755 USA
Phone: 603-643-3441
Fax: 603-643-5352

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TRADEMARKS

Printed in USA

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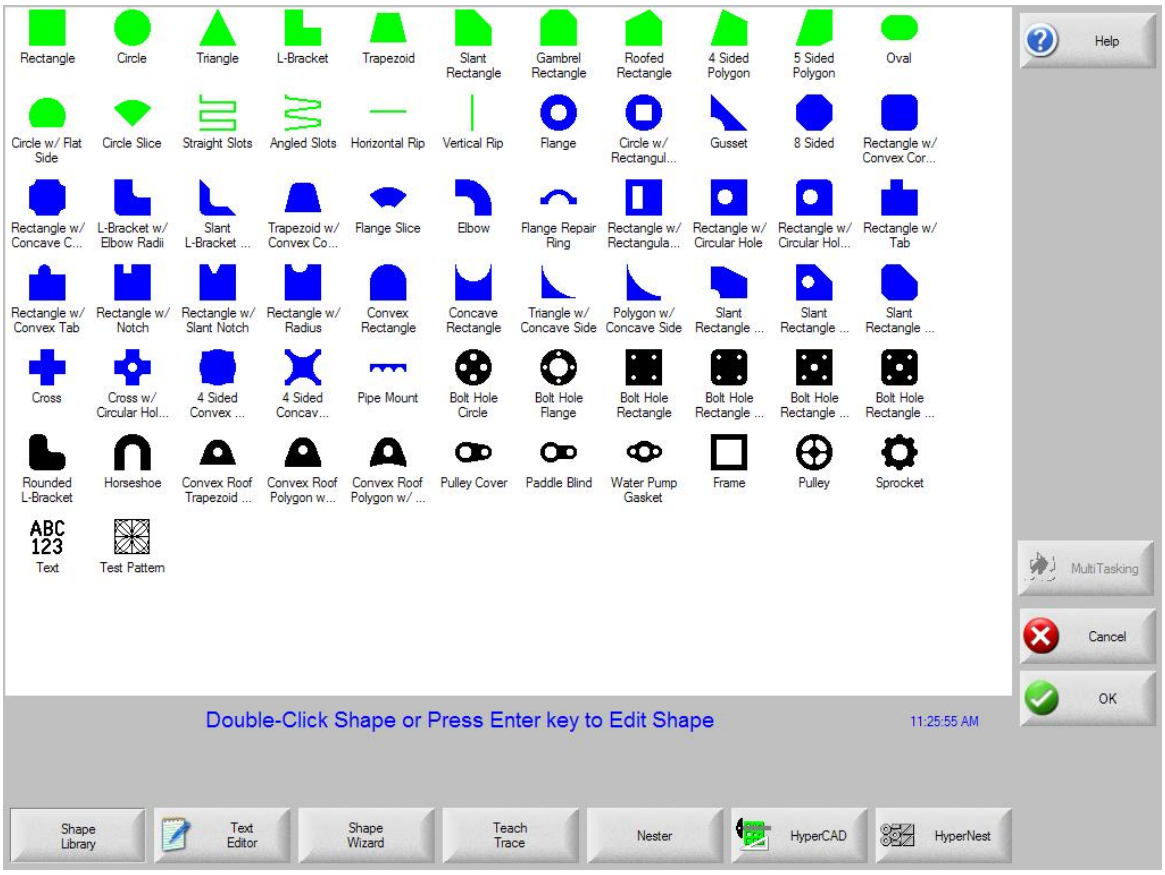
Shape Library

The CNC contains a built-in Shape Library with more than 68 commonly used shapes. These shapes are *parametric.* Parametric shapes are shapes whose size or geometry you can edit. The shapes in the library are color-coded from easy (green) to difficult (black).



To select a simple shape:

1. On the Main screen, press Shape Manager
2. Double click a shape.
   or
   Press a shape and press OK.
3. If the selection is incorrect, press Cancel and select the shape again.

Keypad operation:

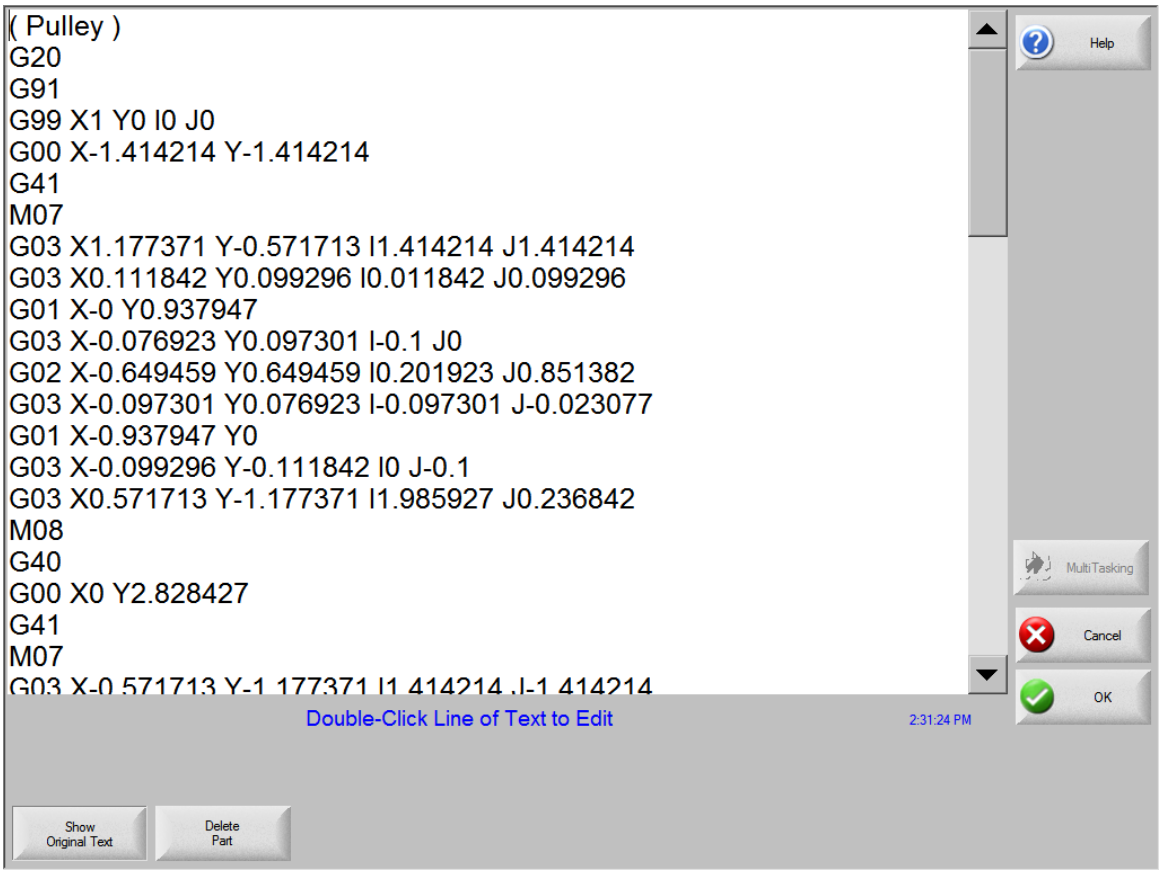
1. Use the arrow keys to navigate to a shape.
2. Press Enter.

The shape is displayed with the default parameters or the parameters from the last time this shape was edited. For more information on the available shapes, see *Library Shapes* in the *Operator's Manual*.

Text Editor

The text editor screen allows you to write or edit a part program in either ESSI or EIA format. The current part that is in memory is displayed when this screen opens.

You can make changes by pressing on a line of code. An alphanumeric keyboard displays to allow you to enter changes.



To edit code:

1. Select or press a line of code.
   On the CNC, the alphanumeric keypad displays.
2. Enter changes to existing lines of code or add new lines.
3. Press OK to save your changes.
   If you want to save the changes to the hard drive, select Files > Save to Disk.
4. Press Cancel to return to the previous screen without saving your changes.

Soft Key	Description
Show Original Text	Allows you to view and edit the part program in its original format.
Delete Part	Deletes the current part from the Text Editor so that a new part can be constructed.

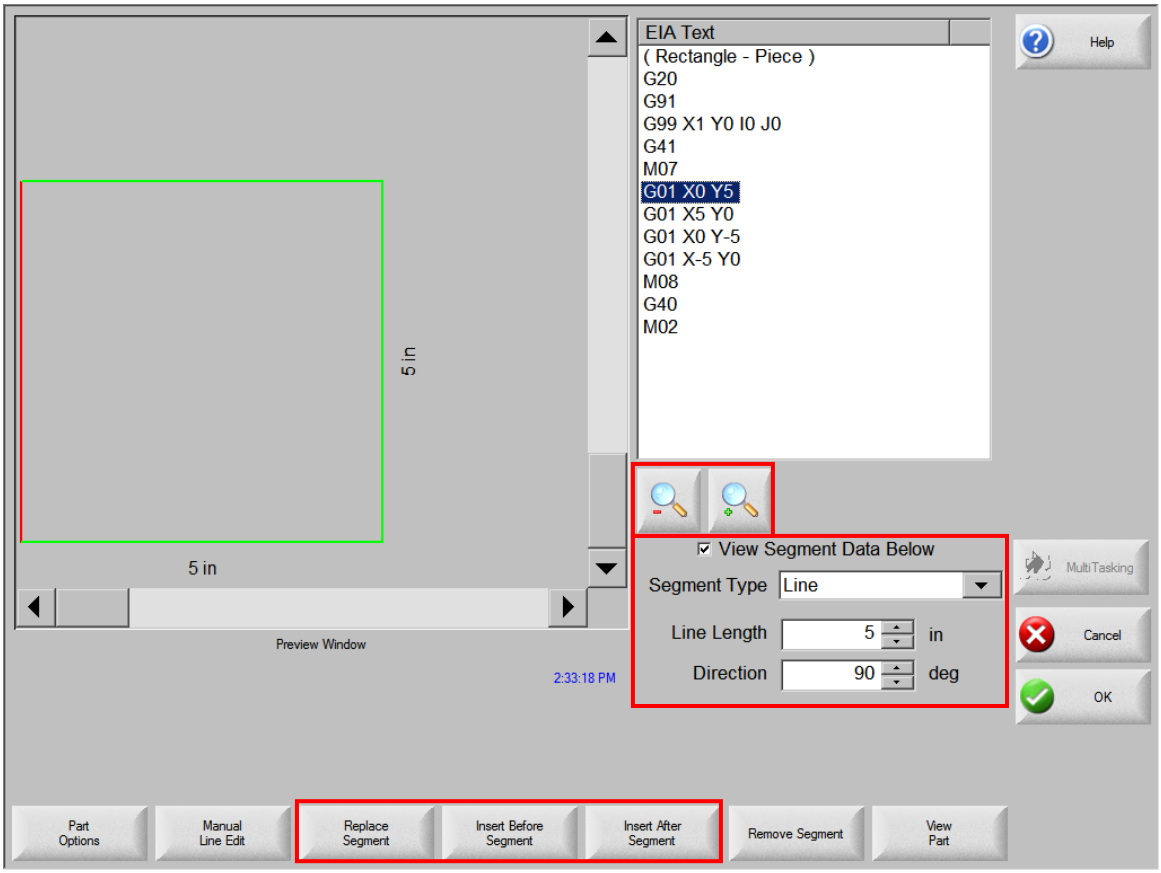
Shape Wizard

ShapeWizard® is a proprietary graphical part editor that provides a user-friendly, graphical interface for editing part programs.

You can view the segment that you edit and other changes that you make, as well.

There are a number of features on the Shape Wizard screen to facilitate editing part programs:

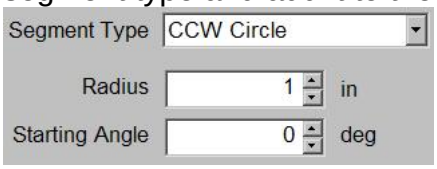
- The shape you select is displayed in the Preview Window and the corresponding code is displayed in the EIA Text window.
- As you edit lines of code, the changes are visible in the Preview Window.
- You can add or modify EIA RS-274D codes in a part program in the EIA Text window.
- If you don't know EIA RS-274D codes, you can edit or create segments by making entries and selections in the Segment Data fields below the EIA Text window.
- Zoom keys decrease or increase the size of the part in the Preview Window.



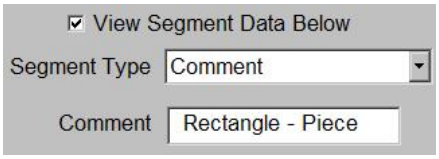
To edit a part program in the EIA Text window:

1. Press or click on a line of code to highlight it.

2. Press or click Manual Line Edit.
   The alphanumeric keypad is displayed for line edits.
3. Type over a line to replace the text.
   The ASCII text that you enter must be a valid EIA RS-274D code or an error message will display.
4. To view data about the segment of the part that you have highlighted, select the View Segment Data Below checkbox.
5. You can use the Segment Type field and related fields to change the highlighted segment type and add it to the program.



6. While a line is highlighted in blue, you can use soft keys to replace a segment or add a new one:

Soft Key	Description
Replace Segment	Replaces the segment highlighted in gray in the Text Editor window with the segment selected from the Segment Type window. 
Insert Before Segment	Inserts the segment selected from the Segment Type window to be inserted before the segment highlighted in gray in the Text Editor window.
Insert After Segment	Inserts the segment selected from the Segment Type window after the segment highlighted in gray in the Text Editor window.
Remove Segment	Deletes the segment that is highlighted in gray or blue in the EIA Text window from the part program.

7. As you edit a line of code, the picture of the part in the Preview window is updated. The corresponding segment is highlighted in red if it is a cut segment or in blue if it is a traverse.

Teach Trace

The Teach Trace function of the CNC allows parts and remnants to be traced rather than programmed. The position information from the traced part remains as a part program that can be saved to disk.

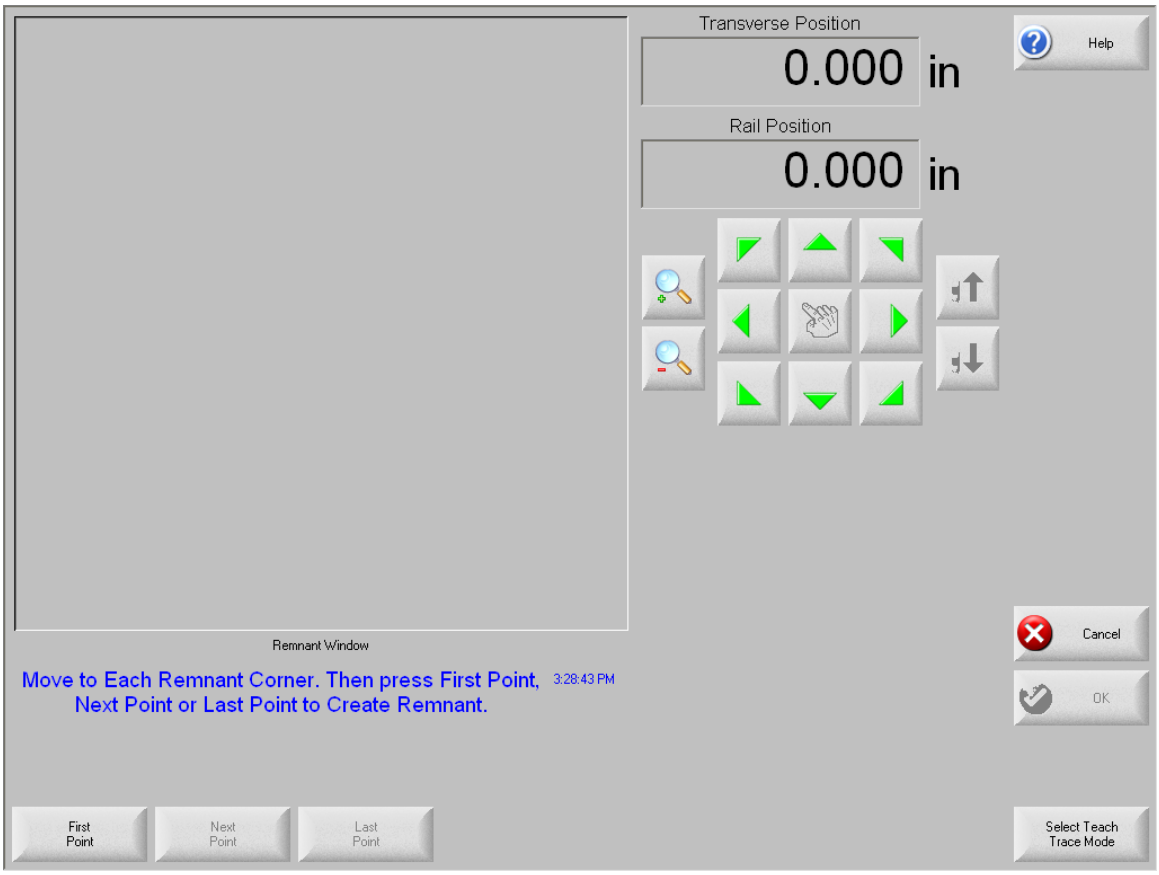
The Teach Trace algorithms in the CNC can recognize both arcs and lines. This reduces the overall memory required to store these parts and improves the smoothness of the cut.

The traced part in memory is in EIA format and can be cut, saved or edited using any of the part options.

Teach Trace has two modes, Remnant Trace and Teach Trace. The screen opens in Remnant Trace mode. Press the Select Teach Trace Mode soft key to use Teach Trace.

Remnant Trace Mode

In Remnant Trace mode, you can trace the outline of a plate remnant and save it as a file so that it can be used later and nests of parts can be cut from the remnant.

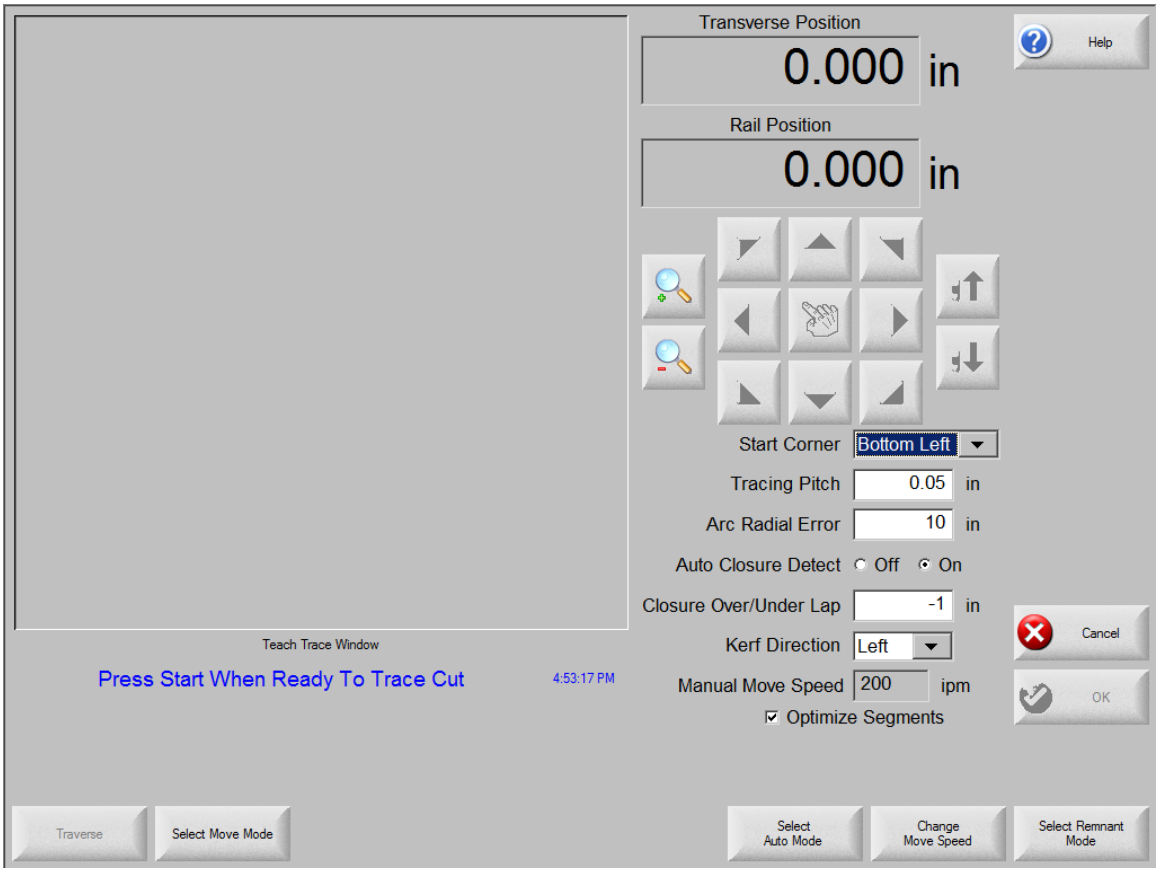


To trace a remnant:

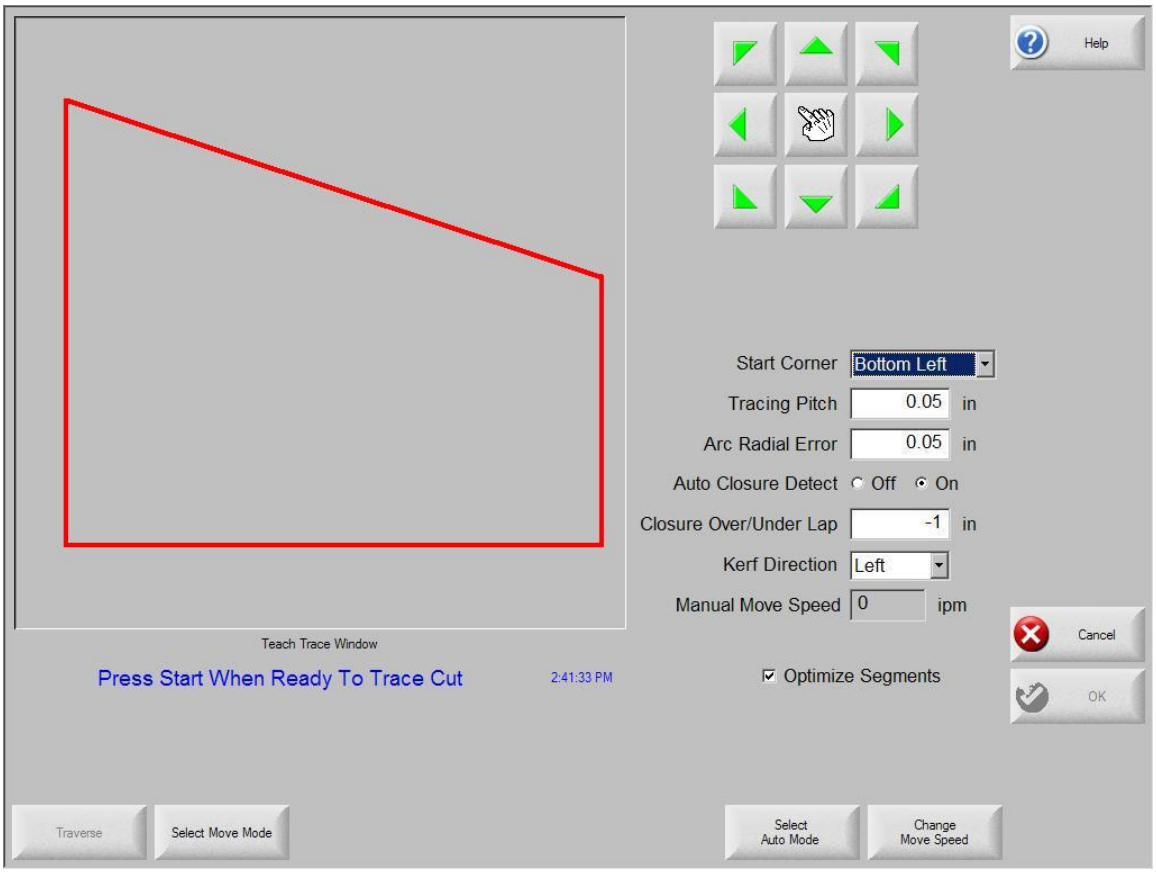
1. On the TeachTrace screen, press the Select Remnant Mode soft key.

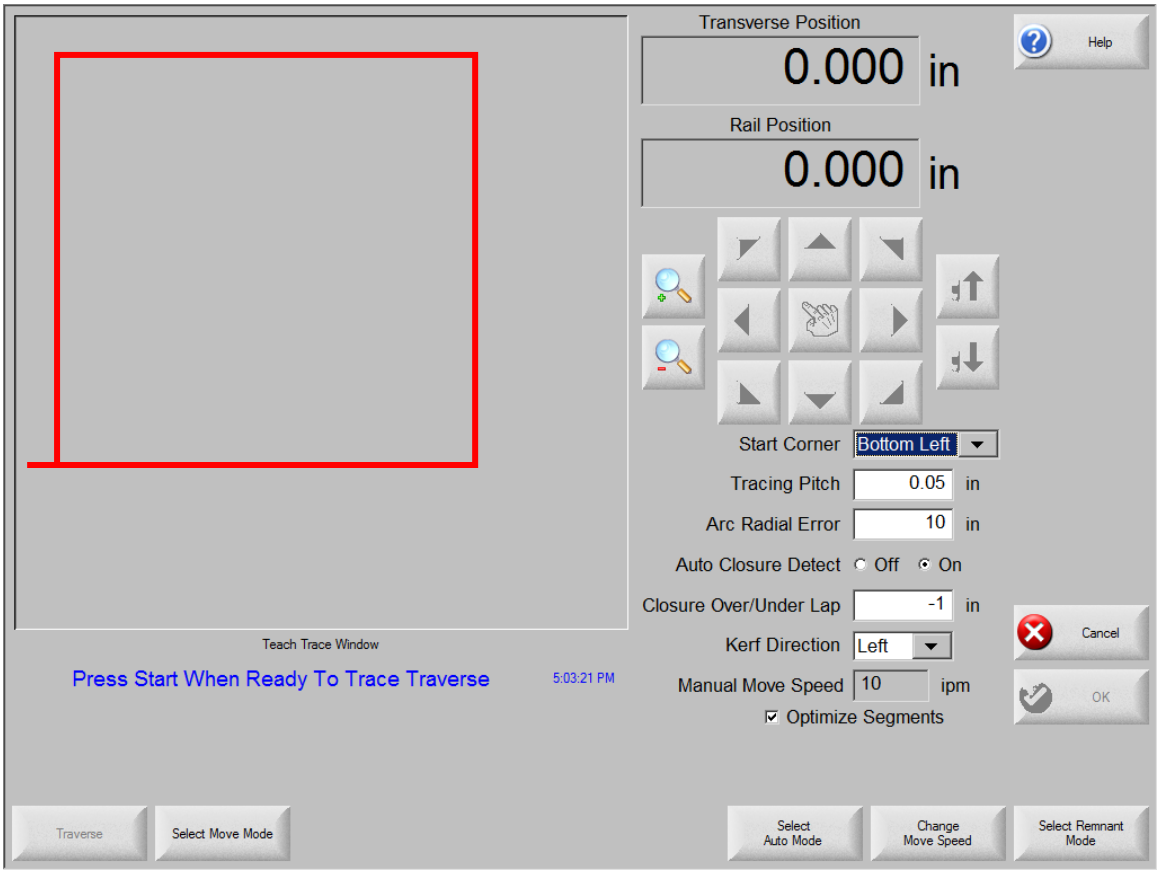
2. Jog to the point on the Remnant window where you want the trace to begin. Use the joystick or jog keys to move the torch over the plate.
3. Press or click First Point.
4. Jog to the next point and press or click Next Point.
   Repeat this step until you have traced all but the final point.
5. When the pointer is over the last point you need to trace, press or click Last Point. Trace Remnant draws a line between this point and the first point to close the remnant.
6. Press or click OK to let TeachTrace create the remnant.
   TeachTrace connects the last point to the first point automatically and returns to the Preview Window.
7. Press or click Files then Save to Disk.
8. Select a folder for the new remnant file from the Save to dropdown list.
   It is helpful to have a folder named Remnant to hold your remnant files.
9. Enter a file name in the File Name field.
10. Press or click OK.

Teach Trace Mode



The Teach Trace function must be used with an optional stand-alone optical tracing system.





To trace a part:

1. Press Select Auto Mode to trace the part automatically.
2. Press Select Manual Mode to trace the part manually.
   This also enables the Change Move Speed button so you can change the speed at which the sensor moves.
3. Select traverse or pierce.
   You can switch between traverse and pierce during the tracing procedure.
4. Position the optical sensor near the part drawing.
5. Press Start.
   Use the sensor positioning controls to direct the sensor towards the part.
6. After the sensor has located the part, the tracing system will follow the part outline until completion.
7. If you are using manual mode, you can press the Change Move Speed button repeatedly to select a speed for the optical sensor.
8. When the tracing system is finished tracing, press OK.
   You can cut, save or edit the part.

Parameter	Description
Start Corner	Allows you to select where the part you trace will begin for proper viewing on the screen.
Tracing Pitch	Determines how precisely to learn a part. The Tracing Pitch can be adjusted to favor the resolution or size of the taught part. This value does not affect the actual position resolution of the part. A good starting point for most tracing systems is 0.01”.
Arc Radial Error	Specifies the arc error tolerance to be used when checking the current segment for dimensional accuracy. All ESSI or EIA programs are comprised of lines, arcs, and circles. Arc Radial Error is used to ensure that the starting and ending radial vectors are within tolerance to describe a valid geometry.
Auto Closure Detect	Allows the CNC to detect that it has returned to the starting point. With this feature on, the CNC stops the motion of the tracer when the part is complete and programs a lead-out.
Closure Over/Under Lap	By specifying a positive value for this parameter, the CNC does not stop the tracer until it has gone past the start point by the value of this parameter. Specify a negative value to stop the tracer as soon as the tracing head position is within this parameter’s distance of the starting point. This is only available if the Auto Closure Detect is On.
Kerf Direction	Selects the kerf for cut segments.
Traverse/Pierce	Switches between the traverse and cut segments of the part as it is taught.
Select Auto/Manual Mode	Use this button to change trace modes. If you select manual mode, you can also use the Change Move Speed button to change the trace speed.
Change Move Speed	Press this button to change the trace speed in manual mode.
Select Remnant Mode	Press this button to use remnant mode to create remnants.

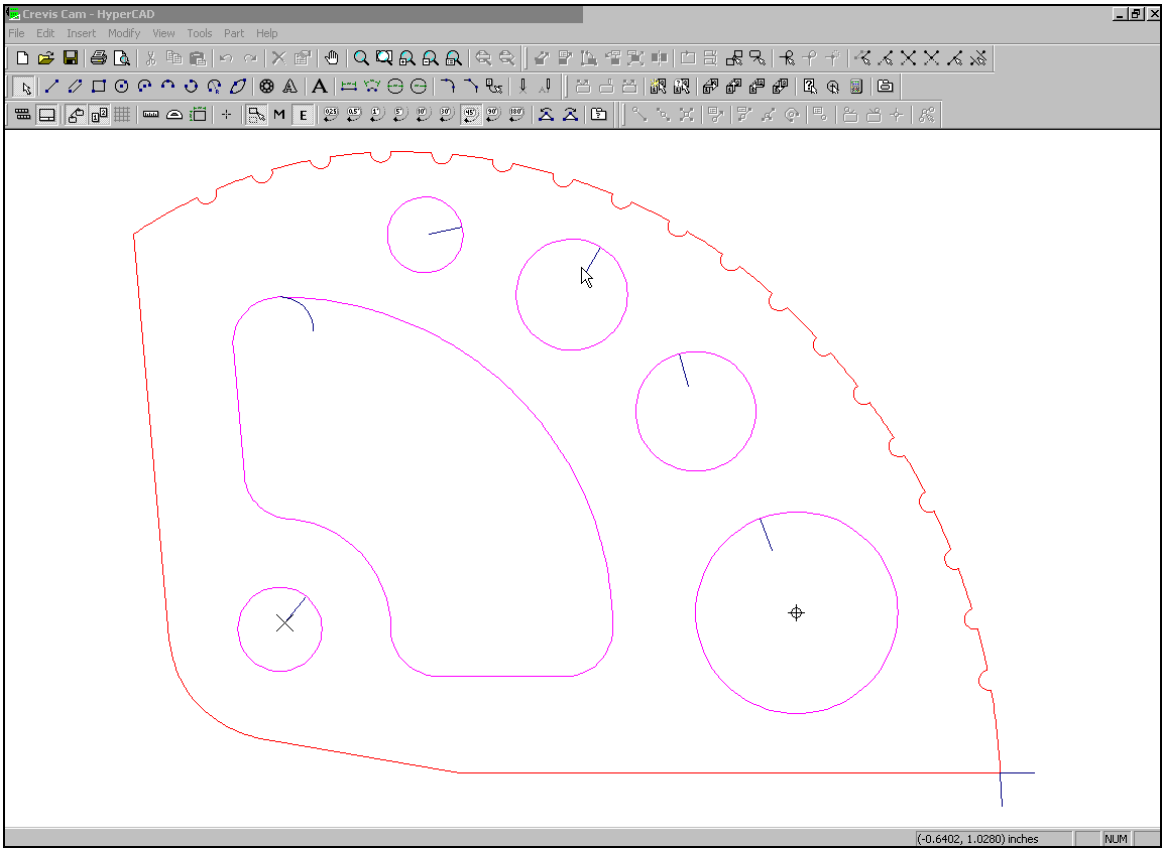
Refer to the instructions provided with your Optical tracing system for additional details.

HyperCAD

HyperCAD is an easy to use 2D drawing application specifically designed for shape cutting. The software's powerful CAD utilities let users import DXF and CNC files or draw from scratch. Files can be converted to graphical parts for editing and saving or go directly to cutting.

HyperCAD is a simple CAD/CAM application that lets you move easily from drawing to cutting. Its features include:

- English or metric units
- Part/sheet viewing capabilities
- Scaling, mirroring or rotating of parts
- Repeating and copying of shapes
- Moving/modifying of lead-ins and lead-outs
- Add-on of chamfers, fillets and notches
- On-screen, full-part cutting simulation
- Built in Help functions



This feature is offered as a limited use trial version. Contact your CNC vendor for information on enabling unlimited use of this feature. This package may be used on the CNC equipped with a mouse and PC keyboard, or offline on a PC.

Automatic Nesting

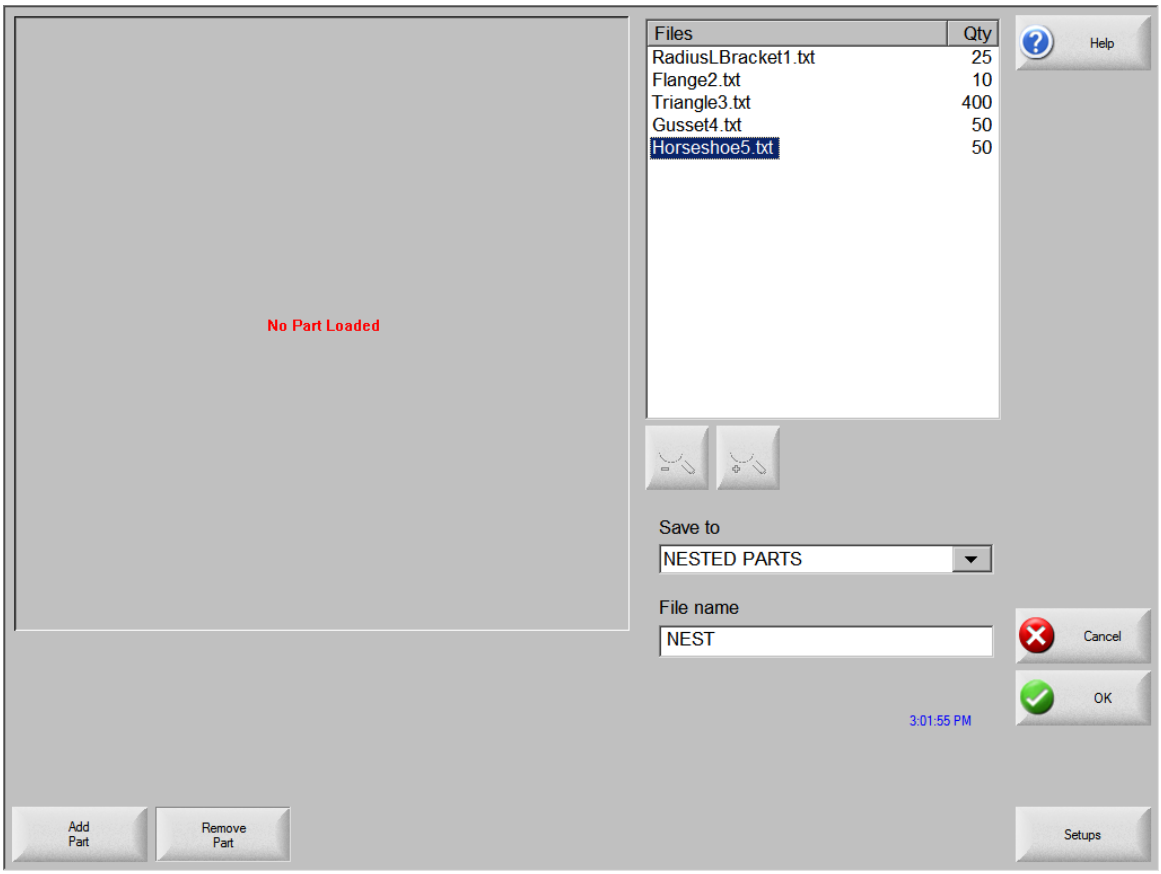
Note: This software feature on the CNC is protected by a hardware key. If the hardware key has been removed from the CNC, the following message appears when the Nest Parts soft key is pressed.

Nesting Screen Layout

The preview window is located in the upper left corner of the Nester screen and is used to preview manual nests. During an automatic nest, this area remains blank.

The plate size that is used during automatic nesting is based on plate information that has been selected at the main setup screen.

The Files window in the upper right corner displays the list of part programs and quantities of parts that have been selected for nesting. In the lower right, there are fields to specify the location and name of the nest file.

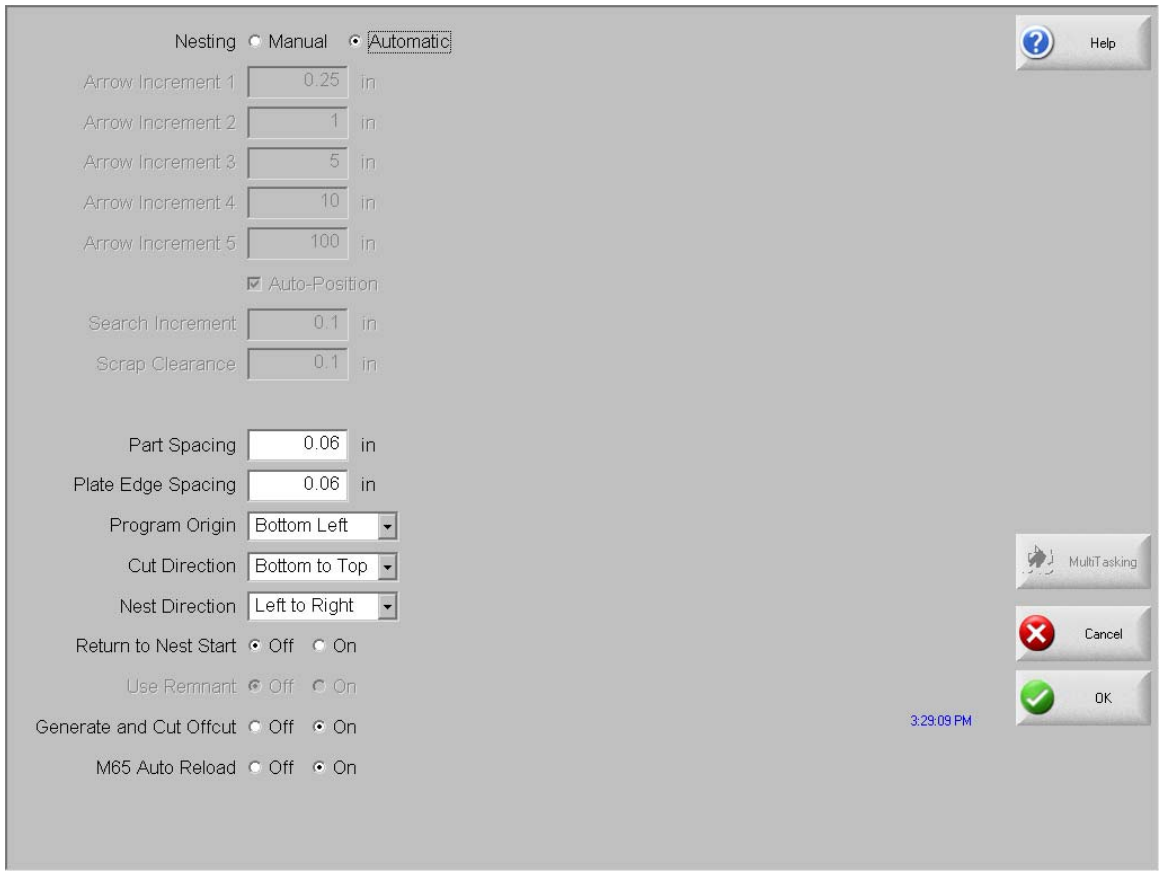


Automatic Nesting Setup

To set up automatic nesting:

1. From the Main screen, select Shape Manager > Nesting > Setup.
2. Use the following setup parameters to configure the automatic nesting process.

Note: If the Setup soft key is not available (grayed out), the feature has not been enabled on your CNC. Contact your CNC vendor for details on how to enable the Automatic Nesting feature.



Parameter	Description
Nesting	Switching Automatic to enable automatic nesting.
Part Spacing	Sets the spacing between parts during automatic nesting process.
Plate Edge Spacing	Sets spacing around the edge of the plate.
Program Origin	Select the nest start location from the dropdown list.
Cut Direction	From the dropdown list, select the direction in which the parts will be cut in the automatic nest.

Nest Direction	Select the direction in which nests are arranged during the automatic nesting process.
Return to Nest Start	When enabled, the Return to Nest Start feature inserts a traverse segment from the end of the nest back to the start point.
Use Remnant	If remnants are created and saved for future use, select On to use one of these remnants for automatic nesting.
Generate and Cut Offcut	Select On to generate offcuts for standard, rectangular nests.If this feature is enabled, offcuts are created when 30% or more of the sheet remains after nesting. The offcut is cut after a pause at the end of the nest on the last nested rectangular sheet.
M65 Auto Reload	Select On to allow new sheets to be reloaded automatically. When this feature is selected, there is a pause at the end of each sheet until the operator presses Start to Resume. Then, a new sheet automatically loads and runs. Auto reload works with standard, rectangular nests only.

Using Automatic Nesting

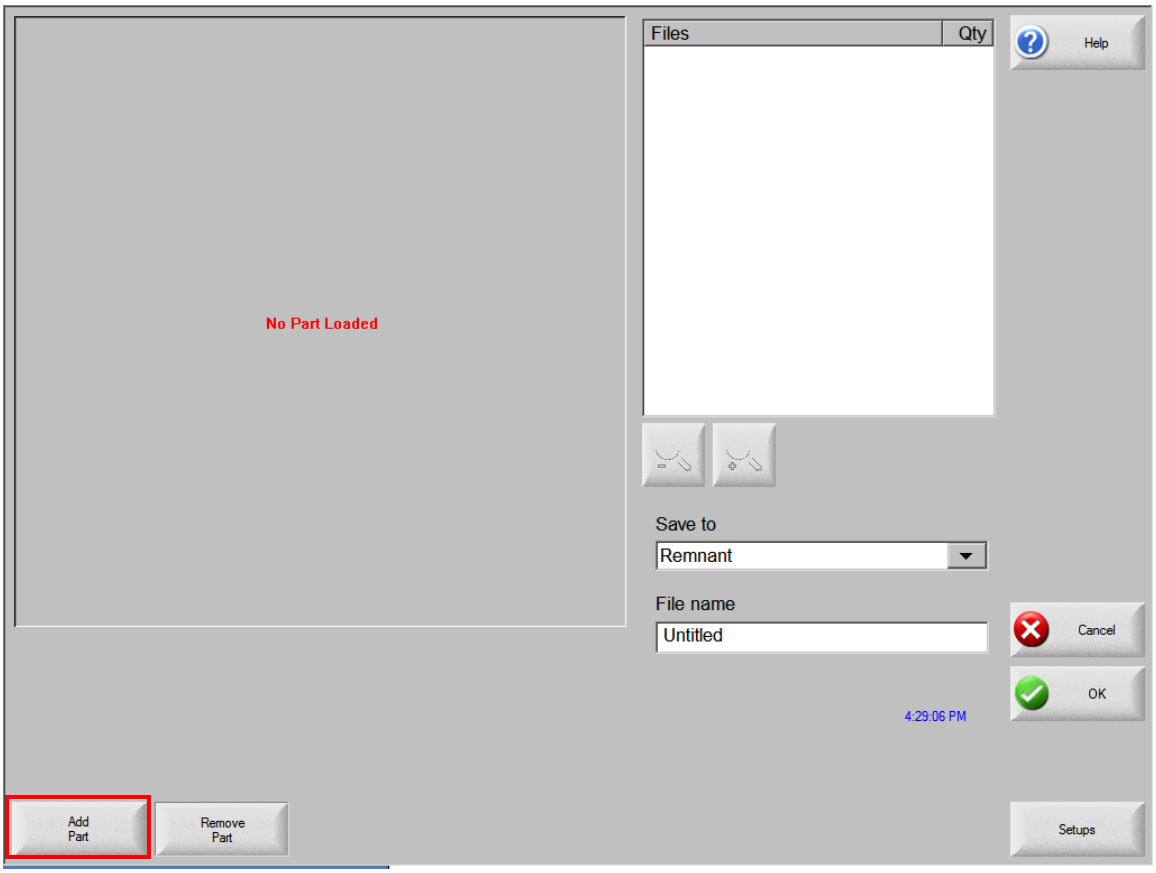
To begin using Nesting:

1. On the Shape Manager screen, select Nester > Setups.
2. On the Setup screen, select Automatic for the Nesting option.
3. Configure the setup parameters.
4. Press OK to return to the Nesting screen and begin adding parts to the nest.

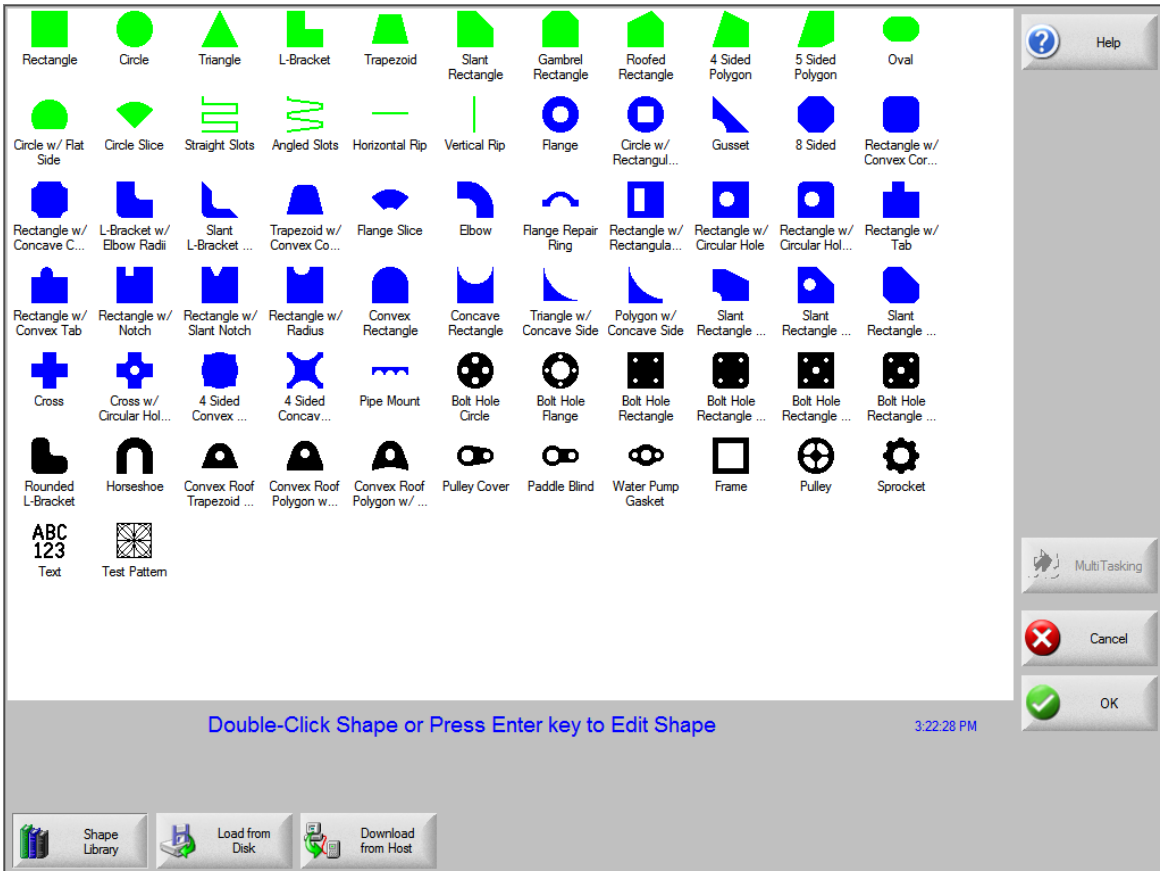
Adding a Part

To add a part to a nest part list:

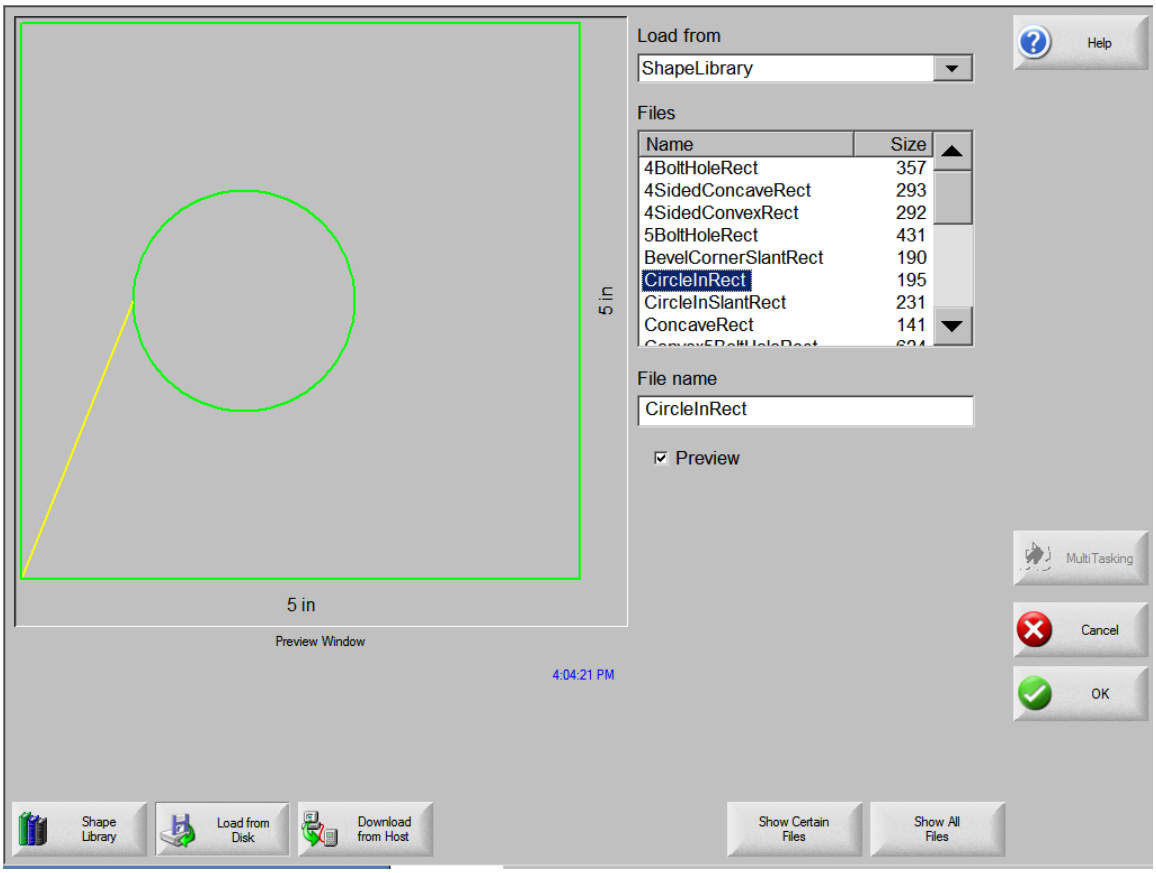
1. On the Nesting screen, press the Add Part soft key.



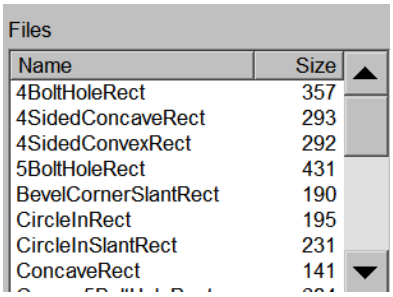
2. On the Add Part screen, use the soft keys at the bottom to select the source of a part file; Shape Library, disk, or host.



3. Select the part you want to add:
   - In the Shape Library, double-click or press a shape.
   - On the Load from Disk screen, select the source of the file from the Load from dropdown list and then select the file from the Files list.
   - On the Download from Host screen, select the source of the file from the Download dropdown list and then select the file from the Files list.



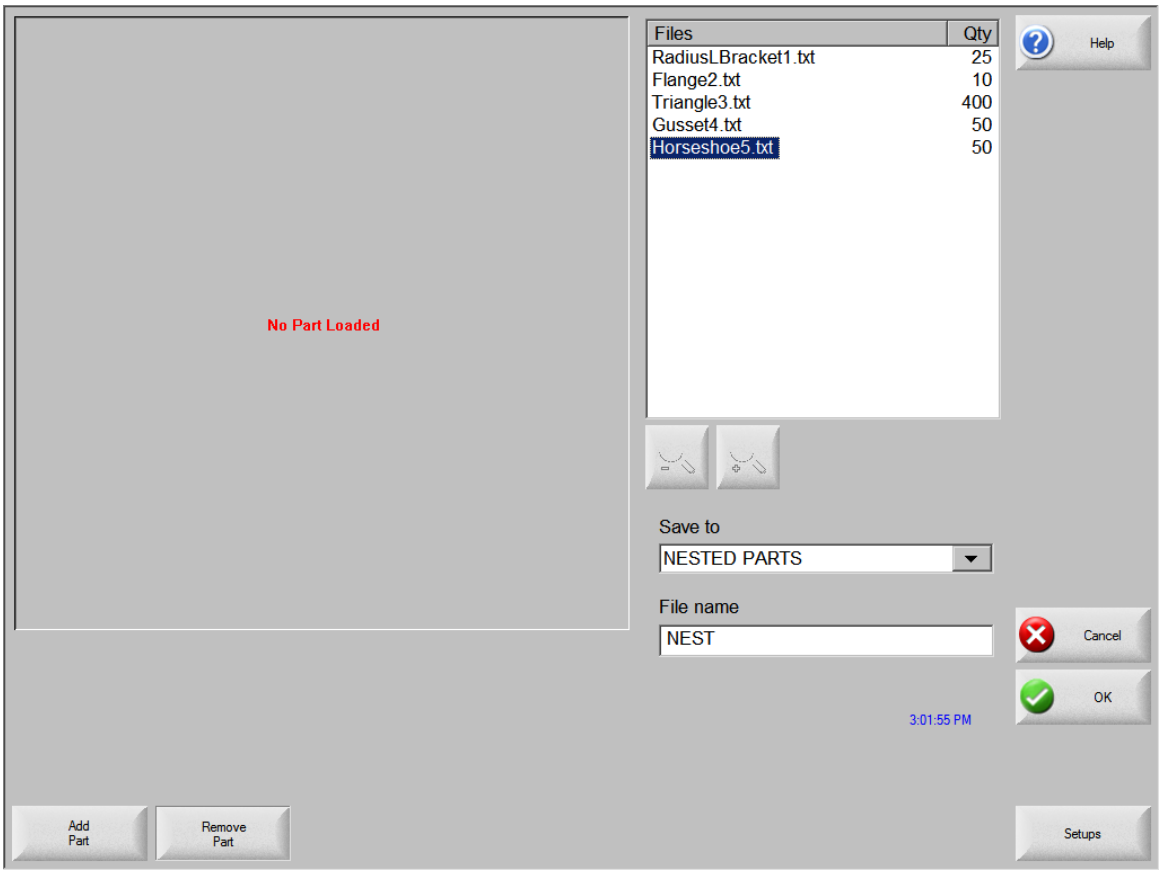
4. To narrow down the list of files in the Files list, click or press the Show Certain Files soft key.
5. On the keyboard that displays, enter wildcard characters and a portion of the file name you are looking for. For example, if you enter *Rect, you will see the following list of files:



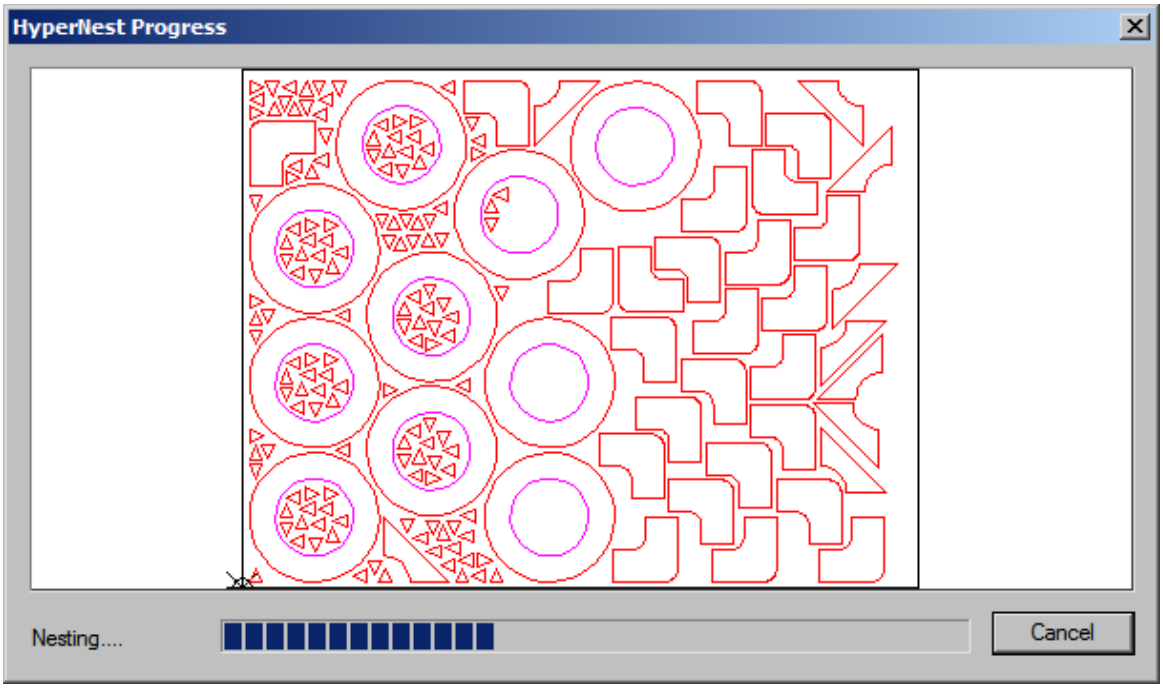
6. To return to the complete list of files, click or press Show All Files.
7. Select the Preview checkbox to view the part you selected in the Preview window.
8. Click or press Cancel to return to the Add a Part screen without adding the part.
9. Click or press OK to add the part to the nest.
10. On the Part Setup screen, enter values in the setup parameters, as necessary for the part you selected.

11. Click or press OK.
12. In the Part Configuration popup, enter the number of parts to include in the nest and indicate whether the part will be mirrored in the nest, for greater efficiency, or used as a wildcard part.
    Wildcard parts “fill in” a sheet on which the nest occupies at least 75% of the sheet.

13. As you add new parts to the nest, file names and quantity are listed in the Files window on the Nesting screen.

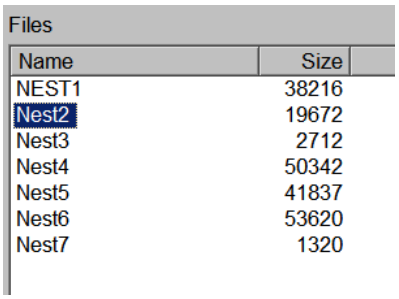


14. Save the nest of parts:
    a. Select the file location from the Save to dropdown list.
    b. Enter name for the nest file in the File name field.
    c. Click or press OK to begin the automatic nesting process.
    A window displays the progress of the nesting process.



Note: The nest process progresses quickly and all shapes may not be visible on the screen. Other drawing anomalies may be noted during the nesting process.

If more parts are selected than can fit on one plate, multiple plates or sheets (nested program) files are generated and saved in the selected folder with the selected file name, but a numeric suffix is added. For example, if you saved the part file as Nest, the nesting process may generate multiple part files named NEST1.txt, NEST2.txt, NEST3.txt, and so on. The numbers in the file names indicate the number of individual sheets that are needed for the nest selection, based on the sheet size parameter.

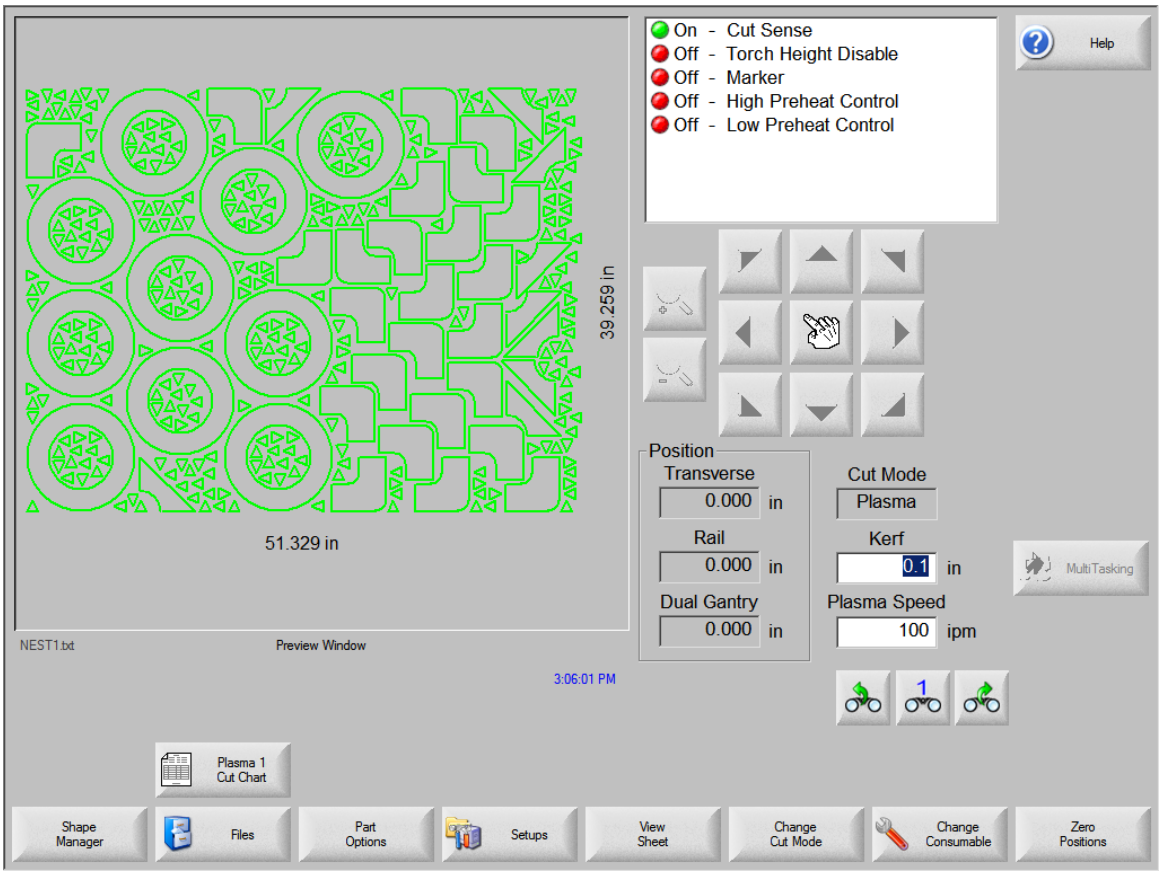


Deleting a Part

To delete a part from the part files list:

1. Select the part name in the files list.
2. Press the Remove Part soft key before you begin the nesting.

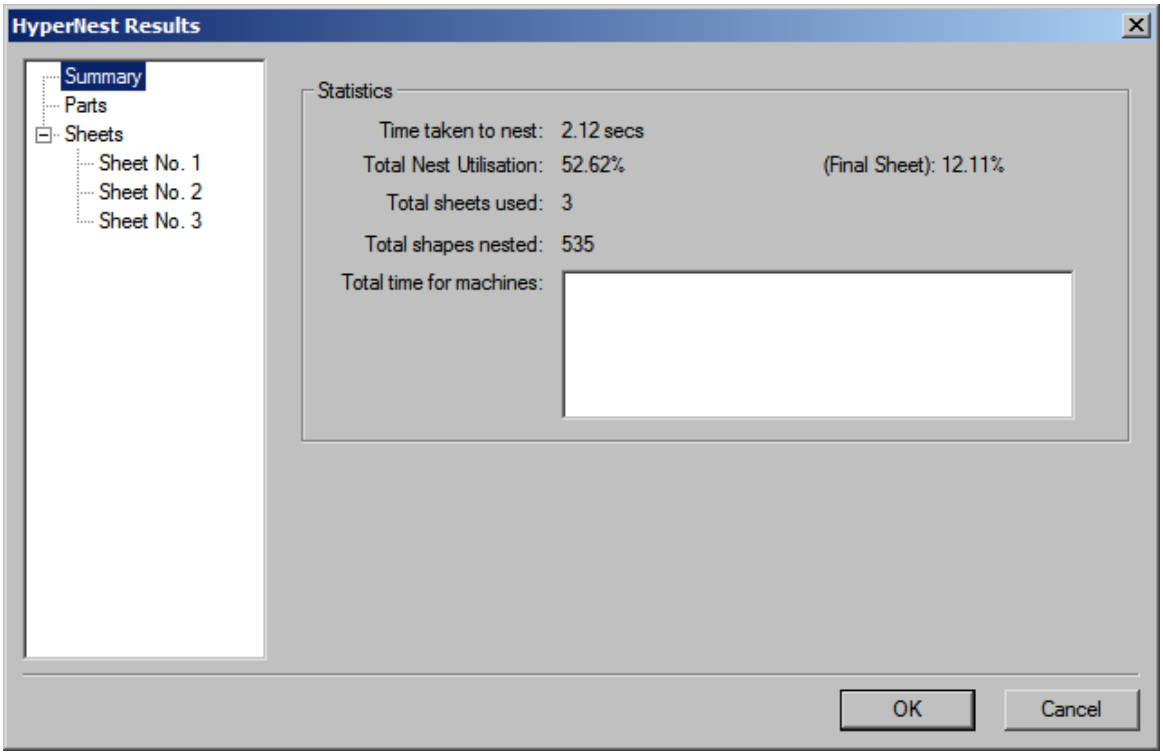
When you have finished nesting your parts, you can view the entire nest in the Preview Window of the Main screen:



Note: Parts with open loops or other invalid geometries may not be able to be automatically nested. It may be possible to manually nest parts which have been rejected by the Automatic Nesting function.

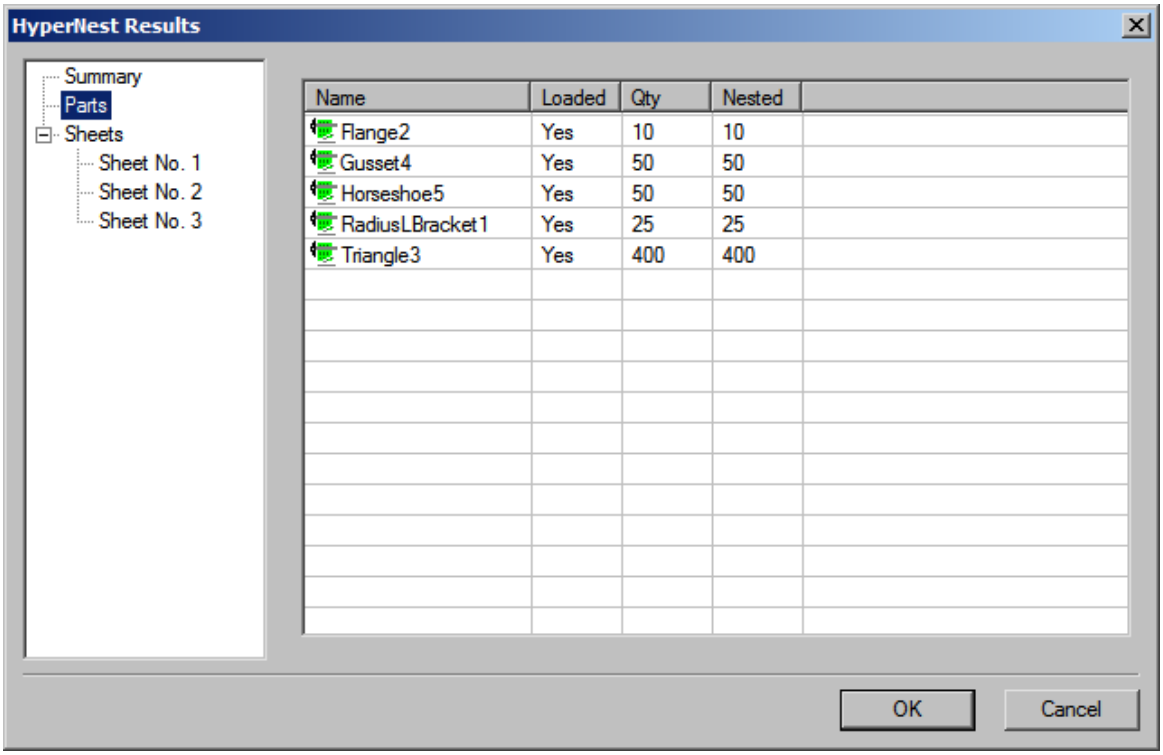
Nest Summary

After a nest is completed, the software provides a summary of the Automatic Nesting process.



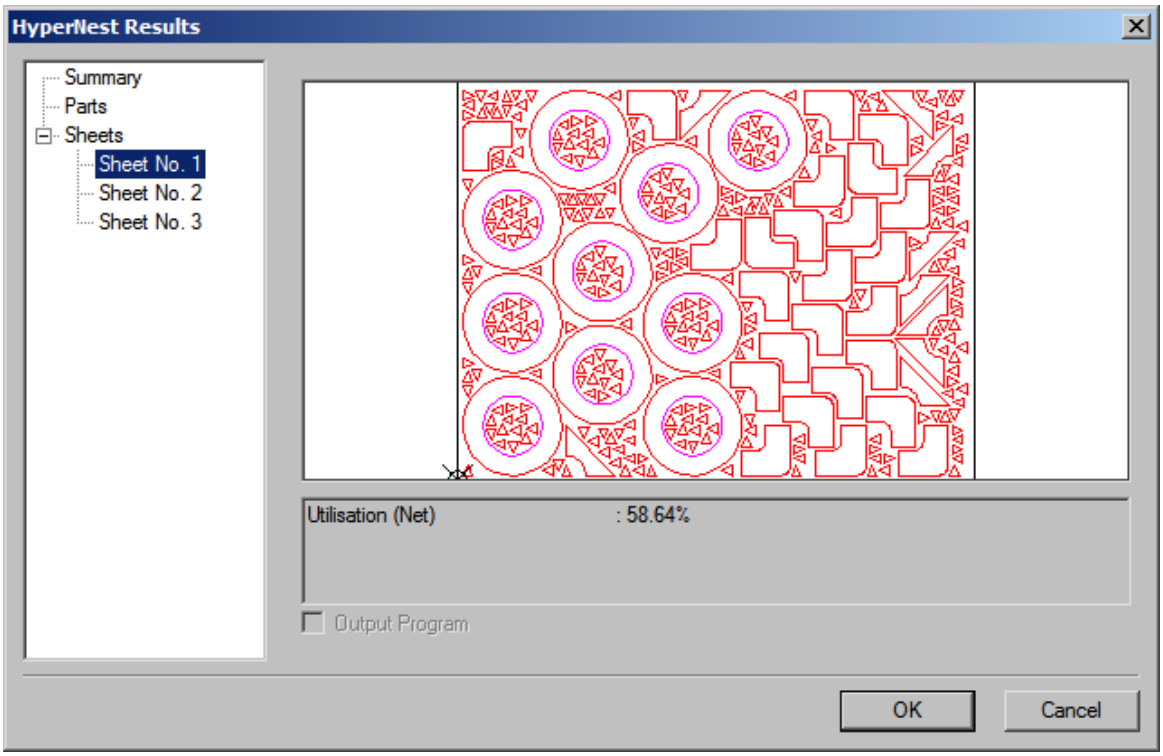
Statistical analysis of the process is provided for the number of sheets, time to execute nest, total nest utilization and total number of shapes nested.

Note: Sheets that are generated with the same part configuration are listed as "Sheet No. # (total #)".



To view the summary:

1. Scroll down to view an analysis of the parts, the individual sheets produced, and a listing of the net utilization for the specific sheet.



2. Press OK to accept the nest and have the first sheet become the current part.

3. Press Cancel to reject the nest and return to the main nesting screen to add or remove parts from the nest.

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			

EIA RS-274D Program Support

The CNC supports EIA RS-274D part programs. An EIA RS-274D program lists the sequence of lines, arcs, speeds, kerf and I/O functions that are 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.

The following list defines the EIA codes that are directly supported, mapped, or currently unsupported by the CNC. Mapped EIA codes are automatically converted into directly supported EIA codes when the program is loaded. Unsupported EIA codes are ignored. All other EIA codes generate an error.

Directly Supported EIA Codes

EIA Code	**Description**
Fvalue	Machine Speed (if Speed Override enabled)
Nvalue	Line Number
(text)	Comments
Xvalue	X Axis Endpoint or other Data
Yvalue	Y Axis Endpoint or other Data
Ivalue	I Axis Integrand or Part Option Data
Jvalue	J Axis Integrand or Part Option Data
Ovalue Svalue	Output (1-64), State (0-Off or 1-On)
Wvalue Svalue	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*val* A*val*	Performs Linear Interpolation of Tilt angle along line segment.
G01 A*value* F*value*	Sets Tilt 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.
G00 Zx.xx Tx	Index THC height “Z” distance for torch “T”. Manual mode only.

G00 Cxx	Move to rotate "C" position
G01 Cxx Fxx	Move to rotate "C" position with Speed "F" command in RPM
G00 C180-	Rotate Axis offset 180 degrees will continue to rotate in the proper direction
G00 C-180-	Rotate Axis offset -180 degrees will continue to rotate in the proper direction
G01 C180- Fxx	Rotate Axis offset 180 degrees with speed
G01 C-180- Fxx	Rotate Axis offset -180 degrees with speed
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 / Right Kerf
G59 D1-200Xvalue	Sets Kerf table variable from 1-200

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
G66 Dval Bval Cval	Auto Align 3 Point Method with Long Offset Distance, Fast Speed, Slow Speed values respectively
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 Tvalue	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 Txx.xx	Cutting Device Off (Temporary Optional Time Delay from –1 to 99.99 seconds)
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(s) Disable
M29	CBH / Rotator(s) Enable
M30	End of Program (same as M02)
M31	Reset Functions (Cut Off, Marker Off, Kerf Off)
M32	Unclamp / Unlock All Stations
M32 T*value*	Unclamp / Unlock 'T" Station, where T = 1 through 19
M33	Unclamp / Lock All Stations
M34	Clamp / Unlock All Stations
M34 T*value*	Clamp / Unlock 'T" Station, where T = 1 through 19
M35	Clamp / Unlock All Stations Mirror
M35 T*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 Tvalue (1-20)	Select Station “T” where T = 1 through 20
M38 Tvalue (1-20)	Deselect Station “T” where T = 1 through 20
M40	Start of Subroutine
M40 Xvalue	Start of Subroutine. Executes the repeat X times
M41	End of Subroutine
M48	Speed Override Enable
M49	Speed Override Disable
M50	Height Sensor Disable
M51 Txx.xx	Height Sensor Enable (Temporary Optional Time Delay in seconds before Enable)
M52	Height Sensor Disable and Raise Torch
M53	Height Sensor Enable and Lower Torch
M63	User Defined 1 On
M64	User Defined 1 Off
M54	User Defined 2 On
M55	User Defined 2 Off
M56	User Defined 3 On
M57	User Defined 3 Off
M58	User Defined 4 On
M59	User Defined 4 Off
M65	End of Program (same as M02) or Auto Reload

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
M90-	Align rotator negative, when not using shortest path motion
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
M305	Assigns the current X/Y position to Home Position 5
M306	Assigns the current X/Y position to Home Position 6
M307	Assigns the current X/Y position to Home Position 7
M308	Assigns the current X/Y position to Home Position 8
M309	Assigns the current X/Y position to Home Position 9
M310	Assigns the current X/Y position to Home Position 10
M311	Assigns the current X/Y position to Home Position 11
M312	Assigns the current X/Y position to Home Position 12

Mapped EIA Codes

EIA Code	Description	Mapped to
G04 F*value*	Program Dwell	G04 X*value*
G05	Set Axis Presets	G92
G21	Linear Interpolation	G01 (at cut speed)
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
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	)
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**
G30	Mirror Off
G46	Table 0 Select
G94	Feed per minute
G95	Feed per rev
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
G277	External Variable Load
G278	X Axis Home
G279	Y Axis Home
G280	X Home Return
G281	Y Home Return
M66	PLC Control Code
M75	Ignored if not using CBH, Tilt Rotator(s)

M76	Ignored if not using CBH, Tilt Rotator(s)
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 Code Support

The CNC 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
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	G97, G98 or M41 as appropriate or start of program if no 97
99	End of Program	M02
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

Advanced Feature Codes

Kerf Table Codes

Code	Description
G59 D1-200X*value*	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

Special Kerf and G59 Code Settings

Kerf Override

By default, this option is enabled. If the parameter is disabled, all kerf value codes (G41 X, G42 X, G43 X, etc.) are ignored. The Load Kerf Table variable is also ignored. This parameter cannot be changed while the part program is paused.

G59 Code Override

By default, this option is enabled. If the parameter is disabled, all G59 codes are ignored. The parameter cannot be changed while the part program is paused.

Parallel Kerf Enable for Hole Center Piercing

This parameter allows the kerf to be enabled in parallel with the first segment of cut motion that follows the Enable Kerf command. Kerf location is interpolated in parallel with the first cut segment so that the kerf offset is reached by the end of the first cut segment. The overall effect on a radial lead-in is to turn it into a spiral lead-in. This parameter allows all current part programs and nests to take advantage of parallel kerf enable without being reposted by the host.

Users of Hypertherm CNCs now have an option to enable or disable this feature in the Cut Setup screen.

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
M90-	Align rotator when not using shortest path motion
M75	A axis/Tilt Goto Home Cmd - Rapid Index
G00 Cxx	Move to rotate "C" position
G01 Cxx Fxx	Move to rotate "C" position with Speed "F" command
G00 C180-	Rotate Axis align 180 degrees will continue to rotate in the proper direction
G00 C-180-	Rotate Axis align -180 degrees will continue to rotate in the proper direction
G01 C180- Fxx	Rotate Axis align 180 degrees with speed
G01 C-180- Fxx	Rotate Axis align -180 degrees with speed

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 Select Codes

Stations (Lifter / THCs) can be selected and de-selected using the following EIA-274D program codes.

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 can be overridden using the user selected THC inputs to the CNC. The feature to override the part program must be enabled at the Cutting Setup screen.

Process Select Codes

Process selections can be made using a EIA-274D program code in the following format.

Example: M36 T*value*

M36 = Misc. M Code

T*value* = 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 station configuration:

Lifter

None	Sensor THC	Command THC (with Serial Link)
HD4070 Integrated THC 1	Other	

or 2 (used only with the HD4070 power supply)	(any standalone 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

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.

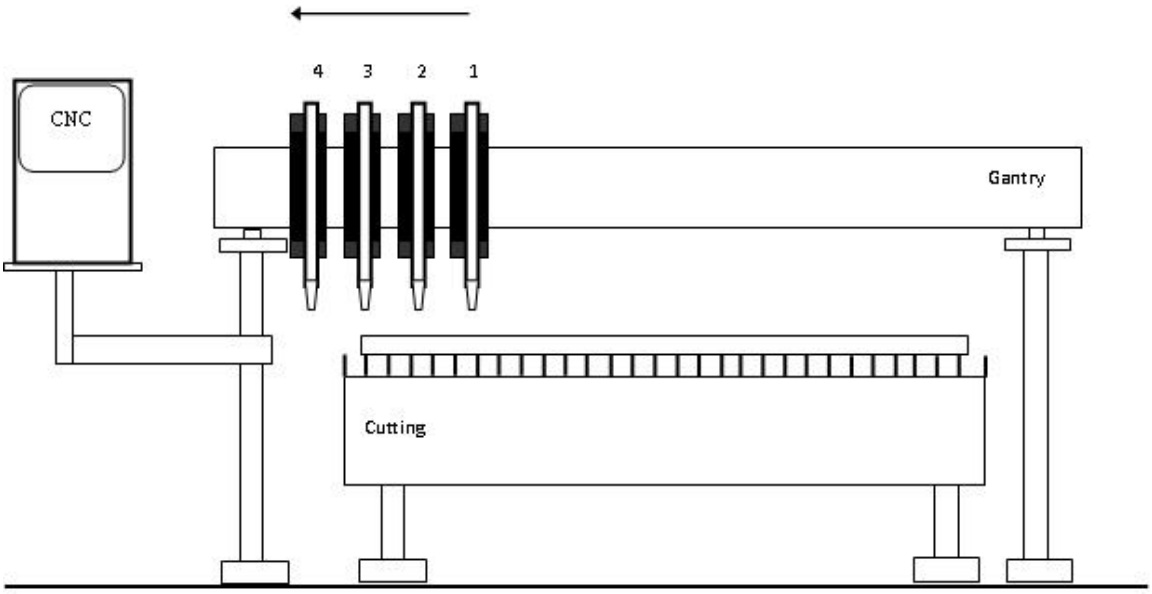
This feature must be enabled in Machine Setups. The Auto Torch Spacing Override feature in Cutting Setups must also be enabled.

In this process, the primary torch station has a fixed mount to the transverse axis and the other secondary 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.

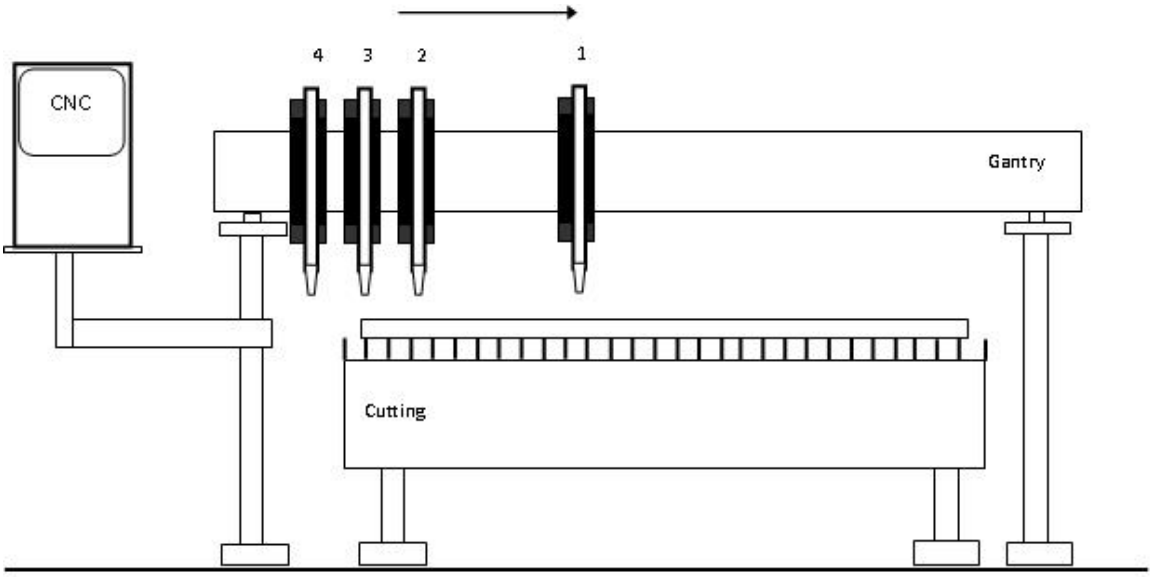
For the example, in the following illustration, Torch 1 is the primary station and Torch 2-4 are the secondary stations.

Typical use is as follows:

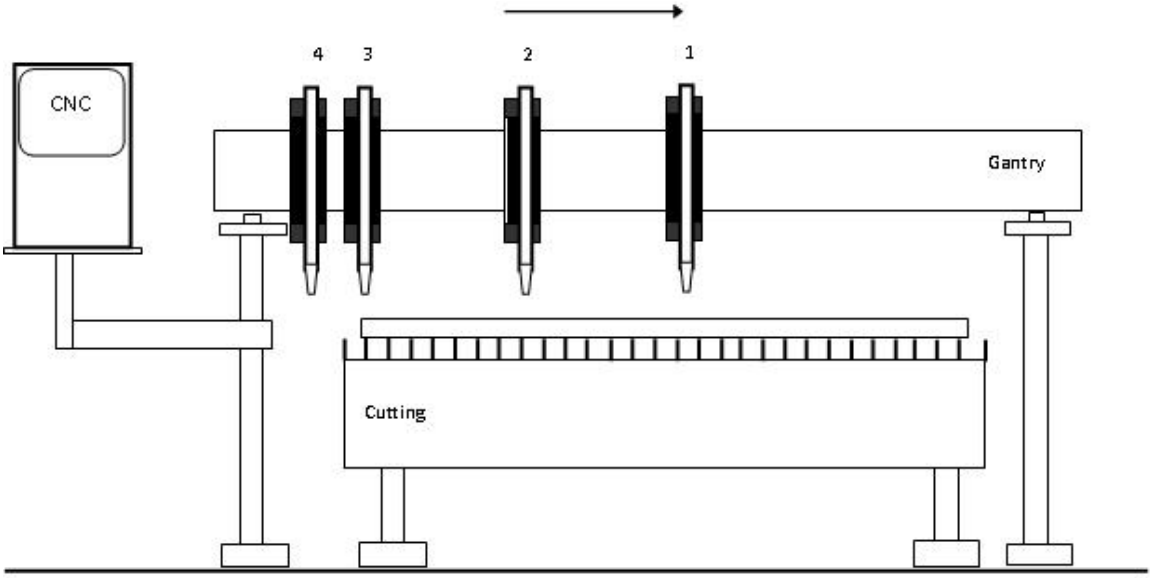
1. Unclamp and unlock all stations (except the first which is fixed and slides the others)
2. Go to Home Command on Transverse Axis (M77 or M78 depending on orientation)



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 the next station.



6. Repeat Step 5 until as many stations as needed are spaced.

Note: Homing also automatically includes the commands necessary to push the stations to the side and lock or 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 X*n* Y*n*	Traverse command where n = value to move the desired axes a distance.

Automatic Torch Spacing I/O

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

Automatic Plate Alignment Codes

Three point alignment distance and speeds can be defined with the following EIA format program code:

G66D100B300C30

G66	3-point alignment command
D*value*	Distance between two plate edge reference points
B*value*	Rapid feed rate for distance (D) motion
C*value*	Slow feed rate for the distance to the edge

Example Part Program

The transverse axis is configured as the 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

Dual Transverse without Beveling

Hypertherm supports dual transverse without beveling for tables that have only SERCOS drives.

To set up this type of table:

1. A CNC must be enabled with 10 axes.
2. SERCOS drives should be set up with the following addresses (on the physical drives):
   - Address 1: Rail
   - Address 2: Transverse
   - Address 3: Dual Gantry
   - Address 4: Sensor THC1
   - Address 5: Dual Transverse
   - Address 6: Sensor THC2 (if a second THC is used)
3. After these addresses are set, enable dual transverse. From the Main screen, select Setups > Password and enter the NRT password (no rotate and tilt).
   Note: The RT password reverses this setup. Effectively, RT allows the use of dual transverse axis without dual bevel axes systems.
4. The measurement units (English or metric) that are used in the drives must match the units that are used in the CNC.
5. Park Dual Head 1 and park Dual Head 2 are both required I/O points that must be assigned for either Park Dual Head 1 or Park Dual Head 2 to function.

Beveling

Hypertherm supports several software beveling options. The following sections describe the software beveling options available. Hypertherm does not support the mechanical design of bevel heads.

Contour Bevel Head for Oxy Fuel Cutting (CBH)

The CBH axis supports a rotational motion bevel for oxy-fuel cutting process. There is no tilting axis with CBH. The CBH axis is either set up on Axis 3 or Axis 4, depending on whether dual gantry or Sensor THC axes are enabled and assigned to Axis 3. The beveling codes M28, M29, M90, and M76 (described in the M and G Codes Used for Beveling section), can be used with CBH. A CBH axis cannot be defined when tilt rotator or dual tilt rotator axes are defined on the Machine Setups screen.

The program code M90 is typically used at the beginning of a part program to align the rotational axis before cutting begins. The M76 code is used at the end of the part program to bring the CBH back to its rotational home position.

Tilt Rotator Plasma Bevel

The tilt rotator is assigned to Axes 5 and 6 and supports plasma beveling. The preferred tilt rotator settings include No Scaled Rotator, No Dual Tilting Rotator and No Transformation. These are the simplest settings and work well for bevel mechanical designs in which the torch center point is directly in line with the tilt and rotate axes.

Some plasma bevel designs require that the rotator motion be scaled. The Scaled Rotator setting allows the rotational axis motion to be scaled directly by this parameter. It is the responsibility of the machine/bevel designer to determine the value for this setting, if it is required.

Some plasma bevel designs require dual tilting axes. Dual Tilting Mode 1 is used for most standard dual tilting systems where both tilt axes move through +/- 45 degrees to achieve the desired tilt and rotation motions. Mode 2 is a special form of dual tilting axis in which special equations control the motion. If Dual Tilting mode is needed, and special equations are needed, the machine/bevel designer must calculate and provide them. Hypertherm determines the amount of time that is required to add these equations to a new Dual Tilting mode for the customer.

Note that BACF, described in the Bevel Angle Change on the Fly (BACF) section, is not supported for dual tilting bevel designs. In addition, even though both axes are dual tilting, they are still referred to as rotate and tilt axes on all screens, as the effective motions are still rotation and tilt.

Some plasma bevel designs require a transformation of the rotate and tilt axes motion to achieve the proper motion. The transformation allows the torch to be at the correct bevel angle and orientation to the cut for the given bevel mechanical design. The machine/bevel designer must provide these equations if they are needed. Hypertherm determines the amount of time that is required to add these equations to a new Transformation mode for the customer. BACF, described in the Bevel Angle Change on the Fly (BACF) section, is supported for transformed bevel designs.

The beveling codes M28, M29, M90, M75, and M76, described in M and G Codes Used for Beveling, can be used with tilt rotator.

M90 is typically used at the beginning of the part to align the rotational axis before cutting begins. M75 and M76 are used at the end of the part to bring the tilt rotator back to its vertical home position.

Dual Tilt Rotator Plasma Bevel

The dual tilt rotator is assigned to Axes 8 and 9 and supports a second plasma beveling system. All of the settings described in the Tilt Rotator Plasma Bevel section also apply to the dual tilt rotator.

In addition, the dual tilt rotator can also have its own dual transverse axis assigned to Axis 7. When there is a dual transverse axis assigned, the two plasma bevel systems are homed to opposite sides of the machine. The dual transverse axis allows the two transverse axes to be independently parked and unparked, spaced, and mirrored to

each other using the M84 through M92 commands described in M and G Codes Used for Beveling.

Include the following code sequences in your torch spacing part programs:

M91Yxx	Moves Head 2 Yxx inches from Bevel Head 1
M92Yxx	Moves Head 1 Yxx inches from Bevel Head 2

These spacing commands establish a relative spacing between the heads regardless of where the heads are actually located. Only one of these commands should be used at one time. If Head 1 needs to be at a specific position before head 2 is positioned in relation to Head 1, then the command sequence is:

M89	Park Head 2
G01 Yxx	Move Head 1 to actual coordinate
M88	Unpark Head 2
M91Yxx	Space Head 2 in relation to Head 1 by Yxx inches
M02	End Program – Used if this is a standalone Torch Spacing program

Likewise, if Head 2 needs to be at a specific position before Head 1 is positioned in relation to Head 2, then the command sequence is:

M87	Park Head 1
G01 Yxx	Move Head 2 to actual coordinate
M86	Unpark Head 1
M92Yxx	Space Head 1 from Head 2 by Yxx inches
M02	End Program – if this is a standalone torch spacing program

Bevel Angle Change on the Fly (BACF)

BACF allows the tilt axis to change position in parallel with X and Y motion, instead of only in a preparatory G00 'Axx' command. 'G01,02,03 X Y I J Axx' is supported for true rotate and tilt bevel mechanical designs. BACF is not supported for dual tilting bevel mechanical designs.

The 'Axx' command (where xx = the bevel angle) executes in parallel with X and Y motion. The A angle is reached at the end of the segment.

All BACF motions are only performed if the maximum speed of the appropriate axis is not exceeded by excess X and Y speed, or by Max Tilt or Rotator Max speeds that are too low.

M and G Codes Used for Beveling

The following lists of the M and G codes can be used for beveling.

Kerf Table Commands to Change Kerf During Multi-pass, Multi-bevel Cuts:

G59 D(1-200) X*value*:	Sets the kerf table variable from 1-200
G41 D(1-200):	Enables the left kerf using a kerf table variable
G42 D(1-200):	Enables the right kerf using a kerf table variable
G43 D(1-200):	Changes the current kerf value via kerf table using previously set left or right kerf

Tilt/Rotator Commands:

G00 Aangle in degrees:	Sets Tilt angle as a preparatory command
G01 X Y A*angle* in degrees:	Performs Tilt BACF
M28:	Disables follower
M29:	Enables follower
M90:	Aligns rotator to tangent angle of next cut segment
M75:	A axis/tilt go to home command - rapid index
M76:	C axis/rotate go to home command - rapid index

Dual Tilt/Rotator Commands Used with Dual Plasma Bevel Systems:

M84	Disable mirror Head 2
M85	Enable mirror Head 2
M86	Unpark Head 1
M87	Park Head 1
M88	Unpark Head 2
M89	Park Head 2

M91 Yxxxx	Space Head 2 xxxx millimeters
M92 Yxxxx	Space Head 1 xxxx millimeters

Square Pipe Cutting

RACF - Rotate Angle Change on the Fly

RACF allows rotate angle change on the fly interpolated along with X, Y motion so that cuts can be made on more than one side of a square tube when it is rotated during the cut. The THC must be able to respond to the arc voltage fast enough during the tube rotation.

'G01,02,03 X Y I J Cxx' is the command that is used.

The transverse backs up or moves ahead to account for the change in part location due to the CBH or rotary axis tube rotation.

All Possible Axis Assignments

- Axis 1 – Transverse or Rail
- Axis 2 – Rail or Transverse
- Axis 3 – Dual Gantry, CBH or Sensor THC
- Axis 4 – CBH or Sensor THC
- Axis 5 – Rotate or Sensor THC
- Axis 6 – Tilt or Sensor THC
- Axis 7 – Dual Transverse or Sensor THC
- Axis 8 – Dual Rotate or Sensor THC
- Axis 9 – Dual Tilt or Sensor THC
- Axis 10 – Sensor THC
- Axis 11 – Sensor THC
- Axis 12 – Sensor THC

Special Passwords

NRT – No Rotate Tilt

The NRT password allows you to use a dual transverse axis without physically having the tilt rotator and dual tilt rotator drives and motors. The Tilt Rotator Axes screens are still visible, but are not used. They are typically used when non-bevel 2-torch servo spacing with vertical cutting is needed with a dual transverse. This password remains in effect after the CNC is powered off.

RT – Rotate Tilt

The RT password re-enables the use of the tilt rotator and dual tilt rotator drives and motors with a dual transverse system. This password is needed only if the NRT password has previously been used. This password remains in effect after the CNC is powered off.

NSA – No SERCOS Axes

The NSA password allows a SERCOS ring to be phased up but does not phase up any SERCOS axes that are configured. This allows SERCOS I/O nodes or modules, such as Hypertherm I/O, Beckhoff, or Reco I/O modules to be tested without requiring the SERCOS drives to phase up. The password is temporary until the power on the CNC is cycled.

SA – SERCOS Axes

The SA password re-enables SERCOS axes for phase up.

Number of SERCOS Axes to Phase Up

(1SA, 2SA, 3SA, 4SA, 5SA, 6SA, 7SA, 8SA, 9SA, 10SA, 11SA and 12SA)

1SA through 12SA passwords enable the specified number of SERCOS axes for phase up. For example, the 3SA password phases up SERCOS drive addresses 1, 2 and 3 only, even if the system has 6 axes installed. .

PRO – Partial Retract Only

The PRO password enables a partial retract of the Sensor THC, even at the end of part programs and nests. This password is not retained across power cycles of CNC.

NOPRO – No Partial Retract Only

The NOPRO password disables the use of only a partial retract of the Sensor THC. A full retract is used at the end of each part program or nest. This is the default state on power-up.

SIMULATESERCOS

The SIMULATESERCOS password simulates the SERCOS setup screens for true SERCOS drives.

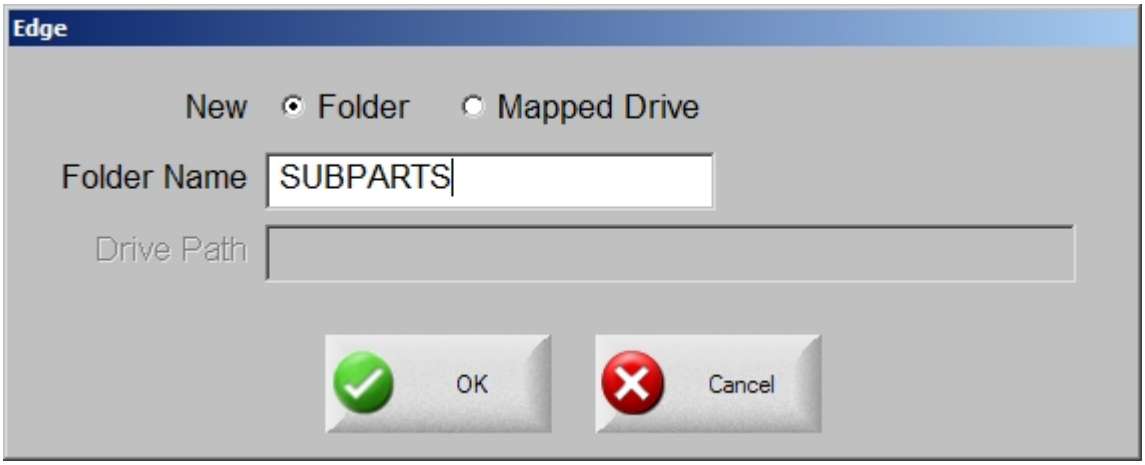
SIMULATESMCC

The SIMULATESMCC password simulates the SERCOS MCC setup screens for the Hypertherm SERCOS MCC slave card analog drive interface.

Subparts

Subparts allow you 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 CNC hard drive named “SUBPARTS”. To create a folder on the hard drive, select Load From Disk. With the folder location highlighted, press the + key to create a new folder.



Save the part program in the SUBPARTS folder.

To execute the part, insert a line of code within the part program 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.

For example, to execute subpart L-Bracket after completing a simple 5” x 5” square with a programmed traverse, the part program would look something like the following 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

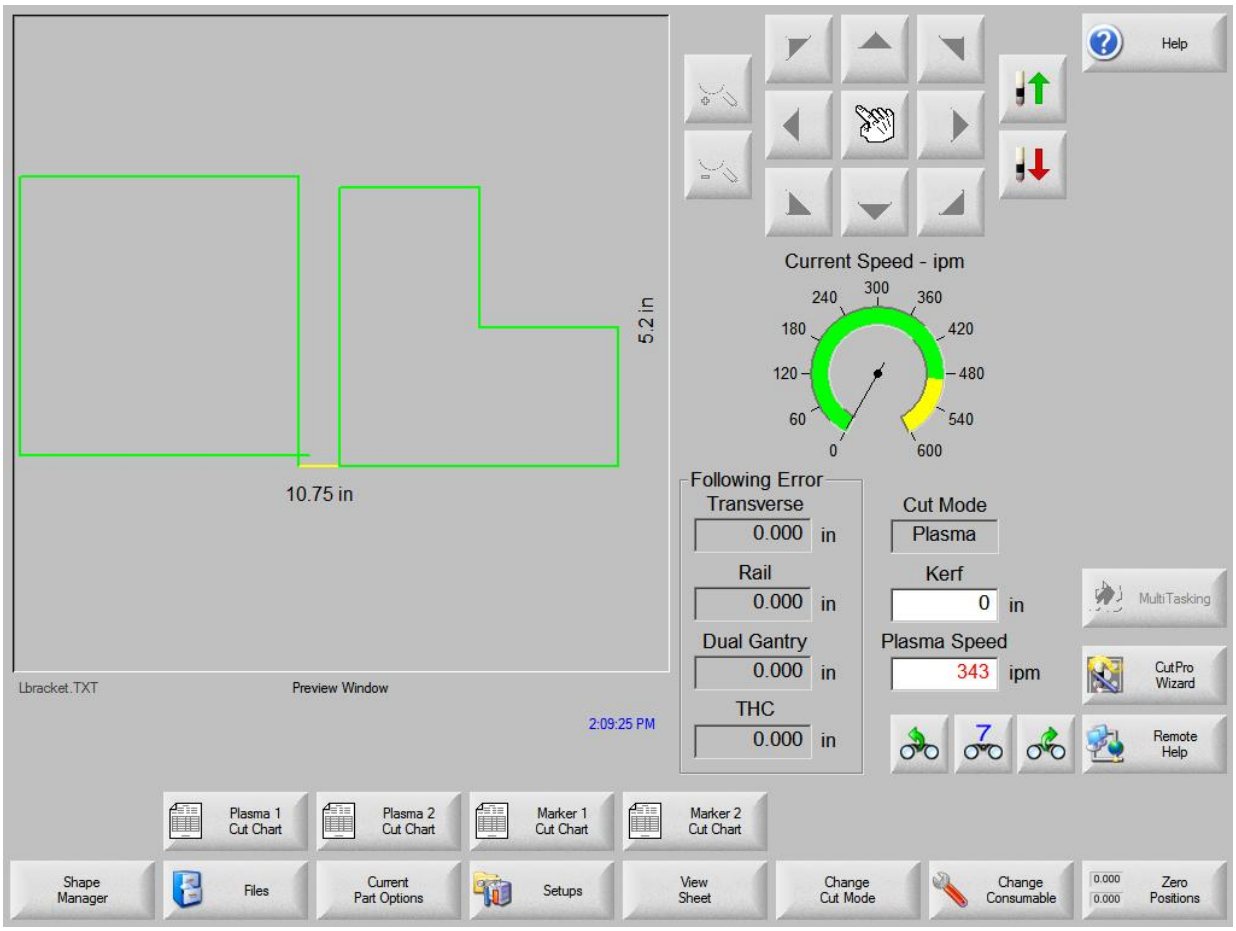
G00 X.75 Y0

PL-BRACKET

G40

M02

When it is executed, this program will be represented as the original part plus the additional subpart and will include the programmed traverse.



Note: Subparts can also contain subparts. After being translated by the CNC, the final text of the part will contain the complete text of the original part and subpart.

Marker Font Generator

The Marker Font Generator feature can be used to label or identify parts with a marking device before 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

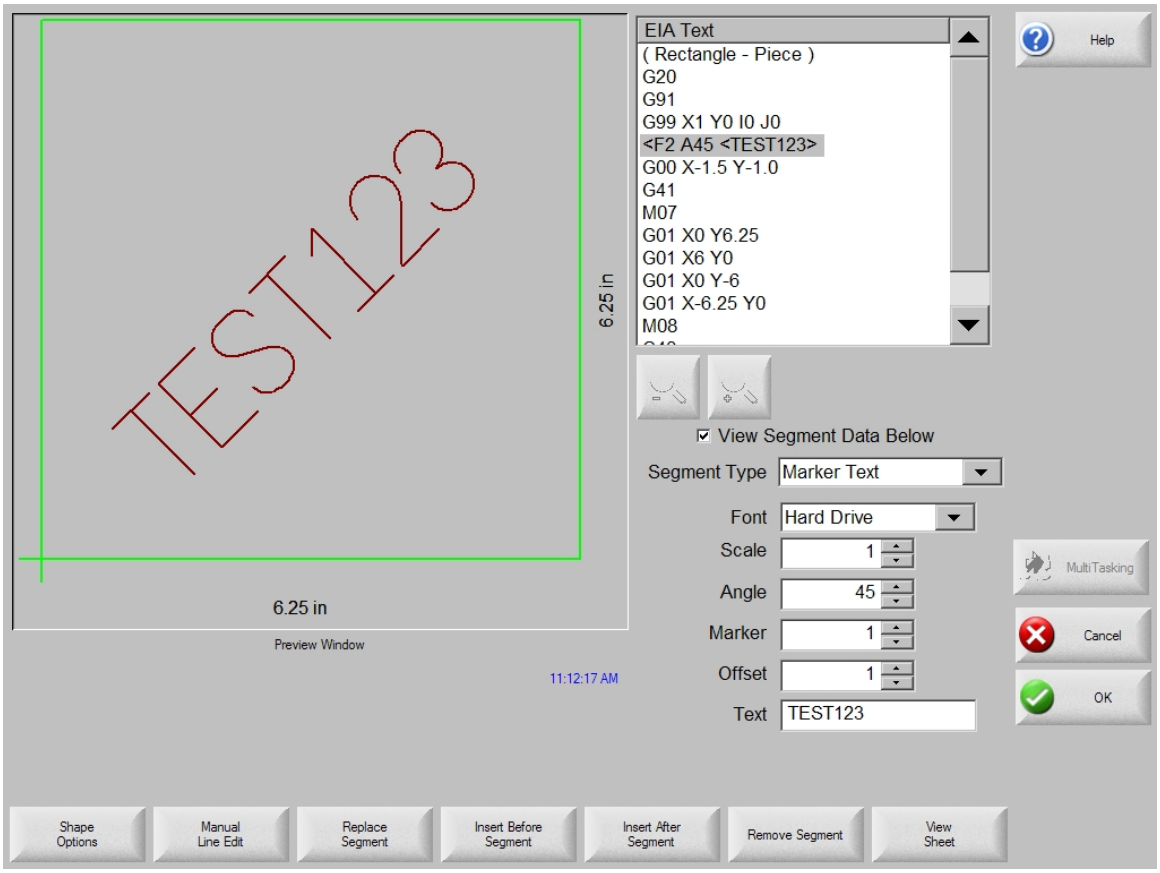
Example of a simple command string:

<F2 S2 A45 M2 O2 <TEST 123>

<	The program command must begin with the “<” symbol to indicate that the Marker Font Generator feature is being used.
F	The first block of information is the Font Source location. The “F” is followed by a digit to indicate the location where the font is stored: 1 = an internal font in the control software 2 = a font located on the CNC hard drive 3 = a font from diskette or USB memory. 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 followed by a number that indicates the scale factor. For the example given, the scale factor is twice the original font dimensions.
A	The third information block determines the angle of the text. The “A” is followed by a number that indicates the degree of angle. For the example given, the

	degree of the angle is 45.
M	The fourth information block determines the Marker Tool to be used. The "M" is 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" is followed by a number indicates that 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"

When the previous code example is translated by the CNC, it generates 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 always inserts 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 can be loaded from a floppy disk or from the control hard drive. When the CNC generates the text, the CNC 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.

For example, for the marker text “Ab 12”, the control searches 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

For more information on ASCII codes, refer to the ASCII Codes chapter.

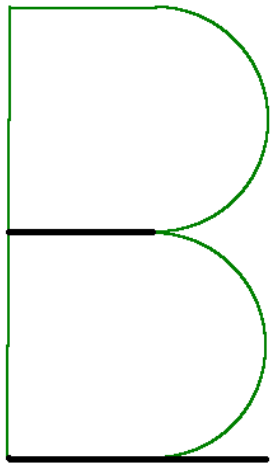
Font programs may be saved on the control hard drive by creating a folder labeled “Fonts” using the “Save to Disk” feature and saving the font programs within this folder. Remember, if a corresponding part file to text requested is not found at the selected source location, the internal font file will be used.

Custom Fonts

Custom fonts can be used when using the marker font generator. To construct these font files, certain guidelines should be adhered to.

1. Programming format must be EIA
2. Only M09 and M10 can be used to enable and disable the marker.
3. Only G00, G01, G02 and G03 codes can 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.

ArcGlide THC Programming Support

The ArcGlide allows you to configure the THC parameters through the part program codes (when connected to the CNC over Hypernet). This is the most efficient way of passing information to the ArcGlide, and is done automatically with certain brands of process optimization and nesting software, such as the Hypertherm MTC ProNest off-line software.

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

- Arc Voltage
- Pierce / start time
- Pierce / Start height factor
- Cut / mark height
- Transfer height factor
- Arc current

Use the following format to set up the ArcGlide in a part program:

G59 V601 F*value*, where G59 is any applicable G code, and V6XX is the variable identity and F is the value.

V6XX variable	**Name**	**Range for F*value* English (Metric)**	**F*value* format**	**F*value* units English (Metric)**
V600	Plasma 1 Arc Voltage	10 to 300	XXX.XX	volts
V601	Plasma 1 Pierce Time	0 to 9	X.XX	seconds
V602	Plasma 1 Pierce Height Factor	50 to 400	XXX.XX	%
V603	Plasma 1 Cut Height	0 to 1 (0 to 25.4)	XX.XX	inches (mm)
V604	Plasma 1 Transfer Height Factor	50 to 400	XXX.XX	%
V605	Plasma 1 Cut Height Delay	0 to 5	X.XX	seconds
V607	Plasma 1 Mode Select	F1 = Manual F2 = Auto		N/A
V608	Plasma 1 Arc Current	See plasma system	XXX	Amps
V625	Plasma 2 Arc Voltage	10 to 300	XXX.XX	volts

V628	Plasma 2 Cut Height	0 to 1 (0 to 25.4)	X.XX	inches (mm)
V629	Plasma 2 Transfer Height Factor	50 to 400	XXX.XX	%
V630	Plasma 2 Cut Height Delay	0 to 5	X.XX	seconds
V632	Plasma 2 Mode Select	F1 = Manual F2 = Auto		N/A
V650	Marker 1 Set Arc Voltage	10 to 300	XXX.XX	volts
V652	Marker 1 Start Height Factor	50 to 400	XXX.XX	%
V653	Marker 1 Mark Height	0 to 1 (0 to 25.4)	XX.XX	inches (mm)
V657	Marker 1 Mode Select	F1 = Manual F2 = Auto		N/A
V675	Marker 2 Set Arc Voltage	10 to 300	XXX.XX	volts
V677	Marker 2 Start Height Factor	50 to 400	XXX.XX	%
V678	Marker 2 Mark Height	0 to 1 (0 to 25.4)	XX.XX	inches (mm)
V682	Marker 2 Mode Select	F1 = Manual F2 = Auto		N/A

The following M-codes are available in Phoenix version 9.5 and later:

M07 HS	Forces an IHS for cutting, regardless of the distance between cuts or any previous M08 RT command.
M08 RT *–x.xx*	Retracts to the Transfer Height instead of the Retract Height at the end of a cut. The *–x.xx* variable represents the amount of time before the end of a cut that the Cut Off command is issued.
M09 HS	Forces an IHS for marking, regardless of the distance between marks or any previous M10 RT command
M10 RT	Retracts to the Transfer Height instead of the Retract Height at the end of a mark.

Sensor THC Programming Support

The Sensor THC allows you to configure the THC parameters through the part program codes. This is the most efficient way of passing information to the Sensor THC, and is done automatically with certain brands of Process Optimization / Nesting software, such as the Hypertherm MTC ProNest off-line software.

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

- Arc Voltage
- Pierce / start time
- Pierce / Start height factor
- Cut / mark height
- Transfer height factor
- Arc current

Use the following format to set up the Sensor THC in a part program:

G59 V601 F*value*, where G59 is any applicable G code, and V6XX is the variable identity and F is the value.

V6XX variable	**Name**	**Range for F*value*** **English** **(Metric)**	**F*value* format**	**F*value* units** **English** **(Metric)**
V600	Plasma 1 Arc Voltage	10 to 300	XXX.XX	volts
V601	Plasma 1 Pierce Time	0 to 9	X.XX	seconds
V602	Plasma 1 Pierce Height Factor	50 to 400	XXX.XX	%
V603	Plasma 1 Cut Height	0 to 1 (0 to 25.4)	XX.XX	inches (mm)
V604	Plasma 1 Transfer Height Factor	50 to 400	XXX.XX	%
V605	Plasma 1 Cut Height Delay	0 to 5	X.XX	seconds
V606	Plasma 1 Kerf Detect Reacquire Time	0 to 10	XX.XXX	seconds

V607	Plasma 1 Mode Select	F1 = Manual F2 = Auto		N/A
V608	Plasma 1 Arc Current	See plasma system	XXX	amps
V625	Plasma 2 Arc Voltage	10 to 300	XXX.XX	volts
V626	Plasma 2 Pierce Time	0 to 9	X.XX	seconds
V627	Plasma 2 Pierce Height Factor	50 to 400	XXX.XX	%
V628	Plasma 2 Cut Height	0 to 1 (0 to 25.4)	X.XX	inches (mm)
V629	Plasma 2 Transfer Height Factor	50 to 400	XXX.XX	%
V630	Plasma 2 Cut Height Delay	0 to 5	X.XX	seconds
V631	Plasma 2 Kerf Detect Reacquire Time	0 to 10	XX.XXX	seconds
V632	Plasma 2 Mode Select	F1 = Manual F2 = Auto		N/A
V633	Plasma 2 Arc Current	See plasma system	XXX	amps
V650	Marker 1 Set Arc Voltage	10 to 300	XXX.XX	volts
V651	Marker 1 Start Time	0 to 10	XX.XXX	seconds
V652	Marker 1 Start Height Factor	50 to 400	XXX.XX	%
V653	Marker 1 Mark Height	0 to 1 (0 to 25.4)	XX.XX	inches (mm)
V657	Marker 1 Mode Select	F1 = Manual F2 = Auto		N/A

V658	Marker 1 Arc Current	See plasma system	XXX	amps
V675	Marker 2 Set Arc Voltage	10 to 300	XXX.XX	volts
V676	Marker 2 Start Time	0 to 10	XX.XXX	seconds
V677	Marker 2 Start Height Factor	50 to 400	XXX.XX	%
V678	Marker 2 Mark Height	0 to 1 (0 to 25.4)	XX.XX	inches (mm)
V682	Marker 2 Mode Select	F1 = Manual F2 = Auto		N/A
V683	Marker 2 Arc Current	See plasma system	XXX	amps

THC Index Code

When the Sensor THC process is in manual mode, G00 Z-xxx Tx can be used to raise the specified Sensor THC by a variable amount.

G00 Zx.xx Tx	Index Sensor THC height “Z” distance for torch “T”, in manual mode only.

The following M-codes are available in Phoenix version 9.5 and later:

M07 HS	Forces an IHS for cutting, regardless of the distance between cuts or any previous M08 RT command.
M08 RT *–x.xx*	Retracts to the Transfer Height instead of the Retract Height at the end of a cut. The *–x.xx* variable represents the amount of time before the end of a cut that the Cut Off command is issued.
M09 HS	Forces an IHS for marking, regardless of the distance between marks or any previous M10 RT command
M10 RT	Retracts to the Transfer Height instead of the Retract Height at the end of a mark.

Sample Part Program

The following sample part program includes commands to change control modes and to raise the Plasma 1 THC height in a corner by .25 inches:

```
G59V600F155      Program arc voltage for first segment
G41
M07
G01 X0 Y3
G59 V607 F1      Set plasma process 1 THC to manual mode
G00 Z-.25 T1     Raise the THC 1 .25 inches
G59 V607 F2      Set plasma process 1 THC back to automatic mode
G59V600F165      Program the new arc voltage for the next segment
G01 X3 Y0
M08
G40
M02
```

Plasma Supply Programming Support

HPR and HD4070 Support

The same cut chart data that is used on the cut chart setup screen can 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.

Only the variables that you are changing need be inserted into the part program. You do not have to insert a line of code for each cut chart variable within a part program.

Part program codes for the power supply should be grouped together at the beginning of the program. The variables that can be set through the part program are Material Type, Current Setting and Material Thickness, Torch Type, and Cutting Surface.

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

G59 V503 F5

G59	Any G code
V5*xx*	The variable identity: V502 – Torch Type Plasma 1 V512 – Torch Type Plasma 2 V522 – Torch Type Marker 1 V532 – Torch Type Marker 2 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 V505 – Plasma Shield Gasses Plasma 1 V515 – Plasma Shield Gasses Plasma 2 V525 – Plasma Shield Gasses Marker 1 V535 – Plasma Shield Gasses Marker 2 V506 -- Cutting Surface Plasma 1

	V516 – Cutting Surface Plasma 2 V526 – Cutting Surface Marker 1 V536 -- Cutting Surface Marker 2 V507 – Material Thickness Plasma 1 V517 – Material Thickness Plasma 2 V527 – Material Thickness Marker 1 V537 – Material Thickness Marker 2 V508 – Water Muffler Plasma 1 V518 – Water Muffle Plasma 2
F*x*	The variable value, which depends on the variable identity: For torch type V502, V512, V522, V532: Add Fx for Torch type x (for example: V512 F34 for Plasma 2, torch type HPRXD) 1 = MAX200 2 = SE200 3 = HT4400 4 = FineLine200 5 = FineLine100 6 = LH2100S 7 = LH2100T 8 = LH2125S 9 = LH2125T 10 = PAC186 11 = T80M 12 = MAX100 13 = MAX100D 14 = ArcWriter 15 = PAC620 16 = PAC123 17 = PAC125 18 = T60M 19 = T100M

	20 = HySpeed 21 = HPR 22 = LH1510S 23 = LH1510T 24 = LH1575S 25 = LH1575T 26 = FineLine260 27 = FineCut 28 = Spirit275 29 = HSD 30 = Spirit400 31 = HPR Bevel 32 = TDC_XT300 33 = TDC_XT301 34 = HPRXD 35 = HPRXD Bevel 36 = T45M 37 = HPRXD Thick Pierce For material type V503, V513, V523, V533: Add .0x for Specific Material x (for example: V503 F1 .01 for mild steel, specific material 1) 1 = Mild Steel 2 = Stainless Steel 3 = Aluminum For current setting V504, V514, V524, V534: 7 = 7A 70 = 70A 10 = 10A 80 = 80A 15 = 15A 100 = 100A 18 = 18A 130 = 130A 30 = 30A 200 = 200A 45 = 45A

For gas settings V505, V515, V525, V535:

1 = Air/Air	9 = H35/N2	17 = O2-N2/O2
2 = O2/Air	10 = H5/N2	18 = O2
3 = O2/O2	11 = Air/N2	19 = N2
5 = N2/CO2	13 = CO2/N2	21 = Air
6 = None/N2	14 = None/Air	22 = F5/N2
7 = O2/N2	15 = CH4/Air	23 = H35&N2/N2
8 = CH4 / N2	16 = O2-N2/Air	

For cutting surface: V506, V516, V526, V536

1 = Above water

2 = 3 inches below water

For material thickness V507, V517, V527, V537:

EIA F*number*	Gauge and Fraction	Decimal	Metric
1	None	None	None
2 or 3	28GA	0.015"	0.35mm
4 or 5	27GA	0.016"	0.4mm
6 or 7	26GA	0.018"	0.5mm
8 or 9	24GA	0.024"	0.6mm
10 or 11	22GA	0.030"	0.8mm
12 or 13	20GA	0.036"	0.9mm
14	19GA	0.040"	1mm
15 or 16	18GA	0.048"	1.2mm
17 or 18	16GA	0.060"	1.5mm
19	1/16"	0.063"	1.6mm
20 or 21	14GA	0.075"	2mm

	47	13GA	0.090”	2.2mm
	22	3/32”	0.094”	2.4mm
	23 or 24	12GA	0.105”	2.5mm
	48	11GA	0.120”	3mm
	25	1/8”	0.125”	3.2mm
	26 or 27	10GA	0.135”	3.5mm
	49	9GA	0.150”	3.8mm
	52	8GA	0.164”	4mm
	50	7GA	0.180”	4.5mm
	28	3/16”	0.188”	4.8mm
	53	6GA	0.194”	5mm
	51	5GA	0.210”	5.5mm
	29	1/4”	0.25”	6mm
	30	5/16”	0.313”	8mm
	31	3/8”	0.375”	10mm
	32	7/16”	0.438”	11mm
	33	1/2”	0.5”	12mm
	34	9/16”	0.563”	14mm
	35	5/8”	0.625”	15mm
	36	3/4”	0.75”	20mm
	37	7/8”	0.875”	22mm
	38	1”	1”	25mm
	39	1 1/8”	1.125”	30mm
	40	1 1/4”	1.25”	32mm
	41	1 3/8”	1.375”	35mm

	42	1 1/2"	1.5"	38mm
	54	1 5/8"	1.625"	40mm
	43	1 3/4"	1.75"	45mm
	55	1 7/8"	1.875"	48mm
	44	2"	2"	50mm
	56	2 1/8"	2.125"	55mm
	45	2 1/4"	2.25"	60mm
	46	2 1/2"	2.5"	65mm
	57	2 3/4"	2.75"	70mm
	58	3"	3"	75mm
	59	3 1/8"	3.125"	80mm
	60	3 1/4"	3.25"	85mm
	61	3 1/2"	3.5"	90mm
	62	3 3/4"	3.75"	95mm
	63	4"	4"	100mm
	For water muffler: V508, V518, V528, V538 1 = Installed 2 = Not installed			

Note: Programming a code for a nonexistent process will result in an invalid process.

HD3070 Support

The same valve setting data that is used on the Auto Gas setup screen can also be used within a part program to configure the HD3070. This code is used to select the valve and indicate the valve set point.

Use an EIA-274D G59 code with the following format:

G59 V65 B5

G59	Any G code

Vxx	The 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
Bx	The valve value, which depends on the valve identity: For Valves V65 – V70, a whole integer is used to set the desired percentage value. For Valve 71: 0 = Oxygen 1 = H35/N2 2 = Air

For this example, 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 all the necessary valves.

FineLine 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 power supply. 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 that 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 can be set through the part program are Material Type, Current Setting, and Material Thickness.

Configure cut parameters for the FineLine using an EIA-274D G59 code with the following format:

G59 V503 F5

G59	Any G code
V5*xx*	The variable identity:

	V502 – Torch Type Plasma 1 V512 – Torch Type Plasma 2 V522 – Torch Type Marker 1 V532 – Torch Type Marker 2 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 V505 – Plasma Shield Gasses Plasma 1 V515 – Plasma Shield Gasses Plasma 2 V525 – Plasma Shield Gasses Marker 1 V535 – Plasma Shield Gasses Marker 2 V506 -- Cutting Surface Plasma 1 V516 – Cutting Surface Plasma 2 V526 – Cutting Surface Marker 1 V536 -- Cutting Surface Marker 2 V507 – Material Thickness Plasma 1 V517 – Material Thickness Plasma 2 V527 – Material Thickness Marker 1 V537 – Material Thickness Marker 2 V508 – Water Muffler Plasma 1 V518 – Water Muffle Plasma 2
F*x*	The variable value, which depends on the variable identity: For material type V503, V513, V523, V533: Add .0x for Specific Material x (for example: V503 F1 .01 for mild steel, specific material 1) 1 = Mild Steel 2 = Stainless Steel

	3 = Aluminum For current setting V504, V514, V524, V534: 7 = 7A 70 = 70A 10 = 10A 80 = 80A 15 = 15A 100 = 100A 18 = 18A 130 = 130A 30 = 30A 200 = 200A 45 = 45A For gas settings V505, V515, V525, V535: 1 = Air/Air 9 = H35/N2 17 = O2-N2/O2 2 = O2/Air 10 = H5/N2 18 = O2 3 = O2/O2 11 = Air/N2 19 = N2 5 = N2/CO2 13 = CO2/N2 21 = Air 6 = None/N2 14 = None/Air 22 = F5/N2 7 = O2/N2 15 = CH4/Air 23 = H35&N2/N2 8 = CH4 / N2 16 = O2-N2/Air
	For cutting surface: V506, V516, V526, V536 1 = Above water 2 = 3 inches below water
	For material thickness V507, V517, V527, V537: EIA F*number* / Gauge and Fraction / Decimal / Metric 1 / None / None / None 2 or 3 / 28GA / 0.015” / 0.35mm 4 or 5 / 27GA / 0.016” / 0.4mm 6 or 7 / 26GA / 0.018” / 0.5mm

	8 or 9	24GA	0.024”	0.6mm
	10 or 11	22GA	0.030”	0.8mm
	12 or 13	20GA	0.036”	0.9mm
	14	19GA	0.040”	1mm
	15 or 16	18GA	0.048”	1.2mm
	17 or 18	16GA	0.060”	1.5mm
	19	1/16”	0.063”	1.6mm
	20 or 21	14GA	0.075”	2mm
	47	13GA	0.090”	2.2mm
	22	3/32”	0.094”	2.4mm
	23 or 24	12GA	0.105”	2.5mm
	48	11GA	0.120”	3mm
	25	1/8”	0.125”	3.2mm
	26 or 27	10GA	0.135”	3.5mm
	49	9GA	0.150”	3.8mm
	52	8GA	0.164”	4mm
	50	7GA	0.180”	4.5mm
	28	3/16”	0.188”	4.8mm
	53	6GA	0.194”	5mm
	51	5GA	0.210”	5.5mm
	29	1/4”	0.25”	6mm
	30	5/16”	0.313”	8mm
	31	3/8”	0.375”	10mm
	32	7/16”	0.438”	11mm
	33	1/2”	0.5”	12mm

	34	9/16”	0.563”	14mm
	35	5/8”	0.625”	15mm
	36	3/4”	0.75”	20mm
	37	7/8”	0.875”	22mm
	38	1”	1”	25mm
	39	1 1/8”	1.125”	30mm
	40	1 1/4”	1.25”	32mm
	41	1 3/8”	1.375”	35mm
	42	1 1/2”	1.5”	38mm
	54	1 5/8”	1.625”	40mm
	43	1 3/4”	1.75”	45mm
	55	1 7/8”	1.875”	48mm
	44	2”	2”	50mm
	56	2 1/8”	2.125”	55mm
	45	2 1/4”	2.25”	60mm
	46	2 1/2”	2.5”	65mm
	57	2 3/4”	2.75”	70mm
	58	3”	3”	75mm
	59	3 1/8”	3.125”	80mm
	60	3 1/4”	3.25”	85mm
	61	3 1/2”	3.5”	90mm
	62	3 3/4”	3.75”	95mm
	63	4”	4”	100mm
	For water muffler: V508, V518, V528, V538 1 = Installed			

	2 = Not installed

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. There are 2 Serial Messaging ports available.

Overview

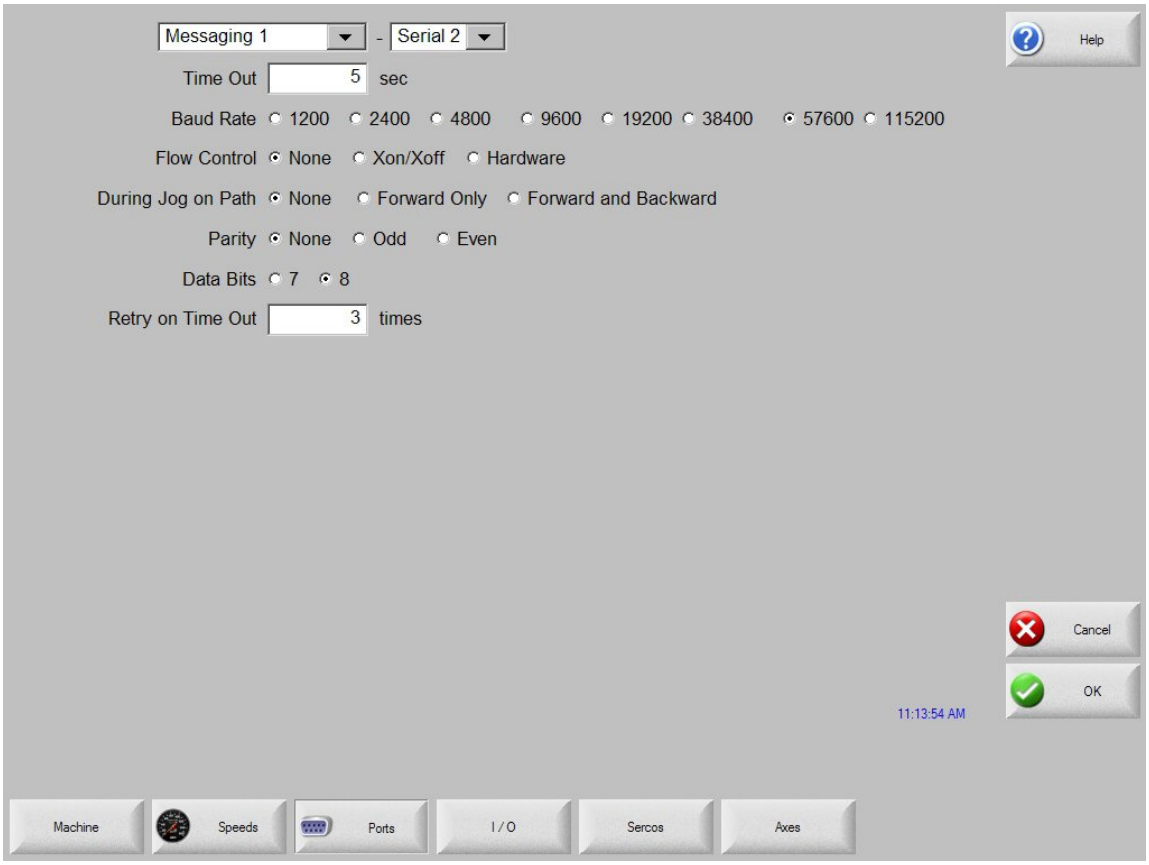
Serial Messaging has a fairly basic communication protocol that has three simple formats to send ASCII codes as command strings. During the messaging function, a status indicator for “Message Transmit”, “Message Delay” or “Message Verify” will be displayed in the Watch window.

Options

- 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.
- 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.
- The message is sent with a suspension of the program during transmission as in the first option, 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 selected port(s) at the Ports setup screen.

After you enable serial messaging, the flow control parameters that communicate with the external device must be selected.



The following parameters must be configured. Hardware and flow control configuration information must match the external device.

Parameter	**Description**
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.
Baud Rate	Select a communication speed from 1200 to 115200 Baud.
Flow Control	Select to use None, Xon/Xoff or Hardware.
During Jog on Path	Select whether messages will be sent when jogging Forward or Backward on Path while at the Pause screen. **Notes:** • All messaging will stop when the Stop Key has been pressed or the Remote Pause input becomes active. • The Message Type 21 will transmit the message concurrent to the associated motion segment during Backup on Path.

Parity	Select None, Odd or Even.
Data Bits	Select 7 or 8 Data Bits.
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.

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:

>20+Format+Delay Time/Time Out+Port<Message

>2*x*	Message Command type (see Message Command Type section): >20 = Direct message with Delay >21 = Direct message without Delay >22 = Message that requires Acknowledge
Format	Optional format value that 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 section).
Delay Time/ Time Out	Optional delay time/time out value Time in seconds (see Time Out Value section.)
Port	Optional serial port number: 0 = Default port 1 1 = Port 2
Message	The message content (see the message text section.) **Note:** Serial message format is always written within comment characters and the command portion of the program code is between

	the ">" Character and the "<" Character. ESSI Example: 3 >20,1,1,0<Message 4 EIA Example: (>20,1,1,0<Message)

Note: You can use the plus sign (+), hyphen (-), comma (,) or space as a delimiter between fields for the command instruction.

Message Command Type

Command	Description
>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 nonacknowledge (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

The following specialty characters for the format can be sent, in addition to a 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 because it does not include any of the 'Format' characters, including the CR/LF option.

Optional Format Character Assignments

Value	Assignment
0	No special assignment (must be used in the format location if a Delay or Port is required but no Format options are required). 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 an 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 issues 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) within 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.

If there is no delay, but the optional port below is being selected, then 0 is required to be entered in the optional delay location.

Optional Port

The Optional Port setting selects which Messaging Port to use. The default messaging port to use is Port 1 if this parameter is omitted. If the optional port is used, 0 = Messaging Port 1 and 1 = Messaging Port 2.

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. For more information on ASCII codes and the Hexadecimal value, refer to the ASCII Code chapter.

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. For more information on these values, refer to the Non-printing Character section.

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

- The “&” two-character pair clears the 0x40 bit from the 2nd character code value.
- The “!” two-character pair clears the 0x40 bit and sets the 0x80 bit set in the 2nd character code.
- 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 0xC1, 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 Hexadecimal 20

Code	Hex	Code	Hex	Code	Hex	Code	Hex
&@	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 Hexadecimal 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

Importing Prepared DXF Files

The DXF Translator software allows the control to load and translate a DXF style drawing created in Autocad ® or Autocad LT® into an EIA part program. Certain guidelines must be observed when creating the CAD drawing to allow the CNC to load and understand the file. The optional DXF translation utility is enabled through a password provided by your control supplier.

Drawing Format

There should be nothing on the cut layer except lines, arcs, circles and text commands. Do not put dimensions or notes on the same layer as cut data.

Elliptical segments, squares and polylines are not supported. Divide these elements into short arcs or line segments. You can use the ACAD EXPLODE command to convert POLYLINES into segments.

The end angles of two arcs from any intersection point cannot be within the same quadrant.

Text commands determine cut sequence, and determine the path through multi-segment intersections. Text commands are placed on the drawing with the text feature of your CAD program. The size of the text is not important. However, the location of the text is extremely important. Text must be left-justified and text commands must be snapped to the appropriate intersection or pierce points.

Text commands indicate pierce points and cut direction. Note that the directional commands should only be used to determine the direction of the next line segment when more than one exit path exists at an intersection of segments.

Text Commands

1 Indicates the first pierce point (subsequent pierce points follow in numerical order)

\+ Indicates a Counter-Clockwise circle

\- Indicates a Clockwise circle

Directional Commands

The following commands indicate the next segment's direction, if it is a line, or the ending angle, if it is an arc, if the angle is:

R 350° to 10°

RU 0° to 45°

UR 45° to 90°

U 80° to 100°

UL 90° to 135°

LU 135° to 180°

L 170° to 190°

LD 180° to 225°

DL 225° to 270°

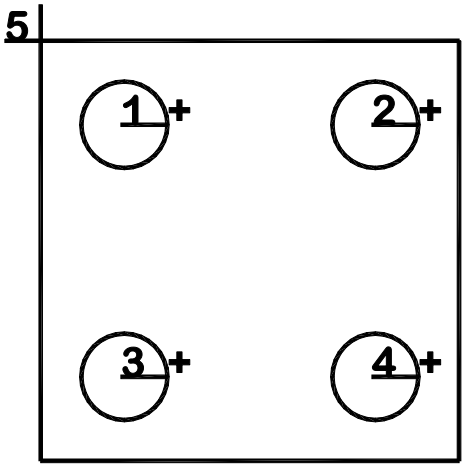
D 260° to 280°

DR 270° to 315°

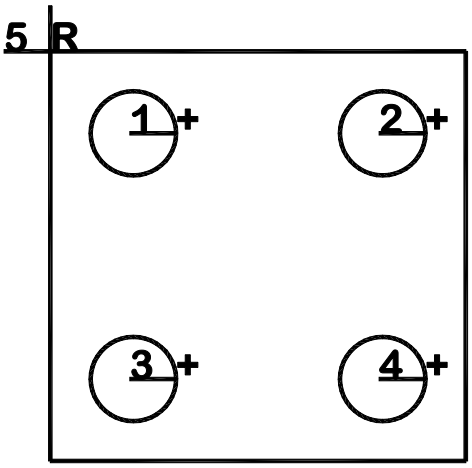
RD 315° to 360°

Traverses are automatically determined between pierce points and do not need to be entered on the CAD drawing.

The following example is a basic bolt hole rectangle with the lead-in and lead-out for the rectangle as part of the top and side line segments. The numbers indicate the order of the pierces and the "+" sign indicates a counter-clockwise rotation for the circles.



If the lead-in and lead-out are created as additional line segments added to the top and side line segments, additional text is required to indicate which direction the next line segment should take as part of the part program, as shown in the following diagram:



In this example, the letter “R” has been snapped to the intersection of the four line segments to indicate that the next line segment after lead-in (pierce 5) would be the segment which is located at 350 to 10 degrees and then to the other connected segments on the square. After the left side (vertical) segment has been cut, no additional text is required to indicate which line should be cut. The Lead-out segment is the only segment left to cut because the lead-in and the first segment have already been cut.

Notes:

- There should be nothing on the cut layer except lines, arcs, circles and text or directional commands.
- Line segments must be connected to complete the cut path.
- If multiple line segments or arcs need to be repeated, each line segment should be drawn, rather than copied and pasted.
- Features for marking are not available.
- No traverse lines are required. All lines in the CAD drawing are assumed to be cut lines.
- Left kerf is assumed.

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