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**PHOENIX<sup>®</sup> SOFTWARE FOR  
HYPERTHERM SHAPE CUTTING CONTROL**  
*PROGRAMMER'S REFERENCE*  
Version 8.5 for Touch Screen CNCs

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# Editing Part Programs

## 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:

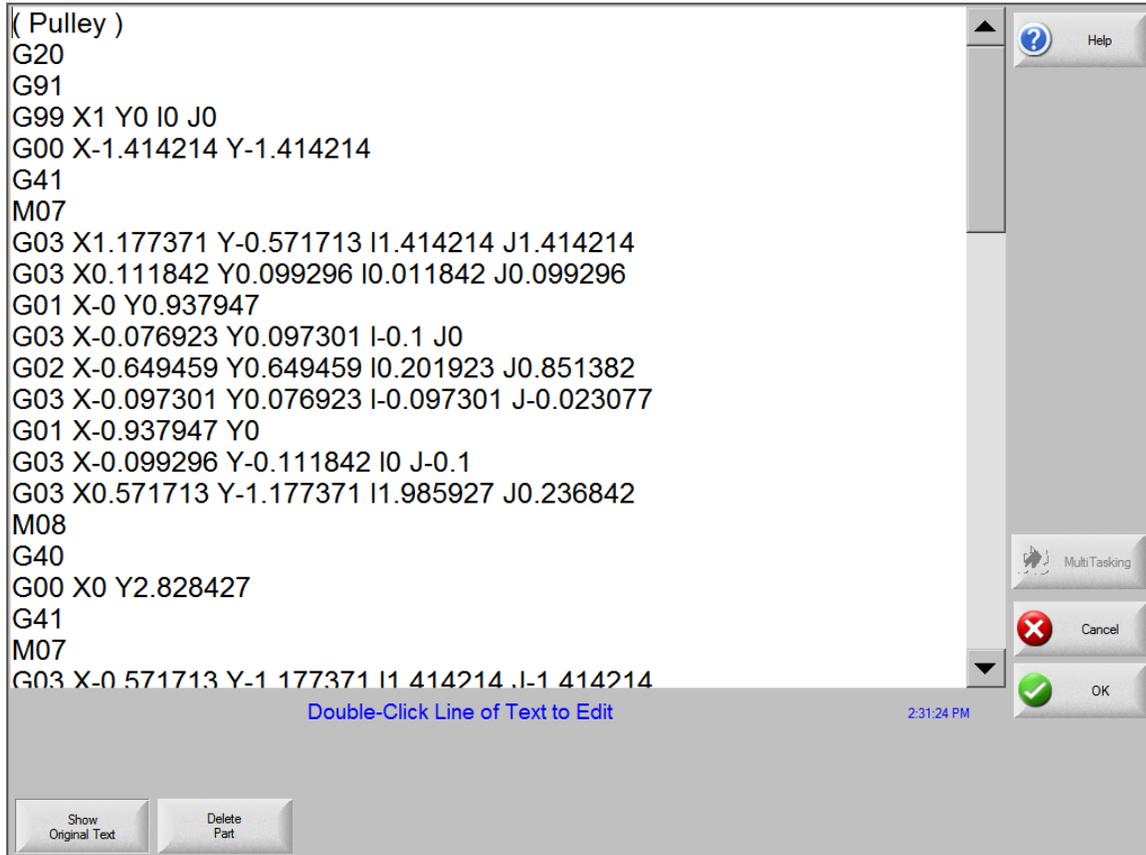
1. Use the arrow keys to navigate to a shape.
2. Press Enter.

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.

Changes can be made by pressing on the desired 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.

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.

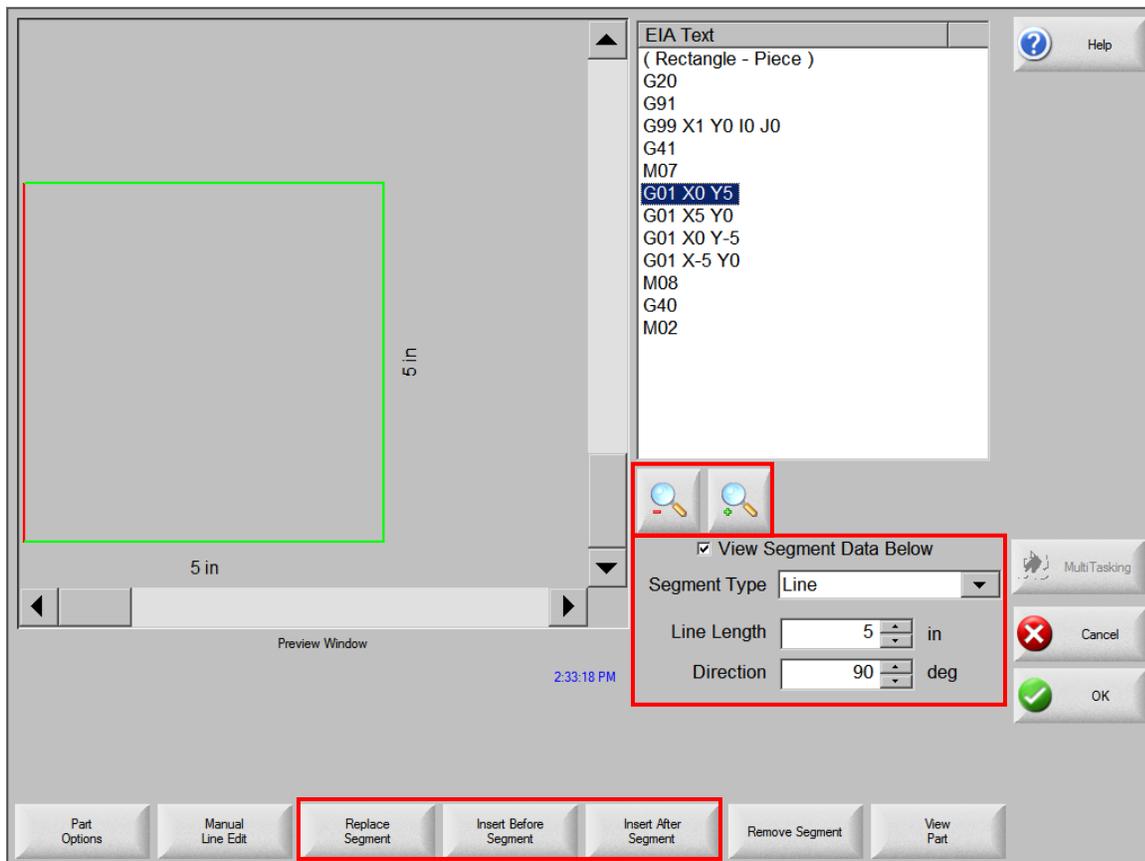
## Shape Wizard

*ShapeWizard*<sup>®</sup> is a proprietary graphical part editor that provides a user-friendly, graphical interface for editing part programs.

You can view not only the segment that is being edited, but other changes that are made, as well.

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

- The shape you selected 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.

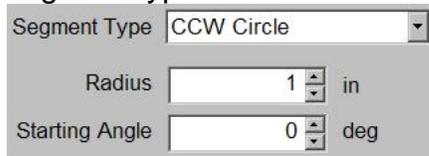


To edit a part program in the EIA Text window:

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

## Programmer's Reference

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.



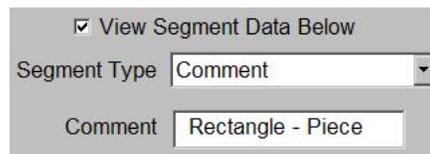
Segment Type CCW Circle

Radius 1 in

Starting Angle 0 deg

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

Replace Segment	Replaces the segment highlighted in gray in the Text Editor window with the segment selected from the Segment Type window.
-----------------	--



View Segment Data Below

Segment Type Comment

Comment Rectangle - Piece

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.



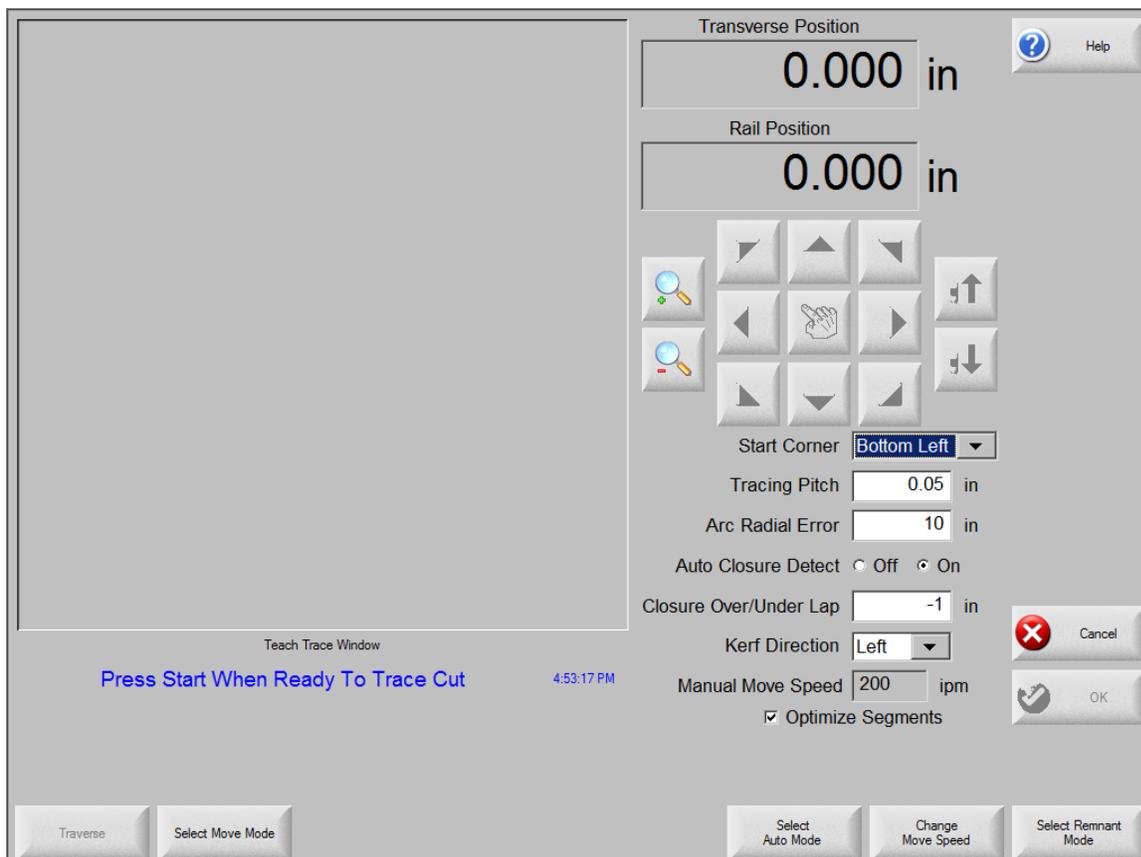
To trace a remnant:

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

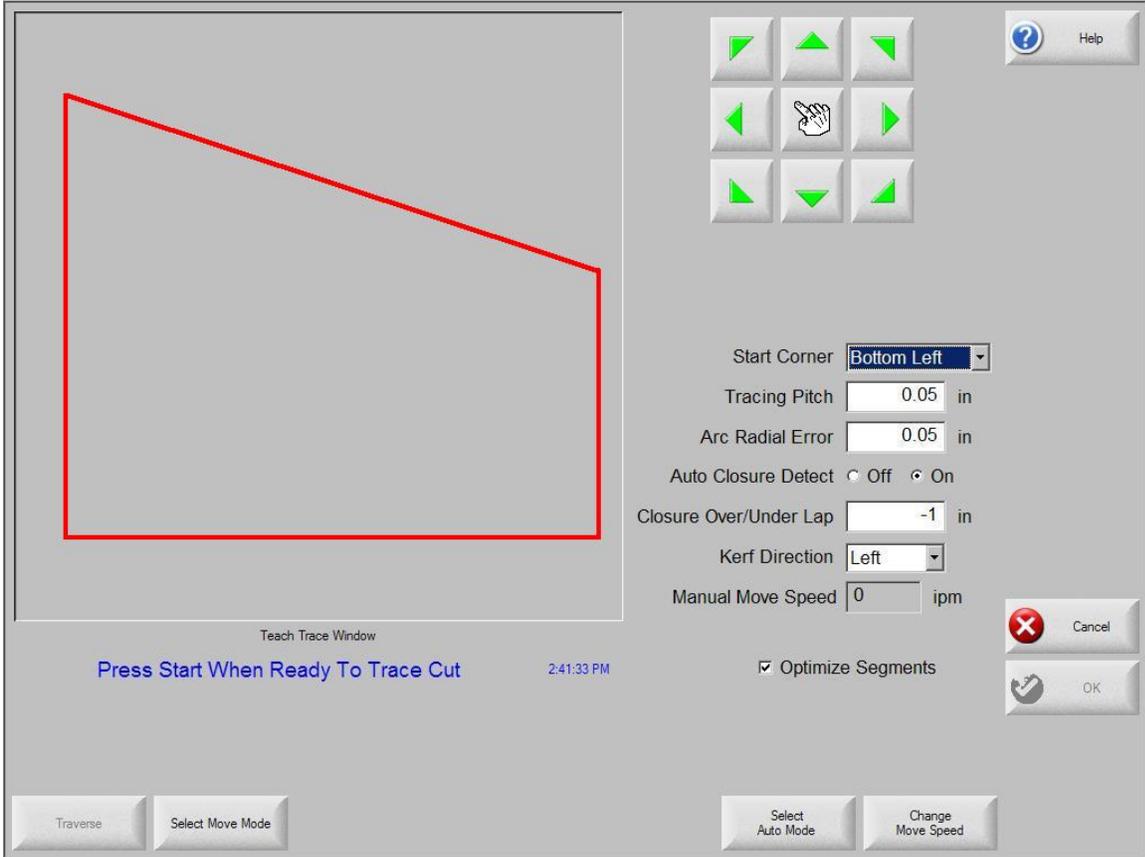
## Programmer's Reference

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 create a folder named Remnant to hold your remnant files.
9. Enter a file name in the File Name field.
10. Press or click OK.

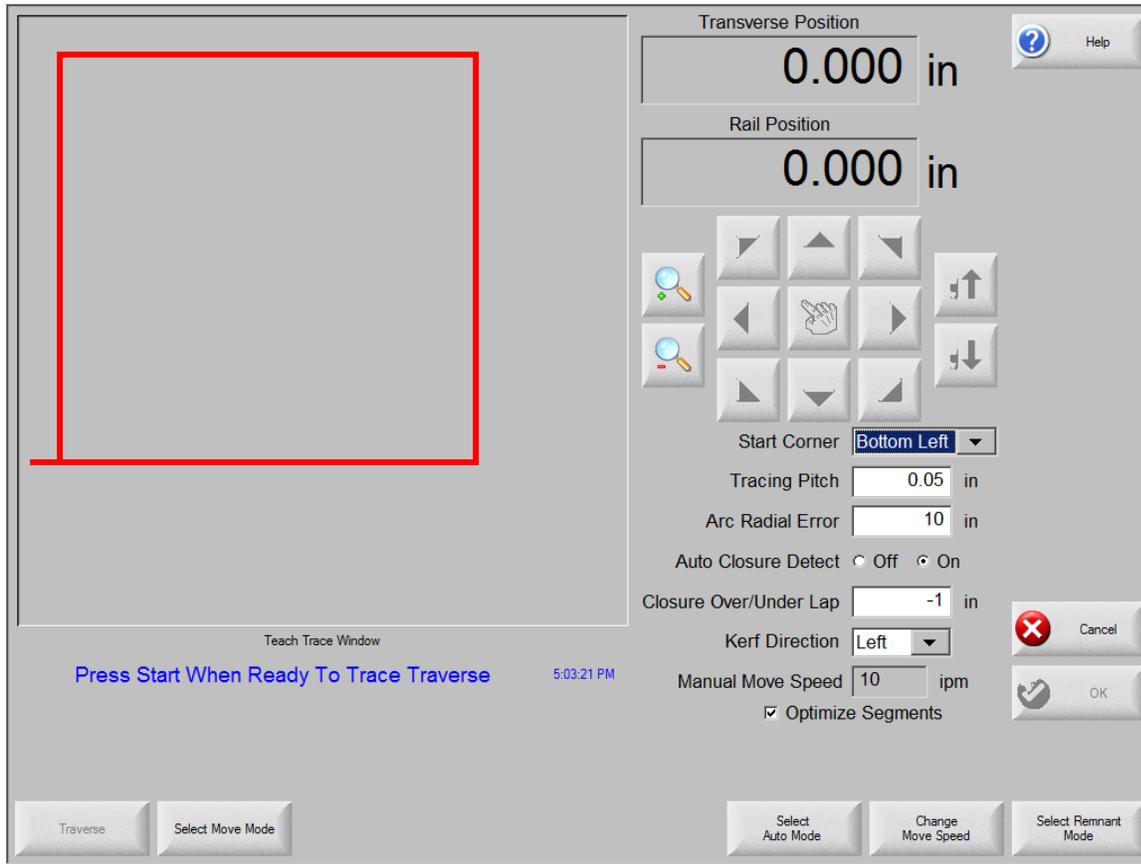
## Teach Trace Mode



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



## Programmer's Reference



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.

Start Corner	Allows you to select where the part you trace will begin for proper viewing on the screen.
Tracing Pitch	<p>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.</p> <p>A good starting point for most tracing systems is 0.01”.</p>
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	<p>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.</p> <p>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.</p>
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	<p>Use this button to change trace modes.</p> <p>If you select manual mode, you can also use the Change Move Speed button to change the trace speed.</p>
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.

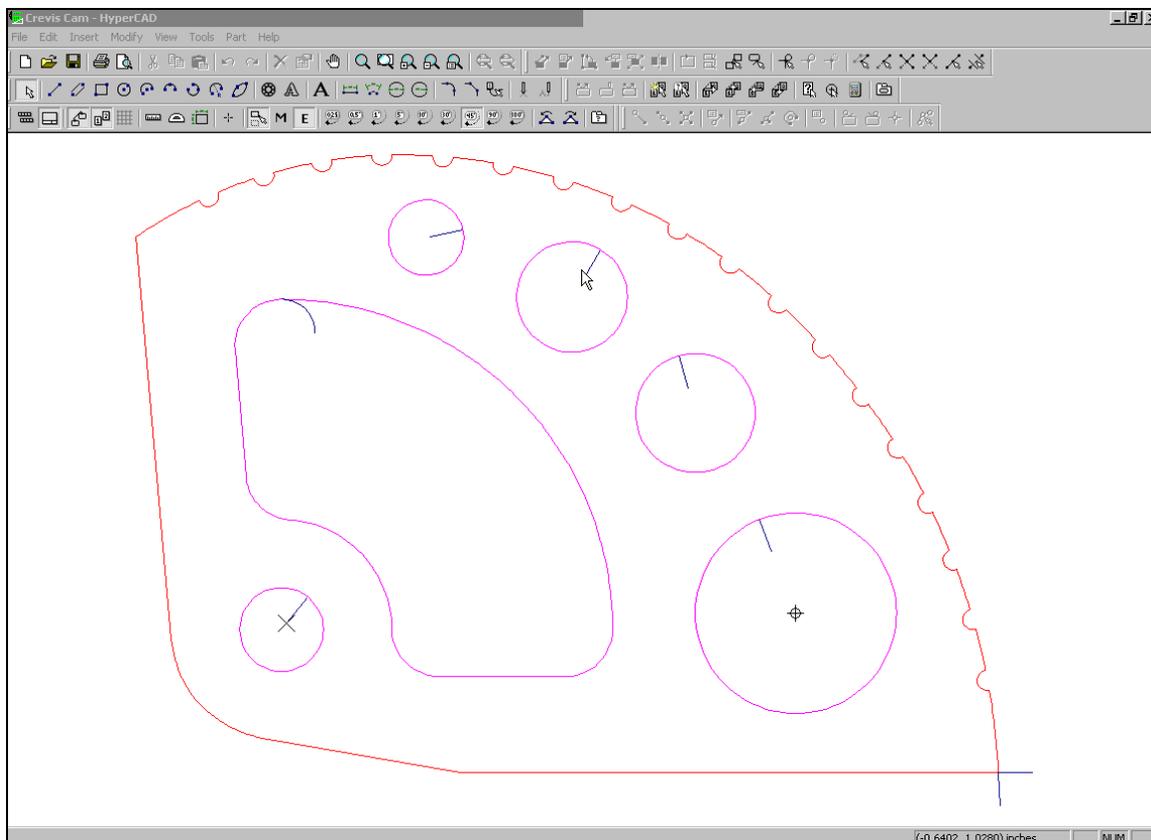
Refer to the instructions provided with your Optical tracing system for additional details.

## 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 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.

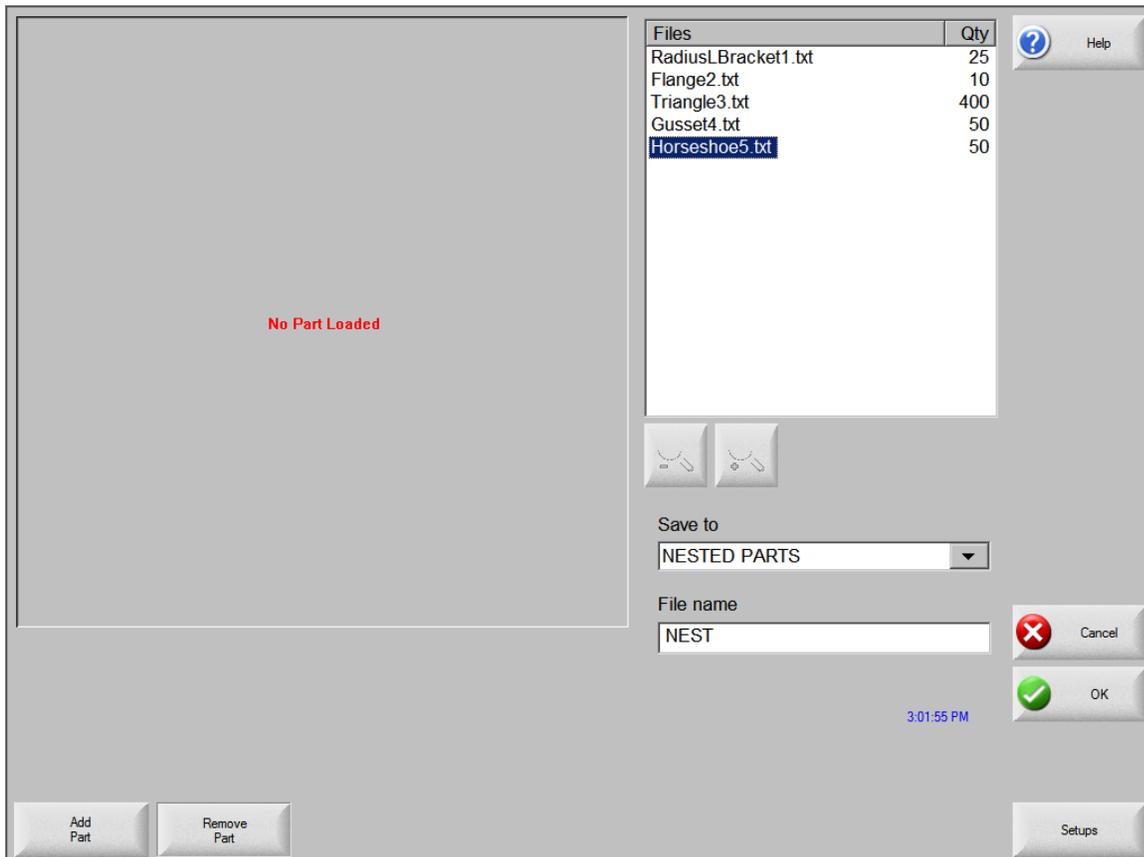


## Nesting Screen Layout

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.

The screenshot shows the 'Automatic Nesting Setup' interface. At the top, 'Nesting' is set to 'Automatic'. The parameters are as follows:

- Arrow Increment 1: 0.25 in
- Arrow Increment 2: 1 in
- Arrow Increment 3: 5 in
- Arrow Increment 4: 10 in
- Arrow Increment 5: 100 in
- Auto-Position:
- Search Increment: 0.1 in
- Scrap Clearance: 0.1 in
- Part Spacing: 0.06 in
- Plate Edge Spacing: 0.06 in
- Program Origin: Bottom Left
- Cut Direction: Bottom to Top
- Nest Direction: Left to Right
- Return to Nest Start:  Off  On
- Use Remnant:  Off  On
- Generate and Cut Offcut:  Off  On
- M65 Auto Reload:  Off  On

Buttons on the right include: Help, MultiTasking, Cancel, and OK. A timestamp '3:29:09 PM' is visible at the bottom right.

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:

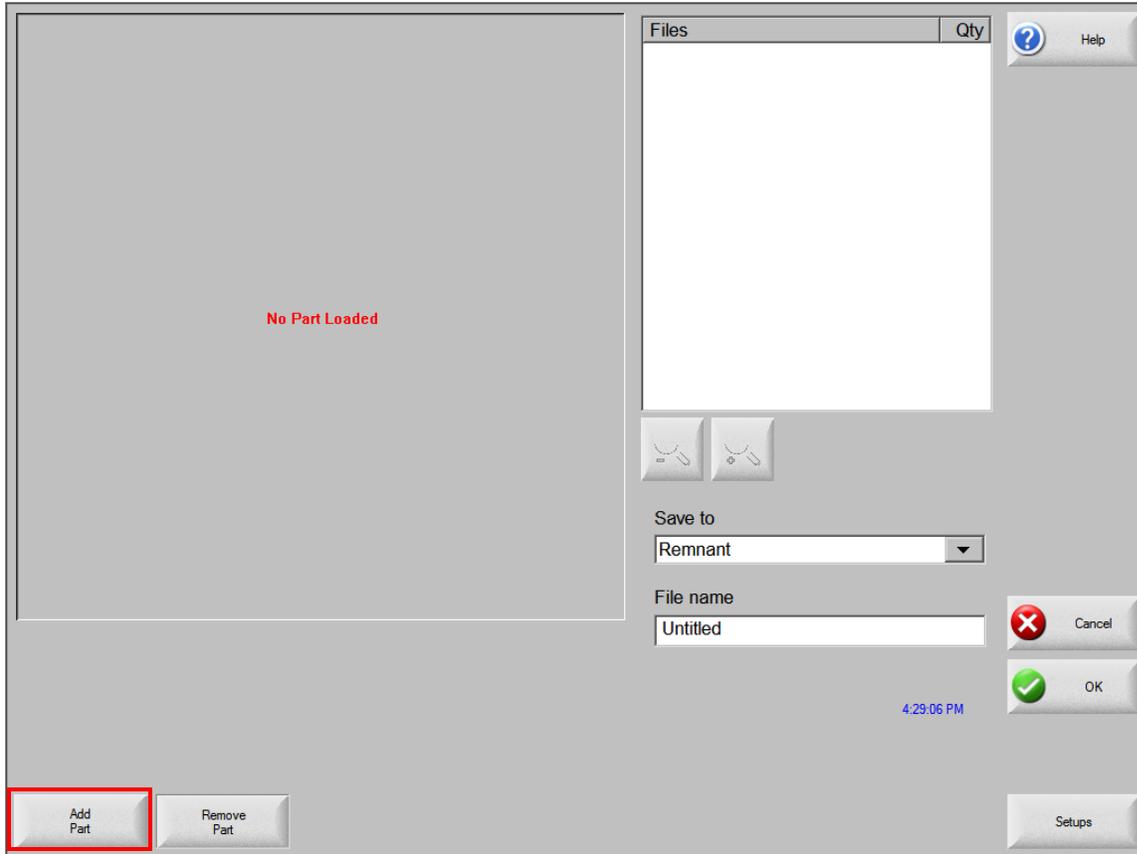
1. On the Shape Manager screen, select Nester > Setups.
2. On the Setup screen, select Automatic for the Nesting option.
3. Configure the setup parameters.
4. Press OK to return to the Nesting screen and begin adding parts to the nest.

## Adding a Part

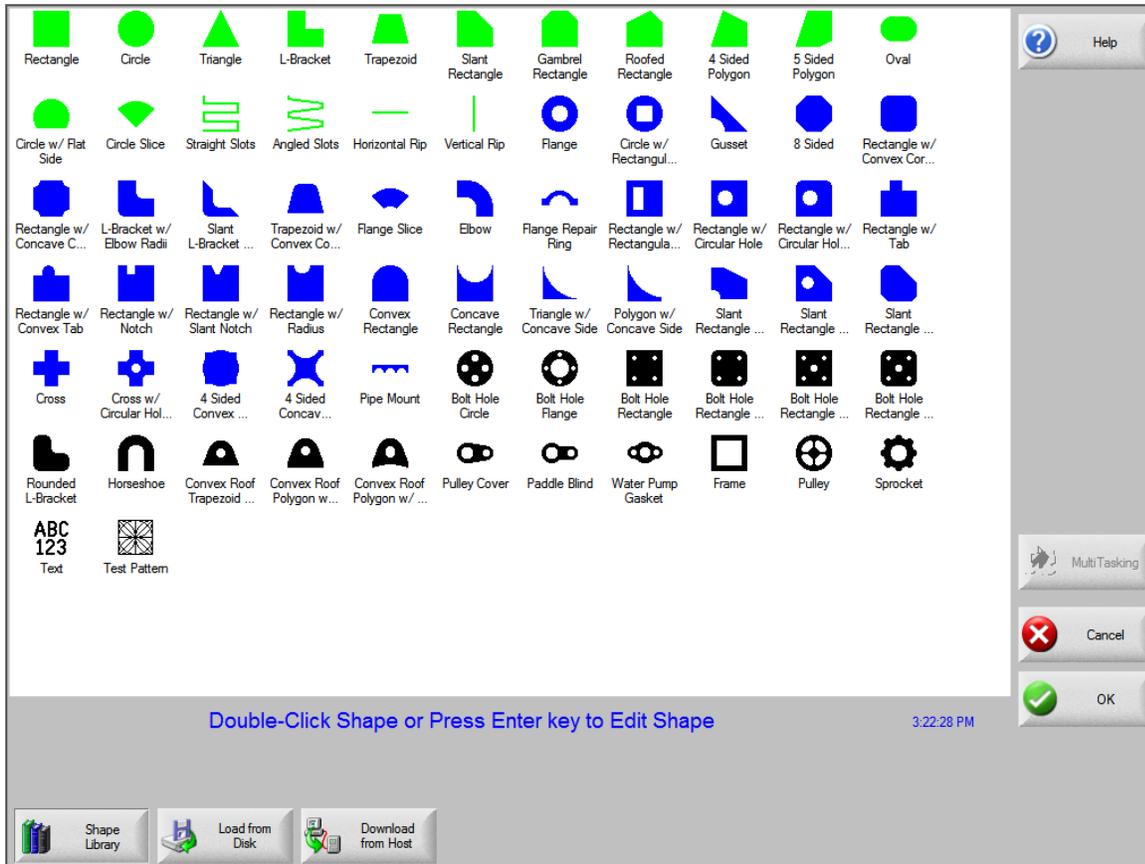
To add a part to a nest part list:

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

## Programmer's Reference



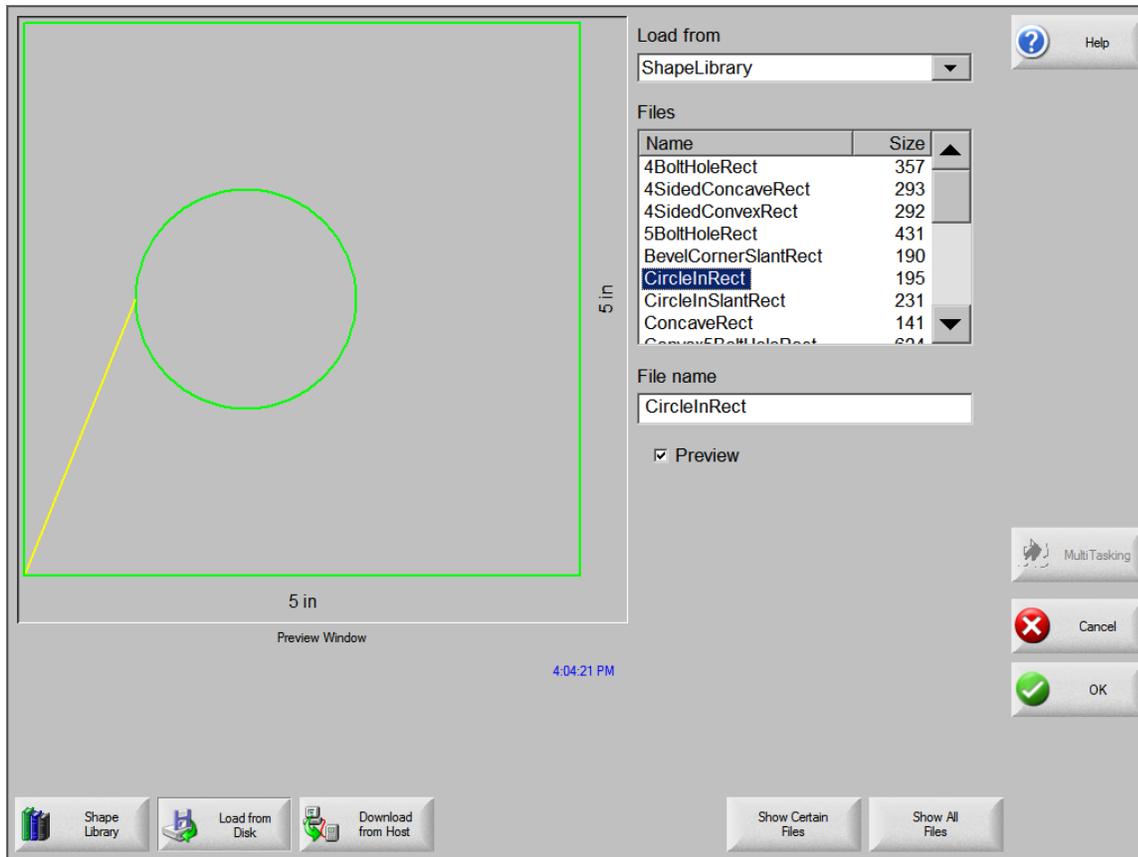
2. On the Add Part screen, use the soft keys at the bottom to select the source of a part file; Shape Library, disk, or host.



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.

## Programmer's Reference



- To narrow down the list of files in the Files list, click or press the Show Certain Files soft key.
- 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:

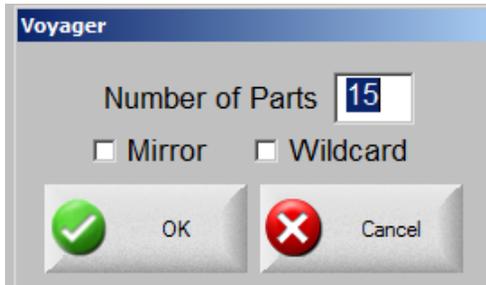
Files	
Name	Size
4BoltHoleRect	357
4SidedConcaveRect	293
4SidedConvexRect	292
5BoltHoleRect	431
BevelCornerSlantRect	190
CircleInRect	195
CircleInSlantRect	231
ConcaveRect	141
Convex5BoltHoleRect	604

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

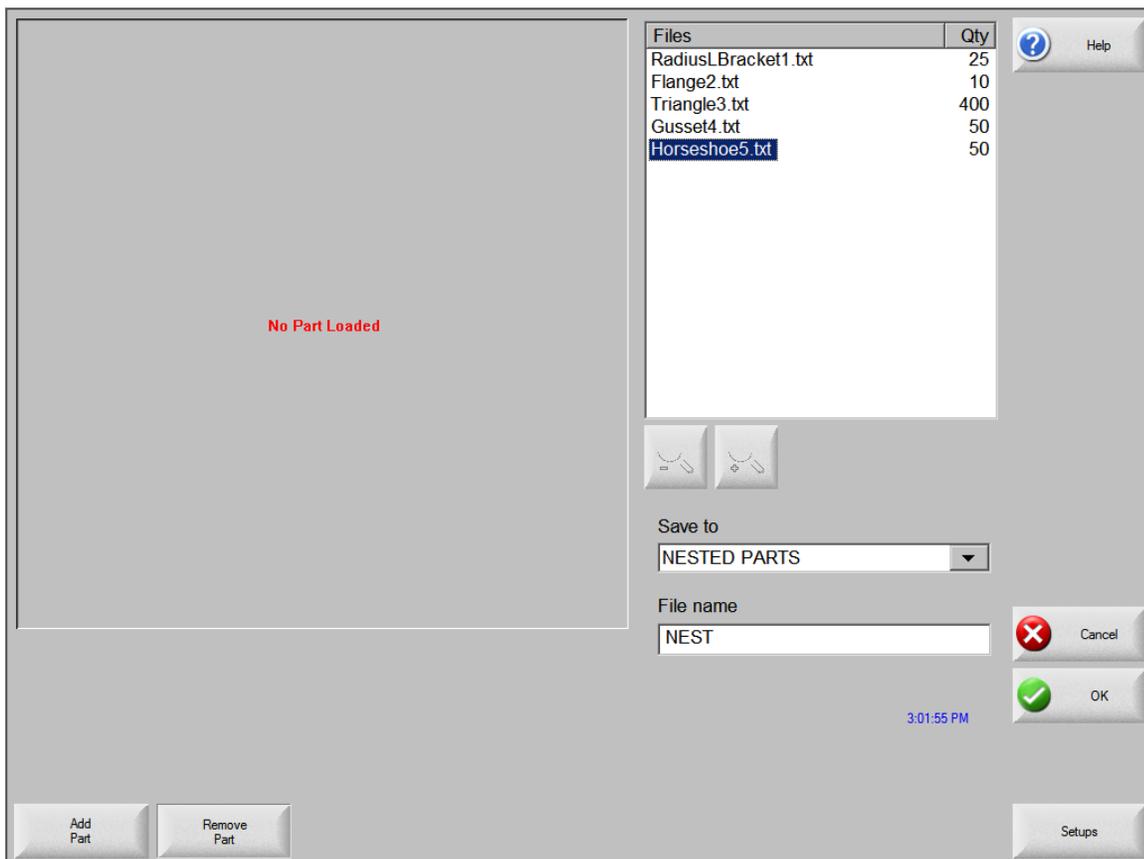
11. Click or press OK.

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.

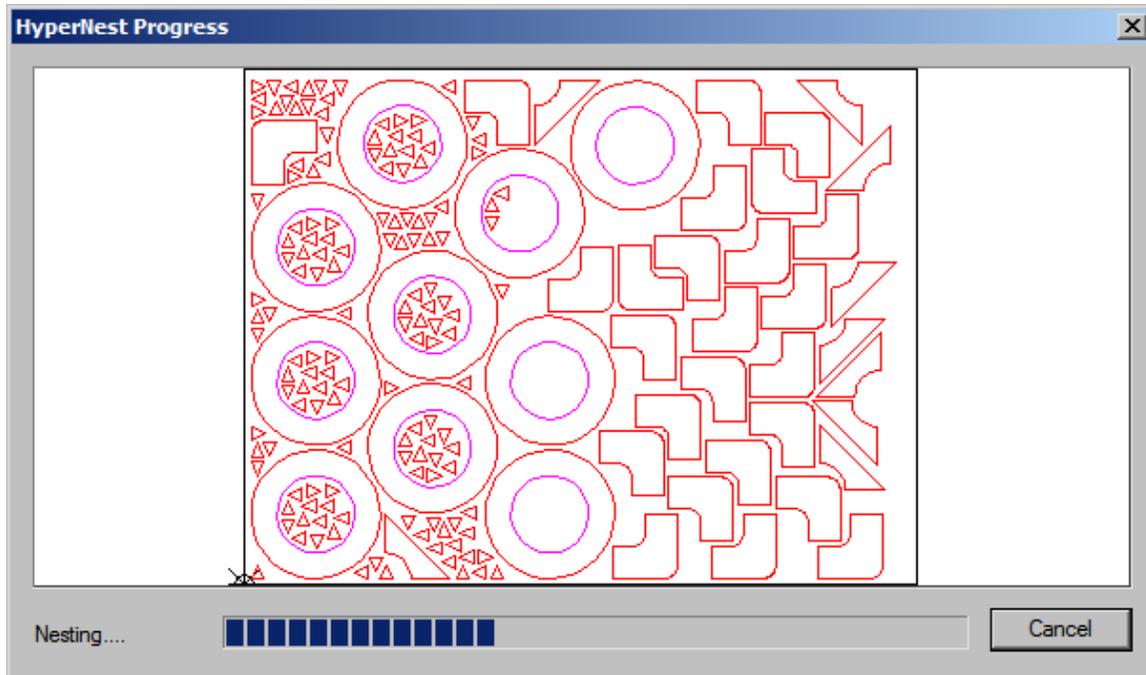


13. As you add new parts to the nest, file names and quantity are listed in the Files window on the Nesting screen.



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.

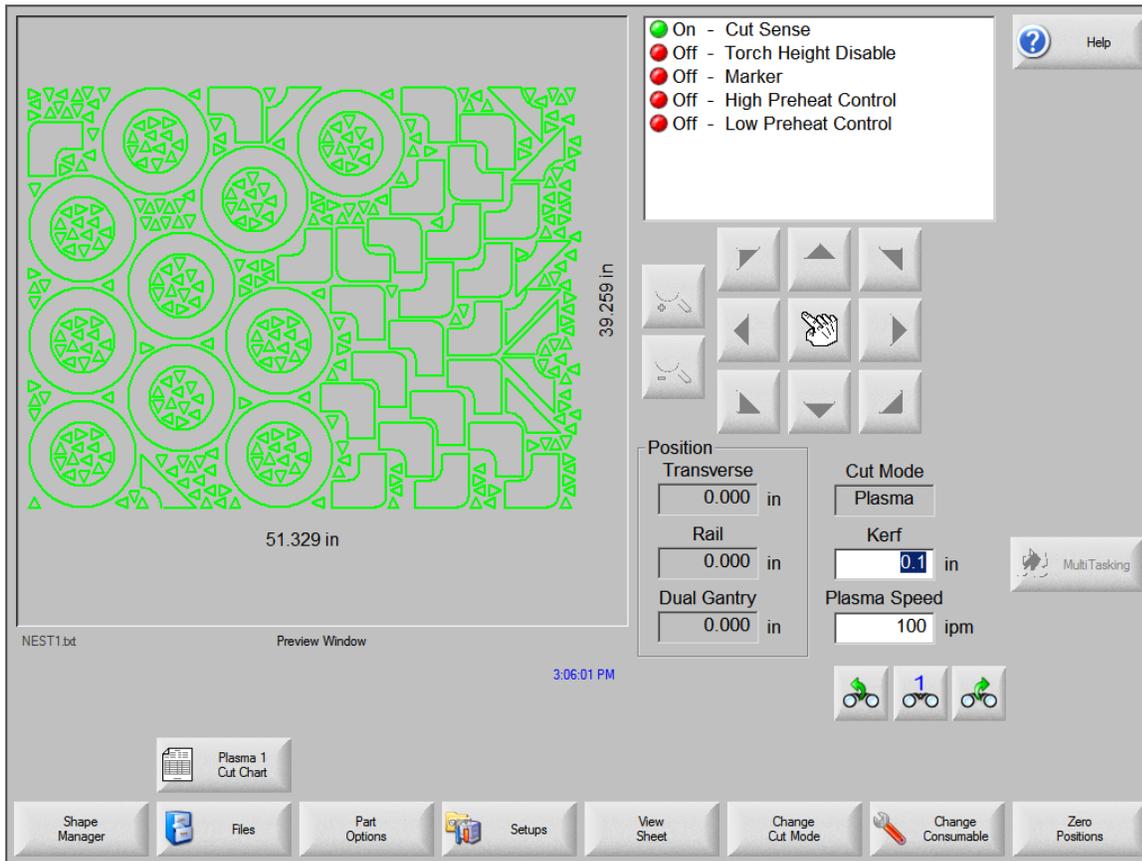
Files	
Name	Size
NEST1	38216
Nest2	19672
Nest3	2712
Nest4	50342
Nest5	41837
Nest6	53620
Nest7	1320

## 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.

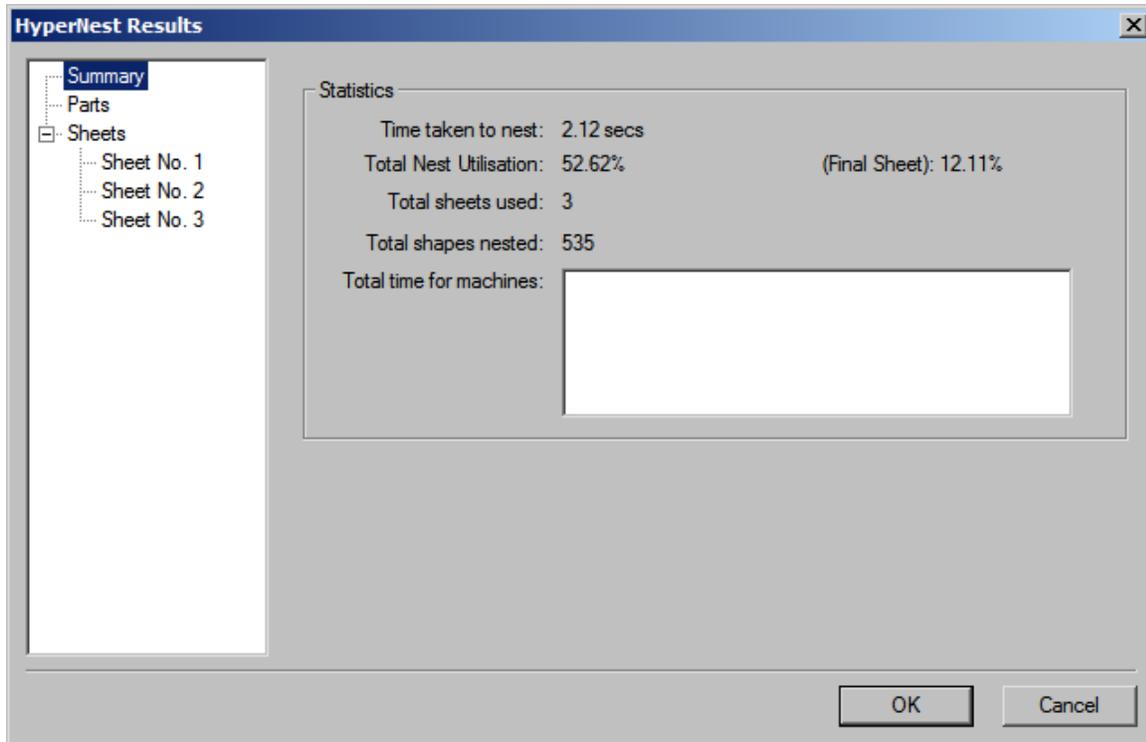
When you have finished nesting your parts, you can view the entire nest in the Preview Window of the Main screen:



**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.

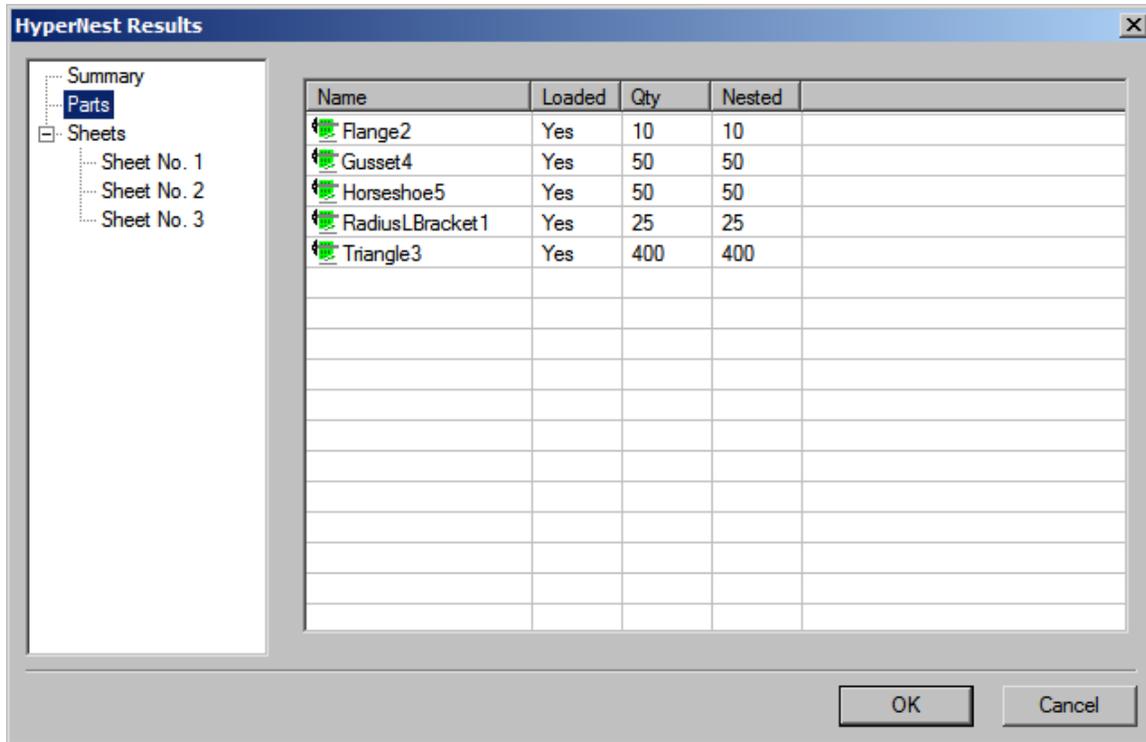
## Nest Summary

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



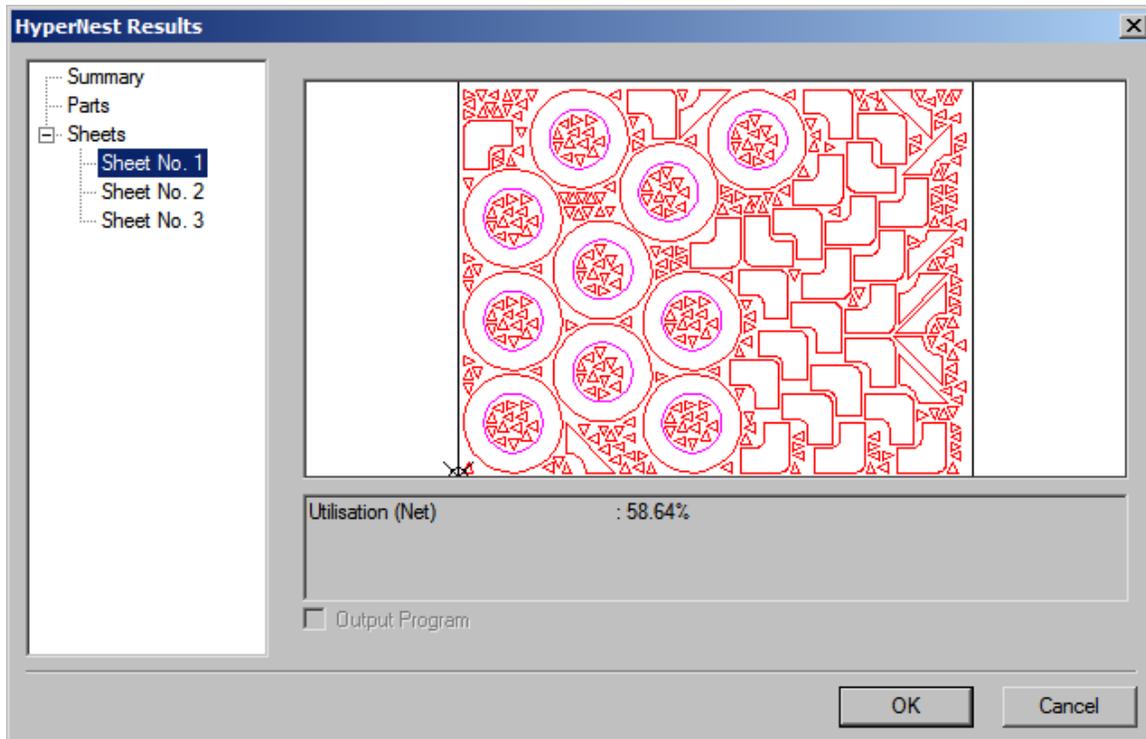
Statistical analysis of the process is provided for the number of sheets, time to execute nest, total nest utilization and total number of shapes nested.

**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.

## Programmer's Reference

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	DC1	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

## Programmer's Reference

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

## Programmer's Reference

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 control 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*<sup>®</sup> Graphical Programming environment be used instead.

Following is a list of the EIA codes that are directly supported, mapped, or currently unsupported by the control. Mapped EIA codes are automatically converted upon program load into directly supported EIA codes. Unsupported EIA codes are ignored. All other EIA codes 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 Avalue	Sets Tilt angle – A is the angle value in degrees
G00 XYval Aval	Performs Linear Interpolation of Tilt angle along line segment.
G01 Avalue Fvalue	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 Sensor™ THC height “Z” distance for torch “T”. Manual mode only.

## Programmer's Reference

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 Xvalue	Program Dwell in Seconds
G08 Xvalue	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 Xvalue	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 <i>Vvalue</i> <i>Fvalue</i>	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 <i>Dval</i> <i>Bval</i> <i>Cval</i>	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 <i>Tvalue</i>	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 <i>Txx.xx</i>	Cutting Device Off (Temporary Optional Time Delay from –1 to 99.99 seconds)
M09	Enable Marker 1
M10	Disable Marker 1

## Programmer's Reference

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 <i>T value</i>	Unclamp / Unlock "T" Station, where T = 1 through 19
M33	Unclamp / Lock All Stations
M34	Clamp / Unlock All Stations
M34 <i>T value</i>	Clamp / Unlock "T" Station, where T = 1 through 19
M35	Clamp / Unlock All Stations Mirror
M35 <i>T value</i>	Clamp / Unlock Mirror "T" Station, where T = 1 through 19
M36 <i>T value</i>	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

## Programmer's Reference

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

<b>EIA CODE</b>	<b>DESCRIPTION</b>	<b>MAPPED TO</b>
G04 <i>Fvalue</i>	Program Dwell	G04 <i>Xvalue</i>
G05	Set Axis Presets	G92
G21	Linear Interpolation	G01 (at cut speed)
G22	CW Circular Interpolation	G02
G23	CCW Circular Interpolation	G03
G41 <i>Kvalue</i>	Left Kerf with Value	G41 with Kerf Value
G42 <i>Kvalue</i>	Right Kerf with Value	G42 with Kerf Value
G97 <i>TValue</i>	Subroutine Loop	G08 <i>Xvalue</i> 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

## Programmer's Reference

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 <i>Qname</i>	Stop Current Program/ Load New Program
G201	Incremental Line In2
G202	Incremental CW Arc In2
G203	Incremental CCW Arc In2
G211	Incremental Line In3

## Programmer's Reference

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:

<i>Pvalue</i>	Program Number
<i>Dvalue</i>	Indexed Kerf Operations
<i>Vvalue</i>	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 ESS1 0 code).

#### **EIA Example:**

M00 – Pauses Program

(Comment) – Text to be displayed

## Programmer's Reference

## 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*<sup>®</sup> 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

## Programmer's Reference

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+ <i>value</i>	Machine Speed	<i>Fvalue</i>
40+ <i>value</i>	Programmable Kerf	G43 <i>Xvalue</i>
41	Preset Dwell	G04
41+ <i>value</i>	Program Dwell in mSec	G04 <i>Xvalue</i>
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

## Programmer's Reference

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+ <i>value</i>	Subroutine Loop	M40 X <i>value</i>
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

## Programmer's Reference

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

<b>CODE</b>	<b>DESCRIPTION</b>
G59 D1-200Xvalue	Sets kerf table variable from 1-200
G41 D1-200	Enables Left Kerf using a Kerf Table variable
G42 D1-200	Enables Right Kerf using a Kerf Table variable
G43 D1-200	Changes current kerf value via Kerf Table using previously set left or right kerf

## Tilt / Rotator Part Codes

<b>CODE</b>	<b>DESCRIPTION</b>
G00 Avalue	Sets tilt angle as a preparatory command – A is the angle value in degrees
G00 XYvalue Avalue	Performs Linear Interpolation of Tilt angle along line segment.
G00 Avalue Fvalue	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

## Programmer's Reference

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

<b>CODE</b>	<b>DESCRIPTION</b>
M32	Unclamp / Unlock All Stations
M33	Unclamp / Lock All Stations
M34	Clamp / Unlock All Stations
M34Tvalue	Clamp / Unlock 'T' Station, where T = 1 through 19
M35	Clamp / Unlock All Stations Mirror
M35Tvalue	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.

<b>CODE</b>	<b>DESCRIPTION</b>
M19 Tvalue	Cancel All Station Selections
M37 Tvalue	Select Station 1-20 (Tvalue)
M38 Tvalue	De-Select Station 1-20 (Tvalue)

Additionally, these Station Select program codes may 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 Tvalue

M36 = Misc. M Code

Tvalue = 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 or 2 (used only with the HD4070 power supply)	Other (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
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## 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.

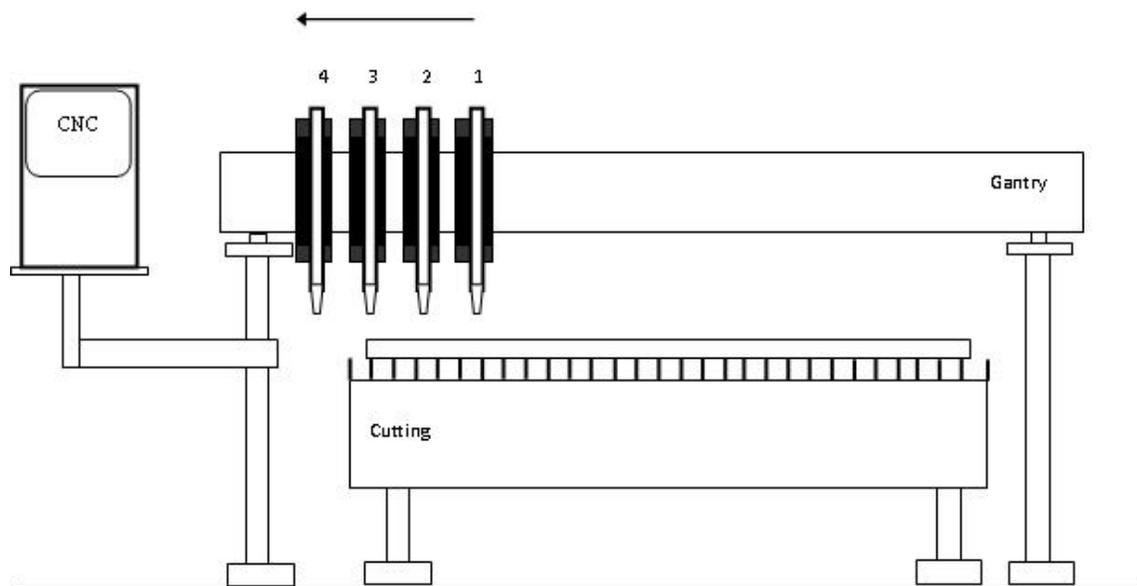
This feature must be enabled in Machine Setups. The Auto Torch Spacing Override feature in Cutting Setups must also be enabled.

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.

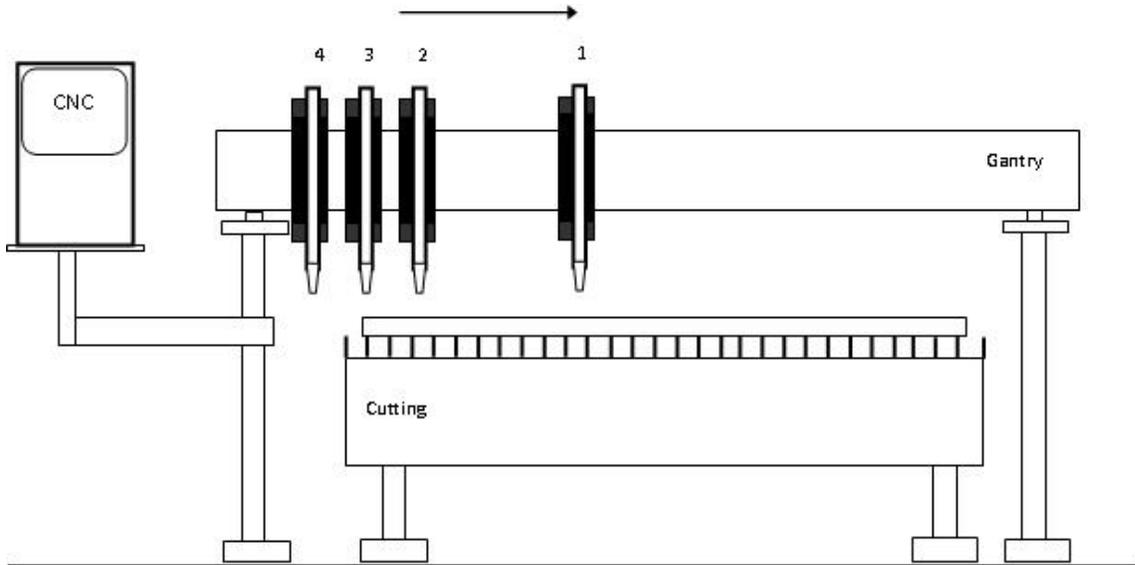
For the example, in the following illustration, Torch 1 is the primary station and Torch 2-4 are the secondary stations.

Typical use is as follows:

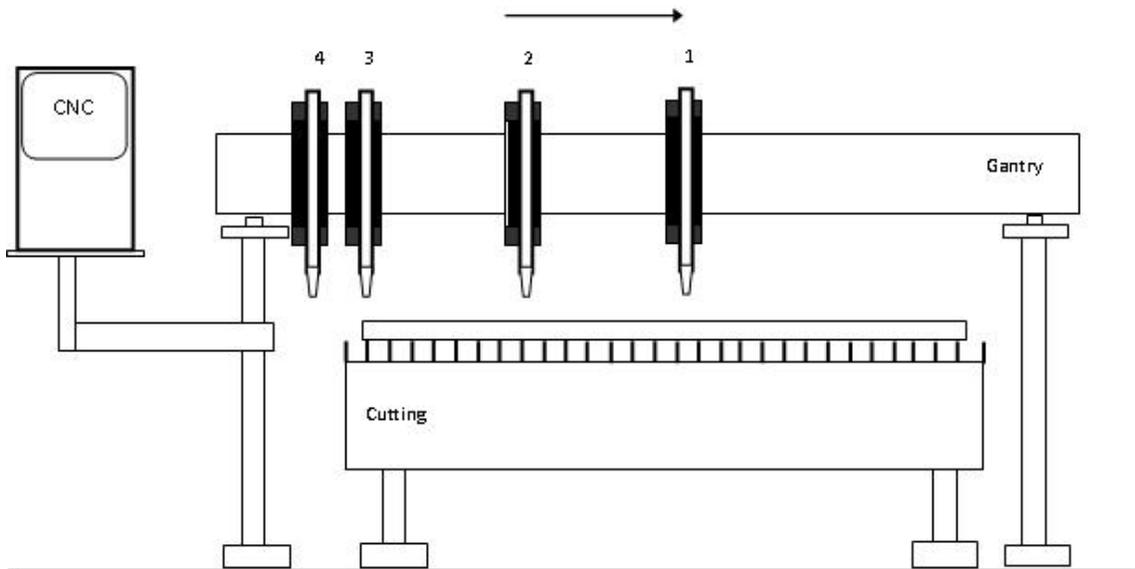
1. Unclamp and unlock all stations (except the first which is fixed and slides the others)
2. Go to Home Command on Transverse Axis (M77 or M78 depending on orientation)



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

<b>Code</b>	<b>Description</b>
M32	Unclamp / Unlock All Stations
M33	Unclamp / Lock All Stations
M34	Clamp / Unlock All Stations
M34Tvalue	Clamp / Unlock 'T' Station, where T = 1 through 19
M35	Clamp / Unlock All Stations Mirror
M35Tvalue	Clamp / Unlock Mirror "T" Station, where T = 1 through 19
M77	Go to Home position Y Axis
M78	Go to Home position X Axis
G00 Xn Yn	Traverse command where n = value to move the desired axes a distance.

## Automatic Torch Spacing I/O

Station Lock 1-19	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
Dvalue	Distance between two plate edge reference points
Bvalue	Rapid feed rate for distance (D) motion
Cvalue	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.

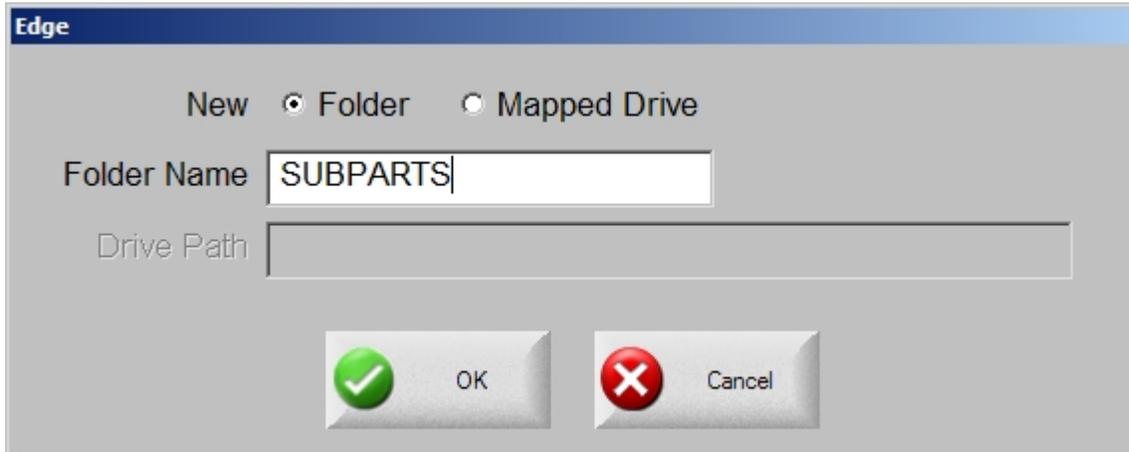
<b>Code</b>	<b>Description</b>
G70	English Units
G91	Incremental Mode
G99 X1 Y0 I0 J0	Axes Preset zero Scaling
M32	Unclamp / Unlock All Stations
M78	Home X Axis (move all stations to Home position)
M34	Clamp All / Unlock All
G00X2Y0	Traverse X axis 2 inches (to move off edge/ switch)
M33	Unclamp All / 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

## Programmer's Reference

# 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
```

## Programmer's Reference

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.

The screenshot displays a CNC control interface. On the left, a 'Preview Window' shows a green outline of a part with dimensions: 10.75 in width and 5.2 in height. The file name 'Lbracket.TXT' is visible. The interface includes a 'Following Error' section with 'Transverse' and 'Rail' both at 0.000 in, and 'Dual Gantry' and 'THC' also at 0.000 in. The 'Cut Mode' is set to 'Plasma' and 'Kerf' is 0 in. 'Plasma Speed' is 343 ipm. A 'Current Speed - ipm' gauge is shown with a needle pointing to 300. The bottom of the interface features a toolbar with buttons for 'Shape Manager', 'Files', 'Current Part Options', 'Setups', 'View Sheet', 'Change Cut Mode', 'Change Consumable', and 'Zero Positions'. There are also buttons for 'MultiTasking', 'CutPro Wizard', and 'Remote Help'.

**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.

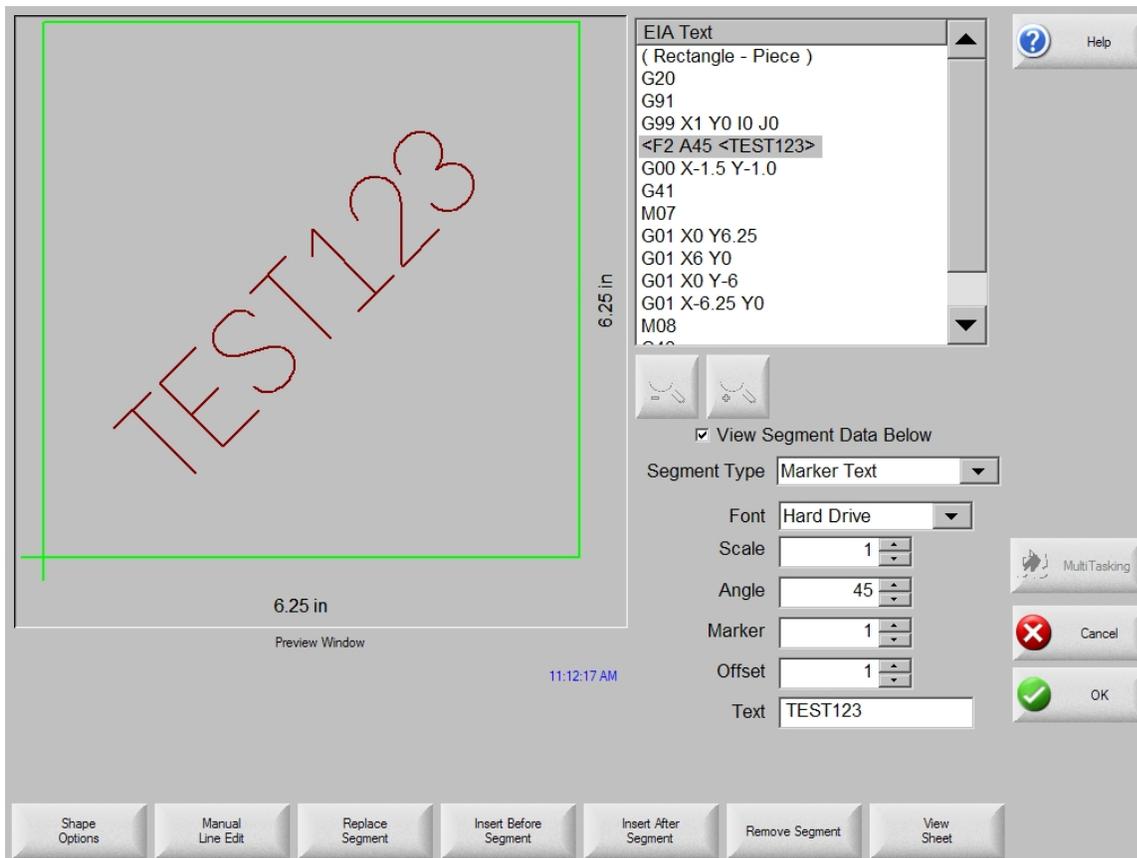
A     The third information block determines the angle of the text. The “A” is followed by a number that indicates the degree of angle. For the example given, the

## Programmer's Reference

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:

<b>Text</b>	<b>ASCII No.</b>	<b>File Name</b>
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.

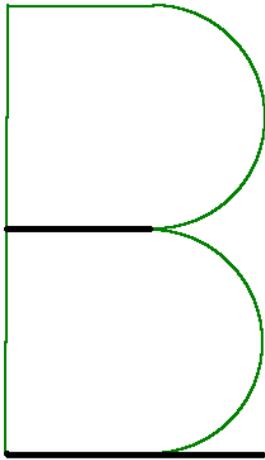
Font programs may be saved on the control hard drive by creating a folder labeled "Fonts" using the "Save to Disk" feature and saving the font programs within this folder. Remember, if a corresponding part file to text requested is not found at the selected source location, the internal font file will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

# Sensor THC Programming Support

The Sensor THC allows you to configure THC setup parameters through part program codes.

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

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

G59 V601 Fvalue

G59                    Any G Code

V6xx                  Variable Identity:

V600 = Plasma 1 Arc Voltage

V601 = Plasma 1 Pierce Time

V602 = Plasma 1 Pierce Height Factor

V603 = Plasma 1 Cut Height

V604 = Plasma 1 Transfer Height Factor

V605 = Plasma 1 Cut Height Delay

V606 = Plasma 1 Kerf Detect Reaquire Time

V625 = Plasma 2 Arc Voltage

V626 = Plasma 2 Pierce Time

V627 = Plasma 2 Pierce Height Factor

V628 = Plasma 2 Cut Height

V629 = Plasma 2 Transfer Height Factor

V630 = Plasma 2 Cut Height Delay

V631 = Plasma 2 Kerf Detect Reaquire Time

V650 = Marker 1 Arc Voltage

V651 = Marker 1 Start Time

V652 = Marker 1 Start Height Factor

V653 = Marker 1 Mark Height

V675 = Marker 2 Arc Voltage

V676 = Marker 2 Start Time

## Programmer's Reference

V677 = Marker 2 Start Height Factor

V678 = Marker 2 Mark Height

*Fvalue*

Variable Value

The selected value for the variable

## THC Index Code

G00 Zx.xx Tx      Index Sensor THC height "Z" distance for torch "T". Manual mode only.

# 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 three variables that can be set through the part program are Material Type, Current Setting and Material Thickness.

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

V5xx     The variable identity:

- V503 – Material Type Plasma 1
- V513 – Material Type Plasma 2
- V523 – Material Type Marker 1
- V533 – Material Type Marker 2
- V504 – Current Setting Plasma 1
- V514 – Current Setting Plasma 2
- V524 – Current Setting Marker 1
- V534 – Current Setting Marker 2
- V507 – Material Thickness Plasma 1
- V517 – Material Thickness Plasma 2
- V527 – Material Thickness Marker 1
- V537 – Material Thickness Marker 2

## Programmer's Reference

Fx 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 material thickness V507, V517, V527, V537:

EIA <i>Fnumber</i>	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

## Programmer's Reference

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

**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 a 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

Vxxx

The variable identity:

V503 – Material Type Plasma 1

V513 – Material Type Plasma 2

V523 – Material Type Marker 1

V533 – Material Type Marker 2

V504 – Current Setting Plasma 1

V514 – Current Setting Plasma 2

V524 – Current Setting Marker 1

V534 – Current Setting Marker 2

V507 – Material Thickness Plasma 1

V517 – Material Thickness Plasma 2

V527 – Material Thickness Marker 1

V537 – Material Thickness Marker 2

Fx

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:

8 = 8A            50 = 50A

9 = 9A            70 = 70A

10 = 10A        100 = 100A

30 = 30A        200 = 200A

For material thickness V507, V517, V527, V537:

EIA <i>Fnumber</i>	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

## Programmer's Reference

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

## Plasma Supply Programming Support

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



## 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.

## Programmer's Reference

Messaging 1 - Serial 2

Time Out  sec

Baud Rate  1200  2400  4800  9600  19200  38400  57600  115200

Flow Control  None  Xon/Xoff  Hardware

During Jog on Path  None  Forward Only  Forward and Backward

Parity  None  Odd  Even

Data Bits  7  8

Retry on Time Out  times

Cancel

OK

11:13:54 AM

Machine Speeds Ports I/O Sercos Axes

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

**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

>2x            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.

## Programmer's Reference

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

- >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 0D) and a Line Feed (<LF> = Hex Value 0A).
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.

## Programmer's Reference

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

## Serial Messaging

!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

## Programmer's Reference

## Importing Prepared DXF Files

The DXF Translator software allows the control to load and translate a DXF style drawing created in Autocad<sup>®</sup> or Autocad LT<sup>®</sup> into an EIA part program. Certain guidelines must be observed when creating the CAD drawing to allow the control 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°

## Programmer's Reference

L 170° to 190°

LD 180° to 225°

DL 225° to 270°

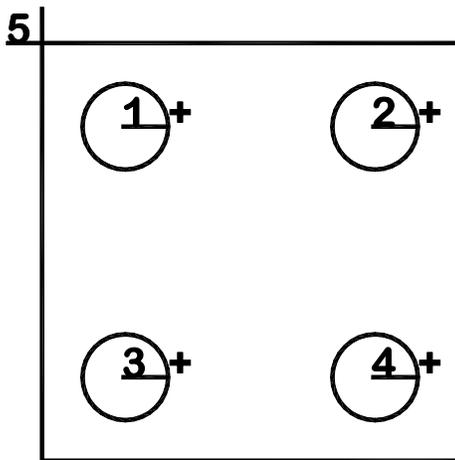
D 260° to 280°

DR 270° to 315°

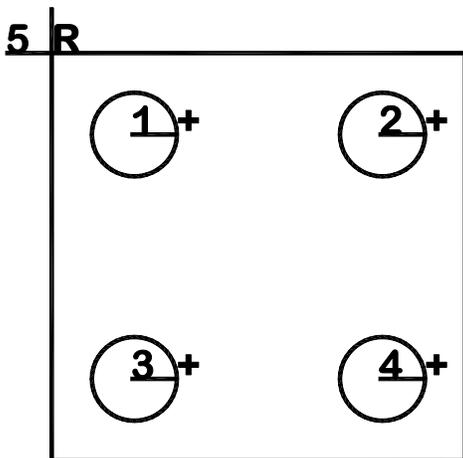
RD 315° to 360°

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.

## Programmer's Reference



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