HYPERTHERM®
A Hypertherm Associates Brand

EDGE® Connect

Programmer Reference

809550 – REVISION 6

ENGLISH

EDGE® Connect

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809550
REVISION 6

English
Original instructions

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For training and education resources, go to the Hypertherm Cutting Institute (HCI) online at www.hypertherm.com/hci.

Contents

1 EIA RS-274D Program Support

The EDGE® Connect CNC supports EIA RS-274D part programs. An EIA RS-274D program lists the codes that are used to create a part. The Phoenix software provides the Shape Wizard® graphical programming environment to help you edit your programs.

The following lists define the EIA codes that are directly supported or currently unsupported by the CNC. Mapped EIA codes are provided in the Appendix on page 92. Unsupported EIA codes are ignored. All other EIA codes generate an error.

When using XPR, see also *XPR Part Programs* on page 55.

Hypertherm recommends including a blank space between codes that appear on the same line in a part program (even though this is not required for some legacy codes).

Directly Supported EIA Codes

EIA code	Description
Fx	Machine Speed.
FAx	Time delay in milliseconds to smooth active bevel motion across non-tangent segments. The feature is supported with the ABXYZ or ACXYZ bevel head when the Follower is ON. This delay allows the C axis (imaginary or real) to lag behind by the defined FA-value to help prevent a large positional command at the intersection of non-tangent segments.
Nx	Line number.
(text)	Comments.
Xxx	X Axis Endpoint or other Data.
Yxx	Y Axis Endpoint or other Data.
Ixx	I Axis Integrand or Part Option Data.
Jxx	J Axis Integrand or Part Option Data.
Oxx Sxx	Output (1-64), State (0-Off or 1-On).
Wxx Sxx	Wait for Input (1-64), State (0-Off or 1-On).
G00 Xx Yx	Rapid traverse (linear interpolation).
G00 Ax	Sets Tilt angle – A is the angle value in degrees.
G01 XYxx Axx	Performs Linear Interpolation of Tilt angle along line segment.
G00 Xx Yx	Traverse command where x = 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.
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.
G00 Px Tx Sx Rx	Rotate Transverse 2 axis for square or rectangular tube positioning using program cutting speed. P = +/- 180 degrees T = Top measurement of tube S = Side measurement of tube R = Corner radius, +/- 90 degrees X or Y = Optional: Rail axis position
G01 Xx Yx	Linear interpolation (cut) at program cut speed.
G01 Ax Fx	Sets Tilt angle, A-axis position in degrees with a speed command (F) in RPM. F is required.
G01 Cx Fx	Sets Rotate angle, C-axis position in degrees with a speed command (F) in RPM. F is required.

EIA code	Description
G01 C180- Fx	Rotate Axis offset 180 degrees with speed command in RPM. F is required.
G00 Px Tx Sx Rx	Rotate Transverse 2 axis for square or rectangular tube positioning using program cutting speed. P = +/- 180 degrees T = Top measurement of tube S = Side measurement of tube R = Corner radius, +/- 90 degrees X or Y = Optional: Rail axis position
G01 Xx Yx	Linear interpolation (cut) at program cut speed.
G01 Ax Fx	Sets Tilt angle, A-axis position in degrees with a speed command (F) in RPM. F is required.
G01 Cx Fx	Sets Rotate angle, C-axis position in degrees with a speed command (F) in RPM. F is required.
G01 C180- Fx	Rotate Axis offset 180 degrees with speed command in RPM. F is required.
G01 C-180- Fx	Rotate Axis offset -180 degrees with speed command in RPM. F is required.
G01 Px Fx Tx Sx Rx	Rotate Transverse 2 axis for square or rectangular tube cutting with the ability to change the RPM (pipe rotational speed). P = +/- 180 degrees F = Rotational speed in RPM T = Top measurement of tube S = Side measurement of tube R = Corner radius, +/- 90 degrees X or Y = Optional: Rail axis position
G02 Xx Yx Ix Jx	Clockwise Circle or Arc. Xx Yx = Arc end point (If omitted, the default end point is the current position of the torch.) Ix Jx = Arc center point (radius value)
G03 Xx Yx Ix Jx	Counterclockwise Circle or Arc. Xx Yx = Arc end point (If omitted, the default end point is the current position of the torch.) Ix Jx = Arc center point (radius value)
G04	Preset Dwell (uses Setup Dwell Time).
G04 xx	Program Dwell in Seconds.
G08 X x	Repeat Subroutine X Times.F
G20	Select English Units (inches).

EIA code	Description
G21	Select Metric Units (mm).
G40	Disable Kerf Compensation.
G41	Enable Left Kerf Compensation.
G42	Enable Right Kerf Compensation.
G43 Xx	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 D1-200Xx	Sets Kerf table variable from 1200.
G59 Vxx Fxx	This command selects Hypertherm CNC cut chart parameters from within part programs. G59 commands can also override certain parameters in the Process screen. This use of the G59 code is unique to Hypertherm part programs that run on a Hypertherm CNC. See *G59 Process Variables* on page 30.  For XPR, see page 57.
G66 Dx Bx Cx	Auto Align 3 Point Method with Long Offset Distance, Fast Speed, Slow Speed values respectively.
G82	Oxyfuel Cut Mode.
G83	Oxyfuel 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.

EIA code	Description
G93 Xx.xxx	Bevel consumable correction. Adds or subtracts a value from the Bevel Pivot Length parameter used only with ABXYZ bevel heads. The Bevel Pivot Length baseline value uses 130 A O2/Air consumables for HPRXD and 170A O2/Air for XPR. When using a different consumable set, issue the G93 code at the beginning of the part program (after setting the part program units) to change the Bevel Pivot Length. **HPRXD example:** G93 X0.035 adds 0.035 inches (0.89 mm) to the Bevel Pivot Length to correct for HPR260XD consumables. 80 A O2/Air = 0.000 inches or mm 130 A O2/Air = 0.000 inches or mm 200 A O2/Air = 0.011 inches or 0.28 mm 260 A O2/Air = 0.035 inches or 0.89 mm 400 A O2/Air = -0.019 inches or -0.48 mm (The 400 A values are subtracted from the Bevel Pivot Length.) **XPR example:** G93 X0.030 adds 0.030 inches (0.76 mm) to the Bevel Pivot Length to correct for XPR130 A consumables. 80 A O2/Air = 0.058 inches or 1.47 mm 130 A O2/Air = 0.030 inches or 0.76 mm 170 A O2/Air = 0.000 inches or 0.00 mm 300 A O2/Air = -0.007 inches or -0.18 mm (The 300 A values are subtracted from the Bevel Pivot Length.)
G96 X xx or Y xx	G96 identifies the part program as a pipe program. Identify the Transverse 2 axis (X or Y). Phoenix then sets the rotational speed of a rotating Transverse 2 using the circumference of the pipe which it calculates from the diameter (xx).
G97	Program Repeat Pointer.
G97 Tx	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.

EIA code	Description
M07	Cut On.*
M07 HS	Forces an IHS for cutting, regardless of the distance between cuts or any previous M08 command.*
M08	Cut Off.*
M08 RF	Retracts to Full Retract height at the end of a cut.* Works only with Sensor THC.
M08 Tx.xx RT	Turns OFF Cut Control x.xx (seconds) before the end of the cut (-1.0 sec – 10.0 sec). Retracts to Transfer Height instead of the Retract Height.
M08 Txx.xx	Cut Off.* T = Temporary Optional Time Delay from –1 to 99.99 seconds
M09	Enable Marker 1.*
M09 HS	Forces an IHS for marking, regardless of the distance between marks or any previous M10 RT command.*
M10	Disable Marker 1.*
M10 RF	Retracts to Retract Height. Works only with Sensor THC.*
M10 RT	Retracts to the Transfer Height instead of the Retract Height at the end of a mark.
M11	Marker Offset 1 On.*
M12	Marker Offset 1 Off.*
M13	Enable Marker 2.*
M14	Disable Marker 2.*
M14 RF	Retracts to Retract Height. Works only with Sensor THC. (Not applicable for XPR.)
M17	Oxy Gas On.
M18	Oxy Gas Off.
M19	Cancel All Stations.
M26	Station Select On. (Not applicable for XPR.)
M27	Station Select Off. (Not applicable for XPR.)
M28	Follower Disabled / CBH rotator disable or disable automatic control of C axis.
M29	Follower Enable / CBH rotator disable/ enable automatic control of C axis.
M30	End of Program (same as M02).
M31	Reset Functions (Cut Off, Marker Off, Kerf Off).
M32	Unclamp / Unlock All Stations.
M32 Txx	Unclamp / Unlock T Station, where T = 1 through 19.
M33	Unclamp / Lock All Stations.

* For XPR, see page 55 – page 66.

EIA code	Description
M34	Clamp / Unlock All Stations.
M34 Txx	Clamp / Unlock T Station, where T = 1 through 19.
M35	Clamp / Unlock All Stations Mirror.
M35 Txx	Clamp / Unlock Mirror T Station, where T = 1 through 19.
M36 Tx	Process Select T where x selects the process 1 = Plasma 1 2 = Plasma 2 3 = Marker 1* 4 = Marker 2* 6 = Waterjet
M37 Txx (1-20)	Select Station T where T = 1 through 20.
M38 Txx (1-20)	Deselect Station T where T = 1 through 20.
M40	Start of Subroutine.
M40 x	Start of Subroutine. Executes the repeat X times.
M41	End of Subroutine.
M48	Speed Override Enable.
M49	Speed Override Disable.
M50	Disable torch height control.
M50 H-x.xx	For HPR and XPR, turns OFF Cut Control x.xx (seconds) before the end of current line segment. The torch does not start to decelerate until the line segment after the M50H.
M50N	Disables Height Control and temporarily turns OFF the Nozzle Contact Cutting feature in Phoenix.
M51 Txx.xx	Enable torch height control (Optional Time Delay in seconds before enable).
M52	Disable Sensor THC and raise torch (for oxyfuel parts only).
M53	Enable Sensor THC and lower torch (for oxyfuel parts only).
M63	User Defined 1 On.
M64	User Defined 1 Off.
M54	User Defined 2 On.
M55	User Defined 2 Off.

* For XPR, see page 55 – page 66.

EIA code	Description
M56	User Defined 3 On.
M57	User Defined 3 Off.
M58	User Defined 4 On.
M59	User Defined 4 Off.

* For XPR, see page 55 – page 66.

EIA code	Description
M65	End of Program for Auto Reload. Use only with Auto Reload.* Files called for Auto Reload must use these file naming guidelines: ▪ Numeric (such as 1234.txt) or alphanumeric (such as 1234ABC.txt) ▪ Numeric characters must precede alpha characters. **Example:** 123ABC.txt is supported, but ABC123.txt is *not* supported. ▪ The file extension must only contain letters. **Example:** .txt is supported, but .7z and .$$$ are *not* supported. ▪ In commands that call more than one file, include a number at the start of each file name to indicate the sequence in which the files must run. This will prevent the files from running in a random sequence. **Example:** **File Name – Run Sequence** 1Triangle.txt – Loads first because the file name begins with 1. 2Square.txt – Loads second because the file name begins with 2. 3Octagon.txt – Loads third because the file name begins with 3.
M72	Marker Offset 2 Off.*
M73	Marker Offset 2 On.*
M75	A Axis/Tilt Go to Home Position - Rapid Index.
M76	C Axis/Rotate Go to Home Position - Rapid Index.
M77	Go to Home position Y Axis.
M78	Go to Home position X Axis.
M79 Tx (1-4)	Go To Home Position (1-4).
M84	Disable Mirror Head 2.
M85	Enable Mirror Head 2.
M86	Unpark Head 1.
M87	Park Head 1.
M88	Unpark Head 2.

* For XPR, see page 55 – page 66.

EIA code	Description
M89	Park Head 2.
M90	Aligns CBH / Rotator to Tangent angle of next cut segment.
M90-	Aligns CBH / Rotator negative to tangent angle of next cut segment.
M91	Space Head 2. Includes a *spacingvalue* that is an absolute position on the specified axis.
M92	Space Head 1. Includes a *spacingvalue* that is an absolute position on the specified axis.
M93	Drill Cycle output.
M94	Peck Drill Cycle output.
M95	Tap Cycle output.
M96	Tool Change output.
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 Off.*
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.

* For XPR, see page 55 – page 66.

EIA code	Description
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.

* For XPR, see page 55 – page 66.

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.

Supported legacy codes

The legacy codes listed below are *not* recommended for use with EDGE Connect.

M15	Cut On.
M16	Cut Off.

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 Qname	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

EIA Code	Description
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:

- Pxx: Program number
- Dxx: Indexed Kerf operations
- Vxx: 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). For example:

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

2 ESSI Code Support

The EDGE® Connect 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.

When you open an ESSI part program, Phoenix converts it to EIA codes. This section shows the ESSI codes that Phoenix converts into EIA, and unsupported ESSI codes. Phoenix ignores unsupported ESSI codes. All other ESSI codes generate errors.

For the ESSI part program to convert and run, you must specify the ESSI termination code used by the part program.

1. Close Phoenix.
2. Open the file C:\Phoenix\Phoenix.ini file.
3. Save a copy of Phoenix.ini as a backup.
4. Locate the [Cutting] section of the file.
5. Change the value of the following line to specify the end of program code: ESSIProgramTermination=0.
6. Enter a value 0 – 5.

0 = 0 is the ESSI termination code	3 = 99
1 = 64	4 = /
2 = 63	5 = '=' (equal sign)

7. Before you save the file, change the Checksum line (the first line in Phoenix.ini) to Checksum=RESET (RESET must be all capital letters.)

8. Restart Phoenix.

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

ESSI Code	Description	Mapped to EIA
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

ESSI Code	Description	Mapped to EIA
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

ESSI Code	Description	Mapped to EIA
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

3 ASCII Codes

This section 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

Hex	Dec	Character	name	Description
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	Character	Hex	Dec	Character	Hex	Dec	Character
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	^

Hex	Dec	Character	Hex	Dec	Character	Hex	Dec	Character
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	12	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	|

Hex	Dec	Character	Hex	Dec	Character	Hex	Dec	Character
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			

4 G59 Process Variables

The EDGE® Connect provides cut charts for a variety of cutting processes: plasma, marker, and waterjet. An operator can select a cut chart manually on the CNC, or the part program can issue codes that select the cut chart automatically.

Computer aided manufacturing (CAM) software places process variables, called G59 codes, in the part program to select the cut chart for a process. Using the process variables in the part program automates cut chart selection on the CNC. This section lists the G59 code and its variables and values supported by Hypertherm CNCs.

This section does not apply to XPR part programs. See *XPR Part Programs* on page 55.

To use G59 codes in your part program, you must enable EIA G59 Code Override on the Cutting screen on the CNC.

G59 codes use the following format:

G59 Vxxx Fxx

Where:

- G59 = Load a variable
- Vxxx = The variable type
- Fxx = The variable value
- xx or xxx = the number of digits for the F value. When the F value has a decimal, the value is represented as xx.x

Example: G59 V507 F33

Where:

- V507 = Plasma 1 Material Thickness
- F33 = 0.5 inch

Variable Types

The G59 code supports several variable types:

- V5xx selects the process and makes selections within the cut chart.
- V6xx selects plasma process parameters.
- V825 and up selects waterjet process parameters.

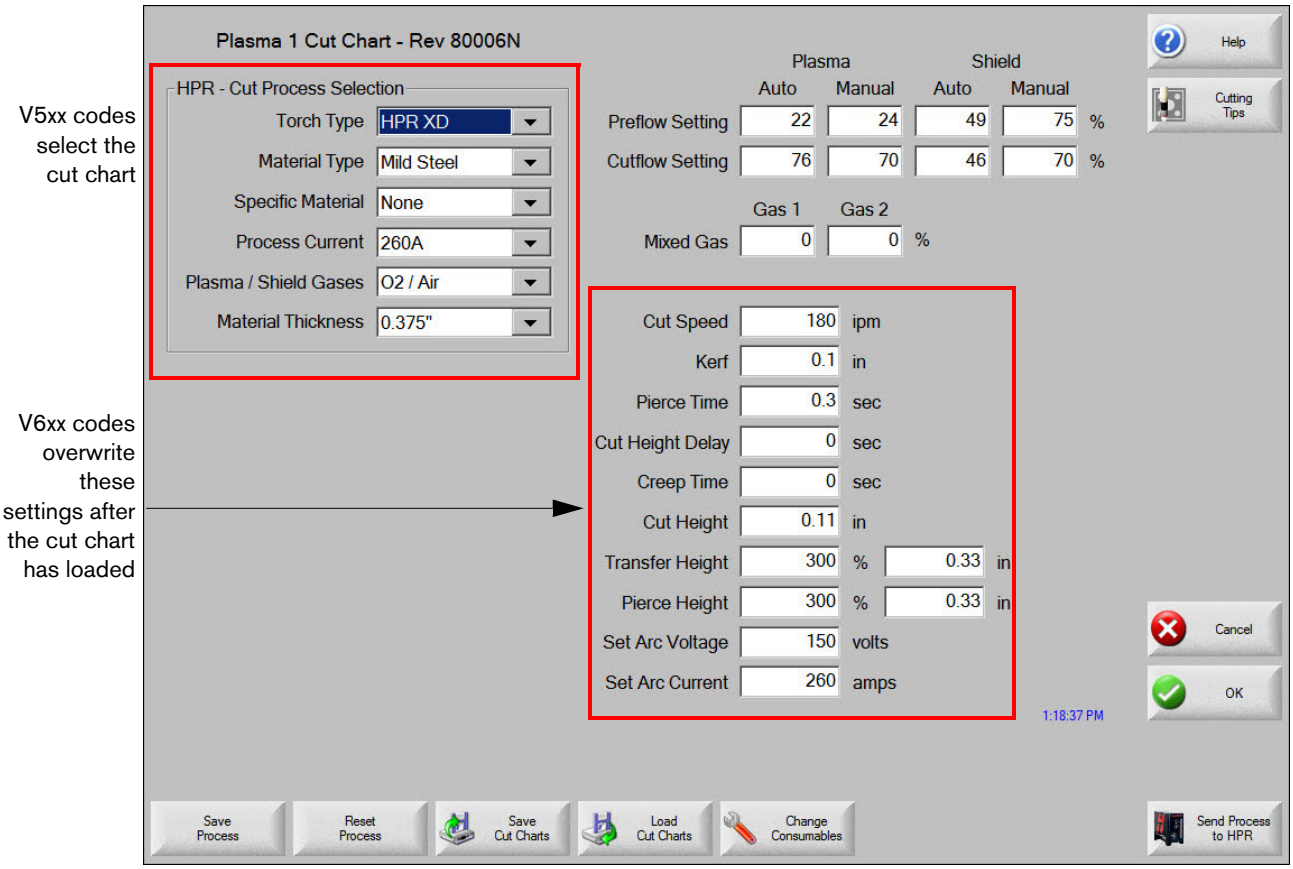
The value for each variable must be present in the cut chart on the CNC. For example, if the part program includes a G59 code with the material thickness variable with a value of ½ inch (G59 V507 F33) but the cut chart for that process does not include a material thickness of ½ inch, an “Invalid Process” error will display when the CNC loads the program. To clear the error, you must remove the unsupported code from the part program. For more information on resolving an “Invalid Process” or “Conflicting Process” errors, see the Conflicting process section of the EDGE Connect Installation and Setup Manual.

In addition, V5xx variables must be issued in the part program in the same order that they are listed in the cut chart:

1. Torch Type
2. Material Type
3. Specific Material (optional)
4. Process Current
5. Plasma/Shield Gases
6. Material Thickness

7. Cutting Surface

8. Water Muffler (for some older plasma supplies)



The V6xx variables override other parameters that are part of the cut chart, such as Arc Voltage, Cut Height, Pierce Time, and Marker Amperage. The V6xx variables (listed on page 49 – page 50) are not required when using process variables to select a cut chart; they are only needed when overriding the values in the cut chart. For example, to change the value of Set Arc Voltage in the Plasma 1 process from 120 VDC in the cut chart, to 125 VDC, issue a G59 V600 F125 code in the part program.

Part program format

Hypertherm CNCs require that the G59 codes be in specific positions in the part program. Each cut in the part starts with an M07 (Cut On) and ends with the M08 (Cut Off). The M07 and M08 turn on the Cut Control output which activates the cutting tool.

- The G41 (Enable Left Kerf Compensation) or G42 (Enable Right Kerf Compensation) must immediately precede the M07.
- A combination of G59 V5xx codes (listed on page 35) locate the cut chart and must precede the G41 or G42 code. Once the program selects the cut chart, the V5xx codes do not need to be re-issued unless the program requires a change in process (a new cut chart).
- V6xx and V8xx codes are needed only when overriding a cut chart value.

Sample part program

The order of the codes listed in the following table represent a typical part program.

Code	Description
G20	English units
G91	Incremental mode
G99 X1 Y0 I0 J0	Set part options
G59 V502 F34	Plasma 1 HPRXD torch
G59 V503 F1.00	Plasma 1 material type mild steel
G59 V504 F130	Plasma 1 current 130 A
G59 V505 F2	Plasma 1 plasma/shield gas O2/air
G59 V507 F33	Plasma 1 material thickness 1/2 inch
G59 V525 F27	Marker 1 plasma/shield gas air/air
G59 V658 F10	Override Marker 1 current, set to 10 A
M36 T3	Select Marker 1 process
M50	Disable torch height control
M09	Marker on
G03 X0 Y0 I0.5 J0	Counterclockwise arc
M10	Marker Off
M51	Enable torch height control
G00 X-0.75 Y-1.299	Rapid traverse
M36 T1	Select Plasma 1 process
G59 V600 F125	Override Plasma 1 arc voltage setting, set to 125 V
G41	Enable left kerf

Code	Description
M07	Cut on
G01 X0.176777 Y0.176777	Line
G02 X0 Y0 I1.06066 J1.06066	Clockwise arc
G01 X-0.1 Y0	Line
M08	Cut Off
G40	Disable kerf
M02	End program

V5xx Variables

The following table lists the V5xx variable types. The G59 codes that contain these variables must be entered in the part program in the order listed below (the same order as they appear in the cut chart). Each variable type has a set of Fx values. The following sections list the values for each variable type.

Variable	Plasma 1	Plasma 2	Marker 1	Marker 2	Waterjet	Oxyfuel
Torch Type	V502	V512	V522	V532		V561
Material Type	V503	V513	V523	V533	V553	V562
Process Current	V504	V514	V524	V534		
Plasma/Shield Gases	V505	V515	V525	V535		
Cutting Surface*	V506	V516	V526	V536		
Material Thickness	V507	V517	V527	V537	V557	V564
Water Muffler*	V508	V518	V528	V538		
Orifice Size					V554	
Nozzle Size					V556	
Cut Pressure (waterjet)					V558	
Fuel Gas						V563
Tip Type (Oxyfuel)						V566
Tip Size						V565

* Not required to select a cut chart.

Torch type

Add the torch type Fx values to the these variables:

V502 Plasma 1 torch type	V512 Plasma 2 torch type
V522 Marker 1 torch type	V532 Marker 2 torch type
V561 Oxyfuel torch type	

Examples:

- G59 V512 F34 – Plasma 2, HPRXD torch.
- G59 V561 F62 – Oxyfuel, Airco torch.

F1 = MAX200	F2 = SE200	F3 = HT4400
F4 = FineLine200	F5 = FineLine100	F6 = LH2100S
F7 = LH2100T	F8 = LH2125S	F9 = LH2125T
F10 = PAC186	F11 = T80M	F12 = MAX100
F13 = MAX100D	F14 = ArcWriter	F15 = PAC620
F16 = PAC123	F17 = PAC125	F18 = T60M
F19 = T100M	F20 = HySpeed	F21 = HPR
F22 = LH1510S	F23 = LH1510T	F24 = LH1575S
F25 = LH1575T	F26 = FineLine260	F27 = FineCut
F28 = Spirit275	F29 = HSD	F30 = Spirit400
F31 = HPR Bevel	F32 = TDC_XT300	F33 = TDC_XT301
F34 = HPRXD	F35 = HPRXD Bevel	F36 = T45M
F37 = HPRXD Thick Pierce	F38 = LF150	F39 = HyPro2000
F40 = TDC_XT300 Bevel	F42 = M45 (Powermax45)	F43 = M65 (Powermax65)
F44 = M85 (Powermax85)	F45 = HyPro2000 (Silver)	F46 = Duramax Retrofit Torch
F47 = Generic	F48 = Harris Model 80	F49 = Harris Model 98
F50 = Victor MT 200	F51 = Victor MT 300	F52 = M105 (Powermax105)
F53 = Low Speed FineCut	F54 = MAXPRO200	F55 = Duramax Hyamp
F56 = Dialine 281	F57 = Dialine 300	F58 = FineCut Hyamp
F59 = Koike 100L	F60 = Koike 200L	F61 = Koike 500L
F62 = Airco	F63 = IHT	F64 = Meco
F65 = Messer	F66 = Oxyweld	F67 = Smith
F68 = Duramax Lock	F69 = SmartSYNC	F70 = MAXPRO200 Bevel
F71 = Duramax/Duramax Lock Cartridge Adapter		

Material type

Add one of the following material type values to these variables

V503 Plasma 1 material type	V513 Plasma 2 material type
V523 Marker 1 material type	V533 Marker 2 material type
V553 Waterjet material type	V562 Oxyfuel

Material types (F*x*)

F1 = Mild Steel	F4 = Other
F2 = Stainless Steel	F5 = Brass
F3 = Aluminum	F6 = Copper

Specific material (F*x.xx*)

To select a specific cut chart process (such as True Hole®), add *.xx* to the Material Type F*x* code.

Example: G59 V503 F1.01 – Plasma 1, mild steel, specific custom process 1.

The table that follows gives examples of process codes that can be added to material types F1 – F6. CNC operators with supported plasma power supplies can also select these processes in the **Specific Material** menu on the Cut Chart screen in Phoenix.

Plasma power supply	Specific material	F*x.xx* code	Example
Powermax (all models)	Production	F*x*.90	G59 V503 F2.90 – Plasma 1, stainless steel, Powermax Production
Powermax (all models)	FineCut	F*x*.91	G59 V503 F1.91 – Plasma 1, mild steel, Powermax FineCut
Powermax (all models)	LS FineCut	F*x*.92	G59 V503 F1.92 – Plasma 1, mild steel, Powermax LS FineCut
Powermax 45XP	Dimpling	F*x*.94	G59 V523 F1.94 – Plasma 1, mild steel, Powermax45 XP Dimpling
Powermax 45XP	Light Mark	F*x*.95	G59 V523 F1.95 – Marker 1, mild steel, Powermax45 XP Light Mark
Powermax 45XP	Heavy Mark	F*x*.96	G59 V523 F2.96 – Marker 1, stainless steel, Powermax45 XP Heavy Mark
HPR	Fine Feature	F*x*.97	G59 V503 F1.97 – Plasma 1, mild steel, HPR Fine Feature
HPR	True Hole	F*x*.99	G59 V503 F1.99 – Plasma 1, mild steel, HPR True Hole

Plasma current

Add one of the following process current values to these variables:

V504 Plasma 1 current	V514 Plasma 2 current
V524 Marker 1 power current	V534 Marker 2 current

Example: G59 V514 F100 – Plasma 2, 100 A process current.

F5 = 5 A	F7 = 7 A	F8 = 8 A
F9 = 9 A	F10 = 10 A	F15 = 15 A
F18 = 18 A	F20 = 20 A	F22 = 22 A
F25 = 25 A	F30 = 30 A	F35 = 35 A
F40 = 40 A	F45 = 45 A	F50 = 50 A
F55 = 55 A	F60 = 60 A	F65 = 65 A
F70 = 70 A	F80 = 80 A	F85 = 85 A
F100 = 100 A	F105 = 105 A	F125 = 125 A
F130 = 130 A	F150 = 150 A	F200 = 200 A
F260 = 260 A	F275 = 275 A	F300 = 300 A
F340 = 340 A	F400 = 400 A	F500 = 500 A
F600 = 600 A	F760 = 760 A	F800 = 800 A
F1000 = 1000 A	F1500 = 1500 A	F2000 = 2000 A
F2500 = 2500 A	F3000 = 3000 A	F3500 = 3500 A
F4000 = 4000 A	F4500 = 4500 A	F5000 = 5000 A
F5500 = 5500 A	F6000 = 6000 A	

Plasma/shield gas

Add one of the following gas selection values to these variables:

V505 Plasma 1 plasma/shield gas	515 Plasma 2 plasma/shield gas
V525 Marker 1 plasma/shield gas	V535 Marker 2 plasma/shield gas

Example: G59 V505 F2 – Plasma 1, O2 plasma gas and air shield gas

F1 = Air/Air	F2 = O2/Air	F3 = O2/O2
F4 = N2/Air	F5 = N2/CO2	F6 = None/N2
F7 = O2/N2	F8 = CH4 / N2	F9 = H35/N2
F10 = H5/N2	F11 = Air/N2	F12 = N2/N2
F13 = CO2/N2	F14 = None/Air	F15 = CH4/Air
F16 = O2-N2/Air	F17 = O2-N2/O2	F18 = O2
F19 = N2	F20 = N2/None	F21 = Air
F22 = F5/N2	F23 = H35&N2/N2	F24 = H17/N2
F25 = Ar/Ar	F26 = Ar/N2	F27 = Ar/Air
F28 = F5	F29 = Argon	

Cutting surface

Add one of the following cutting surface values to these variables:

V506 Plasma 1 cutting surface	V516 Plasma 2 cutting surface
V526 Marker 1 cutting surface	V536 Marker 2 cutting surface

Example: G59 V536 F2 – Marker 2, cutting 3 inches below water.

- 1 = Above water
- 2 = 3 inches below water

Material Thickness

Add one of the following material thickness values to these variables:

V507 Plasma 1 material thickness	V517 Plasma 2 material thickness
V527 Marker 1 material thickness	V537 Marker 2 material thickness
V557 Waterjet material thickness	V564 Oxyfuel material thickness

Example: G59 V507 F14 – Plasma 1, 1 mm thick.

The following table shows material thickness values sorted by the metric (decimal) thickness. To look up a material thickness by the Fxx value, see the table beginning on page 52.

Metric (Decimal)	Gauge and Fraction	Fx
None	None	1
0.35 mm (0.015 in.)	28 GA	2 or 3
0.40 mm (0.016 in.)	27 GA	4 or 5
0.50 mm (0.018 in.)	26 GA	6 or 7
0.55 mm (Metric only)	25 GA	100
0.60 mm (0.024 in.)	24 GA	8 or 9
0.70 mm (Metric only)	23 GA	101
0.80 mm (0.030 in.)	22 GA	10 or 11
0.90 mm (0.036 in.)	20 GA	12 or 13
1 mm (0.040 in.)	19 GA	14
1.2 mm (0.048 in.)	18 GA	15 or 16
1.5 mm (0.060 in.)	16 GA	17 or 18
1.6 mm (0.063 in.)	1/16 in.	19
2 mm (0.075 in.)	14 GA	20 or 21
2.2 mm (0.090 in.)	13 GA	47
2.4 mm (Metric only)	3/32 in.	22
2.5 mm (0.105 in.)	12 GA	23 or 24
3 mm (0.120 in.)	11 GA	48
3.2 mm (0.125 in.)	1/8 in.	25
3.5 mm (0.135 in.)	10 GA	26 or 27
3.8 mm (0.150 in.)	9 GA	49

Metric (Decimal)	Gauge and Fraction	Fx
4 mm (0.164 in.)	8 GA	52
4.5 mm (0.180 in.)	7 GA	50
4.8 mm (0.188 in.)	3/16 in.	28
5 mm (0.194 in.)	6 GA	53
5.5 mm (0.210 in.)	5 GA	51
6 mm (0.25 in.)	1/4 in.	29
7 mm (Metric only)	9/32 in.	102
8 mm (0.313 in.)	5/16 in.	30
9 mm (Metric only)	11/32 in.	92
10 mm (0.375 in.)	3/8 in.	31
11 mm (0.438 in.)	7/16 in.	32
12 mm (0.5 in.)	1/2 in.	33
13 mm (Metric only)	17/32 in.	103
14 mm (0.563 in.)	9/16 in.	34
15 mm (Metric only)	19/32 in.	93
16 mm (0.625 in.)	5/8 in.	35
17 mm (Metric only)	11/16 in.	104
18 mm (Metric only)	23/32 in.	105
19 mm (0.75 in.)	3/4 in.	36
20 mm (Metric only)	25/32 in.	106
21 mm (Metric only)	13/16 in.	107
22 mm (0.875 in.)	7/8 in.	37
23 mm (Metric only)	29/32 in.	98
24 mm (Metric only)	15/16 in.	108
25 mm (1 in.)	1 in.	38
26 mm (Metric only)	1-1/32 in.	109
27 mm (Metric only)	1-1/16 in.	110
28 mm (Metric only)	1-3/32 in.	94
29 mm (1.125 in.)	1-1/8 in.	39
30 mm (Metric only)	1-3/16 in.	111
31 mm (Metric only)	1-7/32 in.	112
32 mm (1.25 in.)	1-1/4 in.	40

Metric (Decimal)	Gauge and Fraction	Fx
33 mm (Metric only)	1-5/16 in.	113
34 mm (Metric only)	1-11/32 in.	114
35 mm (Metric only)	1-3/8 in.	41
36 mm (Metric only)	1-7/16 in.	99
37 mm (Metric only)	1-15/32 in.	115
38 mm (1.5 in.)	1-1/2 in.	42
40 mm (Metric only)	1-5/8 in.	54
44 mm (Metric only)	1-23/32 in.	95
45 mm (1.75 in.)	1-3/4 in.	43
48 mm (Metric only)	1-7/8 in.	55
50 mm (2 in.)	2 in.	44
55 mm (Metric only)	2-1/8 in.	56
58 mm (Metric only)	2-9/32 in.	96
60 mm (2.25 in.)	2-1/4 in.	45
64 mm (2.5 in.)	2-1/2 in.	46
65 mm (Metric only)	2-9/16 in.	97
70 mm (2.75 in.)	2-3/4 in.	57
75 mm (3 in.)	3 in.	58
80 mm (Metric only)	3-1/8 in.	59
85 mm (3.25 in.)	3-1/4 in.	60
90 mm (3.5 in.)	3-1/2 in.	61
95 mm (3.75 in.)	3-3/4 in.	62
100 mm (4 in.)	4 in.	63
105 mm (Metric only)	4-1/8 in.	64
110 mm (4.25 in.)	4-1/4 in.	65
115 mm (4.5 in.)	4-1/2 in.	66
120 mm (4.75 in.)	4-3/4 in.	67
125 mm (5 in.)	5 in.	68
130 mm (Metric only)	5-1/8 in.	69
135 mm (5.25 in.)	5-1/4 in.	70
140 mm (5.5 in.)	5-1/2 in.	71
145 mm (5.75 in.)	5-3/4 in.	72

Metric (Decimal)	Gauge and Fraction	Fx
150 mm (6 in.)	6 in.	73
155 mm (Metric only)	6-1/8 in.	74
160 mm (6.25 in.)	6-1/4 in.	75
165 mm (6.5 in.)	6-1/2 in.	76
170.0 mm (6.75 in.)	6-3/4 in.	77
180 mm (Metric only)	7-1/8 in.	79
185 mm (7.25 in.)	7-1/4 in.	80
190.0 mm (7.5 in.)	7-1/2 in.	81
195 mm (7.75 in.)	7-3/4 in.	82
200 mm (8 in.)	8 in.	83
215 mm (8.5 in.)	8-1/2 in.	84
230 mm (9 in.)	9-in.	85
240 mm (9.5 in.)	9-1/2 in.	86
255 mm (10 in.)	10 in.	87
265 mm (10.5 in.)	10-1/2 in.	88
280 mm (11 in.)	11 in.	89
290 mm (11.5 in.)	11-1/2 in.	90
305 mm (12 in.)	12 in.	91
7 in. (English only)	7 in.	78

The following table shows material thicknesses by Fx value.

Fx	Metric (Decimal)	Gauge and Fraction
1	None	None
2 or 3	0.35 mm (0.015 in.)	28 GA
4 or 5	0.40 mm (0.016 in.)	27 GA
6 or 7	0.50 mm (0.018 in.)	26 GA
8 or 9	0.60 mm (0.024 in.)	24 GA
10 or 11	0.80 mm (0.030 in.)	22 GA
12 or 13	0.90 mm (0.036 in.)	20 GA
14	1 mm (0.040 in.)	19 GA
15 or 16	1.2 mm (0.048 in.)	18 GA
17 or 18	1.5 mm (0.060 in.)	16 GA

Fx	Metric (Decimal)	Gauge and Fraction
19	1.6 mm (0.063 in.)	1/16 in.
20 or 21	2 mm (0.075 in.)	14 GA
22	2.4 mm (Metric only)	3/32 in.
23 or 24	2.5 mm (0.105 in.)	12 GA
25	3.2 mm (0.125 in.)	1/8 in.
26 or 27	3.5 mm (0.135 in.)	10 GA
28	4.8 mm (0.188 in.)	3/16 in.
29	6 mm (0.25 in.)	1/4 in.
30	8 mm (0.313 in.)	5/16 in.
31	10 mm (0.375 in.)	3/8 in.
32	11 mm (0.438 in.)	7/16 in.
33	12 mm (0.5 in.)	1/2 in.
34	14 mm (0.563 in.)	9/16 in.
35	16 mm (0.625 in.)	5/8 in.
36	19 mm (0.75 in.)	3/4 in.
37	22 mm (0.875 in.)	7/8 in.
38	25 mm (1 in.)	1 in.
39	29 mm (1.125 in.)	1-1/8 in.
40	32 mm (1.25 in.)	1-1/4 in.
41	35 mm (Metric only)	1-3/8 in.
42	38 mm (1.5 in.)	1-1/2 in.
43	45 mm (1.75 in.)	1-3/4 in.
44	50 mm (2 in.)	2 in.
45	60 mm (2.25 in.)	2-1/4 in.
46	64 mm (2.5 in.)	2-1/2 in.
47	2.2 mm (0.090 in.)	13 GA
48	3 mm (0.120 in.)	11 GA
49	3.8 mm (0.150 in.)	9 GA
50	4.5 mm (0.180 in.)	7 GA
51	5.5 mm (0.210 in.)	5 GA
52	4 mm (0.164 in.)	8 GA
53	5 mm (0.194 in.)	6 GA

Fx	Metric (Decimal)	Gauge and Fraction
54	40 mm (Metric only)	1-5/8 in.
55	48 mm (Metric only)	1-7/8 in.
56	55 mm (Metric only)	2-1/8 in.
57	70 mm (2.75 in.)	2-3/4 in.
58	75 mm (3 in.)	3 in.
59	80 mm (Metric only)	3-1/8 in.
60	85 mm (3.25 in.)	3-1/4 in.
61	90 mm (3.5 in.)	3-1/2 in.
62	95 mm (3.75 in.)	3-3/4 in.
63	100 mm (4 in.)	4 in.
64	105 mm (Metric only)	4-1/8 in.
65	110 mm (4.25 in.)	4-1/4 in.
66	115 mm (4.5 in.)	4-1/2 in.
67	120 mm (4.75 in.)	4-3/4 in.
68	125 mm (5 in.)	5 in.
69	130 mm (Metric only)	5-1/8 in.
70	135 mm (5.25 in.)	5-1/4 in.
71	140 mm (5.5 in.)	5-1/2 in.
72	145 mm (5.75 in.)	5-3/4 in.
73	150 mm (6 in.)	6 in.
74	155 mm (Metric only)	6-1/8 in.
75	160 mm (6.25 in.)	6-1/4 in.
76	165 mm (6.5 in.)	6-1/2 in.
77	170.0 mm (6.75 in.)	6-3/4 in.
78	7 in. (English only)	7 in.
79	180 mm (Metric only)	7-1/8 in.
80	185 mm (7.25 in.)	7-1/4 in.
81	190.0 mm (7.5 in.)	7-1/2 in.
82	195 mm (7.75 in.)	7-3/4 in.
83	200 mm (8 in.)	8 in.
84	215 mm (8.5 in.)	8-1/2 in.
85	230 mm (9 in.)	9-in.

Fx	Metric (Decimal)	Gauge and Fraction
86	240 mm (9.5 in.)	9-1/2 in.
87	255 mm (10 in.)	10 in.
88	265 mm (10.5 in.)	10-1/2 in.
89	280 mm (11 in.)	11 in.
90	290 mm (11.5 in.)	11-1/2 in.
91	305 mm (12 in.)	12 in.
92	9 mm (Metric only)	11/32 in.
93	15 mm (Metric only)	19/32 in.
94	28 mm (Metric only)	1-3/32 in.
95	44 mm (Metric only)	1-23/32 in.
96	58 mm (Metric only)	2-9/32 in.
97	65 mm (Metric only)	2-9/16 in.
98	23 mm (Metric only)	29/32 in.
99	36 mm (Metric only)	1-7/16 in.
100	0.55 mm (Metric only)	25 GA
101	0.70 mm (Metric only)	23 GA
102	7 mm (Metric only)	9/32 in.
103	13 mm (Metric only)	17/32 in.
104	17 mm (Metric only)	11/16 in.
105	18 mm (Metric only)	23/32 in.
106	20 mm (Metric only)	25/32 in.
107	21 mm (Metric only)	13/16 in.
108	24 mm (Metric only)	15/16 in.
109	26 mm (Metric only)	1-1/32 in.
110	27 mm (Metric only)	1-1/16 in.
111	30 mm (Metric only)	1-3/16 in.
112	31 mm (Metric only)	1-7/32 in.
113	33 mm (Metric only)	1-5/16 in.
114	34 mm (Metric only)	1-11/32 in.
115	37 mm (Metric only)	1-15/32 in.

Water Muffler

Add one of the following water muffler values to these variables:

V508 Plasma 1 water muffler	V518 Plasma 2 water muffler
V528 Marker 1 water muffler	V538 Marker 2 water muffler

Example: G59 V508 F1 – Plasma 1, water muffler installed.

- F1 = Installed
- F2 = Not installed

Waterjet nozzle size

Add one of the following orifice size values to the variable V556.

Example: G59 V556 F30 – Waterjet, 0.03 inch nozzle

F30 = 0.03 in.	F40 = 0.04 in.

Waterjet orifice size

Add one of the following orifice size values to the variable V554.

Example: G59 V554 F10 – Waterjet, 0.010 inch orifice.

F10 = 0.010 inch	F11 = 0.011 inch	F12 = 0.012 inch
F14 = 0.014 inch	F16 = 0.016 inch	

Waterjet cut pressure

For waterjet cut pressure add F60000 to the variable V558.

Example: G59 V558 F60000 – Waterjet, cut pressure 60000 psi

Fuel gas for Oxyfuel

Add one of the following torch type values to the variable V563.

Example: G59 V512 F2 – Oxyfuel, Propane fuel

F1 = Acetylene	F2 = Propane	F3 = Natural Gas
F4 = Propylene	F5 = Mapp	

Oxyfuel tip type

Add one of the following torch type values to the variable V566.

Example: G59 V566 F1 – Oxyfuel, Standard tip type.

F1 = Standard
F2 = Divergent
F3 = Heavy Preheat
F4 = Divergent Heavy Preheat

Oxyfuel tip size

Add one of the following torch type values to the variable V565.

Example: G59 V565 F3 – Oxyfuel, 4/0 tip size.

F1 = 5/0	F2 = 5/0 ½	F3 = 4/0
F4 = 4/0 ½	F5 = 000	F6 = 000 ½
F7 = 00	F8 = 00 ½	F9 = 0
F10 = 0 ½	F11 = 1	F12 = 1 ½
F13 = 2	F14 = 2 ½	F15 = 3
F16 = 3 ½	F17 = 4	F18 = 4 ½
F19 = 5	F20 = 5 ½	F21 = 6
F22 = 6 ½	F23 = 7	F24 = 7 ½
F25 = 8	F26 = 8 ½	F27 = 9
F28 = 9 ½	F29 = 10	F30 = 10 ½
F31 = 11	F32 = 11 ½	F33 = 12

V6xx plasma height control variables

Use the following G59 V6xx variables to select process parameters that govern torch height control.

Plasma 1 Variables

Variable	Name	Range for Fx	Example
V600	Plasma 1 Set Arc Voltage	10 to 300 volts	F132
V601	Plasma 1 Pierce Time	0 to 9 seconds	F0.5
V602	Plasma 1 Pierce Height Factor	50 to 400%	F200
V603	Plasma 1 Cut Height	0 to 1 in. (0 to 25.4 mm)	F0.13 (inch)
V604	Plasma 1 Transfer Height Factor	50 to 400%	F200
V605	Plasma 1 Cut Height Delay	0 to 5 seconds	F2.00
V606	Plasma 1 Kerf Detect Reacquire Time (Sensor THC only)	0 to 10 seconds	F3.00
V607	Plasma 1 Mode Select	F1 = Manual F2 = Auto	F2
V608	Plasma 1 Arc Current	Amperage depends on plasma system	
V613	Plasma 1 AVC Delay	0 to 10 seconds	F2.25

Plasma 2 Variables

Variable	Name	Range for Fx	Example
V625	Plasma 2 Set Arc Voltage	10 to 300 volts	F250.00
V626	Plasma 2 Pierce Time	0 to 9 seconds	F8.50
V627	Plasma 2 Pierce Height Factor	50 to 400%	F200.00
V628	Plasma 2 Cut Height	0 to 1 in. (0 to 25.4 mm)	F0.75
V629	Plasma 2 Transfer Height Factor	50 to 400%	F200.50
V630	Plasma 2 Cut Height Delay	0 to 5 seconds	F2.00

Variable	Name	Range for Fx	Example
V631	Plasma 2 Kerf Detect Reacquire Time (Sensor THC only)	0 to 10 seconds	F5.25
V632	Plasma 2 Mode Select	F1 = Manual F2 = Auto	F2
V633	Plasma 2 Arc Current	Amperage depends on plasma system	
V638	Plasma 2 AVC Delay	0 to 10 seconds	F2.25

Marker 1 Variables

Variable	Name	Range for Fx	Example
V650	Marker 1 Set Arc Voltage	10 to 300 volts	F250.00
V652	Marker 1 Start Height Factor	50 to 400%	F200.00
V653	Marker 1 Mark Height	0 to 1 in. (0 to 25.4mm)	F0.75
V657	Marker 1 Mode Select	F1 = Manual F2 = Auto	F2
V658	Marker 1 Arc Current	Amperage depends on plasma system	
V663	Marker 1 AVC Delay	0 to 10 seconds	F2.25

Marker 2 Variables

Variable	Name	Range for Fx	Example
V675	Marker 2 Set Arc Voltage	10 to 300 volts	F250.00
V677	Marker 2 Start Height Factor	50 to 400%	F200.00
V678	Marker 2 Mark Height	0 to 1 in. (0 to 25.4 mm)	F0.75
V682	Marker 2 Mode Select	F1 = Manual F2 = Auto	F2
V683	Marker 2 Arc Current	Amperage depends on plasma system	
V688	Marker 2 AVC Delay	0 to 10 seconds	F2.25

THC Index Code

Use this command to raise the Sensor THC when it is in manual mode.

G00 Zx.xx Tx

- Index Sensor THC, to height Z distance for torch T number, in manual mode only.

Sample part program using THC index code

The following sample part program includes commands to change control modes and to raise the Plasma 1 THC height in a corner by 0.25 inches:

Code	Description
G59 V600 F155	Program arc voltage for first segment
G41	Enable left kerf compensation
M07	Cut on
G01 X0 Y3	Linear move
G59 V607 F1	Set plasma process 1 THC to manual mode
G00 Z-.25 T1	Raise THC 1 by 0.25 inches. (A negative value raises the THC when the positive Z-axis direction is down.)
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	Linear move
M08	Cut off
G40	Disable kerf compensation
M02	End of program

V8xx waterjet variables

Use V8xx variables to select process parameters for Hypertherm's HyPrecision™ waterjet systems.

V825	Pierce Type	G59 V825 Fx Dx.x Tx.x Sx.x F1 = Dynamic F2 = Circular F3 = Wiggle F4 = Stationary Dx.xxx = Displacement, 0.254 – 25.4 mm (0.001 – 1.0 inch) ■ Circle diameter for Circular pierce ■ Segment length for Wiggle pierce Tx.x = Pierce time in seconds, 0 – 9999.99 Sxxx = Pierce speed 2.54 – 2540 mm/min (0.1 – 100 in/min)	G59 V825 F2 D0.1 T10 S10 Select Circular Pierce Type with a circle diameter of 0.1 inch for 10 seconds at 10 in/min.
V827	Low Pressure Pierce	G59 V827 Fx Tx.x Pxxxx F0 = OFF F1 = ON F2 = Maintain until next G59 V827, or a new cut chart is selected, or a new part program is loaded. Tx.x = Low pressure pierce time in seconds 0 - 9999.99 Pxxxxx = Pump pressure 10,000 psi to the cut pressure. ▪ All other G59 variables in the part program must come before G59 V827 F2 and the G04. ▪ Use G04 Xx Dwell for x seconds to allow the waterjet pump to transition to low pressure setting. ▪ Low pressure pierce time cannot exceed the time set for normal piercing. ▪ Low pressure cannot be set below 10,000 psi.	G59 V827 F1 T5 P30000 Low pressure pierce ON for 5 seconds at 30000 psi.

Variable	Name	Range for Fx	Example
V828	Cut Pressure	G59 V828 Fxxxxxx Fxxxxxx = pump pressure in psi ▪ At this time 60000 is the only valid cut pressure.	G59 V828 F60000 Cut pressure set to 60000 psi
V829	Pierce Motion Delay	G59 V829 Fx.x Fx.x = 0 - 9.99 seconds	G59 V829 F3 Delay pierce motion for 3 seconds after M07 Cut On.
V830	Abrasive On Delay	G59 V830 Fx.x or F-x.x Fx.x = -1.0 – 5.0 seconds	G59 V830 F3 Delay starting the abrasive flow for 3 seconds after M07 Cut On. G59 V830 F-1 Start the abrasive flow 1 second *before* the M07 Cut On.

Variable	Name	Range for Fx	Example
V831	Abrasive Off Delay	G59 V831 Fx.x or F-x.x Fx.x = -1 - 9.99 seconds ■ Abrasive Off Delay and Water Off Delay run concurrently.	G59 V831 F3 Delay turning off the abrasive flow for 3 seconds after M08 Cut Off. G59 V831 F-1 Turn off the abrasive flow 1 second *before* the M08 Cut Off.
V832	Water Off Delay	G59 V832 Fx.x or F-x.x Fx.x = - 1 – 9.99 seconds ■ Abrasive Off Delay and Water Off Delay run concurrently.	G59 V832 F3 Delay turning off the water flow for 3 seconds after M08 Cut Off. G59 V832 F-1 Turn off the water flow 1 second *before* the M08 Cut Off.
V837	Cut Height	G59 V837 Fx.x Fx.x = 0.254 - 25.4 mm (0.01 - 1.0 inch)	G59 V837 F0.3 Set Cut Height to 0.3 inch.
V838	Waterjet Mode	G59 V838 Fx Fx = F1 – Q1 Rough F2 – Q2 Coarse F3 – Q3 Medium F4 – Q4 Smooth F5 – Q5 Fine F6 – Q6 Marking - No abrasive	G59 V838 F3 Set Waterjet Mode to Q3 Medium.

5 XPR Part Programs

XPR program codes differ in the following two scenarios:

- Basic cutting and marking (without CAM part programs or G59 codes). See *Basic cutting and marking* below.
- Cutting and marking with a part program outputted from computer aided manufacturing (CAM) software, such as ProNest. See page 57.

Basic cutting and marking

Basic cutting and marking refers to each of the following scenarios:

- Cut or mark *without* a part program created with CAM software.
- Select a simple shape from the Shape Library, but cancel processing it through ProNest CNC.
- Use a part program generated in CAM software, but DISABLE the following overrides on the *Setups > Cutting* screen in Phoenix: EIA G59 Code, Process Select, EIA Kerf, and EIA F-Code Program Code.

If you are using a ProNest part program that includes marking, but you disabled the use of G59 codes, selections on the Cut Chart screen in Phoenix override selections in the part program. In this scenario, for example, Phoenix interprets the M07 AR or M07 N2 in a ProNest part program as an M09 (Marker 1 On) and uses the marking gas selected on the Cut Chart screen.

Basic process selection and overrides

With basic cutting and marking, you do not need to provide any codes to select or override process parameters. Instead, you can:

- Select the process on the Cut Chart screen.

  Select parameters at the top of the Cut Chart screen first. Based on your selection in the top field, Phoenix limits the parameters available to select in the fields below.

- Override process parameters (by editing the values on the Process screen, Cutting screen, or Process Data Watch Window).

  Process override selections cannot be saved for reuse when doing basic cutting and marking. When the CNC reloads a cut chart, the original cut chart values are restored and previously used overrides are lost.

The *Record ID* number on the Cut Chart screen refers to the record in the XPR cut chart database for your selected process. The *Process ID* is a number that represents the XPR process for cutting or marking. The Record ID and Process ID numbers cannot be edited directly. The marking process used is selected on the Plasma 1 Cut Chart screen for XPR marking.

Basic code view

To view the part program code when doing basic cutting or marking, use the Text Editor or EIA Text view in Phoenix (**Shape Manager > Shape Wizard** or **Shape Manager > Text Editor**).

Code definitions and exceptions

Part program codes for basic cutting and marking with XPR are included in *EIA RS-274D Program Support* on page 8.

Marking with a basic part program uses legacy marking codes as follows:

- M09 / M10 (Enable Marker 1 / Disable Marker 1)
- M13 / M14 (Enable Marker 2 / Disable Marker 2)
- M36 T3 / M36 T4 (Select Marker 1 / Select Marker 2)

For text marking information, see *Marker Font Generator* on page 82.

True Hole is not supported with basic cutting.

CAM software part programs for XPR

XPR part programs output from ProNest (or other CAM software) support many codes in the list of *Directly Supported EIA Codes* on page 9. However, there are some exceptions and additional codes specific to XPR as explained in this section.

If you have a part program that was created for an HPRXD, Hypertherm strongly recommends that you create a new part program for XPR. For more information, see Appendix A in *Cut and Mark with an XPR on an EDGE Connect CNC* (809900).

Process selection

With XPR, one G59 command at the beginning of the CAM posted part program assigns the XPR to Plasma 1 or 2 and tells the CNC which record in the XPR cut chart database to use. The single cut chart record contains all of the process parameters for cutting, marking, and True Hole (*when applicable*).

The standard format of a G59 command line in an XPR part program output from CAM software is as follows:

G59 V509 Fxxxxx

Where:

- G59 = Load a variable
- V509 = Load Plasma 1*
- Fxxxxx = Cut chart record ID

* If the XPR is assigned to Plasma 2, replace V509 with V519: G59 V5**19** Fxxxxx

Example: G59 V509 F11189 = Load Plasma 1 and use record 11189 (80 A O2/Air) in the cut chart database

When the CNC reads the M07 (Cut On) command in the part program, the CNC sends the process ID from record number 11189 to the XPR. The XPR and the CNC load the associated cutting process parameters (listed below).

Cut chart process parameters loaded from the cut chart record

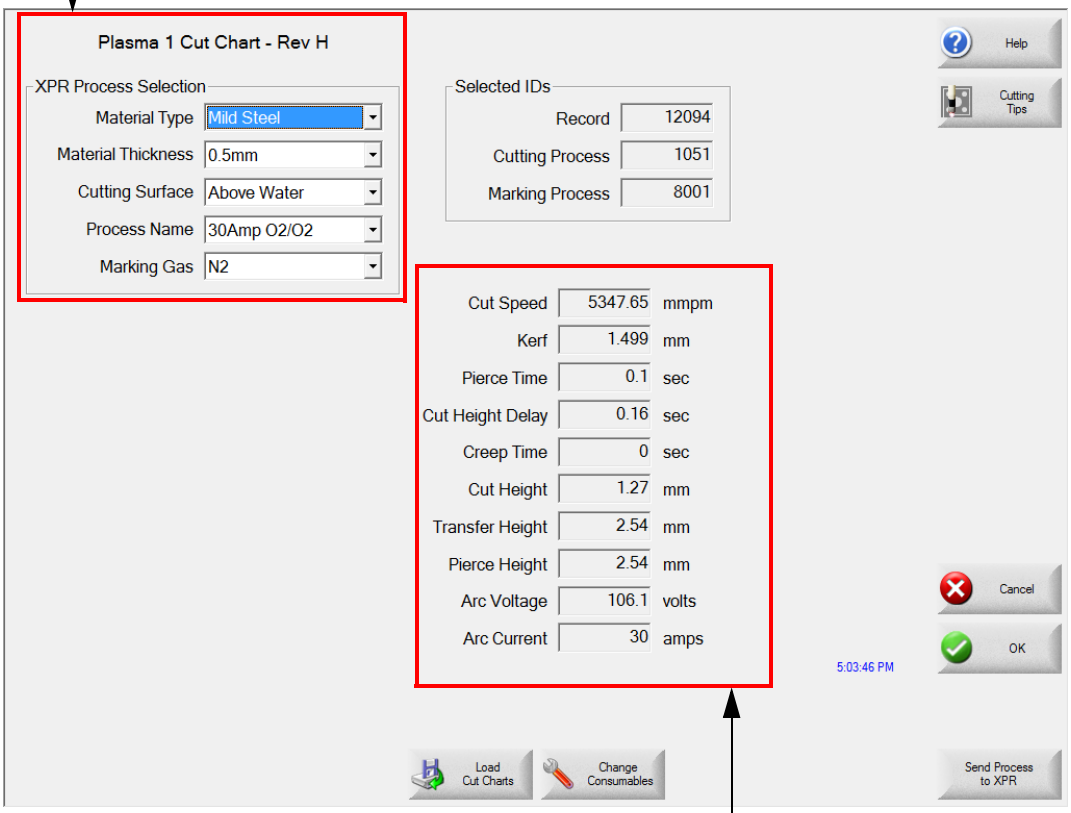
- Arc Voltage
- Cut Current
- Cut Height
- Cut Speed
- Gas type and flow rate
- Kerf
- Pierce Height
- Pierce Time
- Transfer Height

An operator at the CNC cannot override the cut chart parameters listed above.

Process overrides

To modify an XPR part program, modify the cut chart in ProNest (or other CAM software) and output the modified part program to use in Phoenix.

A single G59 V509 Fxxxxx command in the part program automatically populates the XPR Process Selection fields.



An override code on the M07 line in the part program modifies these values.

Process override codes

CAM software, such as ProNest, adds process override codes to the M07 line in XPR part programs. These codes indicate which standard value from the cut chart record to override with the specified value. See *Table 1*.

Table 1 – Process parameter override codes

Override code	Description	Valid range
AVO	Arc Voltage Override	50 VDC – 300 VDC
AVD	Arc Voltage Delay Override*	0.01 second – 10 seconds
CCO	Cut Current Override	-100% through +200% when current is less than 30 A, otherwise ±100%
CHD	Cut Height Delay Override	1 – 10 seconds
CHT	Cut Height Override	0.02 inch – 2 inches
MAF	Mix AR Flow Override	±50%
MHF	Mix H2 Flow Override	±50%
MNF	Mix N2 Flow Override	±50%
PCF	Plasma Cut Flow Override	±100%
PHT	Pierce Height Override**	50% – 400% of cut height (specified as an absolute value in inches or mm)
PJH	Puddle Jump Height Override	50% – 500% of cut height (specified as an absolute value in inches or mm)
PTO	Pierce Time Override	0.001 second – 10 seconds
SCF	Shield Cut Flow Override	±100%
SPF	Shield Pierce Flow Override	±100%
THT	Transfer Height Override**	25% – 400% of cut height (specified as an absolute value in inches or mm)

* Also called automatic voltage control (AVC) delay.

** See page 60.

Examples:

- M07 AVO116 = Cut On and use an arc voltage of 116 (instead of standard arc voltage value from the cut chart record referenced on the G59 line).
- M07 AVD5= Cut On and delay automatic voltage control by 5 seconds.

Make sure that the following Program Code settings are enabled on the Cutting screen in Phoenix (**Setups > Cutting**): EIA G59 Code Override, Process Select Override, EIA Kerf Override, and EIA F-Code Override.

Process overrides applied on the M07 line remain in effect **until the next M07 command which reloads the standard cut chart values.**

Pierce height and transfer height overrides

Pierce height and transfer height are defined in the cut chart as absolute values (in inches or millimeters). For XPR, pierce height and transfer height overrides are independent of cut height.

Example: M07 CHT0.5 THT0.25 = Cut On, use a 0.5 inch cut height, **and** use a 0.25 inch transfer height

The CHT and THT override values are used instead of the cut height and transfer height values from the cut chart record referenced on the G59 line. PHT is not included on the M07 line in the above example, so the pierce height value from the cut chart record referenced on the G59 line is used.

V6xx codes

Prior to the release of the XPR plasma power supply, process overrides were applied with G59 V6xx F*value* codes. Instead of using a part program that contains legacy V6xx codes with XPR, replace the entire part program using CAM software.

V600 and V607 height control override codes are still supported in XPR for bevel cutting. However, the V6*xx* code must appear below the M07 (Cut On) command in the part program. No other V6xx override codes are supported with XPR.

Marking codes

The marking codes used in XPR part programs created with CAM software, such as ProNest, are defined in *Table 2*. These codes differ from the marking codes that are used with other plasma power supplies and when doing basic marking with XPR. All cutting process parameters from the cut chart record will be used unless a process or marking override appears on the M07 line.

Table 2 – Marking codes and definitions specific to XPR part programs output from CAM software

EIA code	Result with XPR
M07 N2	Enables marking with Nitrogen
M07 AR	Enables marking with Argon
M07 N2 HS **OR** M07 AR HS	With XPR, forces an IHS for marking, regardless of the distance between marks or any previous M08 command.
M36 T1	Select Plasma 1 process (for cutting and marking).  M36 T1 must appear before G59 V**5<u>09</u>** F*xxxx.* See page 57.
M36 T2	Select Plasma 2 process (for cutting and marking).  M36 T2 must appear before G59 V**5<u>19</u>** F*xxxx.* See page 57.
Fx	Indicates marking speed (when x is replaced with the marking speed). The marking speed may be the value from the cut chart or an override value (if speed overrides are enabled and you specified a marking speed override in the cut chart in your CAM software). **Example:** M07 N2 F250.  Fx must appear below the M07 AR or M07 N2 line.
M08	M08 disables cutting and marking. M08 only disables marking if the marking override appears on the M07 line.

EIA code	Result with XPR
M08 RF	Retracts to Full Retract height at the end of a cut or mark. Works only with Sensor THC.
M08 RT –x.xx	If the skip IHS distance is >0, retracts to the Transfer Height (instead of the Retract Height) and skips IHS at the end of a cut or mark. The –x.xx variable represents the amount of time before the end of a cut or mark that the Cut Off (also the Marker Off) command is issued.
M08 Txx.xx	Cut Off or Marker Off with time delay. T = Temporary Optional Time Delay from –1 to 99.99 seconds
Marker offsets	The marker offset commands provided in the *Directly Supported EIA Codes* on page 9 are not supported for XPR Marking done with Plasma 1 and Plasma 2.

Marking text

If you are marking text, refer to *Text Marking with ProNest and Phoenix* (Application Note 809850) available at www.hypertherm.com/docs.

Legacy marking codes

Part programs for marking with XPR that are created with CAM software, such as ProNest, do NOT include the following codes that are used for marking with HPRXD:

- Marker offsets (Only supported when using a third party marking tool or drill.)
- M09 / M10 (Enable Marker 1/ Disable Marker 1)*
- M13 / M14 (Enable Marker 2 / Disable Marker 2)*
- M36 T3 / M36 T4 (Select Marker 1 Process / Select Marker 2 Process)*

* These codes are supported in XPR part programs when doing basic cutting or marking. See page 55.

If you have a part program that contains the above legacy codes, Hypertherm recommends that you create a new part program specific to XPR.

There is a manual way to use a legacy part program to mark M09 codes with oxyfuel powder and cut M07 codes with XPR. For more details, refer to *Mark with Oxyfuel Powder and Cut with XPR with Legacy Part Programs* (Application Note 811230).

True Hole codes

ProNest adds the TH code on the M07 (Cut On) command line to tell Phoenix and the XPR to override the standard cutting process parameters with True Hole cutting process parameters (on True Hole-compatible circles only).

Example: M07 TH

A ProNest part program also automatically applies varying speeds across multiple hole segments to complete the True Hole technique.

Interior contour codes

For parts with interior contours such as slots, arcs, or holes that are not True Hole-compatible, CAM software includes the O2S code on the M07 (Cut On) command line. The O2S code tells Phoenix and the XPR to override the standard cutting process parameters with the O2/O2 cutting process parameters from the cut chart record.

Example: M07 O2S

THC Index Code

XPR part programs do not have unique THC index codes. See page 51 for information about THC index codes.

XPR part program format guidelines and examples

Hypertherm CNCs require that certain codes be in specific positions in the part program.

Here are some guidelines on the order of codes in XPR part programs output from ProNest and other CAM software:

- **Process selection:** A G59 V5xx Fxxxxx code is included at the beginning of the part program to select the cut chart record (which contains all process parameters for cutting, marking, and True Hole if applicable).
  - The G59 command must precede the G41 or G42 code.
  - Once the program selects the cut chart, the G59 V5xx code does not need to be re-issued unless the program requires a change in process (a new cut chart).
- **Kerf compensation:** The G41 (Enable Left Kerf Compensation) or G42 (Enable Right Kerf Compensation) must immediately precede the M07 command line.

- **Cutting tool activation:** Each cut or mark in the part starts with M07 (Cut On) or M07 AR/N2 (Marker On) and ends with M08 (Cut Off or Marker Off).
  - With XPR, the marking tool is also the cutting tool.
  - The M07 command must appear after the G41 or G42 kerf compensation command.
- **Process overrides:** All cutting process parameters from the cut chart record will be used unless a process or marking override appears on the M07 line. See *Process overrides* on page 58 and *Marking codes* on page 61.

Legacy G59 V6xx Fxx codes (described on page 60) must appear below the M07 (Cut On) code in the part program. Otherwise, the M07 command will overwrite the override value with the value from the cut chart.

Sample XPR cutting part program

Below is a sample part program that was output from CAM software to cut a circle with XPR.

```
G20
G91
(CutPro Wizard - Load Material: Mild Steel;5.1698" x 5.4627";1.")
M36 T1
M37 T1
G00Y0.2929
G59 V509 F11956 ——► Loads record 11956 (130 A O2/Air) in the cut chart database on Plasma 1
(130Amp O2/Air)
G43X0.161
G41
M07 HS ——► Enables cutting and forces IHS
M51
F20.
G03X1.4142Y1.4142I0.7071J0.7071
G02I1.5556J1.5556
M50
G03X-0.7071I-0.3536J-0.3536
M08
G40
M51
M19
M02
```

Sample XPR marking part program

Below is a sample part program that was output from CAM software to mark a circle with XPR.

```
G20
G91
(CutPro Wizard - Load Material: Mild Steel;4.4" x 4.4";1.")
M36 T1
M37 T1
G00Y2.2
G59 V509 F11956
(130Amp O2/Air)
M07 HS N2
M51
F250.
G02I2.2J0.
M50 H-0.02
G01Y0.25
M08
M19
M02
```

G59 V509 F11956 → Loads record 11956 (130 A O2/Air) in the cut chart database on Plasma 1

M07 HS N2 → Forces IHS and enables marking with Nitrogen

XPR uses Plasma 1 and Plasma 2 for cutting and marking.

6 Advanced Feature Codes

Kerf Table Codes

Code	Description
G59 D1-200Xxx	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 re-posted. Enable or disable this feature in the Status / Program Code section of the Cutting screen.

Make sure Parallel Kerf Enable is disabled for True Hole® part programs.

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

Station Select Codes

Stations (Lifter and THCs) can be selected and deselected using the following EIA-274D program codes. To override the part program, enable Process Select override and Station Select Override in the Status / Program Code section of the Cutting screen.

Code	Description
M19 Tvalue	Cancel All Station Selections
M37 Tvalue	Select Station 1- 20 (Tvalue)
M38 Tvalue	Deselect Station 1- 20 (Tvalue)

Additionally, these Station Select program codes can be overridden with the station inputs to the CNC.

Process Select Codes

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

Example: M36 Tx

- M36 = Select Process
- Tx = Process name, where:
  - T1 = Plasma Process 1
  - T2 = Plasma Process 2
  - T3 = Marker Process 1*
  - T4 = Marker Process 2*
  - T6 = Waterjet

* For XPR part programs, see *Marking codes* on page 61.

Automatic Plate Alignment Codes

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

G66D100B300C30

Where:

- G66 = 3-point alignment command
- Dxx = Distance between two plate edge reference points
- Bxx = Rapid feed rate for distance (D) motion
- Cxx = Slow feed rate for the distance to the edge

Automatic Torch Spacing

The automatic torch spacing feature uses part program codes and CNC outputs to position cutting stations for multiple torch cutting processes.

To enable Automatic Torch Spacing:

1. Choose Setups > Password > Machine Setups and choose ON for Automatic Torch Spacing. Save the values.

2. In the Cutting screen, under Status and Program Code, set Auto Torch Spacing Override to Enabled.

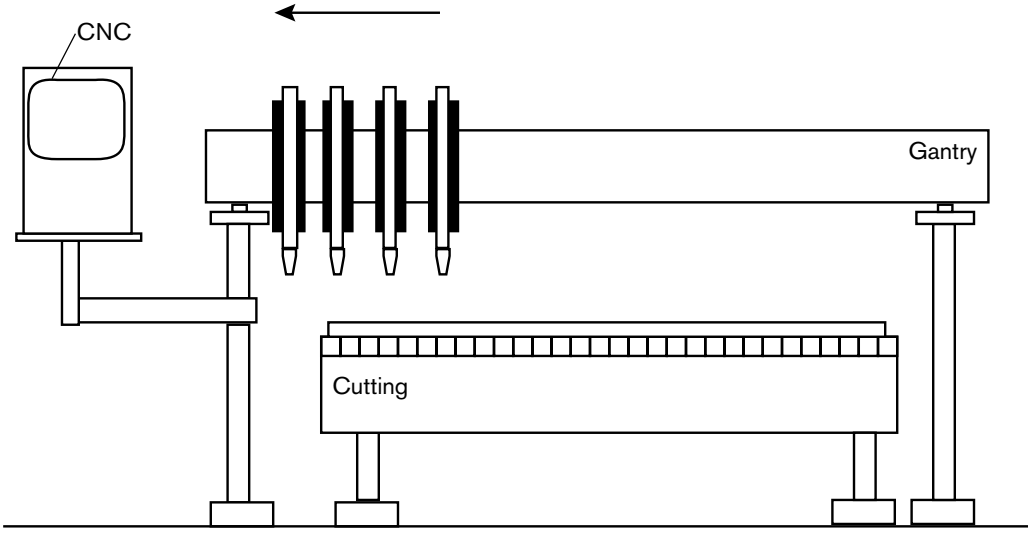
In this process, the primary torch station has a fixed mount to the transverse axis and the other secondary torch stations have the ability to clamp to the mechanics of the transverse axis during use or lock to the gantry or beam when not in use.

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:

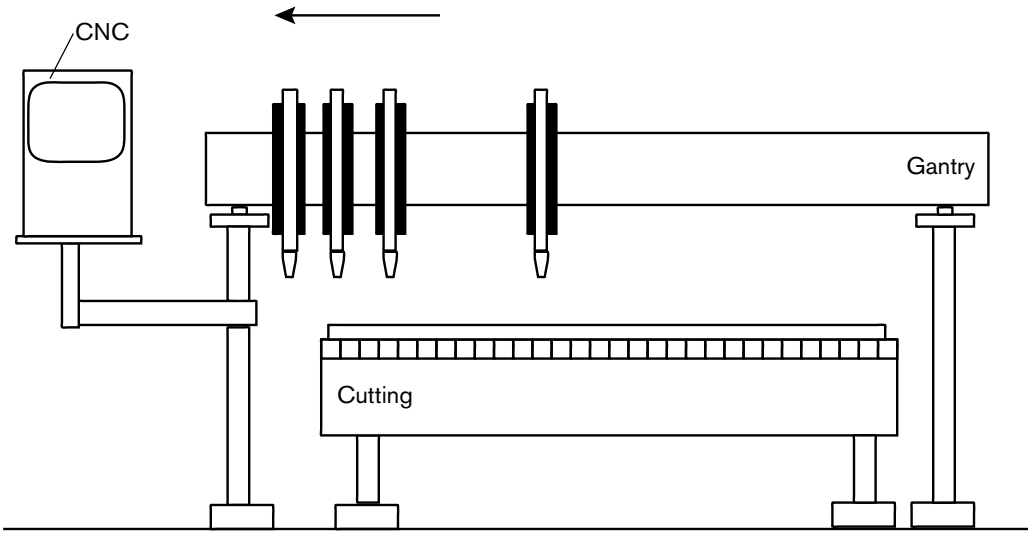
1. Unclamp and unlock all stations (except the first which is fixed and slides the others).

2. Go to Home Command on Transverse Axis (M77 or M78 depending on orientation).

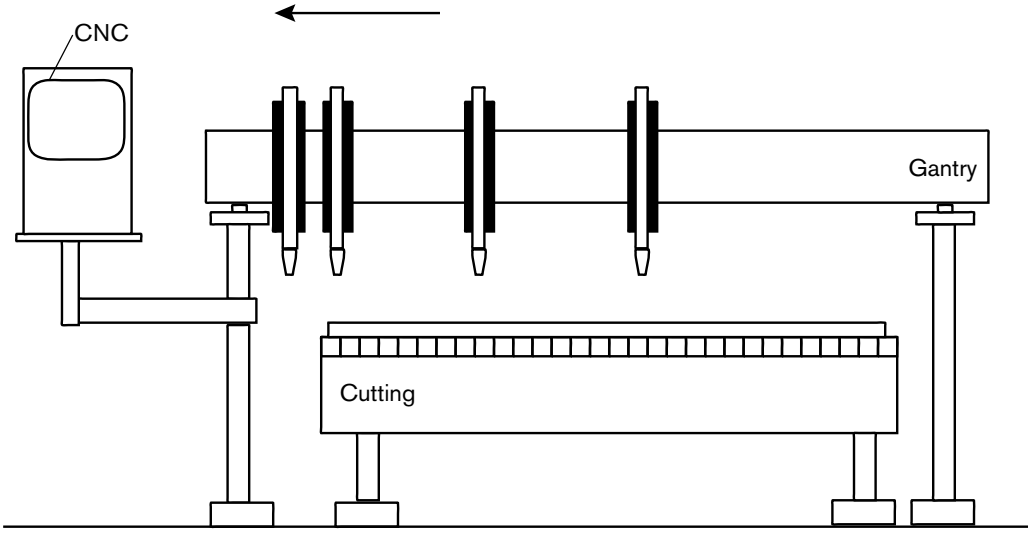


3. Clamp and Unlock all carriages and G00 index inward on transverse (optional command - may be used to space all stations away from edge / OT switch of machine).

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.

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
M34Txx	Clamp / Unlock T Station, where T = 1 through 19
M35	Clamp / Unlock All Stations Mirror
M35Txx	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 Xxx Yx	Traverse command where x = 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.

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)

Code	Description
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 cutting

The EDGE Connect supports dual transverse without beveling on cutting machines. See the Dual Transverse Setup and Operation Application Note (807610) on Hypertherm.com for more information.

To set up this type of table:

1. EtherCAT drives should be set up in the following physical order:
   - 1: Rail
   - 2: Transverse
   - 3: Dual Gantry
   - 4: Sensor THC1
   - 5: Dual Transverse
   - 6: Sensor THC2 (if a second THC is used)
2. After these drives and axes are set, enable dual transverse. From the Main screen, select Setups > Password and enter the NRT password (no rotate and tilt).

   The NRT password allows the use of dual transverse axis without dual bevel axes systems. The RT password reverses this setup.

3. The measurement units (English or metric) that are used in the drives must match the units that are used in the CNC.
4. 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 Oxyfuel Cutting (CBH)

The CBH axis supports a rotational motion bevel for oxyfuel 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 enabled 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. See *Bevel Angle Change on the Fly (BACF)* on page 76 for more information.

The beveling codes M28, M29, M90, M75, and M76 can be used with tilt rotator. See *M and G Codes Used for Beveling* on page 76 for more information.

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.

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.

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) Xvalue: 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 Aangle 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

Tube cutting with bevel command

G00 or **G01 Px Ax Tx Sx Rx Xx or Yx** Rotate Transverse 2 axis for square or rectangular tube cutting.

P = +/- 180 degrees

A = Tilt angle

F = Rotational speed in RPM (optional only for G01. Not used for G00)

T = Top measurement of tube

S = Side measurement of tube

R = Corner radius, +/- 90 degrees

X or Y = Optional: Rail axis position

Drilling and Tapping using a PLC

EDGE Connect and Phoenix now support a software PLC called PLC Connect. For information on PLC Connect, refer to the *PLC Connect Application Note* (809570) available at www.hypertherm.com/docs.

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.

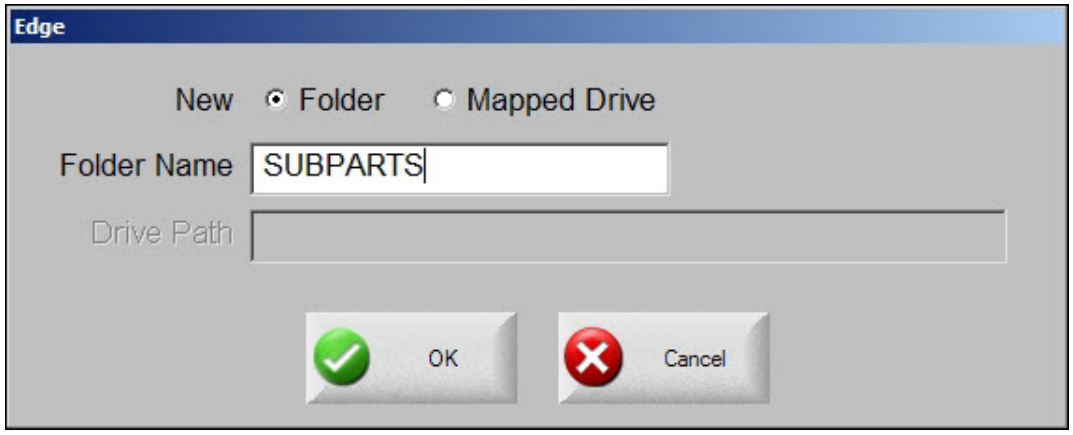
1RT - 1 Rotate Tilt

The 1RT password enables the Rotate and Tilt axes but not Dual Rotate and Dual Tilt axes. 1RT can also be used to add a second station for I-cutting on a cutting machine that also supports a bevel head.

7 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.

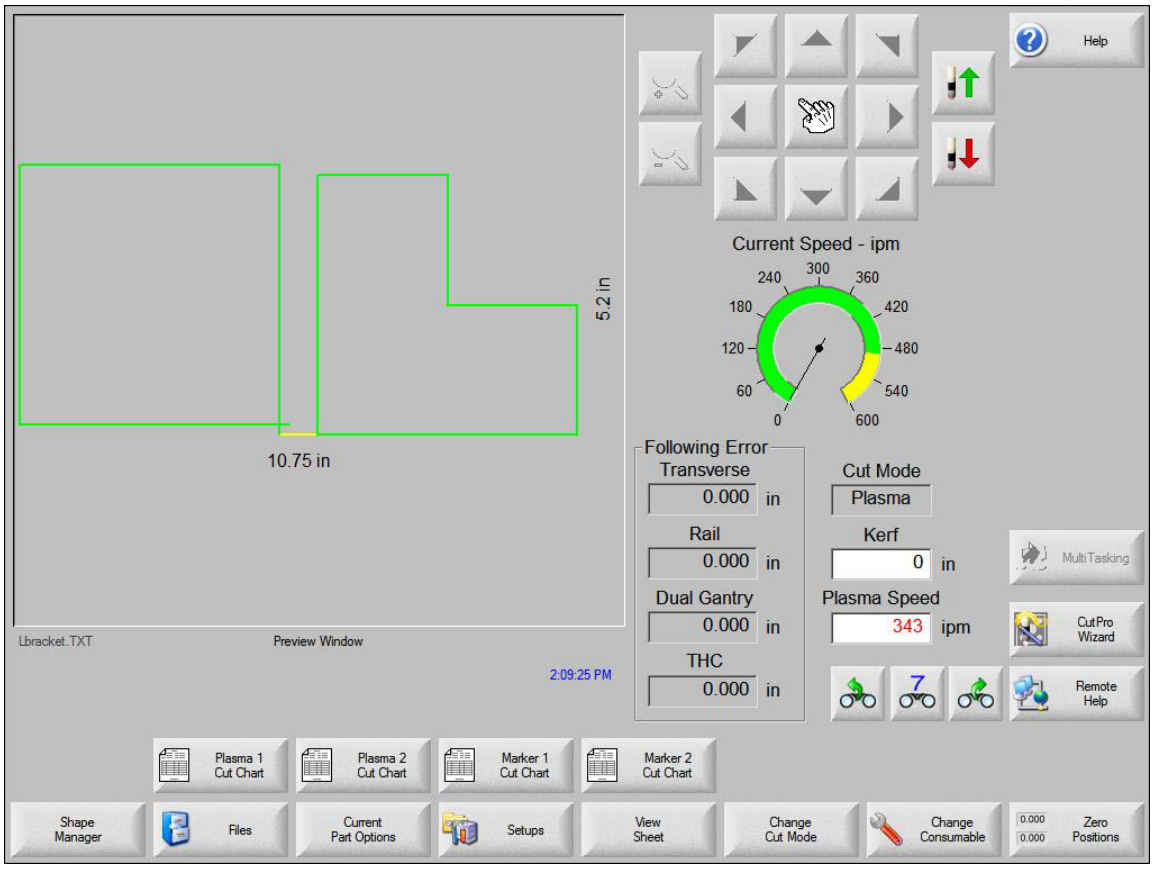
PFILENAME

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.



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.

8 Marker Font Generator

The Marker Font Generator (also called the Phoenix Text Marker) labels or identifies 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 English text characters (fonts) and execute marking of the selected text.

If your marking job requires non-English text or asynchronous stops, do not use the Marker Font Generator. Instead, use ProNest Scribe Text. See kb.hyperthermcam.com/.

Marker Font Generator program code

The Marker Font Generator program code uses a specific command string format to provide information on the marker font source location, scale factor, angle, marker tool, tool offset and text. Each section or information block in the command string is separated by a space. The format and definition of each command code is outlined in *Table 3* on page 83.

Table 3 – Marker Font Generator command codes and default values

Code	Command	Default Value	Note
Fx	**Font**	1= Internal (always ALL CAPS)	
Sx	**Scale**	1.0	
Ax	**Angle**	0.0	
Mx	**Marker**	1 = Marker 1	For XPR, use 0.
Ox	**Offset**	1 = Marker Offset 1	When cutting and marking with the same tool, set the offset to 0 (O0).
Rx	**Retract**	0 = No Retract to Transfer	
Gx	**Gas**	0 = No XPR Marking Gas	Only required with XPR.
Vx	**Speed**	0 = No F-Code Override	

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

Sample marking tool command string:

<F1 S1 A0 M1 O1 R1 <TEST 123> or <R1 <TEST 123>

Sample command string for HPR or any cutting tool other than XPR:

<F1 S2 A45 M1 O0 R1 G1 V100 <TEST 123>

Sample XPR command string:

<F1 S2 A45 M0 O0 R1 G1 V100 <TEST 123>

Where:

<: 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 (All CAPS)
- 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. This number can be a decimal value. For the HPR and XPR examples 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. This number can be a decimal value. For the HPR and XPR examples 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 use. Up to two marker enables are supported. For XPR, use 0 (M0).

O: The fifth information block determines the tool Offset. The “O” is followed by a number to indicate to use one of the nine different tool offsets previously configured in control setups. The marking tool command string example on page 83 indicates that tool offset number 1 should be used.

When cutting and marking with the same tool, set the offset to 0 (O0).

R: The sixth information block determines if a Retract to Transfer is used at the end of each segment of the marked text. The "R" is followed by a number to indicate the type of retract:

0 = retract to the Retract Height value* at the end of each segment

1 = retract to Transfer Height on all text string segments, except for the last segment which retracts to the Retract Height value* before moving to the next location on the plate

2 = retract to Transfer Height at the end of all segments

* Specify the Retract Height value on the Process screen in Phoenix.

G: The seventh information block determines the type of marking gas used for XPR marking. The "G" is followed by a number to indicate the type of gas:

0 = none

1 = argon

2 = nitrogen

V: The eighth information block determines if the default marking speed is overridden with another speed. The "V" is followed by a number to indicate the new marking speed. Zero indicates that the default marking speed will be used. This number can be a decimal value.

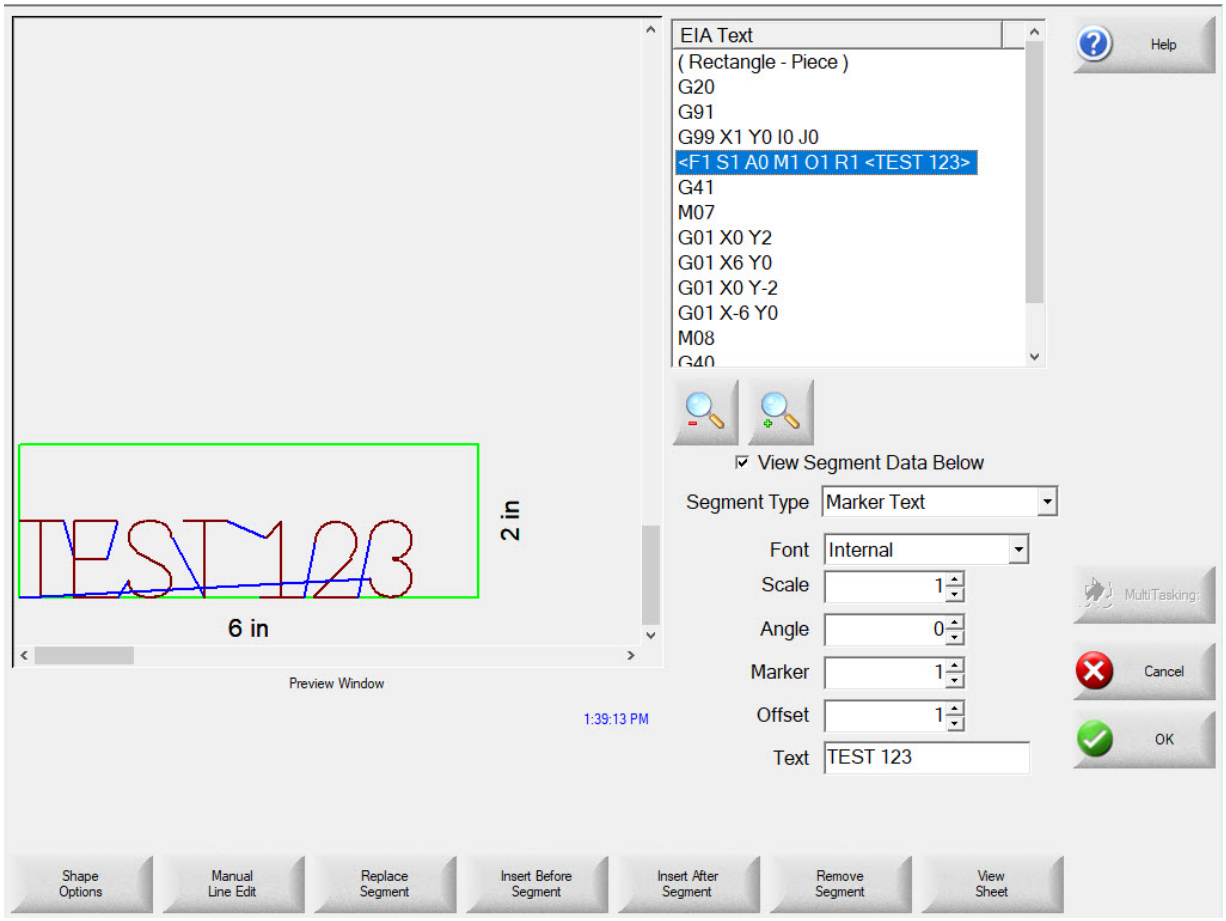
< >: The final information block is used to specify the marker text to be executed. The text must be enclosed in the “<” and “>” marks to be valid and understood as the selected text. For the example given, the marker text executed would be “TEST 123”.

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.

Examples

Marking tool example

When the marking tool code example *<F1 S1 A0 M1 O1 R1 <TEST 123>* is translated by the CNC, it generates the Marker Text “TEST 123” on the plate as shown here in Shape Wizard™.



Shape Wizard is only intended for previewing marker text. **To edit marker text**, use the Phoenix Text Editor (**Shape Manager** > **Text Editor**). The Shape Wizard does not currently support all marker text command codes.

XPR example

Here is an example of how the part program for a rectangle appears in the Phoenix Text Editor when you add the following marker font generator command: <F1 S2 A45 M0 O0 R1 G1 V100 <TEST 123>.

Marker Font Generator font options

Internal Fonts

The internal fonts located within the control software are 1-inch high and are limited to characters available on the control keypad. Alphabetical characters are limited to upper case (ALL CAPS) letters only.

External Fonts

External fonts can be loaded from a memory stick or from the 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* on page 26.

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, use the following guidelines:

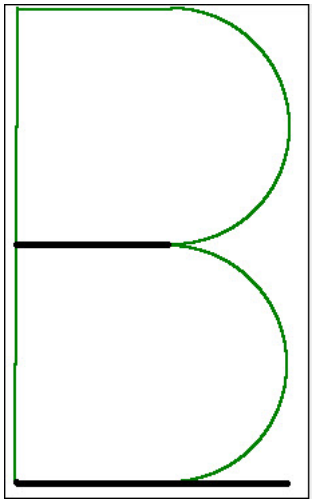
- Programming format must be EIA. See page 9.
- Only M09 and M10 can be used to enable and disable the marker, except in part programs for XPR output from CAM software.

  ProNest part programs for XPR use M07 AR or M07 N2 to enable marking and M08 to disable marking. See page 61 for details.

- Only G00, G01, G02 and G03 codes can be used.
- The program must end in an M02.
- The proper file name must be assigned to the font program. See the letter “B” example and refer to the table on page 86.
- The font program must begin in the lower left and end in the lower right.
- Font programs should have the consistent dimensional limits (i.e. 1 inch high).

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.

The Burny 3/5 style of programming for the Marker Font Generator feature is also supported for the default internal font source.

9 EoE Command Messages

To operate Inkjet or Dot Peen marking systems and other external Internet Protocol (IP) devices, the EDGE® Connect CNC sends command messages through EoE (Ethernet over EtherCAT).

For information about how to set up your EDGE Connect CNC to send EoE command messages to external devices with TCP (Transmission Control Protocol) and UDP (User Datagram Protocol), refer to the *EoE Command Messaging* Application Note (810940) at Hypertherm.com/docs.

10 Import DXF Files

Phoenix uses ProNest CNC to import DXF and other CAD files. To open ProNest CNC, choose Main screen > Shape Manager > ProNest CNC. ProNest CNC can import the following CAD file formats:

- .DXF
- .DWG
- .DGN
- .CAM

CAD files must follow these rules:

1. Only include cut geometry.

   When a CAD file is added in ProNest CNC, all geometry found in the file is cut. Even if there is a designated layer for marking, the geometry on that layer will still be cut. For this reason, make sure that your drawing has been cleaned and only cut geometry is included in the CAD file.

2. Multi-part CAD files are not supported.

   If a CAD file contains multiple separate parts, that file can't be imported into ProNest CNC. Only single-part CAD files are supported. Note that CAD files that contain entire nests of parts can't be added in ProNest CNC.

3. Be sure file units of the CAD file match the units used in Phoenix.

   ProNest CNC assumes that your CAD files are drawn with the same units as the CNC. Phoenix can be set to English or Metric Units. When in English Units, CAD files should be drawn in inches. When in Metric Units, CAD files should be drawn in millimeters.

   If units are different, your parts will be too big or too small. For instance, if ProNest CNC is set to use English Units and you import a part that was drawn in millimeters, the part will be severely oversized.

For more information about ProNest CNC, see the *ProNest CNC Application Note* (809560) available at Hypertherm.com/docs.

11 Appendix: Mapped EIA Codes

Phoenix supports part programs that contain mapped EIA codes. However, *all* of the EIA codes in the program must be mapped. Phoenix supports code-mapping of the entire part program, but not a part program that has a mix of mapped and un-mapped codes.

When Phoenix maps the codes, it changes the codes in the part program into directly supported Phoenix EIA codes when the program is loaded. If you view a mapped part program in the Text Editor, you will see the mapped codes substituted for the original codes.

The following list defines the EIA codes that are directly mapped by the CNC.

EIA code	Description	Mapped to
G04 Fx	Program dwell	G04 x
G05	Set axis presets	G92
G21	Linear interpolation	G01 (at cut speed)
G22	CW circular interpolation	G02
G23	CCW circular interpolation	G03
G41 Kx	Left kerf with value	G41 with kerf value
G42 Kx	Right kerf with value	G42 with kerf Value
G97 Tx	Subroutine loop	G08 Xvalue 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

EIA code	Description	Mapped to
M03	Cutting device On/Off	M07 (Oxyfuel) or M08 as appropriate
M04	Cutting device On	M07
M05	Cutting device Off	M08 (Oxyfuel)
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

EIA code	Description	Mapped to
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

EIA code	Description	Mapped to
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