HYPERTHERM
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CNC Communication Protocol

EtherCAT® Commands and RS-422 Serial / Discrete Signals for XPR® Cutting Systems with the 141545 Main Control PCB

Application Note

10085793 | Revision 3 | September 2026

Warranty information

You can find warranty information for your product at www.hypertherm.com/warranty.

Recycling information

You can find recycling information for your product at www.hypertherm.com/resources/system-support/recycling/.

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Before you use this manual to set signals and protocols

- Make sure that the plasma power supply for your cutting system has the 141545 main control PCB. If you have a different PCB, do not use this manual. Instead, use the *CNC Communication Protocol for the XPR Cutting System (809810)*.

  Note: To find what the 141545 main control PCB looks like, refer to the *Plasma power supply control PCB (141545) diagram* in the instruction manual that came with your cutting system or speak with your cutting machine supplier or regional Hypertherm Technical Service team.

- Select the communication method that is best for your cutting system and then use the connection steps for that method to connect the cutting system to the plasma power supply.

  Note: There are many communication methods to fully operate the plasma cutting system. For information about how to do this, refer to *Connect for Communication* in the instruction manual that came with your cutting system.

  Note: References to the “web interface” in this manual refer to accessing the XPR web server either through the Wi-Fi or Ethernet LAN interfaces. The first physical interface (Wi-Fi or Ethernet LAN) to take control will become the operator unless you reset the control interface.

EtherCAT communication

The XPR cutting system is set up as an EtherCAT connected device. It is configured to use the Controller Area Network (CAN) application protocol over EtherCAT (CoE).

The cutting system is configured for 1-millisecond cyclic data.

The mailbox communications were tested at 5 milliseconds.

Sync manager	Sync manager address	Name	PDO address	Object number
0	1000	Mailbox Out	–	3000
1	1100	Mailbox In	–	3000
2	1200	Outputs	(RxPDO) 1600	(Control) 7000: (sub-index 1 = 16-bit)
3	1600	Inputs	(TxPDO) 1A00	(Status) 6000: (sub-index 1 = 16-bit, sub-index 2 = 32-bit, sub-index 3 = 16-bit)

Connected device – inputs

Object 6000, sub-index 1 (6000:01)

- Bit 0 = Machine motion
- Bit 1 = Transfer
- Bit 2 = Ready for start
- Bit 4 = Error
- Bit 5 = Process ready
- Bit 6 = Error priority level = Info
- Bit 7 = Error priority level = Alert
- Bit 8 = Ohmic contact
- Bit 9 = Remote power status
- Bit 10 = Error priority level = Error
- Bit 11 = Error priority level = Failure
- Bit 12 = Firmware update busy
- Bit 13 = Idle (Eco mode)
- Bit 14 = Manual-set mode enabled
- Bit 15 = External 24 V power status

Object 6000, sub-index 2 (6000:02)

- 32-bit value = Arc voltage

  Note: The plasma power supply calculates the arc voltage and updates it internally over the CAN bus every 2 milliseconds. The scale for the arc voltage value is: 1425 = 142.5 V direct current (DC).

Object 6000, sub-index 3 (6000:03)

- 16-bit value = System information (current error code)

Connected device – outputs

Object 7000, sub-index 1 (7000:01)

- Bit 0 = Plasma Start (starts a torch ignition sequence)
- Bit 1 = Hold ignition (applied at the same time as the Plasma Start and used to keep the cutting system in the Preflow state and to synchronize many plasma power supplies)
- Bit 2 = Pierce (applies the Pierce Gas settings)
- Bit 3 = Request new process (clears the *Process ready* and *Ready for start* bits in 6000:01)

System ID

XPR170 Core = 17	XPR300 Core = 33	XPR460 Core = 49
XPR170 CorePlus = 24	XPR300 CorePlus = 40	XPR460 CorePlus = 56
XPR170 VWI = 18	XPR300 VWI = 34	XPR460 VWI = 50
XPR170 OptiMix = 20	XPR300 OptiMix = 36	XPR460 OptiMix = 52

State codes

ID	XPR state
00	STANDBY
01	POWERUP
02	INITIAL CHECKS
03	GAS PURGE AND PUMP ON
04	INERT PURGE
05	WAIT FOR START
06	NODE UPDATE
07	PREFLOW CHARGE DC
08	IGNITE
09	PILOT ARC
10	RESERVED
11	RAMPUP
12	STEADY STATE
13	RAMPDOWN
14	END OF CYCLE
15	SHUTDOWN
16	TEST PREFLOW
17	TEST CUTFLOW
18	TEST PIERCE FLOW
19	ALTERNATE RAMPDOWN
20	MANUAL LEAK TEST
21	H_2O PURGE
22	AUTOMATIC GAS LEAK CHECK

Gas-type codes

ID	Gas Type
0	No Gas (invalid gas type)
1	Oxygen (O_2)
2	Reserved
3	Hydrogen (H_2)
4	Reserved
5	Air
6	Nitrogen (N_2)
7	Argon (Ar)
8	Reserved
9	Reserved
10	Reserved
11	F5 (95% nitrogen, 5% hydrogen)
12	Water (H_2O) (for water injection processes)
13	Mix (OptiMix only)

Set a process

1. Verify that the XPR is in state 2 or 5 (ready to accept a new process). Refer to Before you use this manual to set signals and protocols.
2. Use the CNC to set Bit 3 of Object 7000, sub-index 1 (Request New Process).
3. Make sure that Bit 2 and Bit 5 of Object 6000, sub-index 1 are both (0).
4. Use the CNC and one of these objects to send the process ID:
   - Use Object 3100 to set the sub-index 1 (Process ID) (RECOMMENDED), *or*
   - Use Object 3000 to set the sub-index 1 (Command Number 609), sub-index 3 (Process ID), and sub-index 11 (1).
5. Use the CNC to send one of these process-offset values:
   - Object 3100, sub-index 2-8, based on the value to offset (offset data) (RECOMMENDED), *or*
   - Object 3000, sub-index 1 (command number for desired offset), sub-index 3 (offset data), and sub-index 11 (1).
6. Use the CNC to clear Bit 3 of Object 7000, sub-index 1.
7. The CNC waits for Bit 5 of Object 6000, sub-index 1 to be set (1).
8. The CNC makes sure that the Process ID matches the value you want:
   - Read Object 3200, sub-index 1 (Process ID) (RECOMMENDED), *or*
   - Use Object 3000, sub-index 1 (Command Number 608) and sub-index 11 (1), then do a check of the Return value in Object 3000, sub-index 13, which is the Process ID that is active in the system.
9. Once Bit 2 of Object 6000, sub-index 1 is set (1), the cutting system will accept a Plasma Start signal.

Purge sequences

Plasma cutting system purges are automatic. The type of purge is based on the active state of operation and on the type of gas connect console (OptiMix, VWI, CorePlus, or Core).

- OptiMix and VWI cutting systems do gas-change and process-setup purges.
- Core and CorePlus cutting systems do process-setup purges.

The length of time necessary to complete a purge is based on the type of operator-selected process and if the active process is the first process sent after the Power-On state (State 01). (Refer to *Automatic purges* and *Sequence of operation* in the instruction manual that came with your cutting system).

Process setup purge – before doing an O_2 / air process (Core, CorePlus, VWI, and OptiMix) (example: setting process ID 1001)

1. If the last process was a mixed-fuel gas process (VWI, OptiMix only), then one of these purge sequences occurs:
   - For an OptiMix cutting system, process ID 115 is active and the plasma power supply uses an inert gas to purge the cutting system for 16 seconds.
   - For a VWI cutting system, process ID 114 is active and the plasma power supply uses an inert gas to purge the cutting system for 15 seconds.
2. If the last process was not a fuel-gas (or if the cutting system has a Core or CorePlus gas connect console), this purge sequence occurs:
   - Process ID 1001 is active and the plasma power supply uses a purge gas to purge the cutting system for 10 seconds.
3. After the purge stops, the cutting system is prepared to do an O_2/air process (process ID 1001).

Process setup purge – before doing a mixed-fuel gas process (VWI, OptiMix only) (example: setting process ID 2059)

1. Process ID 116 is active and the plasma power supply does a gas-leak test for approximately 20 seconds.
2. Process ID 115 is active and the plasma power supply uses an inert gas to purge the cutting system for 16 seconds.
3. Process ID 2059 is active and the plasma power supply uses a purge gas to purge the cutting system for approximately 9 seconds.
4. After the purge stops, the cutting system is prepared to do a mixed-fuel gas process (process ID 2059).

Gas-change purge – from N_2 / H_2O to any other process (VWI and OptiMix only) (example: changing from process ID 2011 to process ID 1001)

1. Process ID 117 is active and the plasma power supply uses water to purge the cutting system for 14 seconds.
2. Process ID 1001 is active and the plasma power supply uses a purge gas to purge the cutting system for approximately 2 seconds.
3. After the purge stops, the cutting system is prepared to do any other process (process ID 1001).

Gas-change purge – from O_2 / air to mixed-fuel gas (VWI, OptiMix only) (example: changing from process ID 1001 to process ID 2059)

1. Process ID 116 is active and the plasma power supply does a gas-leak test for approximately 20 seconds.
2. Process ID 115 is active and the plasma power supply uses an inert gas to purge the cutting system for 16 seconds.
3. Process ID 2059 is active and the plasma power supply uses a purge gas to purge the cutting system for approximately 9 seconds.
4. After the purge stops, the cutting system is prepared to do a mixed-fuel gas process (process ID 2059).

Gas-change purge – from mixed-fuel gas to O_2 / air (VWI, OptiMix only) (example: changing from process ID 2059 to process ID 1001)

1. Process ID 115 is active and the plasma power supply uses an inert gas to purge the cutting system for 16 seconds.
2. Process ID 1001 is active and the plasma power supply uses a purge gas to purge the cutting system for approximately 9 seconds.
3. After the purge stops, the cutting system is prepared to do an O_2 / air process (process ID 1001).

Gas-change purge – from O_2 / air to argon (Ar) marking to O_2 / air (Core, CorePlus, VWI, OptiMix) (example: changing from process ID 1001 to 9003 to 1001)

1. Process ID 9003 is active and the plasma power supply uses a purge gas to purge the cutting system for approximately 2 seconds.
2. After the first purge stops, the cutting system is prepared to do argon marking (process ID 9003).
3. After argon marking stops:
    a. Process ID 1001 is active.
    b. The plasma power supply uses purge gas to purge the cutting system for approximately 2 seconds.
4. After the second purge stops, the cutting system is prepared to do an O_2 / air process (process ID 1001).

Gas-change purge – from mixed-fuel gas to argon (Ar) marking to mixed-fuel gas (VWI, OptiMix only) (example: changing from process ID 2059 to 9003 to 2059)

1. Process ID 9003 is active and the plasma power supply uses a purge gas to purge the cutting system for approximately 2 seconds.
2. After the first purge stops, the cutting system is prepared to do argon marking (process ID 9003).
3. After argon marking stops:
    a. Process ID 2059 is active.
    b. The plasma power supply uses purge gas to purge the cutting system for approximately 2 seconds.

After the second purge stops, the cutting system is prepared to do a mixed-fuel gas process (process ID 2059).

Object dictionary

Write data

Index 0x3100: **Set process**

Sub-index:
- 0x01 Process ID
- 0x02 Current override (in amperes – A)
- 0x03 Plasma cutflow override (psi)
- 0x04 Shield cutflow override (psi)
- 0x05 Shield pierceflow override (psi)
- 0x06 H_2 override (slpm)
- 0x07 N_2 override (slpm)
- 0x08 Ar override (slpm)

Index 0x3101: **System modes**

Sub-index:

0x01 Mode
- 1 = Test pierceflow
- 2 = Test cutflow
- 3 = Test preflow
- 4 = Leak check
- 5 = Set pump timeout to 4,320 minutes
- 6 = Interface (RS-422, EtherCAT, or Web) will release control of the system

0x02 Off/On
- 0 = Off
- 1 = On

0x03 Enable rampdown error protection
- 0 = Off
- 1 = On
- 2 = No change

0x04 Enable torch protection
- 0 = Disable
- 1 = Enable

0x05 Set arc voltage scale
- 30 = 30:1

0x06 Install firmware update
- 1 = Stored Package 1
- 2 = Stored Package 2

Index 0x3102: **Clear alerts**

Sub-index:

0x01 Clear
- 0 = No change
- 1 = Clear

Read data

Index 0x3200: **Process data**

Sub-index:
- 0x01 Process ID
- 0x02 Current override (in amperes – A)
- 0x03 Plasma cutflow override (psi)
- 0x04 Shield cutflow override (psi)
- 0x05 Shield pierceflow override (psi)
- 0x06 H_2 override (slpm)
- 0x07 Ar override (slpm)
- 0x08 N_2 override (slpm)

Index 0x3201: **Modes**

Sub-index:
- 0x01 Active mode
  - 1 = Test pierceflow
  - 2 = Test cutflow
  - 3 = Test preflow
  - 4 = Leak check
- 0x02 RDE protection
  - 1 = Enabled
  - 0 = Disabled
- 0x03 Torch protection
  - 1 = Enabled
  - 0 = Disabled

Index 0x3202: **Chopper 1 data**

Sub-index:
- 0x01 Setpoint (in amperes – A)
- 0x02 DC (in amperes – A)
- 0x03 Temperature (X 10ºC. Example: 253 = 25.3ºC)
- 0x04 Bus voltage (volts)
- 0x05 Arc voltage (volts)

Index 0x3203: **Chopper 2 data**

Sub-index:
- 0x01 Setpoint (in amperes – A)
- 0x02 DC (in amperes – A)
- 0x03 Temperature (X 10ºC. Example: 253 = 25.3ºC)

Index 0x3204: **Chopper 3 data**

Sub-index:
- 0x01 Setpoint (in amperes – A)
- 0x02 DC (in amperes – A)
- 0x03 Temperature (X 10ºC. Example: 253 = 25.3ºC)

Index 0x3210: **Torch connect console (TCC) data**

Sub-index:

0x01 Line A setpoint (psi)
0x02 Line A output (psi)
0x03 Line A type (Refer to Gas-type codes.)
0x04 Line A inlet (psi)
0x05 Line A duty (% on)
0x06 Line B setpoint (psi)
0x07 Line B output (psi)
0x08 Line B type (Refer to Gas-type codes.)
0x09 Line B inlet (psi)
0x0a Line B duty (% on)
0x0b Shield setpoint (psi)
0x0c Shield output (psi)
0x0d Shield type (Refer to Gas-type codes.)
0x0e Shield inlet (psi)
0x0f Shield duty (% on)
0x10 Valve states
- Bit 0: V1
- Bit 1: V2
- Bit 2: V3
- Bit 3: V4
- Bit 4: V5
- Bit 5: V6
- Bit 6: V7
- Bit 7: V8
- Bit 8: V9
- Bit 9: V10
- Bit 10: V11
- Bit 11: V12

Index 0x3211: **Gas connect console (GCC) data**

Sub-index:

0x01 F5 setpoint (psi)
0x02 F5 output (psi)
0x03 F5 inlet (psi)
0x04 F5 duty (% on)
0x05 H_2O setpoint (psi)
0x06 H_2O output (psi)
0x07 H_2O inlet (psi)
0x08 H_2O duty (% on)
0x09 H_2 setpoint (psi)
0x0a H_2 output (psi)
0x0b H_2 inlet (psi)
0x0c H_2 duty cycle (% on)
0x0d Ar setpoint (psi)

0x0e Ar output (psi)
0x0f Ar inlet (psi)
0x10 Ar duty cycle (% on) 0x11 N_2 setpoint (psi)
0x12 N_2 output (psi)
0x13 N_2 inlet (psi)
0x14 N_2 duty cycle (% on)
0x15 Mix outlet pressure (psi)

Index 0x3220: **Main control PCB data**

Sub-index:
0x01 Coolant flow (X 100 gal/min. Example: 183 = 1.83 gal/min)
0x02 Coolant temperature (X 10ºC. Example: 253 = 25.3ºC)
0x03 Coolant level (1 = level good)
0x04 Transformer temperature (X 10ºC. Example: 253 = 25.3ºC)
0x05 Inductor 1 temperature (X 10ºC. Example: 253 = 25.3ºC)
0x06 Inductor 2 temperature (X 10ºC. Example: 253 = 25.3ºC)
0x07 Inductor 3 temperature (X 10ºC. Example: 253 = 25.3ºC)
0x08 Inductor 4 temperature (X 10ºC. Example: 253 = 25.3ºC)
0x09 Fan tach 1 (RPM) MagFan 1
0x0a Fan tach 2 (RPM) MagFan 2
0x0b Fan tach 3 (RPM) Heat Exchanger Fan 1
0x0c Fan tach 4 (RPM) Heat Exchanger Fan 2
0x0d Fan tach 5 (RPM) Control Fan 1
0x0e Fan tach 6 (RPM) Control Fan 2
0x0f Discrete I/O
- Bit 0: System On input
- Bit 1: Start input
- Bit 2: Hold input
- Bit 3: Pierce input
- Bit 4: Main Contactor output
- Bit 5: Pump Enable output
- Bit 6: Coolant Solenoid output
- Bit 7: Fan output
- Bit 8: Heat Exchanger Fan output
- Bit 9: Ready-for-Start output
- Bit 10: Transfer
- Bit 11: Ohmic Contact output
- Bit 12: CNC Motion output
- Bit 13: CNC Hold output
- Bit 14: CNC Error output

0x10 Process current (in amperes – A)
0x11 Display current (in amperes – A)
0x12 Inductor 5 temperature (X 10ºC. Example: 253 = 25.3ºC)

0x13 Inductor 6 temperature (X 10ºC. Example: 253 = 25.3ºC)
0x14 Fan tach 7 (RPM) MagFan 3
0x15 Fan tach 8 (RPM) Cabinet Fan
0x16 Voltage (V) from the nozzle to the electrode (VNE)
0x17 Coolant solenoid current (mA)
0x18 Ambient temperature (X 10ºC. Example: 253 = 25.3ºC)
0x19 Transformer temperature 2 (X 10ºC. Example: 253 = 25.3ºC)
0x1A Control transformer temperature (X 10ºC. Example: 253 = 25.3ºC)

Index 0x3230: **System status**

Sub-index:
0x01 System config (Refer to System ID.)
0x02 System ID (Refer to System ID.)
0x03 System state (Refer to State codes.)
0x04 System error ID (Refer to Code descriptions.)
0x05 System error priority
Info = 0
Alert = 1
Error = 2
Failure = 3
0x06 System error data 1
0x07 System error data 2
0x08 Arc time (seconds)
0x09 On time (seconds)
0x0a MAC address (4 bytes) (each byte is an ASCII character)
0x0b IP address (4 bytes) (each byte is an integer)
0x0c Controlling source
No controlling source = 0
EtherCAT = 1
Web = 2
Internal control = 4
RS-422 = 5
0x0d Arc voltage scale
30 = 30:1

Index 0x3231: **Versions**

Sub-index:
0x01 Main control PCB version (32-16: major ASCII character, 15-0 minor integer)
0x02 Torch connect console version (32-16: major ASCII character, 15-0 minor integer)
0x03 Gas connect console version (32-16: major ASCII character, 15-0 minor integer)
0x04 Chopper 1 version (32-16: major ASCII character, 15-0 minor integer)
0x05 Chopper 2 version (32-16: major ASCII character, 15-0 minor integer)
0x06 Wi-Fi version (32-16: major integer, 15-0: minor integer)
0x07 Database revision (32-0 major ASCII character)
0x08 Chopper 3 version (32-16: major ASCII character, 15-0: minor integer)
0x09 Cooler version (32-16: major ASCII character, 15-0: minor integer)

Index 0x3232: **Code count**

Sub-index:
0x01 Active count (integer)
0x02 Log count (integer)

Index 0x3250-325f: **Active errors, up to 16**

Sub-index:
0x01 Class ID (32-16 Class, 15-0 ID)
(Class: 0 = Info, 1 = Alert, 2 = Error, 3 = Failure)
Refer to Code descriptions for ID.
0x02 Timestamp (time in seconds)
0x03 Data 1
0x04 Data 2

Index 0x3280-329f: **Error log, up to 32**

Sub-index:
0x01 Class ID (32-16 Class, 15-0 ID)
(Class: 0 = Info, 1 = Alert, 2 = Error, 3 = Failure)
Refer to Code descriptions for ID.
0x02 Timestamp (time in seconds)
0x03 Data 1
0x04 Data 2

Index 0x3233: **Application semantic versions**

Sub-index:
0x01 Main control
0x02 Torch connect console
0x03 Gas connect console
0x04 Chopper 1
0x05 Chopper 2
0x06 Chopper 3
0x07 Cooler
0x08 Stored Package 1
0x09 Stored Package 2
0x0A Fieldbus
0x0B Wi-Fi

Index 0x3234: **Bootloader semantic versions**

Sub-index:
0x01 Main control
0x02 Torch connect console
0x03 Gas connect console

0x04 Chopper 1
0x05 Chopper 2
0x06 Chopper 3
0x07 Cooler

Mailbox data

Object 3000

- Sub-index 1 (3000:01)
  - Command ID (Refer to Serial RS-422 and EtherCAT commands.)
  - Size: 32 bits
- Sub-index 2 (3000:02)
  - [0..7] element array of 32-bit data (data from controller)
  - Size: 32 X 8 = 256 bits
- Sub-index 3 (3000:03)
  - Array element [0] (same array that is in sub-index 2) (this field is to get access to an individual element in the array)
  - Size: 32 bits
- Sub-index 4 (3000:04)
  - Array element [1]
  - Size: 32 bits
- Sub-index 5 (3000:05)
  - Array element [2]
  - Size: 32 bits
- Sub-index 6 (3000:06)
  - Array element [3]
  - Size: 32 bits
- Sub-index 7 (3000:07)
  - Array element [4]
  - Size: 32 bits
- Sub-index 8 (3000:08)
  - Array element [5]
  - Size: 32 bits
- Sub-index 9 (3000:09)
  - Array element [6]
  - Size: 32 bits

- Sub-index 10 (3000:0A)
  - Array element [7]
  - Size: 32 bits
- Sub-index 11 (3000:0B)
  - Command status (a value of 1 signals the control PCB to accept the command data)
  - Size: 32 bits
- Sub-index 12 (3000:0C)
  - [0..7] element array of 32-bit data (data from cutting system)
  - Size: 32X 8 = 256 bits
- Sub-index 13 (3000:0D)
  - Array element [0] (same array that is in sub-index 12) (this field is to get access to an individual element in the array)
  - Size: 32 bits
- Sub-index 14 (3000:0E)
  - Array element [1]
  - Size: 32 bits
- Sub-index 15 (3000:0F)
  - Array element [2]
  - Size: 32 bits
- Sub-index 16 (3000:10)
  - Array element [3]
  - Size: 32 bits
- Sub-index 17 (3000:11)
  - Array element [4]
  - Size: 32 bits
- Sub-index 18 (3000:12)
  - Array element [5]
  - Size: 32 bits
- Sub-index 19 (3000:13)
  - Array element [6]
  - Size: 32 bits
- Sub-index 20 (3000:14)
  - Array element [7]
  - Size: 32 bits

- Sub-index 21 (3000:15)
  - EtherCAT error
  - Size: 32 bits
- Sub-index 22 (3000:16)
  - EtherCAT warning
  - Size: 32 bits

Beckhoff™ EtherCAT controller (example)

Object 3000 and the sub-indexes:



3000:0	Command Object	RO	> 22 <
3000:01	CommandNumber	RW	0x000003E8 (1000)
3000:02	Arguments	RW	
3000:03	Cmd Arg 0	RW	0x000003E8 (1000)
3000:04	Cmd Arg 1	RW	0x000003E8 (1000)
3000:05	Cmd Arg 2	RW	0x000003E8 (1000)
3000:06	Cmd Arg 3	RW	0x000003E8 (1000)
3000:07	Cmd Arg 4	RW	0x000003E8 (1000)
3000:08	Cmd Arg 5	RW	0x000003E8 (1000)
3000:09	Cmd Arg 6	RW	0x000003E8 (1000)
3000:0A	Cmd Arg 7	RW	0x000003E8 (1000)
3000:0B	CommandStatus	RW	0x000003E8 (1000)
3000:0C	ReturnVal	RW	

Objects 6000 and 7000 with sub-indexes:

6000:0	Status	RO	> 3 <
6000:01	Status	RW	0x0240 (576)
6000:02	Arc Volts	RW	0x00000000 (0)
6000:03	SysInfo	RW	0x0283 (643)
7000:0	Control	RO	> 1 <
7000:01	Control	RW	0x0000 (0)

Object 3000, sub-index 1 (3000:01), Command Number 760:

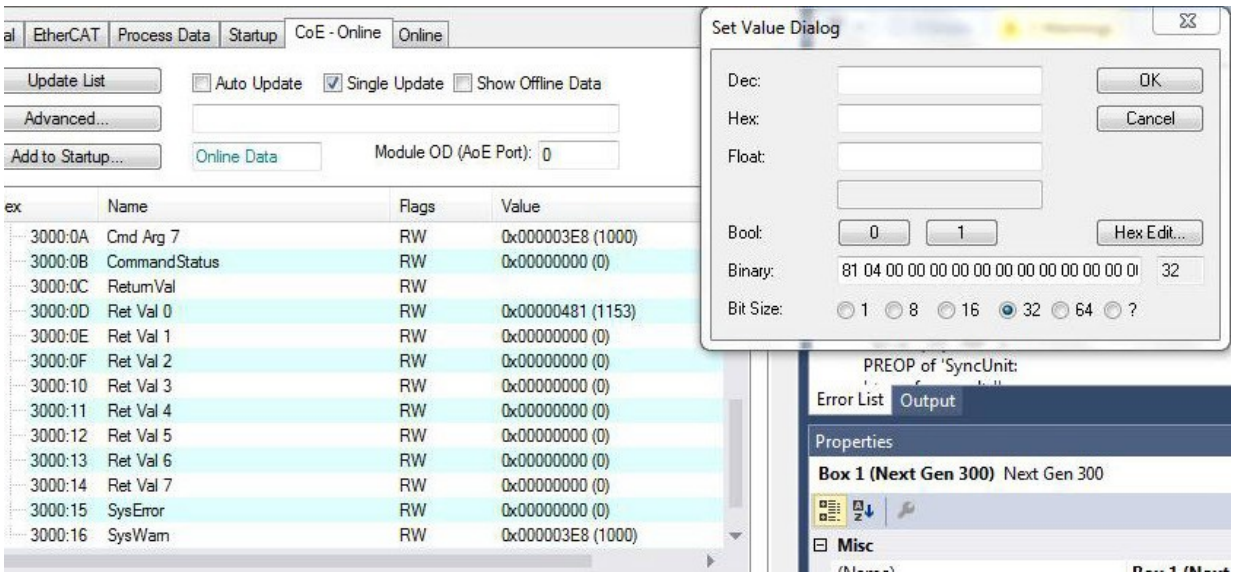
Index	Name	Flags	Value
⊞ 1C13:0	SM3 PDO Assignment	RO	> 1 <
⊟ 3000:0	Command Object	RO	> 22 <
3000:01	CommandNumber	RW	0x000002F8 (760)
3000:02	Arguments	RW	
3000:03	Cmd Arg 0	RW	0x000003E8 (1000)
3000:04	Cmd Arg 1	RW	0x000003E8 (1000)
3000:05	Cmd Arg 2	RW	0x000003E8 (1000)
3000:06	Cmd Arg 3	RW	0x000003E8 (1000)
3000:07	Cmd Arg 4	RW	0x000003E8 (1000)
3000:08	Cmd Arg 5	RW	0x000003E8 (1000)
3000:09	Cmd Arg 6	RW	0x000003E8 (1000)
3000:0A	Cmd Arg 7	RW	0x000003E8 (1000)
3000:0B	CommandStatus	RW	0x000003E8 (1000)

Set the Command Status (3000:0B) equal to 1 to signal the cutting system to execute the Command Number.

Data returned from the cutting system shows in 3000:0D – 3000:14:

Index	Name	Flags	Value
3000:09	Cmd Arg 6	RW	0x000003E8 (1000)
3000:0A	Cmd Arg 7	RW	0x000003E8 (1000)
3000:0B	CommandStatus	RW	0x00000000 (0)
3000:0C	ReturnVal	RW	
3000:0D	Ret Val 0	RW	0x00000043 (67)
3000:0E	Ret Val 1	RW	0x00000030 (48)
3000:0F	Ret Val 2	RW	0x00000030 (48)
3000:10	Ret Val 3	RW	0x00000030 (48)
3000:11	Ret Val 4	RW	0x00000030 (48)
3000:12	Ret Val 5	RW	0x00000000 (0)
3000:13	Ret Val 6	RW	0x00000000 (0)
3000:14	Ret Val 7	RW	0x00000000 (0)
3000:15	SysError	RW	0x00000000 (0)

The Set Value Dialog screen shows the binary value of 3000:0C:



CNC interface hardware

The XPR plasma power supply uses a combination of these signals and commands to communicate with the CNC:

- Discrete signals (Refer to Discrete signals.)
- RS-422 serial commands (Refer to Serial RS-422 commands.)

Discrete signals

Signal name	Type	Description / meaning
Plasma Start	Input	Starts the plasma power supply, which causes ignition of the arc.
Machine Motion	Output	Identifies that machine motion should begin. • **Default**: XPR tells the CNC that an arc transfer to the workpiece has occurred and for machine motion to start after the CNC pierce delay time is completed. • **Extended pilot arc (EPA):** When an EPA process is selected, XPR tells the CNC that a pilot arc has occurred and for machine motion to start.
Transfer	Output	• **Default**: Motion and Transfer operate at the same time. • **Extended pilot arc (EPA)**: XPR tells the CNC that the arc has transferred to the workpiece. During EPA processes, Motion does **not** indicate Transfer.
Hold Ignition	Input	Keeps the plasma power supply in Preflow state and prevents torch ignition. Apply this signal at the same time as the Plasma Start signal. Used to keep many plasma power supplies synchronized.
System Error	Output	The plasma power supply has information available to read. Use serial commands to query for a specific code number.
Shield Pierce Gas	Input	Causes the plasma power supply to use shield pierce settings for piercing. When the Shield Pierce Gas signal is removed, the plasma power supply changes to shield cutflow gases. Apply this signal at the same time as the Plasma Start signal. Remove this signal after the pierce delay time has elapsed. Refer to the XPR cut charts for the time value.
Remote Power	Input	Supplies power and removes power from the cutting system.
Ready for Start	Output	The plasma power supply is prepared for the Plasma Start signal. This output has no effect during plasma power supply purges and in Gas Test mode.
Ohmic Contact	Output	The torch is touching the workpiece.

Discrete signal hardware

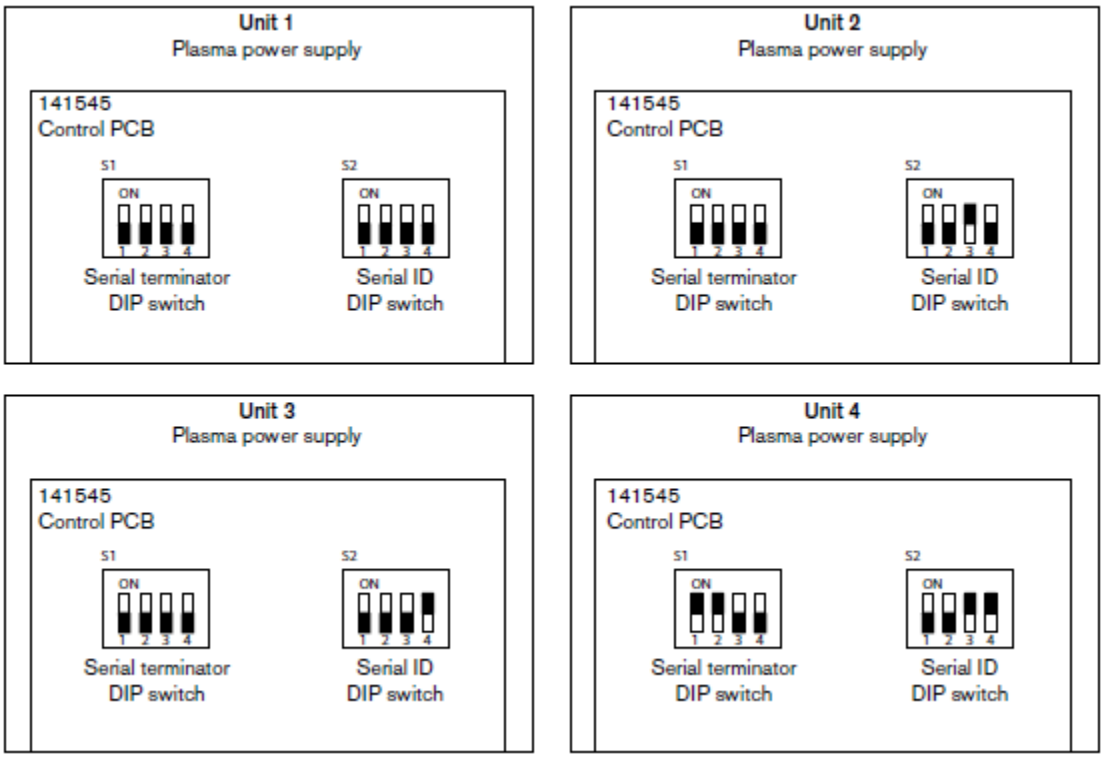
- Inputs are optically isolated. They require 24 VDC at 12.5 mA or dry-contact closure at 8 mA.
- Outputs are optically isolated, open-collector transistors. The maximum rating is 24 VDC at 10 mA.
- The Hold signal is both an input and an output. It is usually used as an input. It can be used as an output to connect many plasma power supplies and make their operation synchronized.
- RS-422 serial communication or the XPR web interface is necessary with discrete signal hardware to fully operate the cutting system.

Serial RS-422 multi-drop (multi-system) addressing

- **For single plasma power supply installations, set the Serial terminators (S1) as shown in Unit 4 and the Serial IDs (S2) as shown in Unit 1. Refer to Figure 1.**
- For multi-plasma power supply installations, set the S1 position 1 and position 2 to the OFF position in all plasma power supplies, except for the last one that you set to ON. Refer to Figure 1.

  Termination resistors (120 Ω) or termination jumpers must be installed and set at the CNC for each of the RS-422 RX and TX signal pairs.
- If a Hypertherm CNC is used and there are intermittent communication failures (PS Link Failure), reverse the switch S1 position 1 and position 2 on the control PCB and the termination jumper (J6 or J8) on the serial isolation PCB in the controller. Only remove the termination jumper on the serial isolation PCB that is connected to the plasma power supply.
- For wiring diagrams of the XPR plasma power supply, refer to the instruction manual that came with your cutting system. Technical documentation is available at www.hypertherm.com/docs.

Figure 1 – Serial RS-422 multi-drop (multi-system) addressing



Multi-drop (multi-system) interface

Use the multi-drop (multi-system) interface from the CNC to communicate with multiple plasma power supplies:

1. Send the sleep command (758). This puts all the plasma power supplies into Sleep mode.
2. Send the wake command (759) and the ID number for the plasma power supply that you want to use. The active plasma power supply can now receive any command.
3. Send the necessary commands to the active plasma power supply.
4. After you send the last command to the active plasma power supply, go back to step 1 to communicate with the next plasma power supply.

Serial RS-422 communications

Serial RS-422 signals

Signal name	Description / meaning
TX +	Transmitting serial data from the plasma power supply to the CNC. Connect to CNC RX + .
TX -	Transmitting serial data from the plasma power supply to the CNC. Connect to CNC RX - .
RX +	Receiving serial data from the CNC to the plasma power supply. Connect to CNC TX + .
RX -	Receiving serial data from the CNC to the plasma power supply. Connect to CNC TX - .

Serial RS-422 commands

Command format

- ASCII-based protocol
- Baud 115200
- 8 data bits
- 1 stop bit
- No parity
- No flow control

Command framing

- > = Start of message
- 3-byte command ID
- Data (space after each data field [ASCII 0x20])
- c = end of data and start of checksum
- 2-byte checksum
- < = End of message Example: >6091004 c84<

Command results

The results to serial RS-422 commands include the ID for the command, unless there is an error in the command. If there is an error, the result is an error response. Refer to the example error results that follow:

Bad checksum result	
Return ID:	500
Description:	The serial command did not have the correct checksum.
Example:	Command: >000 cB1< (in this example, the checksum should be B0, not B1)
	Result: >500c95<
Bad command result	
Return ID:	501
Description:	The serial command was not recognized.
Example:	Command: >999cCB< (unknown ID)
	Result: >501c96<
Bad command format	
Return ID:	502
Description:	The > or < is missing from the serial command.
Example:	Command: 000 cB1<
	Result: >502 c97<
Access denied	
Return ID:	503
Description:	Only 1 interface (RS-422, EtherCAT, or web interface) can control the system. When a process is set by EtherCAT, the cutting system will not accept a process setting from an RS-422 interface or the web interface.
Example:	>503c98<
Invalid data	
Return ID:	504
Description:	The data in the serial command is not correct for that command (such as a bad process ID).
Example:	>504c99<

How checksums are calculated for serial RS-422 commands

Checksums are only calculated for XPR serial RS-422 command IDs and command data. Refer to these examples:

HELLO command: >000 cB0<

- 0 = 0x30 (ASCII value for number 0)
- 0 = 0x30
- 0 = 0x30
- Space = 0x20
- Checksum = 0x30 + 0x30 + 0x30 + 0x20 = 0xB0

Serial RS-422 guidelines

Do a check of the checksum

The serial RS-422 cable between the plasma power supply and the CNC uses a communication protocol that contains a checksum for each message.

Do a check of the checksum for all messages to make sure that the information is complete and accurate.

Send an unacknowledged message again

High frequency can cause interference with serial RS-422 communications, especially when high frequency is active.

If the plasma power supply does not acknowledge a message, send the message again when high frequency is inactive.

Protect the serial RS-422 cable from EMI

Some plasma power supplies use metal-shell (DB style) serial RS-422 interface cables. This type of cable is the best for electromagnetic interference (EMI) shielding.

For the best EMI-shielding outcomes, use a serial RS-422 interface cable that has these properties:

- 360° shield termination on both ends of the cable
- As short as possible
- No coils
- Metal shell

> **Note:** A drain wire alone cannot give sufficient EMI shielding. Do regular maintenance to keep the integrity of the shielding.

Serial RS-422 and EtherCAT commands

ID	Command	System	Description / meaning
000	Hello	XPR RS-422	Establishes communication with the plasma power supply. Use this command to identify the plasma power supply that you want to control.
			Data: none
			Return value: string identifying the plasma power supply
			RS-422 example: >000 cB0< >000XPR460 OptiMix c2E< >000XPR300 OptiMix c27< >000XPR170 OptiMix c2C<
602	Read fault code (replaced with Command Number 780)	XPR RS-422 EtherCAT	Gets the fault code for the latest system error.
			Data: none
			Return value: error code
			RS-422 example: >602 cB8< >602188 c59< (error code 188)
603	Read state	XPR RS-422 EtherCAT	Gets the current state of the plasma system.
			Data: none
			Return value: state code (Refer to State codes.)
			RS-422 example: >603 cB9< >6035 cEE< (state code 5)
			EtherCAT example: X3000: 01 = 603 X3000: 0B = 1 (signal power source to act) X3000: 0D = 5 (state code)

ID	Command	System	Description / meaning
608	Read process ID	XPR RS-422 EtherCAT	Reads the process ID number.
			Data: none
			Return value: process ID
			RS-422 example: (RS-422 does not return the offset values. Refer to command ID 795 to query for the offset values.) >608 cBE< >6081005 c84< (process ID = 1005)
			EtherCAT example: X3000: 01 = 608 X3000: 0B = 1 (signal power source to act) X3000: 0D = 1005 (process ID) X3000: 0E = 85 [Cut current overrides value. If no override is set, the value is (0)] X3000: 0F = 72 [Plasma cutflow psi overrides value. If no override is set, the value is (0).] X3000: 10 = 50 [Shield cutflow psi overrides value. If no override is set, the value is (0).] X3000: 11 = 6 [H_2 slpm overrides value. If no override is set, the value is (0).] X3000: 12 = 22 [N_2 slpm overrides value. If no override is set, the value is (0).] X3000: 13 = 10 [Argon (Ar) slpm overrides value. If no override is set, the value is (0).] X3000: 14 = 17 [Shield pierce psi overrides value. If no override is set, the value is (0).]
609	Write process ID	XPR RS-422 EtherCAT	Writes the process ID.
			Data: process ID
			Return value: 609 if accepted; 504 if not accepted (RS-422 only) (no return value for EtherCAT)
			RS-422 example: >6091004 c84< (process ID 1004) >609c9F< (if successful) >504c99< (if not successful)
			EtherCAT example: X3000: 01 = 609 X3000: 03 = 1004 (process ID) X3000: 0B = 1 (signal power source to act)

ID	Command	System	Description / meaning
611	Read system type (replaced with Command ID 777)	XPR RS-422 EtherCAT	Reads the system type code.
			Data: none
			Return value: system type code (Refer to System ID.)
			RS-422 example: >611 cB8< >61134 c1F< (XPR300 VWI)
			EtherCAT example: X3000: 01 = 611 X3000: 0B = 1 (signal power source to act) X3000: 0D = 36 (XPR300 OptiMix)
615	Read Chopper 1 temperature	XPR RS-422 EtherCAT	Reads the temperature for Chopper 1.
			Data: none
			Return value: temperature in degrees Celsius, scaled X 10
			RS-422 example: >615 cBC< >615246 c58< (24.6°C)
			EtherCAT example: X3000: 01 = 615 X3000: 0B = 1 (signal power source to act) X3000: 0D = 246 (24.6°C)
616	Read Chopper 1 current	XPR RS-422 EtherCAT	Reads the current for Chopper 1.
			Data: none
			Return value: current in amperes (A)
			RS-422 example: >616 cBD< >61685 c2A< (85 A)
			EtherCAT example: X3000: 01 = 616 X3000: 0B = 1 (signal power source to act) X3000: 0D = 85 (A)

ID	Command	System	Description / meaning
619	Read Chopper 2 temperature	XPR RS-422 EtherCAT	Reads the temperature for Chopper 2.
			Data: none
			Return value: temperature in degrees Celsius, scaled X 10
			RS-422 example: >619 cC0< >619253 c5A< (25.3°C)
			EtherCAT example: X3000: 01 = 619 X3000: 0B = 1 (signal power source to act) X3000: 0D = 253 (25.3°C)
620	Read Chopper 2 current	XPR RS-422 EtherCAT	Reads the current for Chopper 2.
			Data: none
			Return value: current in amperes (A)
			RS-422 example: >620 cB8< >62010 c19< (10 A)
			EtherCAT example: X3000: 01 = 620 X3000: 0B = 1 (signal power source to act) X3000: 0D = 10 (A)
624	Read coolant flow rate	XPR RS-422 EtherCAT	Reads the flow rate for the coolant.
			Data: none
			Return value: flow rate in U.S. gallons per minute (gal/min), scaled X 100 Example: 175 = 1.75 gal/min
			RS-422 example: >624 cBC< >624187 c5C< (1.87 gal/min)
			EtherCAT example: X3000: 01 = 624 X3000: 0B = 1 (signal power source to act) X3000: 0D = 187 (1.87 gal/min)

ID	Command	System	Description / meaning
625	Read coolant temperature	XPR RS-422 EtherCAT	Reads the coolant temperature.
			Data: none
			Return value: temperature in degrees Celsius, scaled X 10
			RS-422 example: >625 cBD< >625255 c59< (25.5°C)
			EtherCAT example: X3000: 01 = 625 X3000: 0B = 1 (signal power source to act) X3000: 0D = 255 (25.5°C)
626	Read transformer temperature	XPR RS-422 EtherCAT	Reads the temperature for the main transformer.
			Data: none
			Return value: temperature in degrees Celsius, scaled X 10
			RS-422 example: >626 cBE< >626226 c58< (22.6°C)
			EtherCAT example: X3000: 01 = 626 X3000: 0B = 1 (signal power source to act) X3000: 0D = 226 (22.6°C)
627	Read work lead current	XPR RS-422 EtherCAT	Reads the current in the work lead (maximum value is 258 A).
			Data: none
			Return value: current in amperes (A)
			RS-422 example: >627 cBF< >6270 cEF< 0 (A)
			EtherCAT example: X3000: 01 = 627 X3000: 0B = 1 (signal power source to act) X3000: 0D = 170 (A)
630	Read Chopper 3 temperature	XPR RS-422 EtherCAT	Reads the temperature for Chopper 3.
			Data: none
			Return value: temperature in degrees Celsius, scaled X 10
			RS-422 example: >630 cB9< >630246 c55< (24.6 °C)
			EtherCAT example: X3000: 01 = 630 X3000: 0B = 1 (signal power source to act) X3000: 0D = 246 (24.6 °C)

ID	Command	System	Description / meaning
631	Read Chopper 3 current	XPR RS-422 EtherCAT	Reads the current for Chopper 3.
			Data: none
			Return value: current in amperes (A)
			RS-422 example: >631 cBA< >63185 c27< (85 A)
			EtherCAT example: X3000: 01 = 631 X3000: 0B = 1 (signal power source to act) X3000: 0D = 85 (A)
634	Read output Plasma A pressure	XPR RS-422 EtherCAT	Reads the pressure in Plasma Line A.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >634 cBD< >63415 c23< (15 psi)
			EtherCAT example: X3000: 01 = 634 X3000: 0B = 1 (signal power source to act) X3000: 0D = 15 (psi)
635	Read output Plasma B pressure	XPR RS-422 EtherCAT	Reads the pressure in Plasma Line B.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >635 cBE< >63515 c24< (15 psi)
			EtherCAT example: X3000: 01 = 635 X3000: 0B = 1 (signal power source to act) X3000: 0D = 15 (psi)
636	Read output shield pressure	XPR RS-422 EtherCAT	Reads the shield gas pressure.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >636 cBF< >6365 cF4< (5 psi)
			EtherCAT example: X3000: 01 = 636 X3000: 0B = 1 (signal power source to act) X3000: 0D = 5 (psi)

ID	Command	System	Description / meaning
659	Read Inductor 1 temperature	XPR RS-422 EtherCAT	Reads the temperature of Inductor 1.
			Data: none
			Return value: temperature in degrees Celsius, scaled X 10
			RS-422 example: >659 cC4< >659226 c5E< (22.6°C)
			EtherCAT example: X3000: 01 = 659 X3000: 0B = 1 (signal power source to act) X3000: 0D = 226 (22.6°C)
660	Read Inductor 2 temperature	XPR RS-422 EtherCAT	Reads the temperature for Inductor 2.
			Data: none
			Return value: temperature in degrees Celsius, scaled X 10
			RS-422 example: >660 cBC< >660225 c55< (22.5°C)
			EtherCAT example: X3000: 01 = 660 X3000: 0B = 1 (signal power source to act) X3000: 0D = 225 (22.5°C)
661	Read Inductor 3 temperature	XPR RS-422 EtherCAT	Reads the temperature for Inductor 3.
			Data: none
			Return value: temperature in degrees Celsius, scaled X 10
			RS-422 example: >661 cBD< >661225 c56< (22.5°C)
			EtherCAT example: X3000: 01 = 661 X3000: 0B = 1 (signal power source to act) X3000: 0D = 225 (22.5°C)
662	Read Inductor 4 temperature	XPR RS-422 EtherCAT	Reads the temperature for Inductor 4.
			Data: none
			Return value: temperature in degrees Celsius, scaled X 10
			RS-422 example: >662 cBE< >662225 c57< (22.5°C)
			EtherCAT example: X3000: 01 = 662 X3000: 0B = 1 (signal power source to act) X3000: 0D = 225 (22.5°C)

ID	Command	System	Description / meaning
663	Read Inductor 5 temperature	XPR RS-422 EtherCAT	Reads the temperature for Inductor 5.
			Data: none
			Return value: temperature in degrees Celsius, scaled X 10
			RS-422 example: >663 cBF< >663221 c54< (22.1°C)
			EtherCAT example: X3000: 01 = 663 X3000: 0B = 1 (signal power source to act) X3000: 0D = 221 (22.1°C)
664	Read Inductor 6 temperature	XPR RS-422 EtherCAT	Reads the temperature for Inductor 6.
			Data: none
			Return value: temperature in degrees Celsius, scaled X 10
			RS-422 example: >664 cC0< >664224 c58< (22.4°C)
			EtherCAT example: X3000: 01 = 664 X3000: 0B = 1 (signal power source to act) X3000: 0D = 224 (22.4°C)
665	Read bus voltage	XPR RS-422 EtherCAT	Reads the direct current (DC) bus voltage.
			Data: none
			Return value: voltage in volts (V)
			RS-422 example: >665 cC1< >665352 c5B< (352 VDC)
			EtherCAT example: X3000: 01 = 665 X3000: 0B = 1 (signal power source to act) X3000: 0D = 352 (VDC)
666	Read Line A inlet	XPR RS-422 EtherCAT	Reads the inlet pressure for Line A.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >666 cC2< >66645 c5D< (45 psi)
			EtherCAT example: X3000: 01 = 666 X3000: 0B = 1 (signal power source to act) X3000: 0D = 45 (psi)

ID	Command	System	Description / meaning
667	Read Line B inlet	XPR RS-422 EtherCAT	Reads the inlet pressure for Line B.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >667 cC3< >66745 c5D< (45 psi)
			EtherCAT example: X3000: 01 = 667 X3000: 0B = 1 (signal power source to act) X3000: 0D = 45 (psi)
668	Read coolant level	XPR RS-422 EtherCAT	Reads the sensor that monitors coolant level.
			Data: none
			Return value: 1 = level sufficient; 0 = level low
			RS-422 example: >668 cC4< >6681 cF5< (level sufficient)
			EtherCAT example: X3000: 01 = 668 X3000: 0B = 1 (signal power source to act) X3000: 0D = 1 (level sufficient)
669	Read Wi-Fi MAC address	XPR RS-422 EtherCAT	Reads the MAC address for the wireless module.
			Data: none
			Return value: hexadecimal address characters (ASCII), last 4 digits of the MAC address.
			RS-422 example: >669 cC5< >669aef6 c27< (aef6 = address)
			EtherCAT example: X3000: 01 = 669 X3000: 0B = 1 (signal power source to act) X3000: 0D = 97d (a) X3000: 0E = 101d (e) X3000: 0F = 102d (f) X3000: 10 = 54d (6)

ID	Command	System	Description / meaning
672	Start test preflow	XPR RS-422 EtherCAT	Starts the preflow gases.
			Data: 1 = start
			Return value: none
			RS-422 example: >6721 cF0< >672c9F<
			EtherCAT example: X3000: 01 = 672 X3000: 03 = 1 X3000: 0B = 1 (signal power source to act)
673	Stop test preflow	XPR RS-422 EtherCAT	Stops the preflow gases.
			Data: none
			Return value: none
			RS-422 example: >673 cC0< >673cA0<
			EtherCAT example: X3000: 01 = 673 X3000: 0B = 1 (signal power source to act)
674	Start test cutflow	XPR RS-422 EtherCAT	Starts the cutflow gases.
			Data: 1 = start
			Return value: none
			RS-422 example: >6741 cF2< >674cA1<
			EtherCAT example: X3000: 01 = 674 X3000: 03 = 1 X3000: 0B = 1 (signal power source to act)
675	Stop test cutflow	XPR RS-422 EtherCAT	Stops the cutflow gases.
			Data: none
			Return value: none
			RS-422 example: >675 cC2< >675cA2<
			EtherCAT example: X3000: 01 = 675 X3000: 0B = 1 (signal power source to act)

ID	Command	System	Description / meaning
676	Leak check mode	XPR RS-422 EtherCAT	Commands the system to do a leak check (results show in the error log).
			Data: 1 = start
			Return value: none
			RS-422 example: >6761cF3< >676cA3<
			EtherCAT example: X3000: 01 = 676 X3000: 03 = 1 X3000: 0B = 1 (signal power source to act)
679	Read console type	XPR EtherCAT	Reads the console type.
			Data: none
			Return value: console name in ASCII (up to four characters per line)
			EtherCAT example: X3000: 01 = 679 X3000: 0B = 1 (signal power source to act) X3000: 0D = 6974704F (Opti) X3000: 0E = 0078694D (Mix)
686	Read smart fault	XPR RS-422 EtherCAT	Reads the smart fault information.
			Data: none
			Return value: error code followed by the smart data
			RS-422 example: >686 cC4< >686520 c1:0A_arcv:6V_busv:360V c9C<
			EtherCAT example: X3000: 01 = 686 X3000: 0B = 1 (signal power source to act) X3000: 0D = 520 (error code ID) X3000: 0E = 106 (arc voltage) X3000: 0F = 360 (bus voltage)
			Note: Refer to the faults.xls file to decode the data returned when using EtherCAT. X3000: 0D -> column A “id” X3000: 0E -> column F “Smart Data 1” X3000: 0F -> column G “Smart Data 2”

ID	Command	System	Description / meaning
687	Read error log	XPR RS-422 EtherCAT	Reads the error log.
			Data: none
			Return value: error code IDs
			RS-422 example: >687 cC5< >687643 642 643 642 520 647 643 642 643 642 643 642 647 643 642 647 c75<
			EtherCAT example: X3000: 01 = 687 X3000: 0B = 1 (signal power source to act) X3000: 0D = first error code X3000: 0E = second error code X3000: 0F = third error code
688	Read gas types	XPR RS-422 EtherCAT	Reads the gas type codes. Refer to Gas-type codes.
			Data: none
			Return value: Line A Gas Type Line B Gas Type Shield Gas Type
			Space delimited
			RS-422 example: >688 cC6< >6881 6 6 cA3<
			EtherCAT example: X3000: 01 = 688 X3000: 0B = 1 (signal power source to act) X3000: 0D = 1 (Line A Gas Type) X3000: 0E = 6 (Line B Gas Type) X3000: 0F = 6 (Shield Gas Type)
689	Read all process IDs	XPR RS-422	Reads the available process IDs for the system (currently not available for EtherCAT).
			Data: none
			Return value: process IDs
			RS-422 example: >689 cC7< >68926 32 33 1000 1011 1012 1013 2000 2001 2002 2002 2010 2011 2012 2013 2014 2030 2031 2032 2033 2034 2040 2041 c1D<

ID	Command	System	Description / meaning
690	Current setpoint increment	XPR RS-422 EtherCAT	Increases the current by the specified amperes value. (Limited up to +200% when current is less than 30 A, otherwise +100%.)
			Data: amount to change the current, in amperes (A)
			Return value: none
			RS-422 example: >6905 cF4< (increases the current by 5 A) >690c9F<
			EtherCAT example: X3000: 01 = 690 X3000: 03 = 5 (A) X3000: 0B = 1 (signal power source to act)
691	Current setpoint decrement	XPR RS-422 EtherCAT	Decreases the current by the specified amperes value for up to -100%.
			Data: amount to change the current by, in amperes (A)
			Return value: none
			RS-422 example: >6915 cF5< (decreases the current by 5 A) >691cA0<
			EtherCAT example: X3000: 01 = 691 X3000: 03 = 5 (A) X3000: 0B = 1 (signal power source to act)
692	Plasma cutflow increment	XPR RS-422 EtherCAT	Increases the plasma cutflow pressure by up to +100%.
			Data: amount to change the cutflow pressure, in pounds/square inch (psi)
			Return value: none
			RS-422 example: >6925 cF6< (increases the pressure by 5 psi) >692cA1<
			EtherCAT example: X3000: 01 = 692 X3000: 03 = 5 (psi) X3000: 0B = 1 (signal power source to act)

ID	Command	System	Description / meaning
693	Plasma cutflow decrement	XPR RS-422 EtherCAT	Decreases the plasma cutflow pressure by up to -100%.
			Data: amount to change the cutflow pressure, in pounds/square inch (psi)
			Return value: none
			RS-422 example: >6935 cF7< (decreases the pressure by 5 psi) >693cA2<
			EtherCAT example: X3000: 01 = 693 X3000: 03 = 5 (psi) X3000: 0B = 1 (signal power source to act)
694	Shield cutflow increment	XPR RS-422 EtherCAT	Increases the shield cutflow pressure by up to +100%.
			Data: amount to change the shield pressure, in pounds/square inch (psi)
			Return value: none
			RS-422 example: >6945 cF8< (increase the pressure by 5 psi) >694cA3<
			EtherCAT example: X3000: 01 = 694 X3000: 03 = 5 (psi) X3000: 0B = 1 (signal power source to act)
695	Shield cutflow decrement	XPR RS-422 EtherCAT	Decreases the shield cutflow pressure by up to -100%.
			Data: amount to change the shield pressure, in pounds/square inch (psi)
			Return value: none
			RS-422 example: >6955 cF9< (decreases the pressure by 5 psi) >695cA4<
			EtherCAT example: X3000: 01 = 695 X3000: 03 = 5 (psi) X3000: 0B = 1 (signal power source to act)

ID	Command	System	Description / meaning
696	Mix H_2 setpoint increment	XPR RS-422 EtherCAT	Increases the hydrogen (H_2) flow rate by up to +50%.
			The hydrogen (H_2) flow rate cannot exceed the argon (Ar) flow rate plus the nitrogen (N_2) flow rate. (H_2 flow rate < Ar flow rate + N_2 flow rate)
			Data: amount to change the flow rate, in standard liters per minute (slpm)
			Return value: none
			RS-422 example: >6965 cFA< (increases the flow rate by 5 slpm) >696cA5<
			EtherCAT example: X3000: 01 = 696 X3000: 03 = 5 (slpm) X3000: 0B = 1 (signal power source to act)
697	Mix H_2 setpoint decrement	XPR RS-422 EtherCAT	Decreases the hydrogen (H_2) flow rate by up to -50%.
			Data: amount to change the flow rate, in standard liters per minute (slpm)
			Return value: none
			RS-422 example: >6975 cFB< (decreases the flow rate by 5 slpm) >697cA6<
			EtherCAT example: X3000: 01 = 697 X3000: 03 = 5 (slpm) X3000: 0B = 1 (signal power source to act)
716	Mix N_2 setpoint increment	XPR RS-422 EtherCAT	Increases the nitrogen (N_2) flow rate by up to +50%.
			Data: amount to change the flow rate, in standard liters per minute (slpm)
			Return value: none
			RS-422 example: >7165 cF3< (increase the flow rate by 5 slpm) >716c9E<
			EtherCAT example: X3000: 01 = 716 X3000: 03 = 5 (slpm) X3000: 0B = 1 (signal power source to act)

ID	Command	System	Description / meaning
717	Mix N_2 setpoint decrement	XPR RS-422 EtherCAT	Decreases the nitrogen (N_2) flow rate by up to -50%.
			The hydrogen (H_2) flow rate cannot exceed the argon (Ar) flow rate plus the nitrogen (N_2) flow rate. (H_2 flow rate < Ar flow rate + N_2 flow rate)
			Data: amount to change the flow rate, in standard liters per minute (slpm)
			Return value: none
			RS-422 example: >7175 cF4< (decrease the flow rate by 5 slpm) >717c9F<
			EtherCAT example: X3000: 01 = 717 X3000: 03 = 5 (slpm) X3000: 0B = 1 (signal power source to act)
718	Mix argon setpoint increment	XPR RS-422 EtherCAT	Increases the argon (Ar) flow rate by up to +50%.
			Data: amount to change the flow rate, in standard liters per minute (slpm)
			Return value: none
			RS-422 example: >7185 cF5< (increase the flow rate by 5 slpm) >718cA0<
			EtherCAT example: X3000: 01 = 718 X3000: 03 = 5 (slpm) X3000: 0B = 1 (signal power source to act)
719	Mix argon setpoint decrement	XPR RS-422 EtherCAT	Decreases the argon (Ar) flow rate by up to -50%.
			The hydrogen (H_2) flow rate cannot exceed the argon (Ar) flow rate plus the nitrogen (N_2) flow rate. (H_2 flow rate < Ar flow rate + N_2 flow rate)
			Data: amount to change the flow rate, in standard liters per minute (slpm)
			Return value: none
			RS-422 example: >7195 cF6< (decreases the flow rate by 5 slpm) >719cA1<
			EtherCAT example: X3000: 01 = 719 X3000: 03 = 5 (slpm) X3000: 0B = 1 (signal power source to act)

ID	Command	System	Description / meaning
750	Fan #1 speed	XPR RS-422 EtherCAT	Reads magnetics fan #1 speed in revolutions per minute (RPM).
			Data: none
			Return value: speed in RPM
			RS-422 example: >750 cBC< >7502850 c8B< (2850 RPM)
			EtherCAT example: X3000: 01 = 750 X3000: 0B = 1 (signal power source to act) X3000: 0D = 2850 (RPM)
751	Fan #2 speed	XPR RS-422 EtherCAT	Reads magnetics fan #2 speed in revolutions per minute (RPM).
			Data: none
			Return value: speed in RPM
			RS-422 example: >751 cBD< >7512850 c8C< (2850 RPM)
			EtherCAT example: X3000: 01 = 751 X3000: 0B = 1 (signal power source to act) X3000: 0D = 2850 (RPM)
752	Fan #3 speed	XPR RS-422 EtherCAT	Reads heat exchanger fan #1 speed in revolutions per minute (RPM).
			Data: none
			Return value: speed in RPM
			RS-422 example: >752 cBE< >7522850 c8D< (2850 RPM)
			EtherCAT example: X3000: 01 = 752 X3000: 0B = 1 (signal power source to act) X3000: 0D = 2850 (RPM)

ID	Command	System	Description / meaning
753	Fan #4 speed	XPR RS-422 EtherCAT	Reads heat exchanger fan #2 speed in revolutions per minute (RPM) for XPR300 and XPR460 only.
			Data: none
			Return value: speed in RPM
			RS-422 example: >753 cBF< >7532850 c8E< (2850 RPM)
			EtherCAT example: X3000: 01 = 753 X3000: 0B = 1 (signal power source to act) X3000: 0D = 2850 (RPM)
754	Fan #5 speed	XPR RS-422 EtherCAT	Reads control fan #1 speed in revolutions per minute (RPM) for XPR170 and XPR300 only.
			Data: none
			Return value: speed in RPM
			RS-422 example: >754 cC0< >7542850 c8F< (2850 RPM)
			EtherCAT example: X3000: 01 = 754 X3000: 0B = 1 (signal power source to act) X3000: 0D = 2850 (RPM)
755	Fan #6 speed	XPR RS-422 EtherCAT	Reads control fan #2 speed in revolutions per minute (RPM) for XPR170 and XPR300 only.
			Data: none
			Return value: speed in RPM
			RS-422 example: >755 cC1< >7552850 c90< (2850 RPM)
			EtherCAT example: X3000: 01 = 755 X3000: 0B = 1 (signal power source to act) X3000: 0D = 2850 (RPM)

ID	Command	System	Description / meaning
756	Shield pierce increment	XPR RS-422 EtherCAT	Increases the shield pierce pressure by up to +100%.
			Data: amount to change the pierce pressure, in pounds/square inch (psi)
			Return value: none
			RS-422 example: >7565 cF7< (increases the pressure by 5 psi) >756cA3<
			EtherCAT example: X3000: 01 = 756 X3000: 03 = 5 (psi) X3000: 0B = 1 (signal power source to act)
757	Shield pierce decrement	XPR RS-422 EtherCAT	Decreases the shield pierce pressure by up to -100%.
			Data: amount to change the pierce pressure, in pounds/square inch (psi)
			Return value: none
			RS-422 example: >7575 cF8< (decreases the pressure by 5 psi) >757cA4<
			EtherCAT example: X3000: 01 = 757 X3000: 03 = 5 (psi) X3000: 0B = 1 (signal power source to act)
758	Sleep	XPR RS-422	Disables the RS-422 transmitter for multi-drop (multi-system) serial installations. All connected systems enter Sleep mode (listen only).
			Data: none
			Return value: none
			RS-422 example: >758cA5< No response
759	Wake	XPR RS-422	Lets the RS-422 transmitter do multi-drop (multi-system) serial installations. Note: Only systems with matching system IDs will be activated.
			Data: system ID (uses DIP switches to set the ID) Refer to Serial RS-422 multi-drop (multi-system) addressing.
			Return value: none
			RS-422 example: >7591 cF6< (wake system ID #1) >759cA6<

ID	Command	System	Description / meaning
760	Firmware versions	XPR RS-422 EtherCAT	Returns the firmware versions for these components: ▪ Main control ▪ Torch connect console ▪ Gas connect console ▪ Choppers ▪ Cooler ▪ Wireless module
			Data: none
			Return value: numeric version space delimited Main control Torch connect Gas connect Chopper 1 Chopper 2 Wireless module Chopper 3 Cooler
			RS-422 example: >760c9D< >760W W W W W 5.2.0.0R8 W W cD9< Main control = W Torch connect = W Gas connect = W Chopper 1 = W Chopper 2 = W Wireless module = 5.2.0.0R8 Chopper 3 = W Cooler = W
			EtherCAT example: X3000: 01 = 760 X3000: 0B = 1 (signal power source to act) X3000: 0D = x57 W (Main control) X3000: 0E = x57 W (Torch connect console) X3000: 0F = x57 W (Gas connect console) X3000: 10 = x57 W (Chopper 1) X3000: 11 = x57 W (Chopper 2) X3000: 12 = x5 (Wireless module major revision) X3000: 13 = x57 W (Chopper 3) X3000: 14 = x57 W (Cooler)

ID	Command	System	Description / meaning
761	Read shield inlet	XPR RS-422 EtherCAT	Reads the shield inlet pressure.
			Data: none
			Return value: shield inlet pressure in pounds/square inch (psi)
			RS-422 example: >761 cBE< >76125 c25< (25 psi)
			EtherCAT example: X3000: 01 = 761 X3000: 0B = 1 (signal power source to act) X3000: 0D = 25 (psi)
762	Read torch protection enable	XPR RS-422 EtherCAT	Reads the enable/disable state of the Torch Protection mode. When active, allows the system to detect that the arc has become excessively unstable. When disabled, the system will not use this mode.
			Data: none
			Return value: 1 = enabled, 0 = disabled
			RS-422 example: >762 cBF< >7621 cF0< (enabled)
			EtherCAT example: X3000: 01 = 762 X3000: 0B = 1 (signal power source to act) X3000: 0D = 1 (enabled)
763	Write torch protection enable	XPR RS-422 EtherCAT	Writes the enable/disable state of the Torch Protection mode. When active, allows the system to detect that the arc is not stable.
			Data: 1 = enable, 0 = disable
			Return value: none
			RS-422 example: >7631 cF1< (enable) >763cA0<
			EtherCAT example: X3000: 01 = 763 X3000: 03 = 1 (enable) X3000: 0B = 1 (signal power source to act)

ID	Command	System	Description / meaning
764	Read rampdown error protection	XPR RS-422 EtherCAT	Reads the enable/disable state of the Ramp-Down Error Protection mode. When active, allows the system to detect that the arc will extinguish in a short time.
			Data: none
			Return value: 1 = enabled, 0 = disabled
			RS-422 example: >764 cC1< >7641 cF2< (enabled)
			EtherCAT example: X3000: 01 = 764 X3000: 0B = 1 (signal power source to act) X3000: 0D = 1 (enabled)
765	Write rampdown error protection	XPR RS-422 EtherCAT	Writes the enable/disable state of the Ramp-Down Error Protection mode. When active, allows the system to detect that the arc will extinguish in a short time.
			Data: 1 = enable, 0 = disable
			Return value: none
			RS-422 example: >7651 cF3< (enable) >765cA2<
			EtherCAT example: X3000: 01 = 765 X3000: 03 = 1 (enable) X3000: 0B = 1 (signal power source to act)
768	Start test pierce flow	XPR RS-422 EtherCAT	Starts the pierce gas settings.
			Data: 1 = start
			Return value: none
			RS-422 example: >7681 cF6< >768cA5<
			EtherCAT example: X3000: 01 = 768 X3000: 03 = 1 (enable) X3000: 0B = 1 (signal power source to act)

ID	Command	System	Description / meaning
769	Stop test pierce flow	XPR RS-422 EtherCAT	Stops the pierce gas settings.
			Data: none
			Return value: none
			RS-422 example: >769 cC6< >769cA6<
			EtherCAT example: X3000: 01 = 769 X3000: 0B = 1 (signal power source to act)
770	Current override	XPR RS-422 EtherCAT	Overrides the current setpoint +200% / -100% if current is less than 30 A, otherwise +/- 100%. A value of 0 A is not permitted.
			Data: the current value in amperes (A)
			Return value: none
			RS-422 example: >770160 c55< (current setpoint = 160 A) >770c9E<
			EtherCAT example: X3000: 01 = 770 X3000: 03 = 160 (A) X3000: 0B = 1 (signal power source to act)
771	Plasma cutflow override	XPR RS-422 EtherCAT	Overrides the plasma cutflow setpoint +/- 100%.
			Data: the plasma cutflow value in pounds/square inch (psi)
			Return value: none
			RS-422 example: >77150 c24< (plasma cutflow = 50 psi) >771c9F<
			EtherCAT example: X3000: 01 = 771 X3000: 03 = 50 (psi) X3000: 0B = 1 (signal power source to act)
772	Shield cutflow override	XPR RS-422 EtherCAT	Overrides the shield cutflow setpoint +/- 100%.
			Data: the shield cutflow value in pounds/square inch (psi)
			Return value: none
			RS-422 example: >77250 c25< (shield cutflow = 50 psi) >772cA0<
			EtherCAT example: X3000: 01 = 772 X3000: 03 = 50 (psi) X3000: 0B = 1 (signal power source to act)

ID	Command	System	Description / meaning
773	H_2 flow override	XPR RS-422 EtherCAT	Overrides the hydrogen (H_2) flow setpoint +/- 50%.
			Data: the H_2 flow value in standard liters per minute (slpm)
			Return value: none
			RS-422 example: >77325 c28< (H_2 setpoint = 25 slpm) >773cA1<
			EtherCAT example: X3000: 01 = 773 X3000: 03 = 25 (slpm) X3000: 0B = 1 (signal power source to act)
774	N_2 flow override	XPR RS-422 EtherCAT	Overrides the nitrogen (N_2) flow setpoint +/- 50%.
			Data: the N_2 flow value in standard liters per minute (slpm)
			Return value: none
			RS-422 example: >77425 c29< (N_2 setpoint = 25 slpm) >774cA2<
			EtherCAT example: X3000: 01 = 774 X3000: 03 = 25 (slpm) X3000: 0B = 1 (signal power source to act)
775	Argon flow override	XPR RS-422 EtherCAT	Overrides the argon (Ar) flow setpoint +/- 50%.
			Data: the argon (Ar) flow value in standard liters per minute (slpm)
			Return value: none
			RS-422 example: >77525 c2A< (Ar setpoint = 25 slpm) >775cA3<
			EtherCAT example: X3000: 01 = 775 X3000: 03 = 25 (25 slpm) X3000: 0B = 1 (signal power source to act)
776	Shield pierce override	XPR RS-422 EtherCAT	Overrides the pierce pressure setpoint +/- 100%.
			Data: the pierce pressure value in pounds/square inch (psi)
			Return value: none
			RS-422 example: >77650 c29< (pierce pressure = 50 psi) >776cA5<
			EtherCAT example: X3000: 01 = 776 X3000: 03 = 50 (psi) X3000: 0B = 1 (signal power source to act)

ID	Command	System	Description / meaning
777	System Type ID	XPR RS-422 EtherCAT	Reads the ID of the system type.
			Data: none
			Return value: system ID (Refer to System ID.)
			RS-422 example: >777 cC5< >77736 c2E< (XPR300 OptiMix)
			EtherCAT example: X3000: 01 = 777 X3000: 0B = 1 (signal power source to act) X3000: 0D = 36 (XPR300 OptiMix)
778	System type description	XPR RS-422	Reads the description of the system type.
			Data: none
			Return value: system type
			RS-422 example: >778 cC6< >778XPR OptiMix c3D<
780	System error ID	XPR RS-422 EtherCAT	Reads the ID of the highest priority active system fault.
			Data: none
			Return value: system error
			RS-422 example: >780 cBF< >780759 c64<
			EtherCAT example: X3000: 01 = 780 X3000: 0B = 1 (signal power source to act) X3000: 0D = 759
781	Arc time	XPR RS-422 EtherCAT	Reads the arc time.
			Data: none
			Return value: arc time (in seconds)
			RS-422 example: >781 cC0< >7811896 c98< (1896 seconds)
			X3000: 01 = 781 X3000: 0B = 1 (signal power source to act) X3000: 0D = 1896 (seconds)

ID	Command	System	Description / meaning
782	Total current	XPR RS-422 EtherCAT	Reads the total current output.
			Data: none
			Return value: current in amperes (A)
			RS-422 example: >782 cC1< >7820 cF1< (0 A)
			EtherCAT example: X3000: 01 = 782 X3000: 0B = 1 (signal power source to act) X3000: 0D = 300 (A)
783	Discrete I/O	XPR RS-422 EtherCAT	Reads the status of the system discrete I/O.
			Data: none
			Return value: I/O
			Bit 0: System On input Bit 1: Start input Bit 2: Hold input Bit 3: Pierce input Bit 4: Main Contactor output Bit 5: Pump Enable output Bit 6: Coolant Solenoid output Bit 7: Fan output Bit 8: Hx Fan output Bit 9: Ready-for-Start output Bit 10: Transfer Bit 11: Ohmic Contact output Bit 12: CNC Motion output Bit 13: CNC Hold output Bit 14: CNC Error output Bit 15: External 24 V power status
			RS-422 example: >783 cC2< >783609 c61< (Convert the 609d to binary. Bits 0, 5, 6, and 9 are turned ON.)
			EtherCAT example: X3000: 01 = 783 X3000: 0B = 1 (signal power source to act) X3000: 0D = 609 (Bits 0, 5, 6, and 9 are turned ON)

ID	Command	System	Description / meaning
784	Active errors	XPR RS-422 EtherCAT	Reads the IDs of the active errors.
			Data: none
			Return value: active error IDs
			RS-422 example: >784 cC3< >784643 759 c25<
			EtherCAT example: X3000: 01 = 784 X3000: 0B = 1 (signal power source to act) X3000: 0D = 643 X3000: 0E = 759
785	Error history	XPR RS-422	Reads the history of the system errors.
			Data: none
			Return value: error history information
			A_B_C_D_E_F A = ID B = Reserved C = Timestamp (on time) D = Data 1 E = Data 2 F = Reserved
			RS-422 example: >785 cC4< >785643_1_44221_0_0 759_1_44219_75_0 642_0_44217_0_0 646_0_44212_0_0 643_0_44123_0_0 759_0_44121_74_0 642_0_44121_0_0 cA3<

ID	Command	System	Description / meaning
786	Gas setpoints	XPR RS-422 EtherCAT	Reads the gas setpoints from the torch connect console.
			Data: none
			Return value: setpoints in pounds/square inch (psi) Line A setpoint Line B setpoint Shield setpoint Space delimited
			RS-422 example: >786 cC5< >7860 0 0 c95<
			EtherCAT example: X3000: 01 = 786 X3000: 0B = 1 (signal power source to act) X3000: 0D = 0 (Line A psi) X3000: 0E = 0 (Line B psi) X3000: 0F = 0 (Shield psi)
787	Gas duty cycles	XPR RS-422 EtherCAT	Reads the pulse width modulation (PWM) duty cycles of the gas control valves in the torch connect console (“percent on”).
			Data: none
			Return value: duty cycles (% on / PWM) Line A duty Line B duty Shield duty Space delimited
			RS-422 example: >787 cC6< >7870 0 0 c96<
			EtherCAT example: X3000: 01 = 787 X3000: 0B = 1 (signal power source to act) X3000: 0D = 0 (Line A duty) X3000: 0E = 0 (Line B duty) X3000: 0F = 0 (Shield duty)

ID	Command	System	Description / meaning
788	Chopper setpoints	XPR RS-422 EtherCAT	Reads the current setpoints of the choppers.
			Data: none
			Return value: current in amperes (A) Chopper 1 setpoint Chopper 2 setpoint Chopper 3 setpoint Space delimited
			RS-422 example: >788 cC7< >7880 0 0 c97<
			EtherCAT example: X3000: 01 = 788 X3000: 0B = 1 (signal power source to act) X3000: 0D = 0 (Chopper 1 setpoint) X3000: 0F = 0 (Chopper 2 setpoint) X3000: 10 = 0 (Chopper 3 setpoint)
794	Read system on time	XPR RS-422 EtherCAT	Reads the total time that the system has been turned ON, in seconds.
			Data: none
			Return value: seconds
			RS-422 example: >794 cC4< >7941000 cB5< (1000 seconds)
			EtherCAT example: X3000: 01 = 794 X3000: 0B = 1 (signal power source to act) X3000: 0D = 1000 (seconds)

ID	Command	System	Description / meaning
795	Read process overrides	XPR RS-422	Reads the process override values.
			Data: none
			Return value: cut current (A), plasma cutflow (psi), shield cutflow (psi), H_2 flow rate (slpm), N_2 flow rate (slpm), argon (Ar) flow rate (slpm), shield pierce (psi) space delimited
			RS-422 example: >795 cC5< >795165 75 50 6 18 12 22 c58< cut current = 165 in amperes (A) plasma cutflow = 75 (psi) shield cutflow = 50 (psi) H_2 flow = 6 (slpm) N_2 flow = 18 (slpm) Argon flow = 12 (slpm) Shield pierce = 22 (psi)
796	Fan #7 speed	XPR RS-422 EtherCAT	Reads Magnetics Fan #3 in revolutions per minute (RPM).
			Data: none
			Return value: speed in RPM
			RS-422 example: >796 cC6< >7962850 c95< (2850 RPM)
			EtherCAT example: X3000: 01 = 796 X3000: 0B = 1 (signal power source to act) X3000: 0D = 2850 (RPM)
797	Fan #8 speed	XPR RS-422 EtherCAT	Reads the speed of Cabinet Fan #1 in revolutions per minute (RPM).
			Data: none
			Return value: speed in RPM
			RS-422 example: >797 cC7< >7972850 c96< (2850 RPM)
			EtherCAT example: X3000: 01 = 797 X3000: 0B = 1 (signal power source to act) X3000: 0D = 2850 (RPM)

ID	Command	System	Description / meaning
850	Outlet pressure mix	XPR RS-422 EtherCAT	Reads the mixing module outlet pressure.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >850 cBD< >85074 c28< (74 psi)
			EtherCAT example: X3000: 01 = 850 X3000: 0B = 1 (signal power source to act) X3000: 0D = 74 (psi)
851	Argon duty cycle	XPR RS-422 EtherCAT	Reads the argon (Ar) duty cycle from the mixing module.
			Data: none
			Return value: duty cycle (% on / PWM)
			RS-422 example: >851 cBE< >8510 cEE< (0 %)
			EtherCAT example: X3000: 01 = 851 X3000: 0B = 1 (signal power source to act) X3000: 0D = 0 (%)
852	N_2 duty cycle	XPR RS-422 EtherCAT	Reads the nitrogen (N_2) duty cycle from the mixing module.
			Data: none
			Return value: duty cycle (% on / PWM)
			RS-422 example: >852 cBF< >8520 cEF< (0 %)
			EtherCAT example: X3000: 01 = 852 X3000: 0B = 1 (signal power source to act) X3000: 0D = 0 (%)
853	H_2 duty cycle	XPR RS-422 EtherCAT	Reads the hydrogen (H_2) duty cycle from the mixing module.
			Data: none
			Return value: duty cycle (% on / PWM)
			RS-422 example: >853 cC0< >8530 cF0< (0 %)
			EtherCAT example: X3000: 01 = 853 X3000: 0B = 1 (signal power source to act) X3000: 0D = 0 (%)

ID	Command	System	Description / meaning
854	Argon inlet pressure	XPR RS-422 EtherCAT	Reads the argon (Ar) inlet pressure from the mixing module.
			Data: none
			Return value: Pressure in pounds/square inch (psi)
			RS-422 example: >854 cC1< >854118 c5B< (118 psi)
			EtherCAT example: X3000: 01 = 854 X3000: 0B = 1 (signal power source to act) X3000: 0D = 119 (psi)
855	N_2 inlet pressure	XPR RS-422 EtherCAT	Reads the nitrogen (N_2) inlet pressure from the mixing module.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >855 cC2< >855119 c5D< (119 psi)
			EtherCAT example: X3000: 01 = 855 X3000: 0B = 1 (signal power source to act) X3000: 0D = 119 (psi)
856	H_2 inlet pressure	XPR RS-422 EtherCAT	Reads the hydrogen (H_2) inlet pressure from the mixing module.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >856 cC3< >856118 c5E< (118 psi)
			EtherCAT example: X3000: 01 = 856 X3000: 0B = 1 (signal power source to act) X3000: 0D = 118 (psi)
857	Argon outlet flow	XPR RS-422 EtherCAT	Reads the argon (Ar) outlet flow from the mixing module.
			Data: none
			Return value: flow in standard liters per minute (slpm)
			RS-422 example: >857 cC4< >8575 cF9< (5 slpm)
			EtherCAT example: X3000: 01 = 857 X3000: 0B = 1 (signal power source to act) X3000: 0D = 5 (slpm)

ID	Command	System	Description / meaning
858	N_2 outlet flow	XPR RS-422 EtherCAT	Reads the nitrogen (N_2) outlet flow from the mixing module.
			Data: none
			Return value: flow in standard liters per minute (slpm)
			RS-422 example: >858 cC5< >8584 cF9< (4 slpm)
			EtherCAT example: X3000: 01 = 858 X3000: 0B = 1 (signal power source to act) X3000: 0D = 4 (slpm)
859	H_2 outlet flow	XPR RS-422 EtherCAT	Reads the hydrogen (H_2) outlet flow from the mixing module.
			Data: none
			Return value: flow in standard liters per minute (slpm)
			RS-422 example: >859 cC6< >8592 cF8< (2 slpm)
			EtherCAT example: X3000: 01 = 859 X3000: 0B = 1 (signal power source to act) X3000: 0D = 2 (slpm)
860	Argon flow setpoint	XPR RS-422 EtherCAT	Reads the argon (Ar) flow setpoint from the mixing module.
			Data: none
			Return value: flow in standard liters per minute (slpm)
			RS-422 example: >860 cBE< >8601 cEF< (1 slpm)
			EtherCAT example: X3000: 01 = 860 X3000: 0B = 1 (signal power source to act) X3000: 0D = 1 (slpm)
861	N_2 flow setpoint	XPR RS-422 EtherCAT	Reads the nitrogen (N_2) flow setpoint from the mixing module.
			Data: none
			Return value: flow in standard liters per minute (slpm)
			RS-422 example: >861 cBF< >8611 cF0< (1 slpm)
			EtherCAT example: X3000: 01 = 861 X3000: 0B = 1 (signal power source to act) X3000: 0D = 1 (slpm)

ID	Command	System	Description / meaning
862	H_2 flow setpoint	XPR RS-422 EtherCAT	Reads the hydrogen (H_2) flow setpoint from the mixing module.
			Data: none
			Return value: flow in standard liters per minute (slpm)
			RS-422 example: >862 cC0< >8622 cF2< (2 slpm)
			EtherCAT example: X3000: 01 = 862 X3000: 0B = 1 (signal power source to act) X3000: 0D = 2 (slpm)
863	F5 outlet pressure	XPR RS-422 EtherCAT	Reads the F5 (nitrogen-hydrogen) outlet pressure from the VWI/OptiMix gas connect console.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >863 cC1< >86369 c30< (69 psi)
			EtherCAT example: X3000: 01 = 863 X3000: 0B = 1 (signal power source to act) X3000: 0D = 69 (psi)
864	H_2O outlet pressure	XPR RS-422 EtherCAT	Reads the water (H_2O) outlet pressure from the VWI/OptiMix gas connect console.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >864 cC2< >8640 cF2< (0 psi)
			EtherCAT example: X3000: 01 = 864 X3000: 0B = 1 (signal power source to act) X3000: 0D = 30 (psi)

ID	Command	System	Description / meaning
865	F5 inlet pressure	XPR RS-422 EtherCAT	Reads the F5 (nitrogen-hydrogen) inlet pressure from the VWI/OptiMix gas connect console.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >865 cC3< >865121 c57< (121 psi)
			EtherCAT example: X3000: 01 = 865 X3000: 0B = 1 (signal power source to act) X3000: 0D = 121 (psi)
866	H_2O inlet pressure	XPR RS-422 EtherCAT	Reads the water (H_2O) inlet pressure from the VWI/OptiMix gas connect console.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >866 cC4< >86639 c30< (39 psi)
			EtherCAT example: X3000: 01 = 866 X3000: 0B = 1 (signal power source to act) X3000: 0D = 39 (psi)
867	F5 setpoint pressure	XPR RS-422 EtherCAT	Reads the F5 (nitrogen-hydrogen) setpoint pressure from the VWI/OptiMix gas connect console.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >867 cC5< >8670 cF5< (0 psi)
			EtherCAT example: X3000: 01 = 867 X3000: 0B = 1 (signal power source to act) X3000: 0D = 50 (psi)

ID	Command	System	Description / meaning
868	H_2O setpoint pressure	XPR RS-422 EtherCAT	Reads the water (H_2O) setpoint pressure from the VWI/OptiMix gas connect console.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >868 cC6< >8684 cFA< (4 psi)
			EtherCAT example: X3000: 01 = 868 X3000: 0B = 1 (signal power source to act) X3000: 0D = 4 (psi)
869	F5 duty cycle	XPR RS-422 EtherCAT	Reads the F5 (nitrogen-hydrogen) duty cycle from the VWI/OptiMix gas connect console.
			Data: none
			Return value: duty (% on / PWM)
			RS-422 example: >869 cC7< >8693 cFA< (3 %)
			EtherCAT example: X3000: 01 = 869 X3000: 0B = 1 (signal power source to act) X3000: 0D = 3 (%)
870	H_2O duty cycle	XPR RS-422 EtherCAT	Reads the water (H_2O) duty cycle from the VWI/OptiMix console.
			Data: none
			Return value: duty (% on / PWM)
			RS-422 example: >870 cBF< >8702 cF1< (2 %)
			EtherCAT example: X3000: 01 = 870 X3000: 0B = 1 (signal power source to act) X3000: 0D = 2 (%)

ID	Command	System	Description / meaning
871	IP address	XPR RS-422 EtherCAT	Reads the IP address of the wireless module.
			Data: none
			Return value: IP address
			RS-422 example: >871 cC0< >871192.168.1.1 cE7<
			EtherCAT example: X3000: 01 = 871 X3000: 0B = 1 (signal power source to act) X3000: 0D =192 X3000: 0E = 168 X3000: 0F = 1 X3000: 10 = 1
			(IP address = 192.168.1.1)

ID	Command	System	Description / meaning
872	Valve states	XPR RS-422 EtherCAT	Reads the valve states of the torch connect console.
			Data: none
			Return value: valve states
			Bit 0: V1 Bit 1: V2 Bit 2: V3 Bit 3: V4 Bit 4: V5 Bit 5: V6 Bit 6: V7 Bit 7: V8 Bit 8: V9 Bit 9: V10 Bit 10: V11 Bit 11: V12
			RS-422 example: >872 cC1< >8721 cF2< (convert 1d to binary, v1 is on)
			EtherCAT example: X3000: 01 = 872 X3000: 0B = 1 (signal power source to act) X3000: 0D = 1 (convert to binary, v1 is on)
873	Process current	XPR RS-422 EtherCAT	Reads the process current once a process has been set.
			Data: none
			Return value: current in amperes (A)
			RS-422 example: >873 cC2< >873300 c55< (300 A)
			EtherCAT example: X3000: 01 = 873 X3000: 0B = 1 (signal power source to act) X3000: 0D = 300 (A)

ID	Command	System	Description / meaning
874	Process plasma cutflow pressure	XPR RS-422 EtherCAT	Reads the process plasma cutflow pressure once a process has been set.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >874 cC3< >87490 c2C< (90 psi)
			EtherCAT example: X3000: 01 = 874 X3000: 0B = 1 (signal power source to act) X3000: 0D = 90 (psi)
875	Process shield cutflow pressure	XPR RS-422 EtherCAT	Reads the process shield cutflow pressure once a process has been set.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >875 cC4< >87553 c2C< (53 psi)
			EtherCAT example: X3000: 01 = 875 X3000: 0B = 1 (signal power source to act) X3000: 0D = 53 (psi)
876	Process shield pierce flow pressure	XPR RS-422 EtherCAT	Reads the process shield pierce flow pressure once a process has been set.
			Data: none
			Return value: pressure in pounds/square inch (psi)
			RS-422 example: >876 cC5< >87653 c2D< (53 psi)
			EtherCAT example: X3000: 01 = 876 X3000: 0B = 1 (signal power source to act) X3000: 0D = 53 (psi)
877	Process H_2 flow setpoint	XPR RS-422 EtherCAT	Reads the process hydrogen (H_2) flow setpoint once a process has been set.
			Data: none
			Return value: flow, in standard liters per minute (slpm)
			RS-422 example: >877 cC6< >8776 cFC< (6 slpm)
			EtherCAT example: X3000: 01 = 877 X3000: 0B = 1 (signal power source to act) X3000: 0D = 6 (slpm)

ID	Command	System	Description / meaning
878	Process N_2 flow setpoint	XPR RS-422 EtherCAT	Reads the process nitrogen (N_2) flow setpoint once a process has been set.
			Data: none
			Return value: flow, in standard liters per minute (slpm)
			RS-422 example: >878 cC7< >87824 c2D< (24 slpm)
			EtherCAT example: X3000: 01 = 878 X3000: 0B = 1 (signal power source to act) X3000: 0D = 24 (slpm)
879	Process Argon (Ar) flow setpoint	XPR RS-422 EtherCAT	Reads the process argon (Ar) flow setpoint once a process has been set.
			Data: none
			Return value: flow, in standard liters per minute (slpm)
			RS-422 example: >879 cC8< >87910 c29< (10 slpm)
			EtherCAT example: X3000: 01 = 879 X3000: 0B = 1 (signal power source to act) X3000: 0D = 10 (slpm)

ID	Command	System	Description / meaning
880	Minor firmware revisions	XPR RS-422 EtherCAT	Reads the minor versions for the printed circuit boards (PCBs) for these components: ▪ Main control ▪ Choppers ▪ Torch connect console ▪ Gas connect console ▪ Cooler
			Data: none
			Return value: numeric version space delimited ▪ Main control ▪ Torch connect console ▪ Gas connect console ▪ Chopper 1 ▪ Chopper 2 ▪ Chopper 3 ▪ Cooler
			RS-422 example: >880cA0< >880256 256 256 256 256 256 256 cCB< Main control = 256 Torch connect = 256 Gas connect = 256 Chopper 1 = 256 Chopper 2 = 256 Chopper 3 = 256 Cooler = 256
			EtherCAT example: X3000: 01 = 880 X3000: 0B = 1 (signal power source to act) X3000: 0D = 256 (Main control) X3000: 0E = 256 (Torch connect console) X3000: 0F = 256 (Gas connect console) X3000: 10 = 256 (Chopper 1) X3000: 11 = 256 (Chopper 2) X3000: 12 = 256 (Chopper 3) X3000: 13 = 256 (Cooler)

ID	Command	System	Description / meaning
881	Controlling source	XPR RS-422 EtherCAT	Identifies the interface that is in control of the power source.
			Data: none
			Return value: interface code number No controlling source = 0 EtherCAT = 1 Web = 2 Internal control = 4 RS-422 = 5
			RS-422 example: >881 cC1< >8815 cF6< (RS-422)
			EtherCAT example: X3000: 01 = 881 X3000: 0B = 1 (signal power source to act) X3000: 0D = 1 (EtherCAT)
882	System code priority	XPR RS-422 EtherCAT	Reads the priority of the active power source code.
			Data: none
			Return value: priority-code number Info = 0 Alert = 1 Error = 2 Failure = 3
			RS-422 example: >882 cC2< >8822 cF4< (Error)
			EtherCAT example: X3000: 01 = 882 X3000: 0B = 1 (signal power source to act) X3000: 0D = 1 (Alert)

ID	Command	System	Description / meaning
883	Set all overrides	XPR RS-422 EtherCAT	Sets all process override values.
			Data: ▪ Current = +200% if current is 30A or less, otherwise +100% and -100% ▪ Plasma cutflow = +/- 100% ▪ Shield cutflow = +/- 100% ▪ Shield pierceflow = +/- 100% ▪ Hydrogen (H_2) flow rate = +/- 50% ▪ Nitrogen (N_2) flow rate = +/- 50% ▪ Argon (Ar) flow rate = +/- 50%
			Return value: none
			RS-422 example: >883295 55 70 22 0 12 0 c1B< >883cA3<
			EtherCAT example: X3000: 01 = 883 X3000: 03 = 295 (set to 295 A) X3000: 04 = 55 (set plasma cutflow to 55 psi) X3000: 05 = 70 (set shield cutflow to 70 psi) X3000: 06 = 22 (set shield pierce flow to 22 psi) X3000: 07 = 0 (no override applied to hydrogen [H_2]) X3000: 08 = 12 (set nitrogen [N_2] flow rate to 12 slpm) X3000: 09 = 0 (no override applied to argon [Ar]) X3000: 0B = 1 (signal power source to act)
885	Database revision	XPR RS-422 EtherCAT	Reads the plasma process database version.
			Data: none
			Return value: database version
			RS-422 example: >885 cC5< >88500K c70< (rev ‘K’)
			EtherCAT example: X3000: 01 = 885 X3000: 0B = 1 (signal power source to act) X3000: 0D = 75 (ASCII ‘K’)

ID	Command	System	Description / meaning
886	Boot firmware versions	XPR RS-422 EtherCAT	Returns the bootloader firmware versions for the printed circuit boards (PCBs) for these components: ▪ Main control ▪ Torch connect console ▪ Gas connect console ▪ Choppers ▪ Cooler
			Data: none
			Return value: numeric version space delimited ▪ Main control ▪ Torch connect console ▪ Gas connect console ▪ Chopper 1 ▪ Chopper 2 ▪ Chopper 3 ▪ Cooler
			RS-422 example: >886cA6< >886W W W W W W W cE7< Main control = W Torch connect = W Gas connect = W Chopper 1 = W Chopper 2 = W Chopper 3 = W Cooler = W
			EtherCAT example: X3000: 01 = 886 X3000: 0B = 1 (signal power source to act) X3000: 0D = x57 W (Main control) X3000: 0E = x57 W (Torch connect console) X3000: 0F = x57 W (Gas connect console) X3000: 10 = x57 W (Chopper 1) X3000: 11 = x57 W (Chopper 2) X3000: 12 = x57 W (Chopper 3) X3000: 13 = x57 W (Cooler)

ID	Command	System	Description / meaning
887	Boot minor firmware revision	XPR RS-422 EtherCAT	Reads bootloader minor versions for the printed circuit boards (PCBs) for these components: ▪ Main control ▪ Choppers ▪ Torch connect console ▪ Gas connect console ▪ Cooler
			Data: none
			Return value: numeric versions spaces delimited Main control Torch connect console Gas connect console Chopper 1 Chopper 2 Chopper 3 Cooler
			RS-422 example: >887cA7< >887256 256 256 256 256 256 256 cD2< Main control = 256 Torch connect = 256 Gas connect = 256 Chopper 1 = 256 Chopper 2 = 256 Chopper 3 = 256 Cooler = 256
			EtherCAT example: X3000: 01 = 887 X3000: 0B = 1 (signal power source to act) X3000: 0D = 256 (Main control) X3000: 0E = 256 (Torch connect console) X3000: 0F = 256 (Gas connect console) X3000: 10 = 256 (Chopper 1) X3000: 11 = 256 (Chopper 2) X3000: 12 = 256 (Chopper 3) X3000: 13 = 256 (Cooler)

ID	Command	System	Description / meaning
892	Set source	XPR RS-422 EtherCAT	Sets the controlling source of the system.
			Data: 9: Set process with Web, use discrete for I/O 10: Set process with Web, use EtherCAT for I/O 11: Set process with EtherCAT, use EtherCAT for I/O 12: Set process with EtherCAT, use discrete for I/O 13: Set process with RS-422, use discrete for I/O 14: Set process with RS-422, use EtherCAT for I/O
			Return value: none
			RS-422 example: >89212 c26< (12, set process with EtherCAT, use discrete for I/O) >892cA3<
			EtherCAT example: X3000: 01 = 892 X3000: 03 = 12 (source) X3000: 0B = 1 (signal power source to act)
893	Get Active Error Log	XPR RS-422	Reads the active error log with details.
			Data: none
			Return value: A_B_C_D_E_F A = ID B = Reserved C = Timestamp (on time) D = Data 1 E = Data 2 F = Reserved
			RS-422 example: >893 cC4< >893643_1_557251_0_0_0 691_1_557684_263_30_0 c73<
895	Set Pump Timeout XPR	RS-422 EtherCAT	Sets the pump timeout (default is 10 minutes).
			Data: time in minutes (maximum 4320 minutes)
			Return value: none
			RS-422 example: >89520 c28< (set timeout to 20 minutes) >895cA6<
			EtherCAT example: X3000: 01 = 895 X3000: 03 = 20 (minutes) X3000: 0B = 1 (signal power source to act)

ID	Command	System	Description / meaning
896	Read Pump Timeout XPR	RS-422 EtherCAT	Reads the pump timeout.
			Data: none
			Return value: timeout time in minutes
			RS-422 example: >896 cC7< >89620 c29< (20 minutes)
			EtherCAT example: X3000: 01 = 896 X3000: 0B = 1 (signal power source to act) X3000: 0D = 20 (minutes)
897	Release system control XPR	XPR RS-422 EtherCAT	The controlling interface releases control of the cutting system, which makes it possible to do system updates with the web interface.
			Data: 1 (indicates intention to release control)
			Return value: none
			RS-422 example: >8971 cF9< >897cA8<
			EtherCAT example: X3000: 01 = 897 X3000: 03 = 1 X3000: 0B = 1 (signal power source to act)
900	Set arc voltage output configuration	XPR RS-422 EtherCAT	Sets the scale and offset of the arc voltage output (default is 30 = 30:1).
			Data: Arc voltage scalar Arc voltage offset
			Return value: none
			RS-422 example: >90030 5 c71< >900c99<
			EtherCAT example: X3000: 01 = 900 X3000: 03 = 30 (set scale to 30:1) X3000: 04 = 5 (set offset to 5 V) X3000: 0B = 1 (signal power source to act)

ID	Command	System	Description / meaning
901	Get semantic version	XPR RS-422 EtherCAT	Gets the semantic versions of the requested component.
			Data: Requested component 0 = Main control application 1 = Torch connect console application 2 = Gas connect console application 3 = Chopper 1 application 4 = Chopper 2 application 5 = Chopper 3 application 6 = Cooler application 7 = Wi-Fi module 8 = Stored Package 1 9 = Stored Package 2 10 = Fieldbus module
			Return value: Space delimited. Component number (RS-422 only) Version information
			RS-422 example: >9011 cEB< >901 1 1.0.15c2E< (v1.0.15)
			EtherCAT example: X3000: 01 = 901 X3000: 03 = 1 X3000: 0B = 1 (signal power source to act) X3000: 0D = 1 (major) X3000: 0E = 0 (minor) X3000: 0F = 15 (patch) X3000: 10 = 0 (prerelease tag: 0 = none, 1 = beta, 2 = alpha) X3000: 11 = 0 (git commit L) X3000: 12 = 0 (git commit H)

ID	Command	System	Description / meaning
902	Get bootloader semantic version	XPR RS-422 EtherCAT	Gets the semantic versions of the requested component.
			Data: Requested component 0 = Main control bootloader 1 = Torch connect console bootloader 2 = Gas connect console bootloader 3 = Chopper 1 bootloader 4 = Chopper 2 bootloader 5 = Chopper 3 bootloader 6 = Cooler bootloader
			Return value: Space delimited. Component number (RS-422 only) Version information
			RS-422 example: >9021 cEC< >902 1 1.0.13 c2D< (v1.0.13)
			EtherCAT example: X3000: 01 = 902 X3000: 03 = 1 X3000: 0B = 1 (signal power source to act) X3000: 0D = 1 (major) X3000: 0E = 0 (minor) X3000: 0F = 13 (patch) X3000: 10 = 0 (prerelease tag: 0 = none, 1 = beta, 2 = alpha) X3000: 11 = 0 (git commit L) X3000: 12 = 0 (git commit H)
904	Read coolant solenoid current	XPR RS-422 EtherCAT	Reads the current for the coolant solenoid (mA).
			Data: none
			Return value: current in milliamperes (mA)
			RS-422 example: >904 cBD< >904399 c62< (399 mA)
			EtherCAT example: X3000: 01 = 904 X3000: 0B = 1 (signal power source to act) X3000: 0D = 399 (mA)

ID	Command	System	Description / meaning
905	Read ambient temperature	XPR RS-422 EtherCAT	Reads the ambient temperature.
			Data: none
			Return value: temperature in degrees Celsius, scaled X 10
			RS-422 example: >905 cBE< >905280 c58< (28.0°C)
			EtherCAT example: X3000: 01 = 905 X3000: 0B = 1 (signal power source to act) X3000: 0D = 280 (28.0°C)
906	Read Transformer #2 temperature	XPR RS-422 EtherCAT	Reads the temperature of Transformer #2.
			Data: none
			Return value: temperature in degrees Celsius, scaled X 10
			RS-422 example: >906 cBF< >906215 c57< (21.5°C)
			EtherCAT example: X3000: 01 = 906 X3000: 0B = 1 (signal power source to act) X3000: 0D = 215 (21.5°C)
907	Read Control Transformer temperature	XPR RS-422 EtherCAT	Reads the temperature of the Control Transformer.
			Data: none
			Return value: temperature in degrees Celsius, scaled X 10
			RS-422 example: >907cA0< >907232 c57< (23.2°C)
			EtherCAT example: X3000: 01 = 907 X3000: 0B = 1 (signal power source to act) X3000: 0D = 328 (32.8°C)

ID	Command	System	Description / meaning
908	Install firmware package	XPR RS-422 EtherCAT	Starts installation of the firmware package.
			Data: Package ID 1 = Stored Package 1 2 = Stored Package 2
			Return value: none
			RS-422 example: >9081 cF2< (install stored package 1) >908 cA1<
			EtherCAT example: X3000: 01 = 908 X3000: 03 = 1 (install stored package 1) X3000: 0B = 1 (signal power source to act)
909	Read arc voltage output configuration	XPR RS-422 EtherCAT	Reads the arc-voltage output scale and offset.
			Data: none
			Return value: Space delimited Arc voltage output scale ratio (30 = 30:1) Arc voltage output offset in volts (V)
			RS-422 example: >909cA2< >90930 5 c7A< (scale is 30:1 and offset is 5V)
			EtherCAT example: X3000: 01 = 909 X3000: 0B = 1 (signal power source to act) X3000: 0D = 30 (30:1 ratio) X3000: 0E = 5 (5V offset)

ID	Command	System	Description / meaning
910	Read Ethernet status	XPR RS-422 EtherCAT	Reads the status of the Ethernet port.
			Data: none
			Return value: Space delimited Mode (0=Invalid, 1=Static IP, 2=DHCP, 3=Disabled) Speed (0=Invalid, 1=Auto, 2=10M, 3=100M) IP address Subnet mask Default gateway MAC address
			RS-422 example: >910c9A< >9101 2 169.254.0.100 255.255.255.0 0.0.0.0 00:1E:29:01:FF:FE cF6<
			EtherCAT example: X3000: 01 = 910 X3000: 0B = 1 (signal power source to act) X3000: 0D = 1 (Static IP) X3000: 0E = 2 (10M) X3000: 0F = 0xA9Fe0064 (169.254.0.100) X3000: 10 = 0xFFFFFF00 (255.255.255.0) X3000: 11 = 0 (0.0.0.0) X3000: 12 = 0x2901FFFE (MAC address Low) X3000: 13 = 0x0000001E (MAC address High)

ID	Command	System	Description / meaning
911	Write Ethernet configuration	XPR RS-422 EtherCAT	Writes the configuration of the Ethernet port. Requires a power cycle to apply the configuration.
			Data: Ethernet configuration parameters Mode (1=Static IP, 2=DHCP, 3=Disabled) IP address (if Static IP mode) Subnet mask (if Static IP mode) Default gateway (if Static IP mode) Speed (0=Invalid, 1=Auto, 2=10M, 3=100M)
			Return value: none
			RS-422 example (Static IP): >9111 169 254 0 100 255 255 0 0 0 0 0 0 1 c11< >911c9B< RS-422 example (DHCP): >91121 c5E< >911c9B<
			EtherCAT example (Static IP): X3000: 01 = 911 X3000: 03 = 1 (Static IP) X3000: 04 = 0xA9Fe0065 (169.254.0.101) X3000: 05 = 0xFFFFFF00 (255.255.255.0) X3000: 06 = 0 (0.0.0.0) X3000: 07 = 1 (Auto) X3000: 0B = 1 (signal power source to act) EtherCAT example (DHCP): X3000: 01 = 911 X3000: 03 = 2 (DHCP) X3000: 04 = 1 (Auto) X3000: 0B = 1 (signal power source to act)

ID	Command	System	Description / meaning
912	Read Ethernet configuration	XPR RS-422 EtherCAT	Reads the configuration of the Ethernet port.
			Data: none
			Return value: Space delimited Configured Mode (0=Invalid, 1=Static IP, 2=DHCP, 3=Disabled) Configured Speed (0=Invalid, 1=Auto, 2=10M, 3=100M) Configured IP address Configured Subnet mask Configured Default gateway MAC address
			RS-422 example: >912c9C< >9121 2 169.254.0.100 255.255.255.0 0.0.0.0 00:1E:29:01:FF:FE cF8<
			EtherCAT example: X3000: 01 = 912 X3000: 0B = 1 (signal power source to act) X3000: 0D = 1 (Static IP) X3000: 0E = 2 (10M) X3000: 0F = 0xA9Fe0064 (169.254.0.100) X3000: 10 = 0xFFFFFF00 (255.255.255.0) X3000: 11 = 0 (0.0.0.0) X3000: 12 = 0x2901FFFE (MAC address Low) X3000: 13 = 0x0000001E (MAC address High)
913	Reset Ethernet configuration	XPR RS-422 EtherCAT	Resets the Ethernet configuration to default values. Requires a power cycle to apply the configuration. Default values: Mode = DHCP Speed = Auto IP address = 169.254.0.100 Subnet mask = 255.255.0.0 Gateway = 0.0.0.0 Webserver credentials = xpr:hypertherm
			Data: 1=Reset 0=No action
			Return value: none
			RS-422 example: >9131 cEE< >913c9D<
			EtherCAT example: X3000: 01 = 913 X3000: 03 = 1 (Reset) X3000: 0B = 1 (signal power source to act)

ID	Command	System	Description / meaning
914	Set Manual Mode	XPR RS-422 EtherCAT	Enable or disable Manual Mode
			Data: 1=Enable 0=Disable
			Return value: none
			RS-422 example: >9141 cEF< >914c9E<
			EtherCAT example: X3000: 01 = 914 X3000: 03 = 1 (Enable) X3000: 0B = 1 (signal power source to act)
915	Set MTConnect Mode	XPR RS-422 EtherCAT	Enable or disable MTConnect. The XPR must be power cycled for the setting to take effect.
			Data: 1=Enable 0=Disable
			Return value: none
			RS-422 example: >9151 cF0< >915c9F<
			EtherCAT example: X3000: 01 = 915 X3000: 03 = 1 (Enable) X3000: 0B = 1 (signal power source to act)
916	Read system source	XPR RS-422 EtherCAT	Reads the controlling source of the system.
			Data: none
			Return value: controlling source 9: Set process with Web, use discrete for I/O 10: Set process with Web, use EtherCAT for I/O 11: Set process with EtherCAT, use EtherCAT for I/O 12: Set process with EtherCAT, use discrete for I/O 13: Set process with RS422, use discrete for I/O 14: Set process with RS422, use EtherCAT for I/O
			RS-422 example: >916cA0< >91612 c23< (12, set process with EtherCAT, use discrete for I/O)
			EtherCAT example: X3000: 01 = 916 X3000: 0B = 1 (signal power source to act) X3000: 0D = 12 (set process with EtherCAT, use discrete for I/O)

Codes

Codes have an ID number, priority level, and description of the conditions that caused the code.

For guidance about how to respond to codes, refer to *Troubleshooting procedures for diagnostic codes* in the instruction manual that came with your cutting system.

Codes that have smart data

Depending on the conditions, codes can also include smart-data measurements.

- Codes can have many smart-data measurements. For example, a temperature-related error code can have 2 data elements:
  - Actual measured temperature
  - Temperature error limit
- Some codes have only 1 smart-data element.
- Not all codes have smart data.

Codes can include these abbreviations:

- GCC = Gas connect console
- CAN = Controller area network
- TCC = Torch connect console
- t/o = Time out
- HF = High frequency
- IGBT = Insulated-gate bipolar transistor
- Ch1 = Chopper 1
- Ch2 = Chopper 2
- Ch3 = Chopper 3
- DC = Direct current, current
- Ind = Inductor
- MagFan = Magnetics fan
- HxFan = Heat-exchanger fan

Codes in the web interface

Information	These codes contain information about the current conditions. In many cases, operator action is not necessary for Information codes. If action is necessary, the steps are usually simple.
Alert	These codes describe conditions that can reduce productivity or quality. Resolve an Alert code as soon as possible.
Error	These codes describe conditions that usually reduce productivity or quality, or cause damage to cutting system components. Resolve the Error code before you go back to cutting system operation.
Failure	These codes describe conditions where you cannot start the arc until the condition is resolved. Failure mode protects the cutting system and system components from permanent damage.

Code descriptions

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
500	11	Failure	GCC->Main CAN t/o	The main control PCB cannot receive (at least once-per-second) communications from the gas connect console (Core, CorePlus, VWI, or OptiMix) through the CAN.	Time since high frequency (milliseconds)	None	Shut down	Remote on-off*
501	12	Failure	Mix->Main CAN t/o	The main control PCB cannot receive (at least once-per-second) communications from the mixing module in the gas connect console through the CAN.	Time since high frequency (milliseconds)	None	Shut down	Remote on-off*
503	10	Failure	TCC->Main CAN t/o	The main control PCB cannot receive (at least once-per-second) communications from the torch connect console through the CAN.	Time since high frequency (milliseconds)	None	Shut down	Remote on-off*
504	13	Failure	Ch1->Main CAN t/o	The main control PCB cannot receive (at least once-per-second) communications from Chopper 1 through the CAN.	Time since high frequency (milliseconds)	None	Shut down	Remote on-off*
505	14	Failure	Ch2->Main CAN t/o	The main control PCB cannot receive (at least once-per-second) communications from Chopper 2 through the CAN.	Time since high frequency (milliseconds)	None	Shut down	Remote on-off*
506	15	Failure	Ch3->Main CAN t/o	The main control PCB cannot receive (at least once-per-second) communications from Chopper 3 through the CAN.	Time since high frequency (milliseconds)	None	Shut down	Remote on-off*
507	8	Failure	Main no CAN	There is a problem with the CAN network when power is supplied to the cutting system.	None	None	None	Remote on-off*
508	16	Error	CAN Busy	The CAN bus is overloaded (for 10 milliseconds or more).	None	None	None	Remote on-off*
509	232	Failure	Cooler->Main CAN t/o	The main control PCB cannot receive (at least once-per-second) communications from the cooler through the CAN.	Time since high frequency (milliseconds)	None	Shut down	Remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
510	3	Failure	Main->GCC CAN t/o	The gas connect console (Core, CorePlus, VWI, or OptiMix) cannot receive (at least once-per-second) communications from the main control PCB through the CAN.	None	None	None	Remote on-off*
511	4	Failure	Main->Mix CAN t/o	The mixing module in the gas connect console cannot receive (at least once-per-second) communications from the main control PCB through the CAN.	None	None	None	Remote on-off*
513	2	Failure	Main->TCC CAN t/o	The torch connect console cannot receive (at least once per second) communications from the main control PCB through the CAN.	None	None	None	Remote on-off*
514	5	Failure	Main->Ch1 CAN t/o	Chopper 1 cannot receive (at least once-per-second) communications from the main control PCB through the CAN.	None	None	None	Remote on-off*
515	6	Failure	Main->Ch2 CAN t/o	Chopper 2 cannot receive (at least once-per-second) communications from the main control PCB through the CAN.	None	None	None	Remote on-off*
516	7	Failure	Main->Ch3 CAN t/o	Chopper 3 cannot receive (at least once-per-second) communications from the main control PCB through the CAN.	None	None	None	Remote on-off*
519	233	Failure	Main->Cooler CAN t/o	The cooler cannot receive (at least once-per-second) communications from the main control PCB through the CAN.	None	None	None	Remote on-off*
520	18	Alert	Ignite t/o	For at least 630 milliseconds, the current sensor in Chopper 1 is unable to measure current more than 75% of the pilot arc setpoint (for three milliseconds).	Most significant byte (MSB): Chopper 1 current amperes (amperes: A) Least significant byte (LSB): arc voltage (volts: V)	Bus voltage (volts: V)	End of cycle	Start or set process or remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
521	17	Alert	Pilot arc t/o	For at least 500 milliseconds, the current sensor in the work lead is unable to measure current more than the transfer reference value (for three milliseconds).	Time without current (milliseconds)	Work lead current (amperes: A)	End of cycle	Start or set process or remote on-off*
522	19	Alert	Preflow t/o	The cutting system cannot complete the preflow routine within 30 seconds.	Time in preflow (milliseconds)	None	End of cycle	Start or set process or remote on-off*
523	123	Error	Preflow purge t/o	The preflow purge cannot get to the setpoint within 45 seconds.	Time in preflow (milliseconds)	Time limit (milliseconds)	None	Set process or remote on-off*
524	124	Error	Cutflow purge t/o	The cutflow purge cannot get to the setpoint within 45 seconds.	Time in cutflow (milliseconds)	Time limit (milliseconds)	None	Set process or remote on-off*
525	210	Error	Inert gas purge t/o	The nitrogen (N_2) purge cannot successfully complete.	Time in N_2 purge (milliseconds)	Time limit (milliseconds)	None	Set process or remote on-off*
526	248	Alert	Extended pilot arc t/o	This occurs after 5 seconds (XPR460) or 1 second (XPR300/XPR170) of extended pilot arc if the work-lead current sensor does not measure current greater than the transfer reference value.	Time without current (milliseconds)	Work lead current (amperes: A)	End of cycle	Start or set process or remote on-off*
527	249	Info	Pilot arc cooldown	This occurs if pilot arc ignition is prevented due to time remaining on cool down	Time remaining (milliseconds)	None	None	Start or set process or remote on-off*
530	56	Alert	Low psi–Line A	The line A pressure (P5) is less than 75% of the setpoint for 200 milliseconds for any process. Or P5 is less than 30% of the P21 sensor reading for 4 seconds for a mixed-fuel gas process. Or P5 is less than 75% of the P7 setpoint for 4 seconds for an F5 process.	Actual pressure (psi)	Line A setpoint (psi)	Ramp down	Set process or remote on-off*
531	57	Alert	Low psi–Line B	For a minimum of 200 milliseconds, Line B pressure is less than 75% of the pressure setpoint, and the setpoint is greater than 0.	Actual pressure (psi)	Line B setpoint (psi)	Ramp down	Set process or remote on-off*
532	59	Alert	Low psi–H_2O	For a minimum of 200 milliseconds, water (H_2O) pressure is less than 50% of the pressure setpoint, and the setpoint is more than 0.	Actual pressure (psi)	H_2O setpoint (psi)	Ramp down	Set process or remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
533	60	Alert	Low psi-F5	For a minimum of 200 milliseconds, F5 (nitrogen-hydrogen) pressure is less than 75% of the pressure setpoint, and the setpoint is more than 0.	Actual pressure (psi)	F5 setpoint (psi)	Ramp down	Set process or remote on-off*
534	58	Alert	Low psi-Shield	For a minimum of 600 milliseconds, shield pressure is less than 75% of the pressure setpoint, and the setpoint is more than 0.	Actual pressure (psi)	Shield setpoint (psi)	Ramp down	Set process or remote on-off*
540	61	Error	Low flow 1–Coolant	For a minimum of 40 seconds after the coolant pump is turned ON, the coolant flow rate is less than 1.9 L/min (0.5 gal/min).	Coolant flow (gal/min)	Pump on time (milliseconds)	Shut down	Remote on-off*
542	63	Failure	Low flow–Coolant	The coolant flow is less than 3.79 L/min (1 gal/min) for a minimum of 1 second.	Coolant flow (gal/min)	Flow limit (gal/min)	Shut down	Remote on-off*
543	64	Error	High flow 1–Coolant	The coolant flow is more than 3.03 L/min (0.8 gal/min) after the coolant pump stops.	Coolant flow (gal/min)	Pump on time (milliseconds)	Shut down	Remote on-off*
544	65	Failure	High flow–Coolant	The coolant flow is more than 11.36 L/min (3 gal/min) for a minimum of 1 second.	Coolant flow (gal/min)	Flow limit (gal/min)	Shut down	Remote on-off*
550	27	Alert	No plasma arc	For a minimum of 10 milliseconds during a Steady State, the total electric current decreases 50% below the electric current setpoint.	Work current (amperes: A)	Current setpoint (amperes: A)	End of cycle	Start or set process or remote on-off*
552	20	Alert	DC below limit Ch1	The Chopper 1 current decreases below 50% of the setpoint for 50 milliseconds and the setpoint is more than 10 A.	Measured current (amperes: A)	Current limit (amperes: A)	End of cycle	Set process or remote on-off*
553	21	Alert	DC below limit Ch2	The Chopper 2 current decreases below 50% of the setpoint for 50 milliseconds and the setpoint is more than 10 A.	Measured current (amperes: A)	Current limit (amperes: A)	End of cycle	Set process or remote on-off*
554	22	Alert	DC below limit Ch3	The Chopper 3 current decreases below 50% of the setpoint for 50 milliseconds and the setpoint is more than 10 A.	Measured current (amperes: A)	Current limit (amperes: A)	End of cycle	Set process or remote on-off*
555	23	Failure	DC exceeds limit–Ch1	For a minimum of 10 milliseconds, the electric current for Chopper 1 is more than 170 A.	Measured current (amperes: A)	Current limit (amperes: A)	Shut down	Remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
556	24	Failure	DC exceeds limit–Ch2	For a minimum of 10 milliseconds, the electric current for Chopper 2 is more than 170 A.	Measured current (amperes: A)	Current limit (amperes: A)	Shut down	Remote on-off*
557	25	Failure	DC exceeds limit–Ch3	For a minimum of 10 milliseconds, the electric current for Chopper 3 is more than 170 A.	Measured current (amperes: A)	Current limit (amperes: A)	Shut down	Remote on-off*
560	29	Error	Over temp–Ch1	The insulated-gate bipolar transistor (IGBT) temperature sensor for Chopper 1 measures more than 75°C (167°F).	Chopper temperature (degrees Celsius: °C)	Temperature limit (degrees Celsius: °C)	Ramp down	Temperature is in range
561	30	Error	Over temp–Ch2	The insulated-gate bipolar transistor (IGBT) temperature sensor for Chopper 2 measures more than 75°C (167°F).	Chopper temperature (degrees Celsius: °C)	Temperature limit (degrees Celsius: °C)	Ramp down	Temperature is in range
562	31	Error	Over temp–Ch3	The insulated-gate bipolar transistor (IGBT) temperature sensor for Chopper 3 measures more than 75°C (167°F).	Chopper temperature (degrees Celsius: °C)	Temperature limit (degrees Celsius: °C)	Ramp down	Temperature is in range
570	70	Alert	Start on powerup	The Plasma Start switch is in the ON position before the cutting system goes into Power-Up state.	None	None	None	Start or set process or remote on-off*
571	71	Alert	Start on wait-start	The Plasma Start switch is in the ON position before the cutting system enters Wait-for-Start state.	None	None	None	Start or set process or remote on-off*
574	74	Info	Start removed preflow	The Plasma Start switch goes OFF during Preflow state.	Time in Preflow state (milliseconds)	None	End of cycle	Start or set process or remote on-off*
575	75	Info	Start removed ignite	The Plasma Start switch goes OFF during Ignite state.	Time in Ignite state (milliseconds)	None	End of cycle	Start or set process or remote on-off*
576	76	Info	Start removed pilot	The Plasma Start switch goes OFF during Pilot Arc state.	Time in Pilot Arc state (milliseconds)	None	End of cycle	Start or set process or remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
577	77	Info	Start removed ramp up	The Plasma Start switch goes OFF during Ramp-up state.	Time in Ramp-up state (milliseconds)	None	End of cycle	Start or set process or remote on-off*
580	88	Error	Over temp–Ind 1	The temperature for Inductor 1 is more than 160°C (320°F).	Temperature (degrees Celsius: °C)	Temperature limit (degrees Celsius: °C)	Ramp down	Temperature is in range
581	89	Error	Over temp–Ind 2	The temperature for Inductor 2 is more than 160°C (320°F).	Temperature (degrees Celsius: °C)	Temperature limit (degrees Celsius: °C)	Ramp down	Temperature is in range
582	90	Error	Over temp–Ind 3	The temperature for Inductor 3 is more than 160°C (320°F).	Temperature (degrees Celsius: °C)	Temperature limit (degrees Celsius: °C)	Ramp down	Temperature is in range
583	91	Error	Over temp–Ind 4	The temperature for Inductor 4 is more than 160°C (320°F).	Temperature (degrees Celsius: °C)	Temperature limit (degrees Celsius: °C)	Ramp down	Temperature is in range
584	92	Error	Over temp–Ind 5	The temperature for Inductor 5 is more than 160°C (320°F).	Temperature (degrees Celsius: °C)	Temperature limit (degrees Celsius: °C)	Ramp down	Temperature is in range
585	93	Error	Over temp–Ind 6	The temperature for Inductor 6 is more than 160°C (320°F).	Temperature (degrees Celsius: °C)	Temperature limit (degrees Celsius: °C)	Ramp down	Temperature is in range
586	47	Error	Over temp–Xfmr	The temperature for the transformer is more than 160°C (320°F) for a minimum of 5 seconds.	Transformer temperature (degrees Celsius: °C)	Temperature limit (degrees Celsius: °C)	Ramp down	Temperature is in range
587	68	Error	Over temp–Coolant	The coolant temperature is more than 85°C (185°F).	Coolant temperature (degrees Celsius: °C)	Temperature limit (degrees Celsius: °C)	Ramp down	Temperature is in range
589	240	Error	Over temp–Xfmr2	The temperature for the transformer is more than 160°C (320°F) for a minimum of 5 seconds.	Transformer temperature (degrees Celsius: °C)	Temperature limit (degrees Celsius: °C)	Ramp down	Temperature is in range

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
600	78	Error	No TCC found	The main control PCB cannot receive communications (at least once-per-second) from the torch connect console through the CAN for a minimum of 30 seconds after power is supplied to the cutting system.	None	None	Shut down	Remote on-off*
601	80	Error	No Chopper 1 found	The main control PCB cannot receive communications (at least once-per-second) from Chopper 1 through the CAN for a minimum of 30 seconds after power is supplied to the cutting system.	None	None	Shut down	Remote on-off*
602	83	Error	No GCC found	The main control PCB cannot receive communications (at least once-per-second) from the gas connect console (Core, CorePlus, VWI, or OptiMix) through the CAN for a minimum of 30 seconds after power is supplied to the cutting system.	None	None	Shut down	Remote on-off*
604	214	Alert	No Chopper 2 found	The main control PCB cannot receive communications from Chopper 2 through the CAN after power is supplied to the cutting system.	None	None	None	Start or set process or remote on-off*
605	234	Error	No cooler found	The main control PCB cannot receive communications from the cooler through the CAN after power is supplied to the cutting system.	None	None	Shut down	Remote on-off*
606	236	Alert	No Chopper 3 found	The main control PCB cannot receive communications from Chopper 3 through the CAN after power is supplied to the cutting system.	None	None	None	Start or set process or remote on-off*
610	110	Failure	Ch1 Torch Protect ChA	A catastrophic failure of a consumable part is found on the Channel A Chopper 1 current signature.	Measured blowout value (ampere-seconds)	Blowout limit (ampere-seconds)	Ramp down	Remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
611	113	Failure	Ch1 Torch Protect ChB	A catastrophic failure of a consumable part is found on the Channel B Chopper 1 current signature.	Measured blowout value (ampere-seconds)	Blowout limit (ampere-seconds)	Ramp down	Remote on-off*
612	111	Failure	Ch2 Torch Protect ChA	A catastrophic failure of a consumable part is found on the Channel A Chopper 2 current signature.	Measured blowout value (ampere-seconds)	Blowout limit (ampere-seconds)	Ramp down	Remote on-off*
613	114	Failure	Ch2 Torch Protect ChB	A catastrophic failure of a consumable part is found on the Channel B Chopper 2 current signature.	Measured blowout value (ampere-seconds)	Blowout limit (ampere-seconds)	Ramp down	Remote on-off*
614	112	Failure	Ch3 Torch Protect ChA	A catastrophic failure of a consumable part is found on the Channel A Chopper 3 current signature.	Measured blowout value (ampere-seconds)	Blowout limit (ampere-seconds)	Ramp down	Remote on-off*
615	115	Failure	Ch3 Torch Protect ChB	A catastrophic failure of a consumable part is found on the Channel B Chopper 3 current signature.	Measured blowout value (ampere-seconds)	Blowout limit (ampere-seconds)	Ramp down	Remote on-off*
620	26	Alert	Arc stretch detected	The chopper duty cycle exceeds the programmed limit.	Duty cycle (%)	Limit (%)	Ramp down	Start or set process or remote on-off*
621	118	Failure	Over voltage-DC bus	The DC bus voltage is more than 414 V.	Bus voltage (volts: V)	Voltage limit (volts: V)	Shut down	Remote on-off*
622	119	Failure	Under voltage-DC bus	The DC bus voltage is less than 280.5 V.	Bus voltage (volts: V)	Voltage limit (volts: V)	Shut down	Remote on-off*
623	191	Error	Ch1 DC at idle	Chopper 1 is in Idle state and the chopper current is more than 10 A.	Measured current (amperes: A)	Current limit (amperes: A)	None	Remote on-off*
624	192	Error	Ch2 DC at idle	Chopper 2 is in Idle state and the chopper current is more than 10 A.	Measured current (amperes: A)	Current limit (amperes: A)	None	Remote on-off*
625	193	Error	Ch3 DC at idle	Chopper 3 is in Idle state and the chopper current is more than 10 A.	Measured current (amperes: A)	Current limit (amperes: A)	None	Remote on-off*
626	44	Alert	No DC output-Ch1	Chopper 1 does not make current for a minimum of 250 milliseconds after the Arc-On state starts.	Actual current (amperes: A)	Current setpoint (amperes: A)	End of cycle	Start or set process or remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
627	45	Alert	No DC output-Ch2	No current is produced by Chopper 2 within 250 milliseconds after the Arc-On state starts.	Actual current (amperes: A)	Current setpoint (amperes: A)	End of cycle	Start or set process or remote on-off*
628	46	Alert	No DC output-Ch3	No current is produced by Chopper 3 within 250 milliseconds after the Arc-On state starts.	Actual current (amperes: A)	Current setpoint (amperes: A)	End of cycle	Start or set process or remote on-off*
631	117	Failure	DC at wait-start	The current in the work lead is more than 5 A while the cutting system is in the Wait-For-Start state.	Work lead current (amperes: A)	Current limit (amperes: A)	Shut down	Remote on-off*
642	53	Info	System powered	Power is supplied to the cutting system and the Remote On-Off switch is set to the ON position.	None	None	None	Start or set process or remote on-off*
643	54	Info	No process loaded	Power is supplied to the cutting system and no process is selected.	None	None	None	Start or set process or remote on-off*
645	109	Info	System is off	Power is supplied to the cutting system and the Remote On-Off switch is set to the OFF position.	None	None	None	Remote on-off*
646	125	Info	System turned off	Power is removed from the cutting system.	None	None	Shut down	Remote on-off*
647	190	Info	Process selected	Shows the selected process.	Process ID	None	None	Start or set process or remote on-off*
648	247	Info	Manual mode	This informs the user of manual mode events.	1: Waiting for user input 2: Cancelled	Cancelled Errors 1: Firmware update 2: Invalid configuration 3: Process set by user	None	Start or set process or remote on-off*
651	116	Alert	HF timeout	The high-frequency output is on for more than 350 milliseconds.	None	None	None	Set process or remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
652	106	Error	Block def over limit	During Ramp-up or Ramp-down state, the process block timer definition exceeds 5 seconds.	Process block type 2:preflow 5:rampup 6:steady state 7:rampdown	Block duration (milliseconds)	Shut down	Remote on-off*
653	107	Error	Block time over limit	During Ramp-up or Ramp-down state, the process block timer exceeds 5 seconds.	Process block type 2:preflow 5:rampup 6:steady state 7:rampdown	Time in block (milliseconds)	Shut down	Remote on-off*
654	108	Error	Ch1 ArcOn t/o	During Ignite state, Chopper 1 does not enter Arc-On State for at least 100 milliseconds.	Time in ignite state (milliseconds)	Chopper state 0:powerup 1:idle 2:chargedc 3:arcon 4:rampup 5:rampdown 6:arcoff 7:lockout 8:test 9:node update	End of cycle	Remote on-off*
655	120	Alert	DC during preflow	During Preflow state, a chopper finds current.	MSB: chopper 1 current LSB: chopper 2 current	MSB: chopper 3 current	Shut down	Remote on-off*
656	121	Error	Default case	A default case occurs unintentionally.	State	Sub state	Shut down	Remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
657	122	Error	Bad block type	The block type is incorrect.	Block type 2:preflow 5:rampup 6:steady state 7:rampdown	Expected block type 2:preflow 5:rampup 6:steady state 7:rampdown	Shut down	Remote on-off*
658	204	Alert	Block def under limit	The process block duration is less than the minimum value.	Process block type 2:preflow 5:rampup 6:steady state 7:rampdown	Process block duration (milliseconds)	End of cycle	Start or set process or remote on-off*
660	100	Error	Thermistor Fault–Ind 1	The main control PCB finds a shorted temperature sensor in Inductor 1.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
661	101	Error	Thermistor Fault–Ind 2	The main control PCB finds a shorted temperature sensor in Inductor 2.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
662	102	Error	Thermistor Fault–Ind 3	The main control PCB finds a shorted temperature sensor in Inductor 3.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
663	103	Error	Thermistor Fault–Ind 4	The main control PCB finds a shorted temperature sensor in Inductor 4.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
664	104	Error	Thermistor Fault–Ind 5	The main control PCB finds a shorted temperature sensor in Inductor 5.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
665	105	Error	Thermistor Fault–Ind 6	The main control PCB finds a shorted temperature sensor in Inductor 6.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
666	49	Error	Thermistor Fault–Xfmr	The main control PCB finds a shorted temperature sensor in the transformer.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
667	38	Error	Thermistor Fault–Ch1	Chopper 1 finds a shorted temperature sensor near the insulated-gate bipolar transistor (IGBT).	Thermistor analog-to-digital converter (ADC) counts	None	Ramp down	Remote on-off*
668	39	Error	Thermistor Fault–Ch2	Chopper 2 finds a shorted temperature sensor near the insulated-gate bipolar transistor (IGBT).	Thermistor analog-to-digital converter (ADC) counts	None	Ramp down	Remote on-off*
669	40	Error	Thermistor Fault–Ch3	Chopper 3 finds a shorted temperature sensor near the insulated-gate bipolar transistor (IGBT).	Thermistor analog-to-digital converter (ADC) counts	None	Ramp down	Remote on-off*
670	67	Error	Thermistor Fault–Coolant	The main control PCB finds a shorted coolant temperature sensor.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
671	94	Error	No Thermistor–Ind 1	The main control PCB cannot find the temperature sensor in Inductor 1.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
672	95	Error	No Thermistor–Ind 2	The main control PCB cannot find the temperature sensor in Inductor 2.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
673	96	Error	No Thermistor–Ind 3	The main control PCB cannot find the temperature sensor in Inductor 3.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
674	97	Error	No Thermistor–Ind 4	The main control PCB cannot find the temperature sensor in Inductor 4.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
675	98	Error	No Thermistor–Ind 5	The main control PCB cannot find the temperature sensor in Inductor 5.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
676	99	Error	No Thermistor–Ind 6	The main control PCB cannot find the temperature sensor in Inductor 6.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
677	48	Error	No Thermistor–Xfmr	The main control PCB cannot find the temperature sensor in the transformer.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
678	35	Error	No Thermistor–Ch1	The cutting system cannot find the temperature sensor for Chopper 1.	Thermistor analog-to-digital converter (ADC) counts	None	Ramp down	Remote on-off*
679	36	Error	No Thermistor–Ch2	The cutting system cannot find the temperature sensor for Chopper 2.	Thermistor analog-to-digital converter (ADC) counts	None	Ramp down	Remote on-off*
680	37	Error	No Thermistor–Ch3	The cutting system cannot find the temperature sensor for Chopper 3.	Thermistor analog-to-digital converter (ADC) counts	None	Ramp down	Remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
681	66	Error	No Thermistor–coolant	The main control PCB cannot find coolant temperature sensor.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
682	241	Error	No Thermistor–Xfmr2	The main control PCB cannot find the temperature sensor in the transformer.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
683	242	Error	Thermistor Fault–Xfmr2	The main control PCB finds that the temperature sensor for the transformer is shorted.	Thermistor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
691	127	Error	Node reset	The main control PCB receives a “console-reset” message after power is supplied to the cutting system.	MSB:node 1:main 2:tcc 3:gcc 4:ch1 5:ch2 6:ch3 7:cooler LSB:rcc value	Time since high frequency (milliseconds)	Shut down	Remote on-off*
695	128	Alert	Low inlet H_2-Mix (OptiMix only)	The hydrogen (H_2) inlet pressure for the mixing module in the gas connect console (only for OptiMix) is less than 7.58 bar (110 psi).	H_2 inlet pressure (psi)	Pressure limit (psi)	None	Set process or remote on-off*
696	129	Alert	Low inlet Ar-mix (OptiMix only)	The argon (Ar) inlet pressure for the mixing module in the gas connect console (OptiMix) is less than 7.58 bar (110 psi).	Argon (Ar) inlet pressure (psi)	Pressure limit (psi)	None	Set process or remote on-off*
697	130	Alert	Low inlet N_2-mix (OptiMix only)	The nitrogen (N_2) inlet pressure for the mixing module in the gas connect console (OptiMix) is less than 7.58 bar (110 psi).	N_2 inlet pressure (psi)	Pressure limit (psi)	None	Set process or remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
699	132	Error	Mix fault (OptiMix only)	The main control PCB finds a mixing module fault in the gas connect console (OptiMix).	Fault info	None	Ramp down	Set process or remote on-off*
700	133	Alert	Gas inlet F5–GCC	For a minimum of 200 milliseconds, the F5 (nitrogen-hydrogen) inlet pressure for P6 in the gas connect console (for VWI or OptiMix only) is less than 5.52 bar (80 psi) or more than 9.31 bar (135 psi).	F5 inlet pressure (psi)	Pressure limit (psi)	None	Set process or remote on-off*
701	134	Alert	Low inlet H_2O–GCC	For a minimum of 600 milliseconds, the water (H_2O) inlet pressure for P8 in the gas connect console (for VWI and OptiMix only) is less than 2.07 bar (30 psi).	H_2O inlet pressure (psi)	Pressure limit (psi)	None	Set process or remote on-off*
702	135	Alert	Shield gas inlet N_2–TCC	For a minimum of 200 milliseconds, the N_2 inlet pressure in the torch connect console is less than 5.52 bar (80 psi) or greater than 9.31 bar (135 psi).	Most significant byte (MSB): N_2 inlet pressure (psi) Least significant byte (LSB): pressure sensor	Pressure limit (psi)	None	Set process or remote on-off*
703	136	Alert	Shield gas inlet O_2–TCC	For a minimum of 200 milliseconds, the oxygen (O_2) inlet gas pressure in the torch connect console is less than 5.52 bar (80 psi) or more than 9.31 bar (135 psi).	Most significant byte (MSB): O_2 inlet pressure (psi) Least significant byte (LSB): pressure sensor	Pressure limit (psi)	None	Set process or remote on-off*
704	137	Alert	Shield gas inlet air – TCC	For a minimum of 200 milliseconds, the air inlet pressure in the torch connect console is less than 5.52 bar (80 psi) or more than 9.31 bar (135 psi).	Most significant byte (MSB): Air inlet pressure (psi) Least significant byte (LSB): pressure sensor	Pressure limit (psi)	None	Set process or remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
705	138	Alert	Shield gas inlet Ar–TCC	For a minimum of 200 milliseconds, the argon (Ar) inlet pressure in the torch connect console is less than 5.52 bar (80 psi) or more than 9.31 bar (135 psi).	Most significant byte (MSB): Argon (Ar) inlet pressure (psi) Least significant byte (LSB): pressure sensor	Pressure limit (psi)	None	Set process or remote on-off*
706	139	Error	No sensor P1–TCC	The P1 pressure sensor in the torch connect console is not found.	Sensor analog-to-digital converter (ADC) counts	Counts limit	Ramp down	Set process or remote on-off*
707	140	Error	No sensor P2–TCC	The P2 pressure sensor in the torch connect console is not found.	Sensor analog-to-digital converter (ADC) counts	Counts limit	Ramp down	Set process or remote on-off*
708	141	Error	No sensor P3–TCC	The P3 pressure sensor in the torch connect console is not found.	Sensor analog-to-digital converter (ADC) counts	Counts limit	Ramp down	Set process or remote on-off*
709	142	Error	No sensor P4–TCC	The P4 pressure sensor in the torch connect console is not found.	Sensor analog-to-digital converter (ADC) counts	Counts limit	Ramp down	Set process or remote on-off*
710	143	Error	No sensor P5–TCC	The P5 pressure sensor in the torch connect console is not found.	Sensor analog-to-digital converter (ADC) counts	Counts limit	Ramp down	Set process or remote on-off*
711	144	Error	No sensor P14–TCC	The P14 pressure sensor in the torch connect console is not found.	Sensor analog-to-digital converter (ADC) counts	Counts limit	Ramp down	Set process or remote on-off*
712	145	Error	No sensor P6–GCC	The P6 pressure sensor in the gas connect console is not found.	Sensor analog-to-digital converter (ADC) counts	Counts limit	Ramp down	Set process or remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
713	146	Error	No sensor P7–GCC	The P7 pressure sensor in the gas connect console is not found.	Sensor analog-to-digital converter (ADC) counts	Counts limit	Ramp down	Set process or remote on-off*
714	147	Error	No sensor P8–GCC	The P8 pressure sensor in the gas connect console is not found.	Sensor analog-to-digital converter (ADC) counts	Counts limit	Ramp down	Set process or remote on-off*
715	148	Error	No sensor P9–GCC	The P9 pressure sensor in the gas connect console is not found.	Sensor analog-to-digital converter (ADC) counts	Counts limit	Ramp down	Set process or remote on-off*
716	149	Alert	Set process denied	The selected process is not supported by this cutting system.	1: PID invalid 2: invalid user 3: invalid user source 4: invalid PID 5: not allowed or system not prepared 6: not supported	None	None	Set process or remote on-off*
717	150	Alert	Low voltage–mix (OptiMix only)	The supply voltage for the gas mixer in the (OptiMix only) gas connect console is less than 21 V.	System state	Time in state (milliseconds)	Ramp down	Set process or remote on-off*
718	151	Alert	High voltage–mix (OptiMix only)	The supply voltage for the gas mixer in the (OptiMix only) gas connect console is more than 27 V.	System state	Time in state (milliseconds)	Ramp down	Set process or remote on-off*
719	152	Alert	Mix PWM 100% (OptiMix only)	100% duty is reached on any line.	Most significant byte (MSB): H_2 duty cycle (%) Least significant byte (LSB): Ar duty cycle (%)	N_2 duty cycle (%)	None	Start or set process or remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
720	153	Alert	Mix P21>Pin (OptiMix only)	Pressure out (P21) is more than pressure in (Pin) by at least 0.068 bar (1 psi).	Most significant byte (MSB): mixing console outlet pressure (psi) Least significant byte (LSB): H_2 inlet pressure (psi)	MSB: Ar inlet pressure (psi) LSB: N_2 inlet pressure (psi)	None	Start or set process or remote on-off*
721	154	Error	Mix checksum (OptiMix only)	There was a failure of the mixing parameter checksum.	None	None	Ramp down	Set process or remote on-off*
722	155	Error	Mix flow cal (OptiMix only)	There was a failure of the mixing flow calibration.	None	None	Ramp down	Set process or remote on-off*
723	156	Error	Mix pressure cal (OptiMix only)	There was a failure of the mixing pressure calibration.	None	None	Ramp down	Set process or remote on-off*
724	157	Error	Mix I2C1 (OptiMix only)	There is a mixing communication error for I2C1.	System state	None	Ramp down	Set process or remote on-off*
725	158	Error	Mix I2C2 (OptiMix only)	There is a mixing communication error for I2C2.	System state	None	Ramp down	Set process or remote on-off*
726	159	Error	Mix system clock (OptiMix only)	There is a problem with the mixing system clock.	None	None	Ramp down	Set process or remote on-off*
730	163	Alert	Solenoid error V1	There is a V1 error.	None	None	Ramp down	Set process or remote on-off*
733	166	Alert	Solenoid error V4	There is a V4 error.	None	None	Ramp down	Set process or remote on-off*
734	167	Alert	Solenoid error V5	There is a V5 error.	None	None	Ramp down	Set process or remote on-off*
735	168	Alert	Solenoid error V6	There is a V6 error.	None	None	Ramp down	Set process or remote on-off*
736	169	Alert	Solenoid error V7	There is a V7 error.	None	None	Ramp down	Set process or remote on-off*
737	170	Alert	Solenoid error V8	There is a V8 error.	None	None	Ramp down	Set process or remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
738	171	Alert	Solenoid error V9	There is a V9 error.	None	None	Ramp down	Set process or remote on-off*
739	172	Alert	Solenoid error V10	There is a V10 error.	None	None	Ramp down	Set process or remote on-off*
740	173	Alert	Solenoid error V11	There is a V11 error.	None	None	Ramp down	Set process or remote on-off*
741	174	Alert	Solenoid error V12	There is a V12 error.	None	None	Ramp down	Set process or remote on-off*
742	175	Alert	Mix I2C1 Alert (OptiMix only)	There is a mixing communication alert for I2C1.	System state	Time in state (milliseconds)	None	Set process or remote on-off*
743	176	Alert	Mix I2C2 Alert (OptiMix only)	There is a mixing communication alert for I2C2.	System state	Time in state (milliseconds)	None	Set process or remote on-off*
744	177	Alert	Low speed–mag (magnetics) Fan 1	Fan 1 speed is below the minimum acceptable RPM value.	Measured fan speed (RPM)	Fan speed limit (RPM)	None	Set process or remote on-off*
745	178	Alert	Low speed–mag (magnetics) Fan 2	Fan 2 speed is below the minimum acceptable RPM value.	Measured fan speed (RPM)	Fan speed limit (RPM)	None	Set process or remote on-off*
746	184	Alert	Low speed–mag (magnetics) Fan 3	Fan 3 speed is below the minimum acceptable RPM value.	Measured fan speed (RPM)	Fan speed limit (RPM)	None	Set process or remote on-off*
747	185	Alert	Low speed-cab (cabinet) Fan 1	Fan 1 speed is below the minimum acceptable RPM value.	Measured fan speed (RPM)	Fan speed limit (RPM)	None	Set process or remote on-off*
748	179	Alert	Low speed–Hx (heat exchanger) Fan 1	Fan 1 speed is below the minimum acceptable RPM value.	Measured fan speed (RPM)	Fan speed limit (RPM)	None	Set process or remote on-off*
749	180	Alert	Low speed–Hx (heat exchanger) Fan 2	Fan 2 speed is below the minimum acceptable RPM value.	Measured fan speed (RPM)	Fan speed limit (RPM)	None	Set process or remote on-off*
750	186	Alert	Low speed-Ctrl (control) Fan 1	Fan 1 speed is below the minimum acceptable RPM value.	Measured fan speed (RPM)	Fan speed limit (RPM)	None	Set process or remote on-off*
751	187	Alert	Low speed-Ctrl (control) Fan 2	Fan 2 speed is below the minimum acceptable RPM value.	Measured fan speed (RPM)	Fan speed limit (RPM)	None	Set process or remote on-off*
752	181	Error	Phase fault–Ch1	Chopper 1 found a 3-phase error.	Minimum bus voltage (V)	Measured bus voltage frequency (Hz)	Shut down	Remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
753	182	Error	Phase fault–Ch2	Chopper 2 found a 3-phase error.	Minimum bus voltage (V)	Measured bus voltage frequency (Hz)	Shut down	Remote on-off*
754	183	Error	Phase fault–Ch3	Chopper 3 found a 3-phase error.	Minimum bus voltage (V)	Measured bus voltage frequency (Hz)	Shut down	Remote on-off*
755	188	Alert	Low level–Coolant	The coolant level is low.	None	None	None	Set process or remote on-off*
756	189	Info	Leak test results	Reports the results of a gas-leak test.	0: leak in v1, v12, or hose 1: leak in b1 2: leak in v1 or b1 3: leak in v1, v10, or hose 4: leak in b3 5: leak in v10 or b3 6: manual leak test failed 7: manual leak test passed 8: leak in v4, v5, v6, or v7 9: leak in b2 10: leak in v10 or hose 11: no n2 inlet or v5 12: leak in p7 volume 13: leak in line A or v1 14: auto leak test failed 15: auto leak test passed 16: timeout	None	None	Start or set process or remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
757	194	Alert	DC work exceeds limit	The work lead current is more than the setpoint by 20 A for at least 10 milliseconds.	Actual current (amperes: A)	current setpoint (amperes: A)	End of cycle	Start or set process or remote on-off*
758	198	Error	Main 24V dip	The 24 V DC bus decreases to less than 20 V on the main control PCB.	24 VDC bus voltage (V)	dip duration (milliseconds)	End of cycle	Set process or remote on-off*
759	199	Alert	GCC 24V bus low	The 24 VDC bus decreases to less than 20 V on the gas connect console.	24 VDC bus voltage (V)	None	Ramp down	Set process or remote on-off*
768	208	Alert	Gas Inlet–O_2 Line A	Line A O_2 inlet pressure is below 5.52 bar (80 psi) or above 9.31 bar (135 psi).	MSB: line A inlet pressure (psi) LSB: pressure sensor	pressure limit (psi)	None	Set process or remote on-off*
769	209	Alert	Gas inlet–Argon Line B	Line B Argon (Ar) inlet pressure is below 5.52 bar (80 psi) or above 9.31 bar (135 psi).	MSB: line B inlet pressure (psi) LSB: pressure sensor	pressure limit (psi)	None	Set process or remote on-off*
770	207	Alert	Gas Inlet–N_2 Line B	Line B N_2 inlet pressure is below 5.52 bar (80 psi) or above 9.31 bar (135 psi).	MSB: line b inlet pressure (psi) LSB: pressure sensor	pressure limit (psi)	None	Set process or remote on-off*
771	206	Alert	Gas inlet–Air Line A	Line A Air inlet pressure is below 5.52 bar (80 psi) or above 9.31 bar (135 psi).	MSB: line A inlet pressure (psi) LSB: pressure sensor	pressure limit (psi)	None	Set process or remote on-off*
772	211	Alert	High inlet line A	Line A inlet pressure is more than 9.65 bar (140 psi).	Line A inlet pressure (psi)	Pressure limit (psi)	Ramp down	Set process or remote on-off*
774	213	Alert	P5 >= P2	Line A outlet pressure (P5) exceeds Line A inlet pressure (P2) while V10 is active.	P2 pressure (psi)	P5 pressure (psi)	Ramp down	Set process or remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
775	215	Alert	Node update	Reports the status of the node update.	low byte: major rev high byte low nibble:result 0:success 1:boundary error 2:byte count error 3:checksum error 4:timeout error 5:target error high byte high nibble:target 0:unknown 1:main control 2:tcc 3:gcc 4:ch1 5:ch2 6:ch3 7:boot main control 8:boot tcc 9:boot gcc 10:boot ch1 11:boot ch2 12:boot ch3 13:cooler 14:boot cooler 15:fieldbus	Minor rev	None	Start or set process or remote on-off*
779	219	Error	Chopper 1 (15 VDC)	The 15 VDC for Chopper 1 is out of range.	Actual voltage (V)	Reference voltage (V)	End of cycle	Remote on-off*
780	220	Error	Chopper 2 (15 VDC)	The 15 VDC for Chopper 2 is out of range.	Actual voltage (V)	Reference voltage (V)	End of cycle	Remote on-off*
781	221	Error	Chopper 3 (15 VDC)	The 15 VDC for Chopper 3 is out of range.	Actual voltage (V)	Reference voltage (V)	End of cycle	Remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
782	222	Alert	Low psi–P2	During mixed-gas flow, gas pressure for P2 is less than 7.58 bar (110 psi) for at least 200 milliseconds.	P2 pressure (psi)	P2 reference (psi)	None	Set process or remote on-off*
784	224	Error	Main 24V high	The 24 VDC bus is above 28 volts.	24 VDC bus voltage (V)	Voltage limit (V)	Ramp down	Voltage is in range
789	231	Alert	Fieldbus fault	The Hilscher™ module has a communications error.	Fault id 1:pdo read 2:start on noise 3:start off noise 4:hold on noise 5:hold off noise 6:pierce on noise 7:pierce off noise 8:spi comms to	fault data 1:val 2:count 3:count 4:count 5:count 6:count 7:count 8:time	None	Start or set process or remote on-off*
790	235	Error	Eco mode timeout	The cutting system cannot find the choppers after Eco mode stops.	None	None	Shut down	Remote on-off*
791	238	Error	No Thermistor-Con Xfrmr	The main control PCB cannot find a temperature sensor for the control transformer from the control-transformer thermistor.	Sensor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
792	239	Error	Thermistor Fault-Con Xfrmr	The main control PCB finds a shorted temperature sensor in the control transformer.	Sensor analog-to-digital converter (ADC) counts	None	Shut down	Remote on-off*
793	237	Error	Over temp-Con Xfrmr	The temperature sensor for the control transformer measures more than 160°C (320°F) for more than 5 seconds.	Transformer temperature (degrees Celsius: °C)	Temperature limit (degrees Celsius: °C)	Ramp down	Temperature is in range
794	243	Alert	No MAC found	The main control PCB is unable to load a MAC address from the EPROM.	None	None	None	Start or set process or remote on-off*
795	229	Alert	Cooler 24V	The 24 VDC bus is less than 20 V.	24 VDC bus voltage (V)	None	None	Start or set process or remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
797	244	Error	Firmware version mismatch	One or more of the firmware versions for the different cutting system components do not have the same Major revision (are incompatible).	System component ID 1:main 2:tcc 3:gcc 4:ch1 5:ch2 6:ch3 7:main boot 8:tcc boot 9:gcc boot 10:ch1 boot 11:ch2 boot 12:ch3 boot 13:cooler 14:cooler boot 15:fieldbus 16:website	Major version	None	Remote on-off*

ID	enum	Priority	Description	Details	Smart data 1	Smart data 2	Action	Clears with
798	245	Info	USB firmware update	Shows the result of a firmware update after an automatic USB update.	Result 0:Automatic Update Requested 1:Successful 2:Package Error 3:Usb Error 4:Canceled System is off	Package Errors 0:Valid 1:Invalid Header 2:Checksum Mismatch 3:Invalid Version 4:Invalid Component 5:Memory Error Usb Errors 4:Usb Package File Error 8:Usb Image Copy Failed	None	Start or set process or remote on-off*
799	246	Alert	Remote-switch mismatch	The inputs from the standard remote on-off switch and the redundant remote on-off switch are different.	Inputs from the standard remote on-off switch	Inputs from the redundant remote on-off switch	None	Start or set process or remote on-off*
800	225	Info	Power transition 24 V	This reports 24 V power source transitions.	1: Switched to backup power 2: Main power restored	None	Ramp down	Start or set process or remote on-off*

* A feature of the 141545 main control PCB is that it offers redundancy to the standard remote on-off switch. If the redundant remote on-off switch is active, the switches for both the standard and redundant remote on-off must be set to ON to supply power to the cutting system. Refer to *Install a redundant remote on-off switch* in the instruction manual that came with your cutting system.

For guidance about how to respond to codes, refer to *Troubleshooting procedures for diagnostic codes* in the instruction manual that came with your XPR cutting system.

How to get the best results from firmware updates

File over EtherCAT (FoE)

Hypertherm OEMs without EDGE Connect CNCs can use standard File over EtherCAT (FoE) protocols to update firmware on any cutting systems that currently have firmware revision M or subsequent versions.

For the best results:

- Use only firmware-update files from Hypertherm.
- Before a firmware update begins:
  - Make sure that the remote on-off switch for the cutting system is set to ON.
  - If the redundant remote on-off switch is installed, make sure that it is set to ON.

Do these steps to update the firmware:

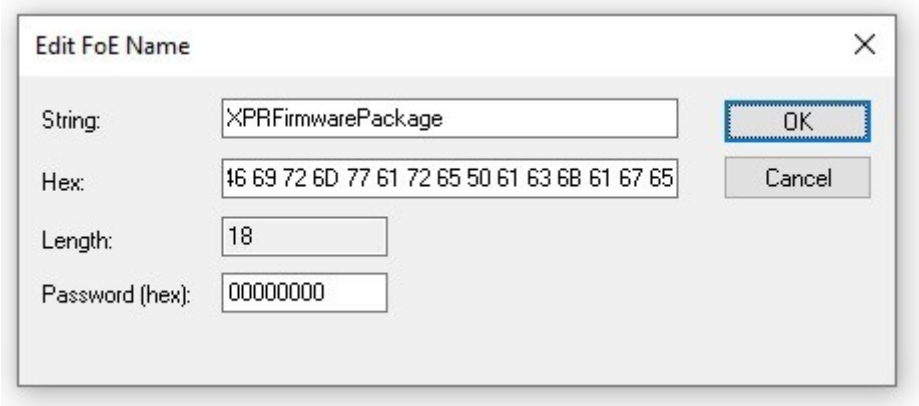
1. Use your EtherCAT controller to get access to the EtherCAT FoE function for your cutting system.



2. Select **Download**.
3. Select the XPR firmware package you want to install.

   Note: XPRFirmwarePackage_Rev_1.0.57-beta.bin is an example name for a firmware package name.

4. Change the firmware-package file name to **XPRFirmwarePackage**.



5. Select **OK** to start the file transfer.

6. Wait approximately five minutes for the XPR cutting system to receive and validate the firmware package.
7. Poll the Control object 0x6000:01 Bit 12 to see the status of the file transfer. Wait for this bit to go from 1 to 0.

   Note: When the bit goes to 0, the file transfer is completed.
8. Read Object 0x3233:08 (stored package 1 firmware version) and Object 0x3233:09 (stored package 2 firmware version) to see if the firmware package version successfully transferred to the XPR cutting system.
   - If the version numbers of the stored package 1 firmware or the stored package 2 firmware are the same as the version numbers for the transferred package, then the file transfer was successful.
   - If the firmware update was not successful, do steps 1 to 8 again.
9. Install the firmware (1 = install stored package 1, 2 = install stored package 2):
   - Write Object 0x3101:06 to start the firmware-package installation.
   - Wait ten minutes for the firmware-package installation to complete.
   - Poll the Control object 0x6000:01 Bit 12 to see the status of the firmware installation. Wait for this bit to go from 1 to 0.

   Note: When the bit goes to 0, the firmware-package installation is complete.

Firmware version descriptions

Note: Refer to the firmware-updates field service bulletin (FSB) for your cutting system to get descriptions of the latest firmware versions: *XPR PCB Firmware Updates* (10084813) Technical documentation is available at www.hypertherm.com/docs.

Notes