

EoE (Ethernet over EtherCAT) Command Messaging

Set up and use an EDGE[®] Connect CNC with Inkjet or Dot Peen printing and marking systems

Application Note

810940 | Revision 0 | June 2023

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EoE Command Messaging

Introduction

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

This document explains how to set up your EDGE Connect CNC to send EoE command messages to external devices with TCP (Transmission Control Protocol) and UDP (User Datagram Protocol).

Before you begin

The equipment that follows is necessary to operate an EDGE Connect CNC with Inkjet or Dot Peen marking systems:

- Ethernet enabled Inkjet/Dot Peen marking system, such as a REA JET (Inkjet), Telesis, Markator (Dot Peen), RN Mark, or others
- Beckhoff EL6601 or a Beckhoff EL6614 EoE module (with coupler)



If you only need 1 port, use the EL6601. If you need 2, 3, or 4 ports, use the EL6614. Refer to [Figure 2](#) on page 5. Only one of these modules is supported per EtherCAT network.

- EDGE Connect CNC with Phoenix® 10.22 or later

Set up EoE command messaging at the CNC

Here is a summary of how to set up an EDGE Connect CNC to send EoE command messages to a printer, marker, or other external IP device:

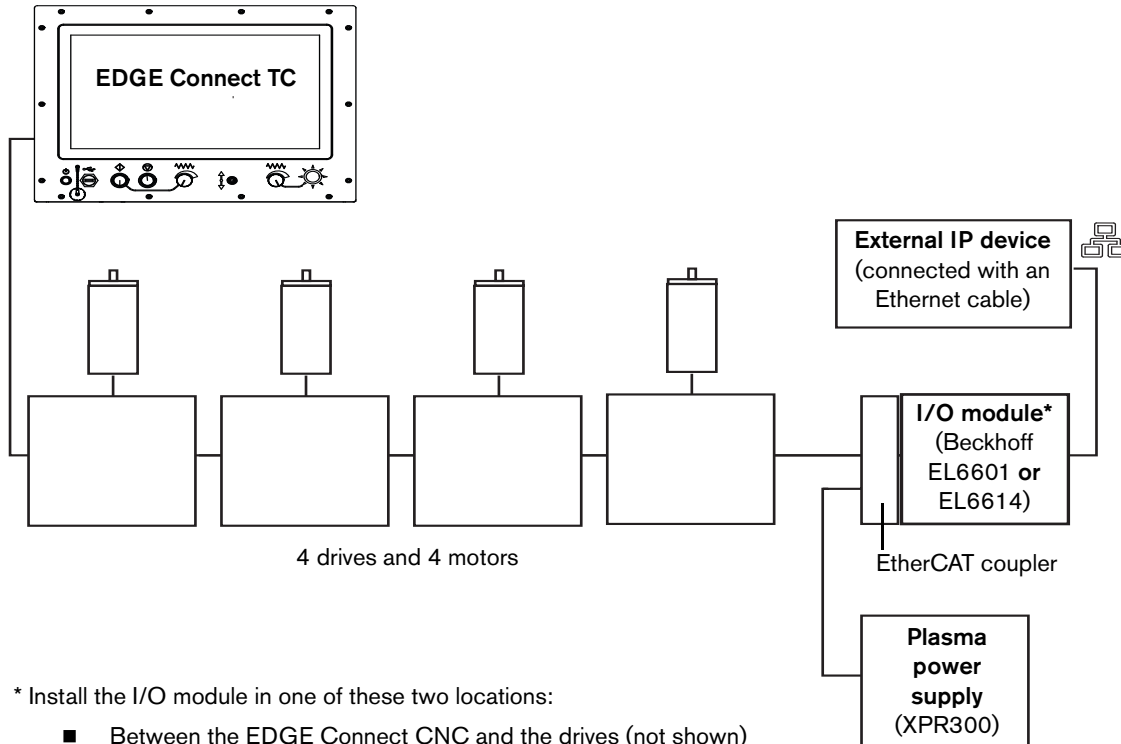
1. Connect the hardware. Refer to [page 5](#).
2. Scan the EtherCAT network. Refer to [page 6](#).
3. Set the IP address in Hypertherm EtherCAT Studio. Refer to [page 6](#).
4. Export the XML. Refer to [page 8](#).
5. Set the IP address and port in Phoenix. Refer to [page 8](#).
6. Create a test part program. Refer to [page 10](#).
7. Test communication. Refer to [page 11](#).

These steps are described in more detail in the sections that follow.

Step 1: Connect the hardware

It is necessary to connect the EDGE Connect CNC, Beckhoff module, and external IP device (printer or marker). Refer to [Figure 1](#).

Figure 1 – Example of the connections between an EDGE Connect CNC and an external IP device



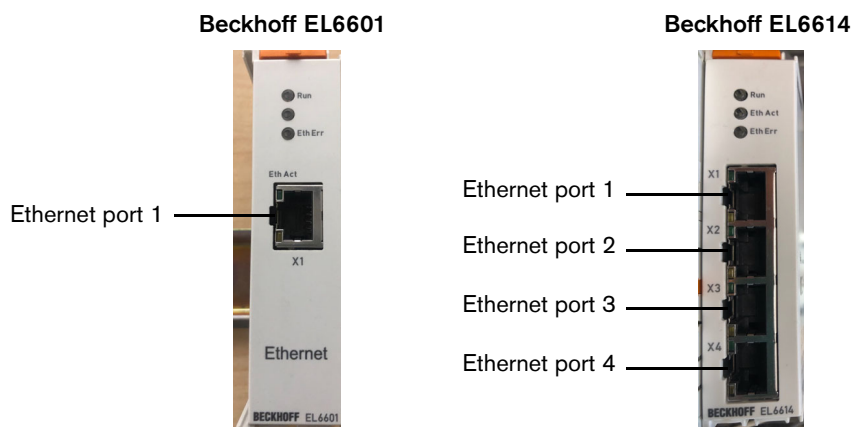
* Install the I/O module in one of these two locations:

- Between the EDGE Connect CNC and the drives (not shown)
- OR
- Between the last drive and the first plasma power supply on the EtherCAT network (as shown)

To connect the hardware:

1. Use an Ethernet cable to connect your printer, marker, or other IP device to a Beckhoff EL6601 (1 port) or to a Beckhoff EL6614 (up to 4 ports) module.

Figure 2



2. Use an EtherCAT cable to connect the EDGE Connect CNC to an EtherCAT coupler.
3. Attach the Beckhoff EL6601 or EL6614 to the EtherCAT coupler. Refer to Beckhoff's recommendations.

Step 2: Scan the EtherCAT network

Use Hypertherm EtherCAT Studio to create a new Network Configuration file (Phoenix.xml) that includes the Beckhoff EL6601 or Beckhoff EL6614 module. Refer to the *EDGE Connect Installation and Setup Manual* (809340 Revision 4). Technical documentation is available at www.hypertherm.com/docs.

Step 3: Set the IP address in Hypertherm EtherCAT Studio

After the hardware is set up, use Hypertherm EtherCAT Studio to review the IP address that is assigned to your printer.

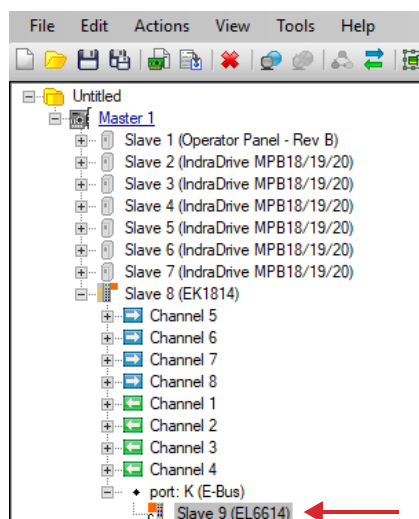
By default, Hypertherm EtherCAT Studio and Phoenix assign these IP addresses to your printer:

- 192.168.50.101: 5002
- 192.168.50.102: 5003
- 192.168.50.103: 5004
- 192.168.50.104: 5005

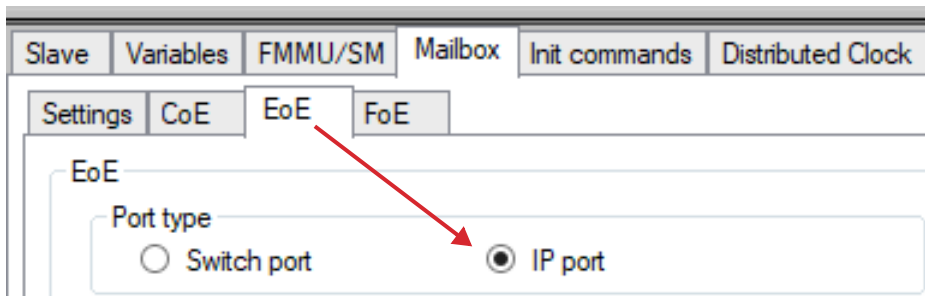
To find out if it is necessary to edit the IP address and port destinations, refer to the documentation from the printer manufacturer.

Optional: Do these steps to edit the IP address destination for your printer in Hypertherm EtherCAT Studio:

1. On the CNC, select the **Windows Start** icon and select **Hypertherm > HT EtherCAT Studio**.
2. In Hypertherm EtherCAT studio, select the **Beckhoff** module in the list, as shown in the example below.



3. On the **Mailbox > EoE** tab, select **IP Port** in the Port type section.



4. In the **IP port settings** section, use the guidelines below to edit the fourth octet (as shown in the example below).

Example:

IP address:

192 . 168 . 50 . 105

Fourth octet
(Edit these characters only.)

Here are the guidelines to know when you edit IP addresses:

- ❑ Only digits 0 – 254 are supported. Do not use special characters or Chinese characters.
- ❑ **Do not** use these three IP addresses which are already in use:
 - 192.168.50.50
 - 192.168.50.100
 - 192.168.50.255
- ❑ For the EL6601 (1-port Beckhoff module), you can assign the IP address anywhere you want within the above guidelines.
- ❑ For the EL6614 (4-port Beckhoff module), the sequence of the **IP addresses is automatically assigned to be one after the other.**

For example, if you edit the IP address to become 192.168.50.150 then ports 2, 3, and 4 will be automatically be assigned as:

- 192.168.50.151
- 192.168.50.152
- 192.168.50.153



If the IP address field cannot be edited, make sure that the EtherCAT network is in the INIT state.

5. Record the IP addresses that you have selected. **You will refer to these values in a later step.**

Step 4: Export the XML

To export the XML from Hypertherm EtherCAT studio, refer to the *EDGE Connect Installation and Setup Manual* (809340 Revision 4). Technical documentation is available at www.hypertherm.com/docs.



We recommend that you also save a copy of the EtherCAT Studio project file with the updated IP addresses. Select **File > Save Project As** and make sure that the **Save as type** field is set to ***.ecsn**.

Step 5: Set the IP address and ports in Phoenix

In Phoenix, review the destination and protocol values that are assigned to your printer, marker, or other external IP device.

If you edited the IP address values in Hypertherm EtherCAT Studio (in [Step 2: Scan the EtherCAT network](#)), you must select the same destination address values in Phoenix.

To view and edit the current settings for an IP device:

1. In Phoenix, select **Setups > Password**.
2. In the Password dialog, type **CONFIGUREMESSAGING** and then select **OK**.
3. In the Messaging Port Configuration dialog, review the settings for each external IP device. Refer to [Figure 3](#) on page 9.

Figure 3 – Example of the Messaging Port Configuration dialog with the default settings

	1 Source	2 Destination	3 Protocol
IP Device 1	192.168.50.100 : 0	192.168.50.101 : 5002	TCP
IP Device 2	192.168.50.100 : 0	192.168.50.102 : 5003	TCP
IP Device 3	192.168.50.100 : 0	192.168.50.103 : 5004	TCP
IP Device 4	192.168.50.100 : 0	192.168.50.104 : 5005	TCP

- 1 Source** This column shows the preset “IP address: Port” that is used by the CNC. The IP address of the EDGE Connect CNC is preset to 192.168.50.100 on port 0.
- 2 Destination (IP address: Port)** This is the “IP address: Port” that is in use by your printer or other IP device.
Edit the fourth octet and Port, if necessary, to make sure that Phoenix sends EoE command messages to the correct device.

Example:

The IP addresses must be the same as the values in the external IP device AND the Hypertherm EtherCAT Studio project file. Refer to [page 6](#).



The **Port** field supports 16-bit unsigned integers (0 – 65535).

- 3 Protocol** Select the protocol that your external IP device uses to receive messages.
- TCP (Transmission Control Protocol)
 - UDP (User Datagram Protocol)
- 4.** Make sure that values in the **Destination** fields are the same as the values that you recorded from Hypertherm EtherCAT Studio. Refer to [page 6](#).



If necessary, you can restore the default destination IP address and protocol for each device with the steps on [page 18](#).

Step 6: Create a test part program

To create a part program that you can use to test communication between the EDGE Connect CNC and the external IP device:

1. Create a simple part program without EoE command messages.

For example:

```
M36 T4           // Enable Marker 2 process settings
M11             // Marker Offset 1 On
M09            // Start Marker Process
G01 X0.357 Y1   // Mark Geometry (optional)
G01 X0.357 Y-1
M10           // End Marker Process
M12          // Cancel Marker Offset 1
```



For information about part program codes, refer to the *EDGE Connect Programmer Reference* (809550). Technical documentation is available at www.hypertherm.com/docs.

2. Create EoE command messages to add to your part program. You can copy and edit the example commands below to support your configuration. Refer to [page 12](#).

For example:

```
(>22,0,2,0,0<MessagePort1)
(>22,0,2,1,0<MessagePort2)
(>22,0,2,2,0<MessagePort3)
(>22,0,2,3,0<MessagePort4)
```

3. Put a command message (from the previous step) **inside the cut cycle or inside the marker cycle** in your part program.

For example:

```
M36 T4           // Enable Marker 2 process settings
M11             // Marker Offset 1 On
M09            // Start Marker Process
(>22,0,2,0,0<StartPrintPort1) // Send EoE command to port 1
G01 X0.357 Y1   // Mark Geometry (optional)
G01 X0.357 Y-1
M10           // End Marker Process
M12          // Cancel Marker Offset 1
```

Step 7: Test communication

To test communication, use Phoenix Version 10.22 or later to load and execute the part program that you created in the previous step.

These status messages show up below the Part Preview on the Main screen in Phoenix during part program execution:

- “[Message Transmit](#)” can sometimes be shown when a message is being sent.
- “[Message Delay](#)” is shown for Message Type 20 during a delay at the end of a message.
- “[Message Verify](#)” is shown for Message Type 22 when Phoenix is waiting for the ACK command to be returned by the external serial device.
- “[Message Error](#)” is shown for Message Type if the Delay Time expires before an ACK command is returned to Phoenix.



For information about Message Type and Delay Time, refer to [page 12](#).

EoE command reference

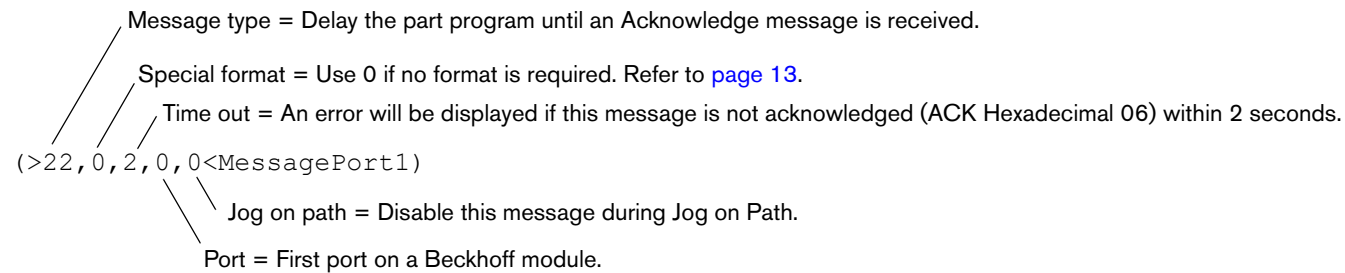
The ASCII message strings in EoE command messages must have this format:

(>[Message type],[Special Format],[Delay or Time Out],[Port Number],[Jog on Path]<[Message Content])



All parameters are necessary. All characters except for the brackets "[]" are also necessary.

Example



Refer to the table on the right for more details.

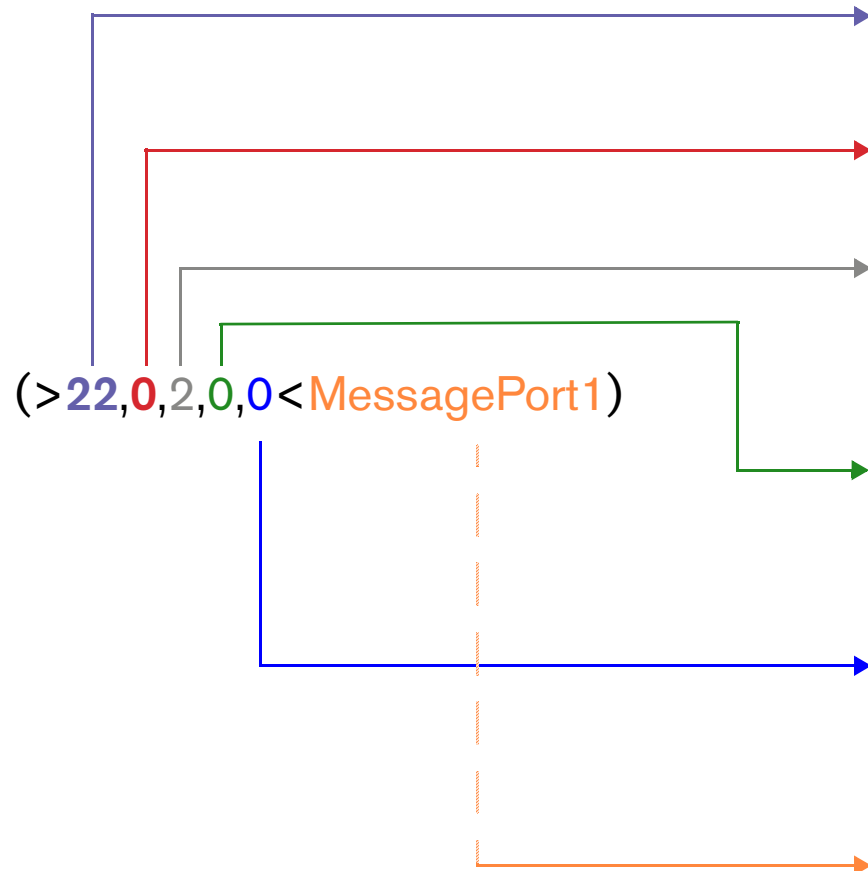


Table 1 – EoE command parameter reference

Parameter	Sequence	Description
Message Type	First	<ul style="list-style-type: none"> 20 = Delay the part program until all bytes have been transmitted and the Delay Time expires. 21 = Send the message without a time delay or acknowledgment during the part program execution. 22 = Delay the part program until all bytes have been transmitted and Phoenix receives an acknowledgment from the external device (ACK = Hexadecimal 06). Report the "Message Verify" status message below the Part Preview until the Delay Time expires. Once the Delay Time expires, the "Message Error" status message shows below the Part Preview.
Special Format	Second	Special format, such as a carriage return. Use 0 if no format is required. Refer to page 13 .
Delay Time or Time Out	Third	<ul style="list-style-type: none"> For Message Type 20, this is the maximum Delay Time (0.00 – 999.99 seconds) at the end of a message. For Message Type 21, the value must be 0. For Message Type 22, this is a Time Out value (0.00 – 999.99 seconds). An error will be displayed if the message is not acknowledged (ACK Hexadecimal 06) within the specified time.
Port Number	Fourth	<p>The TCP or UDP Port Number of the destination printer, or other IP device. A value of 0 represents a remote printer host setup on 192.168.50.101.</p> <ul style="list-style-type: none"> 0 = Port 1 (First port on a Beckhoff EL6601 or a Beckhoff EL6614 module) 1 = Port 2 2 = Port 3 3 = Port 4
Jog On Path	Fifth	<p>Selects if command messages are enabled or disabled while the torch jogs on the path.</p> <ul style="list-style-type: none"> 0 = Disables command messaging during Jog On Path. 1 = Lets the CNC send command messages while the torch is jogging forward on the path only. 2 = Lets the CNC send command messages while the torch is jogging forward and backward on the path.
Message Content	Sixth	<p>Message content with Printable ASCII codes and non-printing ASCII codes. Refer to ASCII Codes on page 15.</p> <ul style="list-style-type: none"> Each command message supports up to 300 characters. The Command characters (information between and including the ">" and "<" signs) are included in this character limit. Non-printing characters are supported with a two-character command. Non-printing characters can send a binary code in the range from 0-255. Double-byte characters that are used to support combinations affect the maximum length count with each pair and decrease the maximum data characters by 1.

Special format characters

EoE command messages support the special format characters that follow.

Hex	Name	Description
01	SOH	Start of Header
02	STX	Start of Text
03	ETX	End of Text
04	EOT	End of Transmission
0D	CR	Carriage Return
0A	LF	Line Feed
	BCC	"Exclusive Or" Check Byte



Checksum is always an "Exclusive OR" of the Data because it does not include any of the "Format" characters, including the CR/LF option. Refer to the "ASCII Codes" section in the *EDGE Connect Programmer Reference* (809550) for more details.

For example, this command below uses SOH, STX, and ETX:

```

      &A= Start of Header (SOH)
      |
      | 1= Type value, printer-specific
      |
      | &B= Start of Text (STX)
      |
(>22,17,3,0<&A1&B01PRINTME&C)
      |
      |
      | &C = End of Text (ETX)
      |
      | PRINTME= Text to print on material
      |
      | 01= nn of the Data field, printer-specific
Replaces the BCC and CR. Refer to the next section.

```

Optional format character assignments

EoE command messages support the optional format characters that follow.

Value	Description
0	No special assignment. If no format options are necessary, use a value of 0 in the format location of the EoE command.
1	Append a Carriage Return (<CR> = Hex value OD) and a Line Feed (<LF> = Hex Value 0A).
16	Append an "Exclusive OR" (<BCC>) to the end of the message.
17	Appends a combination of 16 and 1.
32	Encloses the message with Start of Text (<STX> = Hex Value 02) and End of Text (<ETX> = Hex Value 03). The <ETX> follows the message and the optional <CR><LF>> append codes but precedes the Check Byte <BCC>.

EoE Command Messaging

Value	Description
33	Appends a combination of 1 and 32.
48	Appends a combination of 16 and 32.
49	Appends a combination of 1, 16, and 32.
64	Append a Start of Header (<SOH> = Hex value 01) and an End of Transmission (<EOT> = Hex Value 04) to the message.
65	Appends a combination of 1 and 64.
80	Appends a combination of 16 and 64.
81	Appends a combination of 1, 16, and 64.
96	Appends a combination of 32 and 64.
97	Appends a combination of 1, 32, and 64.
112	Appends a combination of 16, 32, and 64.
113	Appends a combination of 1, 16, 32, and 64.

ASCII Codes

This section gives the 128 ASCII codes (American Standard Code for Information Interchange) as defined by ANSI (American National Standards Institute) Standard X3.4-1977.

ASCII Control Codes

Hex	Dec	Character*	name	Description
00	0	^ @	NUL	Null
01	1	^A	SOH	Start of Header
02	2	^B	STX	Start of Text
03	3	^C	ETX	End of Text
04	4	^D	EOT	End of Transmission
05	5	^E	ENQ	Enquiry
06	6	^F	ACK	Acknowledge
07	7	^G	BEL	Bell
08	8	^H	BS	Backspace
09	9	^I	HT	Horizontal Tab
0A	10	^J	LF	Line Feed
0B	11	^K	VT	Vertical Tab
0C	12	^L	FF	Form Feed
0D	13	^M	CR	Carriage Return
0E	14	^N	SO	Shift Out
0F	15	^O	SI	Shift In
10	16	^P	DLE	Data Link Escape
11	17	^Q	DC1	Device Control 1
12	18	^R	DC2	Device Control 2
13	19	^S	DC3	Device Control 3
14	20	^T	DC4	Device Control 4
15	21	^U	NAK	Negative Acknowledge
16	22	^V	SYN	Synchronous Idle
17	23	^W	ETB	End Transmission Block
18	24	^X	CAN	Cancel
19	25	^Y	EM	End of Medium

* The "^" in the Character column sometimes can be replaced with "&" in the Message Port part of the serial string.

Hex	Dec	Character*	name	Description
1A	26	^Z	Sub	Substitute
1B	27	^[	ESC	Escape
1C	28	^\	FS	File Separator
1D	29	^]	GS	Group Separator
1E	30	^^	RS	Record Separator
1F	31	^_	US	Unit Separator
20	32		SP	Space

* The "^" in the Character column sometimes can be replaced with "&" in the Message Port part of the serial string.

All ASCII codes

Hex	Dec	Character*	Hex	Dec	Character*	Hex	Dec	Character*
00	0	^ @	2B	43	+	56	86	V
01	1	^A	2C	44	,	57	87	W
02	2	^B	2D	45	-	58	88	X
03	3	^C	2E	46	.	59	89	Y
04	4	^D	2F	47	/	5A	90	Z
05	5	^E	30	48	0	5B	91	[
06	6	^F	31	49	1	5C	92	\
07	7	^G	32	50	2	5D	93]
08	8	^H	33	51	3	5E	94	^
09	9	^I	34	52	4	5F	95	_
0A	10	^J	35	53	5	60	96	`
0B	11	^K	36	54	6	61	97	a
0C	12	^L	37	55	7	62	98	b
0D	13	^M	38	56	8	63	99	c
0E	14	^N	39	57	9	64	100	d
0F	15	^O	3A	58	:	65	101	e
10	16	^P	3B	59	;	66	102	f
11	17	^Q	3C	60	<	67	103	g
12	18	^R	3D	61	=	68	104	h
13	19	^S	3E	62	>	69	105	i

* The "^" in the Character column sometimes can be replaced with "&" in the Message Port part of the serial string.

Hex	Dec	Character*	Hex	Dec	Character*	Hex	Dec	Character*
14	20	^T	3F	63	?	6A	106	j
15	21	^U	40	64	@	6B	107	k
16	22	^V	41	65	A	6C	108	l
17	23	^W	42	66	B	6D	109	m
18	24	^X	43	67	C	6E	110	n
19	25	^Y	44	68	D	6D	111	o
1A	26	^Z	45	69	E	70	12	p
1B	27	^[	46	70	F	71	113	q
1C	28	^\	47	71	G	72	114	r
1D	29	^]	48	72	H	73	115	s
1E	30	^^	49	73	I	74	116	t
1F	31	^_	4A	74	J	75	117	u
20	32		4B	75	K	76	118	v
21	33	!	4C	76	L	77	119	w
22	34	"	4D	77	M	78	120	x
23	35	#	4E	78	N	79	121	y
24	36	\$	4F	79	O	7A	122	z
25	37	%	50	80	P	7B	123	{
26	38	&	51	81	Q	7C	124	|
27	39	'	52	82	R	7D	125	}
28	40	(	53	83	S	7E	126	~
29	41	)	54	84	T	7F	127	¬
2A	42	'	55	85	U			

* The "^" in the Character column sometimes can be replaced with "&" in the Message Port part of the serial string.

Review or restore the default settings

You can review and restore the factory default settings for the IP address, port, or protocol for an IP device in Phoenix.

To review the factory default IP address and port settings:

1. In Phoenix, select **Setups > Password**.
2. In the Password dialog, type **CONFIGUREMESSAGING/DEFAULTS** and then select **OK**.
3. In the Messaging Port Configuration dialog, review the information for each IP device. Refer to [Figure 3](#) on page 9.
 - To apply the default settings to your current settings, select **OK**.
 - If you do not want to apply the default settings, you can:
 - Select **Cancel** to close the dialog without making changes.
 - or-
 - Edit the **Destination** and **Protocol** settings on this dialog and then select **OK** to apply your changes.