How To Use Data Communications with the Watlow Series 733/734

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How to Use Data Communications with the Watlow Series 733/734

This manual is a supplement to the Series 733/734 Program and Service Manuals. It is for controls with the data communications option. Use in conjunction with the Program and Service manuals.

You Have One of Two Serial Hardware Interfaces

Depending on your unit's model number, you have one of two hardware interfaces:

1) **EIA/TIA-422** for a "multidrop" or (multiple device) network, up to ten devices total; with 4000 ft. network length limit, or **EIA/TIA-423** (EIA/TIA-232 compatible) for one on one communication with a 50 ft. network length limit with a 733/734 (73xx-xxxx-xBxx) and a host computer. Selecting EIA/TIA-422 or EIA/TIA-423 is user selectable via internal switches. See Page 7.

2) **EIA/TIA-485** (73xx-xxxx-xDxx) also for a multidrop network, up to 32 addresses total, and with a 4000 ft. network length limit.

You Can Use One of Two Software Protocols

There are two protocols available to you. Depending on the type of network you need, you must use the correct combination of interface and protocol.

We use **ANSI X3.28 Protocol**, based on ANSI X3.28 - 1976 Subcategories 2.2, and A3, with the EIA/TIA-422 and EIA/TIA-485 interface to run a multiple device network. We also use **XON/XOFF Protocol**, a simpler protocol, to run a two device network with an EIA/TIA-423 interface. XON/XOFF will also work with the EIA/TIA-422 and EIA/TIA-485 interface, but the network is limited to two devices (one computer and a Series 733/734). XON/XOFF Protocol requires no responses to messages like the ANSI X3.28 Protocol does. Likewise, ANSI X3.28 Protocol, which provides a response to every message, will work with the EIA/TIA-423 interface. But again you are limited to one Series 733/734 and a host computer.

To select which protocol you are going to use, go into the Program menu and use the MODE key to advance to the Prot prompt. Select either **FULL**, for ANSI X3.28 2.2 - A.3, or **On** for XON - XOFF.

If you are using ANSI X3.28 Protocol, choose an address number for the control under the Addr prompt following the Prot prompt. This prompt will only appear if Prot = FULL.

Communications Wiring

To connect your Series 733/734 to a computer, use the next three pages as a reference. Your computer hardware manual will provide more detailed serial port pin information. In the often noisy industrial environments, do not take noise isolation lightly.
EIA/TIA-422 Interface Pinouts

73xx-xxxx-xBxx

The EIA/TIA-422 communications uses a four wire (full duplex) system. There are two separate lines for transmitting, and two lines for receiving data between the computer and the Series 733/734. With EIA/TIA-422 you can have from one to ten Series 733/734 controls connected to a single computer.

This diagram is a typical wiring example. The connections on the host computer may vary depending on models. See page 7 for information about serial interfaces. Refer to your computer user’s manual for more information.

NOTE: The Electronic Industry Association (EIA) EIA/TIA-422 standard recommends a maximum 4000 ft. total network distance.
**EIA/TIA-423 Interface Pinouts (EIA/TIA-232 Compatible)**

**73xx-xxxx-xBxx**

The EIA/TIA-423 communications uses a three wire (full duplex) system. There is a separate line for transmitting, a line for receiving data, and a line for signal common between the computer and the Series 733/734. With EIA/TIA-423 you can have only one Series 733/734 control connected to a single computer.

This diagram is a **typical** wiring example. The connections on the host computer may vary depending on models. Refer to your computer user's manual for more information.

NOTE: The Electronic Industry Association (EIA) EIA/TIA-423 standard recommends a maximum 50 foot total point-to-point distance.

---

**Figure 2 - EIA/TIA-423 Interface, Pin Designations.**

**DB-9 Pinouts**
1. DCD
2. receive
3. transmit
4. DTR
5. common
6. DSR
7. RTS
8. CTS

**DB-9 female viewed from wire side**
(typical connections with jumpers)
EIA/TIA-485 Interface Pinouts

73xx-xxxx-xDxx

The EIA/TIA-485 communications uses a two wire (half duplex) system. There are only two lines, both lines used for transmitting and receiving. Only one device, the computer or the control, can be speaking at a time. The Series 733/734 requires a 7 millisecond delay between transmission and receipt of data. With EIA/TIA-485 you can have from one to thirty-two Series 733/734 controls connected to a computer.

This diagram is a typical wiring example. The connections on the host computer may vary depending on models. See page 7 for information about serial interfaces. Refer to your computer user's manual for more information.

Connecting the Control and the Computer

Remove power from both the Series 733/734 and your computer before connecting them together. This prevents noise or static interference from entering the data communication lines. Assemble a cable and the appropriate wiring at your computer. Refer to the wiring on pages 4 through 6. As soon as you connect the data communications lines, you may apply power to your system.
How to Set the EIA/TIA-422 & EIA/TIA-423 Hardware Protocol Switches for 73xx-xxxx-xBxx Units Only

The EIA/TIA-422 or EIA/TIA-423 switches are on the Communication Module Board (A007-1830) inside the control. Figure 4 shows the approximate location of this board. Select C1 on both switches for EIA/TIA-423, or C2 on both switches for EIA/TIA-422 operation. **Both switches must be set to the same position.**

To change the position of the switches:

*Watlow recommends using a properly grounded wrist strap before opening this control.*

1) Remove power from the Series 733/734.
2) Remove the two snap-on connectors from the back of the unit.
3) Remove the two rear cover screws from the back of the unit.
4) Remove the rear cover and locate the switches. See Figure 4.
5) Set both switches to C1 for EIA/TIA-423, or to C2 for EIA/TIA-422
6) Replace the rear cover; secure the two rear cover screws.
7) Re-attach the two snap-on connectors.
8) Apply power to the control.

Your Computer’s Serial Interface: The Key To Network Connections

You can connect a data communication-equipped Series 733/734 to any computer with an EIA/TIA-422 or EIA/TIA-423 (EIA/TIA-232 compatible) or EIA/TIA-485 serial interface. The IBM™ PC® with an EIA/TIA-232 serial output card, for instance, will talk to a single EIA/TIA-423 equipped Series 733/734. For a multiple 733/734 network with the same PC, you'll need an EIA/TIA-232 to EIA/TIA-422 converter to act as a "bus," or multiple connection point.

*Watlow recommends the Burr-Brown LDM 422 for that purpose.* The address is: Burr-Brown, Inc., 1141 West Grant Rd., Suite 131, Tucson, AZ 85705,
Phone: (602) 624-2434, Fax: (602) 623-8965.

For EIA/TIA-485, we recommend the Black Box LD485A-MP. The address is: Black Box Corp., Mayview Road at Park Drive, Box 12800, Pittsburgh, PA 15241,
Phone: (412) 746-5530, Fax: (412) 746-0746.
Program Mode - Communications Prompts

Enter the Program Mode at the front panel: \[0000\]

Press key sequence: \[\text{↑} \quad \text{↓} \quad \text{←} \quad \text{→} \quad \text{↑} \quad \text{↓} \]

The display shows: \[C.F\]

Continue pressing: \[\text{↓}\]

Until: \[\text{baud}\]

Current value displays alternately: \[1200\] or \[\text{baud}\]

Press to change value: \[\text{↑} \quad \text{↓}\]

Press for next prompt: \[\text{←}\]

Press to exit: \[\text{→}\]

Document any changes.

Enter data on a photocopy of this page.

<table>
<thead>
<tr>
<th>Prompt</th>
<th>This Value</th>
<th>Range</th>
<th>Factory Default</th>
<th>Appears…</th>
</tr>
</thead>
<tbody>
<tr>
<td>[\text{baud}]</td>
<td>(Baud rate)</td>
<td>300, 600, 1200, 2400, 4800, 9600</td>
<td>1200</td>
<td>if comms unit</td>
</tr>
<tr>
<td>[\text{bit}]</td>
<td>(7a = 7) data bits and odd parity (7E = 7) data bits and even parity (8n = 8) data bits and no parity (Start bit = 1) (Stop bit = 1)</td>
<td>(7o) (Fixed) (Fixed)</td>
<td>(7o) (Fixed) (Fixed)</td>
<td>if comms unit</td>
</tr>
<tr>
<td>[\text{Prot}]</td>
<td>FULL = ANSI X3.28 2.2 - A.3 On = XON - XOFF</td>
<td>FULL</td>
<td>FULL</td>
<td>if comms unit</td>
</tr>
<tr>
<td>[\text{Addr}]</td>
<td>0 to 31 (ASCII)</td>
<td>0</td>
<td>0</td>
<td>if Prot = FULL</td>
</tr>
</tbody>
</table>
### ASCII Character Set

<table>
<thead>
<tr>
<th>Dec</th>
<th>Hex</th>
<th>Char</th>
<th>Dec</th>
<th>Hex</th>
<th>Char</th>
<th>Dec</th>
<th>Hex</th>
<th>Char</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>00</td>
<td>NUL</td>
<td>16</td>
<td>10</td>
<td>DLE</td>
<td>32</td>
<td>20</td>
<td>SP</td>
</tr>
<tr>
<td>01</td>
<td>01</td>
<td>SOH</td>
<td>17</td>
<td>11</td>
<td>DC1</td>
<td>33</td>
<td>21</td>
<td>!</td>
</tr>
<tr>
<td>02</td>
<td>02</td>
<td>STX</td>
<td>18</td>
<td>12</td>
<td>DC2</td>
<td>34</td>
<td>22</td>
<td>&quot;</td>
</tr>
<tr>
<td>03</td>
<td>03</td>
<td>ETX</td>
<td>19</td>
<td>13</td>
<td>DC3</td>
<td>35</td>
<td>23</td>
<td>#</td>
</tr>
<tr>
<td>04</td>
<td>04</td>
<td>EOT</td>
<td>20</td>
<td>14</td>
<td>DC4</td>
<td>36</td>
<td>24</td>
<td>$</td>
</tr>
<tr>
<td>05</td>
<td>05</td>
<td>ENQ</td>
<td>21</td>
<td>15</td>
<td>NAK</td>
<td>37</td>
<td>25</td>
<td>%</td>
</tr>
<tr>
<td>06</td>
<td>06</td>
<td>ACK</td>
<td>22</td>
<td>16</td>
<td>SYN</td>
<td>38</td>
<td>26</td>
<td>&amp;</td>
</tr>
<tr>
<td>07</td>
<td>07</td>
<td>BEL</td>
<td>23</td>
<td>17</td>
<td>ETB</td>
<td>39</td>
<td>27</td>
<td>'</td>
</tr>
<tr>
<td>08</td>
<td>08</td>
<td>BS</td>
<td>24</td>
<td>18</td>
<td>CAN</td>
<td>40</td>
<td>28</td>
<td>(</td>
</tr>
<tr>
<td>09</td>
<td>09</td>
<td>HT</td>
<td>25</td>
<td>19</td>
<td>EM</td>
<td>41</td>
<td>29</td>
<td>)</td>
</tr>
<tr>
<td>10</td>
<td>0A</td>
<td>LF</td>
<td>26</td>
<td>1A</td>
<td>SUB</td>
<td>42</td>
<td>2A</td>
<td>*</td>
</tr>
<tr>
<td>11</td>
<td>0B</td>
<td>VT</td>
<td>27</td>
<td>1B</td>
<td>ESC</td>
<td>43</td>
<td>2B</td>
<td>+</td>
</tr>
<tr>
<td>12</td>
<td>0C</td>
<td>FF</td>
<td>28</td>
<td>1C</td>
<td>FS</td>
<td>44</td>
<td>2C</td>
<td>,</td>
</tr>
<tr>
<td>13</td>
<td>0D</td>
<td>CR</td>
<td>29</td>
<td>1D</td>
<td>GS</td>
<td>45</td>
<td>2D</td>
<td>-</td>
</tr>
<tr>
<td>14</td>
<td>0E</td>
<td>SO</td>
<td>30</td>
<td>1E</td>
<td>RS</td>
<td>46</td>
<td>2E</td>
<td>.</td>
</tr>
<tr>
<td>15</td>
<td>0F</td>
<td>SI</td>
<td>31</td>
<td>1F</td>
<td>US</td>
<td>47</td>
<td>2F</td>
<td>/</td>
</tr>
</tbody>
</table>

### ASCII Control Characters (Partial Set)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ENQ</td>
<td>Ctrl E</td>
<td>Enquiry</td>
<td>5</td>
<td>05</td>
</tr>
<tr>
<td>ACK</td>
<td>Ctrl F</td>
<td>Acknowledge</td>
<td>6</td>
<td>06</td>
</tr>
<tr>
<td>NAK</td>
<td>Ctrl U</td>
<td>Neg. Acknowledge</td>
<td>21</td>
<td>15</td>
</tr>
<tr>
<td>STX</td>
<td>Ctrl B</td>
<td>Start of Text</td>
<td>2</td>
<td>02</td>
</tr>
<tr>
<td>ETX</td>
<td>Ctrl C</td>
<td>End of Text</td>
<td>3</td>
<td>03</td>
</tr>
<tr>
<td>EOT</td>
<td>Ctrl D</td>
<td>End of Transmission</td>
<td>4</td>
<td>04</td>
</tr>
<tr>
<td>DLE</td>
<td>Ctrl P</td>
<td>Data Link Escape</td>
<td>16</td>
<td>10</td>
</tr>
<tr>
<td>CR</td>
<td>Ctrl M</td>
<td>Carriage Return</td>
<td>13</td>
<td>0D</td>
</tr>
<tr>
<td>DC1</td>
<td>Ctrl Q</td>
<td>XON</td>
<td>17</td>
<td>11</td>
</tr>
<tr>
<td>DC3</td>
<td>Ctrl S</td>
<td>XOFF</td>
<td>19</td>
<td>13</td>
</tr>
</tbody>
</table>
Learn Syntax

Series 733/734 General Message Syntax

As soon as you link the devices, you'll be able to talk to the Series 733/734 using ASCII characters.

The Series 733/734 will respond to any Operation or Program prompt, plus some others. The control will respond to either upper or lower case ASCII characters from your computer.

Both protocol/interface combinations will respond to the general syntax, providing the commands or queries are correctly transmitted. However, the ANSI X3.28 Protocol requires beginning and ending characters, and the XON/XOFF Protocol requires ending characters. We'll look at those shortly.

Message Syntax

Messages from your computer to the Series 733/734 must take this general form. All commands do not require the full number of data fields.

Command <space> data.1 <space> data.2 <space> data.3... data.N

"Command" is a character set to which the Series 733/734 will respond. The brackets "< >" enclose a non-literal description. "Space" is simply a delimiter, an ASCII space character (Hex 20). "Data Fields" are prompts and values specific to a command; the number of possible data fields depends on the particular command you use. Data 1 is here abbreviated, "data.1", Data 2 is "data.2" and so on.

In the syntax explanations ahead, we'll show you the specific arguments for each command. It will speed the process, if you remember this general syntax.

Data Rules

Data fields are prompts and values specific to particular commands. These rules govern their use. Specific data for each command is listed later in this chapter.

• Data will be ASCII 0 through 9, unless otherwise noted.
• Data can go up to seven total characters, including a minus sign. A + or - sign, if used, must be first, and it must have a decimal point if applicable.
• Data can use leading zeros. (Up to 7 digits.)
• Data does use decimal points.
• Data.1 portion of message can be up to four total characters.

Command List

These commands, represented by their respective ASCII characters, will enable you to program the Series 733/734 from your computer. More detailed descriptions of the commands are in Table 5, pages 17-19.

? Finds the value of a specific prompt. p. 17 - 19
= Sets a specific prompt to a specific value. p. 17 - 19
Example Format

For your benefit, we're presenting message/response examples with syntax required for Series 733/734 communication. Information bracketed by < > indicates a description, rather than literal characters. We show each ASCII character that you must transmit to the Series 733/734, including space between the characters. (A "space" is itself an ASCII character, hex 20). For clarity, we also represent each ASCII character as a hexadecimal pair. The pairs are spread apart on the page for easy reading. However, electronic devices "see" the hex pairs all together in "strings," with no spaces in between.

For instance, from the example just below, you want to set the Alarm 1 Low (A1LO) prompt to 500°. Notice the syntax just below which uses the "=" command.

```
= <space> A1LO <space> 500
```

To send this message, key the ASCII characters into your computer, or write them into your program. The computer, in turn, will send a string similar to the one at the bottom of the example, 3D2041314C4F2030353303.

Notice that we haven't mentioned protocol here, or any characters added to this syntax by a protocol. With XON/XOFF, the message above can be transmitted with only an additional Carriage Return <cr> (hex 0D) character at the end. However, the ANSI X3.28 Protocol requires an envelope of Start of Text <STX> (hex 02) and End of Text <ETX> (hex 03) characters around the information you see above. You'll learn how to do that in the pages ahead.

**XON/XOFF Protocol for EIA/TIA-423**

**XON/XOFF (flow control) Protocol** allows a communicating device (either a 733/734 or the host) to suspend transmission of all messages from the other device, and then to continue transmission when it's again ready.

The device that needs to suspend transmission sends the XOFF character (hex 13) to stop the other device's transmitter, and XON (hex 11) to restart it. Note that technically any character will restart the transmitter, but only the XON character is not a part of any regular message that may be transferring.

Messages transmit according to the syntax described in the XON/XOFF formats which follow for each command.

**The XON/XOFF Protocol requires a Carriage Return <cr> character (hex 0D) at the end of every message.**
How To Start and Stop Communicating with the Series 733/734 and XON/XOFF

Starting communications with XON/XOFF Protocol is simple. You just configure your computer to agree with the Series 733/734 communication prompts and open its serial communication port in software. Then begin to "talk" by transmitting a message to the Series 733/734. You stop communicating with XON/XOFF Protocol simply by ceasing to send messages.

XON/XOFF "=" Command Example

The general command syntax is the one you've already seen. Each command uses a slightly different variation of it, depending on the number of arguments required for a message.

• You want to change the Alarm 1 Low (A1LO) value to 500°. The "=" command will do the job.

The syntax with XON/XOFF Protocol requires an ending Carriage Return <cr>.

"=" Command Syntax with XON/XOFF Protocol:
= <space> data.1 <space> data.2 <cr>

With the "=" Command, data.1 is the Series 733/734 prompt, in this case Alarm 1 Low, A1LO. Data.2 is the value you want to set for that prompt, in this example, 500.

Enter in ASCII:
= <space> A1LO <space> 500 <cr>
The hex string will be:
3D2041314C4F20353030OD

Response from the Series 733/734:
It sends an "XOFF" when a carriage return is received and then an "XON" when the unit is done processing the command.

• The complete list of Commands is in Table 5, Pages 17-19.
XON/XOFF "?" Command Example

You want to know the Alarm 1 Low (A1LO) value. The "?" uses a variation of the message syntax shown just below. This protocol requires an ending carriage return character.

"?" Command syntax with XON/XOFF Protocol:

? <space> data.1 <cr>

Enter in ASCII:

? <space> A1LO <cr>
The hex string will be:

3F2041314C4F0D

The value of A1LO will be between rL (Range Low) and rH (Range High), say, 500.

Response from the Series 733/734:

<XOFF> <XON> <current value of A1LO> <cr>

The hex response string is:

13113530300D
ANSI X3.28 Protocol for EIA/TIA-422 and EIA/TIA-485

The ANSI X3.28 Protocol provides high quality communications by requiring a response to every message. With a multiple device or “multidrop” network, this protocol prevents confusion among the separate devices. Furthermore, if noise occurs somewhere in the system, no prompt will change because noise can’t comply with the protocol.

By placing messages inside a protocol envelope, the messages are protected. In the examples to come you’ll see how this works.

The ANSI X3.28 Protocol requires STX characters at the beginning of a message and ETX characters at the end.

Device Address

If you are using the ANSI X3.28 Protocol, you must have a device address (identification) number. A Watlow EIA/TIA-422 multidrop network can handle up to 10 devices with this protocol. EIA/TIA-485 can handle up to 32 devices.

Set the address number with the Series 733/734 in the Addr prompt under the Setup menu.

Table 4 - Address to ASCII Conversion.

<table>
<thead>
<tr>
<th>Address</th>
<th>ASCII Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 9</td>
<td>0 - 9</td>
</tr>
<tr>
<td>10 - 31</td>
<td>A - V</td>
</tr>
</tbody>
</table>

Starting Communications in ANSI X3.28 Protocol

Here’s the syntax for starting communications with ANSI X3.28 Protocol. The master device, your computer, must initiate the data link. The example below uses the ASCII number 4 as a Series 733/734 device address.

Enter in ASCII, using this syntax: <Address # 4><ENQ>

```
<table>
<thead>
<tr>
<th>ASCII Characters</th>
<th>HEX Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>34 05</td>
</tr>
</tbody>
</table>
```

Response from the 733/734:
<Address # 4><Acknowledge (ACK)>

```
<table>
<thead>
<tr>
<th>ASCII Characters</th>
<th>HEX Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>34 06</td>
</tr>
</tbody>
</table>
```
Stopping Communications in ANSI X3.28 Protocol

The master device, your computer, must end communications with Device #4 by using Data Link Escape (DLE) and End of Transmission (EOT) characters.

Enter in ASCII: \(<\text{DLE}> <\text{EOT}>\)

Response from the 733/734: None

ANSI X3.28 ")" Command Example

The "=" Command sets a specific 733/734 prompt to a specific value. The general command syntax applies to all commands. The definition and number of arguments depends on the command itself. See Table 5, Pages 17.

In this example, you want to change the Alarm 1 Low value to 500°. Here, the "=" command will do the job.

"=" command Syntax with ANSI X3.28 Protocol:
\(<\text{STX}> = <\text{space}> \text{data.1} <\text{space}> \text{data.2} <\text{ETX}>\)

With the ")=" command, data.1 is the Series 733/734 prompt, in this case Alarm 1 Low , A1LO. Data.2 is the value you want to set for that prompt, in this example, 500.

Enter in ASCII:
\(<\text{STX}> = <\text{space}> A1LO <\text{space}> 500 <\text{optional carriage return}> <\text{ETX}>\)

The hex string is:
023D2041314C4F2035303003

How to Use Data Communications
ANSI X3.28 "?"

Response from the Series 733/734:
<ACK>
The hex response string is:
06

- You’ll find the the complete list of "=" command arguments (prompts and value limits) in Table 5, Pages 17-19.

ANSI X3.28 "?" Command Example

You need to know the Alarm 1 Low value (A1LO). The "?" uses a variation of the message syntax shown just below. **This syntax requires the protocol start of text and end of text characters.**

"?" command syntax with ANSI X3.28 Protocol:
<STX> ? <space> <data.1> <ETX>

Enter in ASCII:
<STX> ? <space> <A1LO> <optional carriage return> <ETX>
The hex string will be:
023F2041314C4F03

First response from the Series 733/734:
<ACK>
The <ACK> hex response string is:
06

Your computer’s confirming response:
<EOT>
The <EOT> response hex string is:
04

Second response from the Series 733/734:
<STX> <current A1LO value> <carriage return> <ETX>
The hex string is:
023530302003

Your computer’s next response:
<ACK> or <NAK> (if the message needs to be repeated).
The hex string is:
06 or 15

Final response from the Series 733/734:
<EOT>
The hex string is:
04
## Command Summary Series 733/734 Data Communications

<table>
<thead>
<tr>
<th>Name (data.1)</th>
<th>Description</th>
<th>Read (?) and/or Write (=) Syntax</th>
<th>Range (data.2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1HI</td>
<td>Zone 1 Alarm High</td>
<td>? &lt;sp&gt; A1HI &lt;cr&gt; = &lt;sp&gt; A1LO &lt;sp&gt; data.2 &lt;cr&gt;</td>
<td>Process Alarm: A1HI to R1H Deviation Alarm: 0 to 555°C/0 to 999°F</td>
</tr>
<tr>
<td>A1LO</td>
<td>Zone 1 Alarm Low</td>
<td>? &lt;sp&gt; A1LO &lt;cr&gt; = &lt;sp&gt; A1LO &lt;sp&gt; data.2 &lt;cr&gt;</td>
<td>Process Alarm: A1LO to R1L Deviation Alarm: 0 to -555°C/0 to -999°F</td>
</tr>
<tr>
<td>A2HI</td>
<td>Zone 2 Alarm High</td>
<td>? &lt;sp&gt; A2HI &lt;cr&gt; = &lt;sp&gt; A2HI &lt;sp&gt; data.2 &lt;cr&gt;</td>
<td>Process Alarm: A2HI to R2H Deviation Alarm: 0 to 555°C/0 to 999°F or Units</td>
</tr>
<tr>
<td>A2LO</td>
<td>Zone 2 Alarm Low</td>
<td>? &lt;sp&gt; A2LO &lt;cr&gt; = &lt;sp&gt; A2LO &lt;sp&gt; data.2 &lt;cr&gt;</td>
<td>Process Alarm: R2L to A2HI Deviation Alarm: 0 to -555°C/0 to -999°F or Units</td>
</tr>
<tr>
<td>AL1</td>
<td>Zone 1 Alarm Type</td>
<td>? &lt;sp&gt; AL1 &lt;cr&gt; = &lt;sp&gt; AL1 &lt;sp&gt; data.2 &lt;cr&gt;</td>
<td>0 = Process Alarm 1 = Deviation Alarm 2 = No Alarm</td>
</tr>
<tr>
<td>AL2</td>
<td>Zone 2 Alarm Type</td>
<td>? &lt;sp&gt; AL2 &lt;cr&gt; = &lt;sp&gt; AL2 &lt;sp&gt; data.2 &lt;cr&gt;</td>
<td>0 = Process Alarm 1 = Deviation Alarm 2 = No Alarm</td>
</tr>
<tr>
<td>ALM</td>
<td>Alarm Status (Writing a 0 will clear all alarms if all alarm conditions no longer exist.)</td>
<td>? &lt;sp&gt; ALM &lt;cr&gt; = &lt;sp&gt; ALM &lt;sp&gt; 0 &lt;cr&gt;</td>
<td>0 = No alarms occurring 1 = A1HI occurring 2 = A1LO occurring 4 = A2HI occurring 8 = A2LO occurring</td>
</tr>
<tr>
<td>AUT1</td>
<td>Zone 1 Auto-tune</td>
<td>? &lt;sp&gt; AUT1 &lt;cr&gt; = &lt;sp&gt; AUT1 &lt;sp&gt; data.2 &lt;cr&gt;</td>
<td>0 = No auto-tuning 1 = Slow response tuning 2 = Medium response tuning 3 = Fast response tuning</td>
</tr>
<tr>
<td>AUT2</td>
<td>Zone 2 Auto-tune</td>
<td>? &lt;sp&gt; AUT2 &lt;cr&gt; = &lt;sp&gt; AUT2 &lt;sp&gt; data.2 &lt;cr&gt;</td>
<td>0 = No auto-tuning 1 = Slow response tuning 2 = Medium response tuning 3 = Fast response tuning</td>
</tr>
<tr>
<td>C1</td>
<td>Zone 1 Process Value</td>
<td>? &lt;sp&gt; C1 &lt;cr&gt;</td>
<td>Between R1L and R1H</td>
</tr>
<tr>
<td>C2</td>
<td>Zone 2 Process Value</td>
<td>? &lt;sp&gt; C2 &lt;cr&gt;</td>
<td>Between R2L and R2H</td>
</tr>
<tr>
<td>CAL1</td>
<td>Zone 1 Cal Offset</td>
<td>? &lt;sp&gt; CAL1 &lt;cr&gt; = &lt;sp&gt; CAL1 &lt;sp&gt; data.2 &lt;cr&gt;</td>
<td>-99°F to 99°F -55°C to 55°C</td>
</tr>
<tr>
<td>CAL2</td>
<td>Zone 2 Cal Offset</td>
<td>? &lt;sp&gt; CAL2 &lt;cr&gt; = &lt;sp&gt; CAL2 &lt;sp&gt; data.2 &lt;cr&gt;</td>
<td>-99°F to 99°F -55°C to 55°C -99 Units to 99 Units</td>
</tr>
<tr>
<td>CF</td>
<td>Degrees Select</td>
<td>? &lt;sp&gt; CF &lt;cr&gt; = &lt;sp&gt; CF &lt;sp&gt; data.2 &lt;cr&gt;</td>
<td>0 = Display °F 1 = Display °C</td>
</tr>
<tr>
<td>CSP</td>
<td>Current Set Point</td>
<td>? &lt;sp&gt; CSP &lt;sp&gt; zone &lt;cr&gt;</td>
<td>0 = Zone 1 1 = Zone 2</td>
</tr>
<tr>
<td>CT1</td>
<td>Zone 1 Cycle Time</td>
<td>? &lt;sp&gt; CT1 &lt;cr&gt; = &lt;sp&gt; CT1 &lt;sp&gt; data.2 &lt;cr&gt;</td>
<td>1 to 60 seconds</td>
</tr>
<tr>
<td>CT2</td>
<td>Zone 2 Cycle Time</td>
<td>? &lt;sp&gt; CT2 &lt;cr&gt; = &lt;sp&gt; CT2 &lt;sp&gt; data.2 &lt;cr&gt;</td>
<td>1 to 60 seconds</td>
</tr>
</tbody>
</table>

Table continued on the next page.
**Table 5 - Command Summary with Read (?) and Write (=) Simple Syntax and Data Range/Responses.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Read (?) and/or Write (=) Syntax</th>
<th>Range</th>
</tr>
</thead>
</table>
| ER1      | Error 1 Code (Multiple errors possible.)         | ? <sp> ER1 <cr> = <sp> ER1 <sp> 0 <cr> | 0 = No error
|          |                                                  |                                 | 1 = ROM error            |
|          |                                                  |                                 | 2 = RAM error            |
|          |                                                  |                                 | 3 = Ambient sensor error  |
|          |                                                  |                                 | 4 = Configuration error   |
|          |                                                  |                                 | 5 = EEPROM error          |
|          |                                                  |                                 | 6 = A/D underflow error, Zone 1 |
|          |                                                  |                                 | 7 = A/D overflow error, Zone 1 |
|          |                                                  |                                 | 8 = A/D underflow error, Zone 2 |
|          |                                                  |                                 | 9 = A/D overflow error, Zone 2 |
|          |                                                  |                                 | 10 = Stack overflow error |
|          |                                                  |                                 | 11 = Open sensor, Zone 1   |
|          |                                                  |                                 | 12 = Shorted sensor, Zone 1 |
|          |                                                  |                                 | 13 = Open sensor, Zone 2   |
|          |                                                  |                                 | 14 = Shorted sensor, Zone 2 |
|          |                                                  |                                 | 15 = Loop error, Zone 1    |
|          |                                                  |                                 | 16 = Loop error, Zone 2    |
| ER2      | Error 2 Code                                     | ? <sp> ER2 <cr>                  | 0 = No error
|          |                                                  |                                 | 1 = Transmit buffer overflow |
|          |                                                  |                                 | 2 = Receive buffer overflow |
|          |                                                  |                                 | 3 = Framing error          |
|          |                                                  |                                 | 4 = Overrun error          |
|          |                                                  |                                 | 5 = Parity error           |
|          |                                                  |                                 | 6 = Talking out of turn    |
|          |                                                  |                                 | 7 = Invalid reply error    |
|          |                                                  |                                 | 8 = Noise error            |
|          |                                                  |                                 | 20 = Command not found      |
|          |                                                  |                                 | 21 = Prompt not found       |
|          |                                                  |                                 | 22 = Incomplete command line|
|          |                                                  |                                 | 23 = Invalid character      |
|          |                                                  |                                 | 24 = Number of chars. overflow |
|          |                                                  |                                 | 25 = Input out of limit     |
|          |                                                  |                                 | 26 = Read only command      |
|          |                                                  |                                 | 27 = Write allowed only     |
| GB       | Guard Band                                       | ? <sp> GB <cr> = <sp> GB <sp> data.2 <cr> | 1 to 4000°F
|          |                                                  |                                 | 1 to 2222°C                |
|          |                                                  |                                 | 1 to 4000 Units            |
| HYS1     | Zone 1 Hysteresis                                | ? <sp> HYS1 <cr> = <sp> HYS1 <sp> data.2 <cr> | 1 to 99°F
|          |                                                  |                                 | 1 to 55°C                  |
| HYS2     | Zone 2 Hysteresis                                | ? <sp> HYS2 <cr> = <sp> HYS2 <sp> data.2 <cr> | 1 to 99°F
|          |                                                  |                                 | 1 to 55°C                  |
|          |                                                  |                                 | 1 to 99 Units              |
| INP1     | Zone 1 Input Type                                | ? <sp> INP1 <cr> = <sp> INP1 <sp> data.2 <cr> | 0 = J t/c; 32 to 1382°F/0 to 750°C
|          |                                                  |                                 | 1 = K t/c; 32 to 2282°F/0 to 1250°C |
|          |                                                  |                                 | 2 = E t/c; 32 to 1220°F/0 to 660°C |
|          |                                                  |                                 | 3 = RTD; 32 to 1112°F/0 to 600°C |
| INP2     | Zone 2 Input Type                                | ? <sp> INP2 <cr> = <sp> INP2 <sp> data.2 <cr> | 0 = J t/c; 32 to 1382°F/0 to 750°C
|          |                                                  |                                 | 1 = K t/c; 32 to 2282°F/0 to 1250°C |
|          |                                                  |                                 | 2 = E t/c; 32 to 1220°F/0 to 660°C |
|          |                                                  |                                 | 3 = RTD; 32 to 1112°F/0 to 600°C |
|          |                                                  |                                 | 4 = 0-5V: -500 to 3500 units |
|          |                                                  |                                 | 5 = 4-20mA: -500 to 3500 units |
|          |                                                  |                                 | 6 = 0-10V: -500 to 3500 units |
|          |                                                  |                                 | 7 = 0-20mA: -500 to 3500 units |
| LAT      | Alarm Latching                                   | ? <sp> LAT <cr> = <sp> LAT <sp> data.2 <cr> | 0 = Non-latched alarms
|          |                                                  |                                 | 1 = Latched alarms         |
| LOC      | Keyboard Lock                                    | ? <sp> LOC <cr> = <sp> LOC <sp> data.2 <cr> | 0 = Enable prompt change
|          |                                                  |                                 | 1 = Disable prompt change   |
| LOOP     | Loop Failure                                     | ? <sp> LOOP <cr> = <sp> LOOP <sp> data.2 <cr> | 0 = Loop fail check OFF
|          |                                                  |                                 | 1 = Loop fail check ON      |
| LI       | Logic Input Test                                 | ? <sp> LI <cr>                   | Response depends on 733 hardware and LI switch positions. Change a switch and retry; a switch change = logic data chg. |

Table continued on the next page.
How to Use Data Communications

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Read (?) and/or Write (=) Syntax</th>
<th>Range (data.2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDKY</td>
<td>Mode Key Action</td>
<td>= &lt;sp&gt; MDKY &lt;sp&gt; 1 &lt;cr&gt;</td>
<td>1 = One MODE Key press</td>
</tr>
<tr>
<td>MDL</td>
<td>Model Number</td>
<td>? &lt;sp&gt; MDL &lt;cr&gt;</td>
<td>x1 = 3 or 4; horiz. or vert. unit x2 &amp; x3 = Last two characters of model #, AA-XX x4 = Software rev; 0-9 or A-X</td>
</tr>
<tr>
<td>MENU</td>
<td>Menu Step</td>
<td>? &lt;sp&gt; MENU &lt;sp&gt; menu &lt;sp&gt; step &lt;sp&gt; 1 &lt;cr&gt;</td>
<td>Data entered must be within individual prompt guidelines, i.e., SP1 = R1L to R1H, etc. Enter data for SP2 and events even if they are not available. See 733/4 Program Manual.</td>
</tr>
<tr>
<td>MODE</td>
<td>Mode Status</td>
<td>? &lt;sp&gt; MODE &lt;cr&gt;</td>
<td>0 = Operation mode 1 = Program mode 2 = Setup mode 3 = Service mode 4 = Calibration mode</td>
</tr>
<tr>
<td>MS</td>
<td>Melt Cycle</td>
<td>? &lt;sp&gt; MS &lt;cr&gt;</td>
<td>0 = Melt cycle OFF 1 = Melt cycle ON</td>
</tr>
<tr>
<td>PB1</td>
<td>Zone 1 Prop Band</td>
<td>? &lt;sp&gt; PB1 &lt;cr&gt;</td>
<td>0 to 999°F 0 to 555°C</td>
</tr>
<tr>
<td>PB2</td>
<td>Zone 2 Prop Band</td>
<td>? &lt;sp&gt; PB2 &lt;cr&gt;</td>
<td>0 to 999°F 0 to 555°C 0 to 999 Units</td>
</tr>
<tr>
<td>RA1</td>
<td>Zone 1 Rate</td>
<td>? &lt;sp&gt; RA1 &lt;cr&gt;</td>
<td>0 to 9.99 minutes</td>
</tr>
<tr>
<td>RA2</td>
<td>Zone 2 Rate</td>
<td>? &lt;sp&gt; RA2 &lt;cr&gt;</td>
<td>0 to 9.99 minutes</td>
</tr>
<tr>
<td>RE1</td>
<td>Zone 1 Reset</td>
<td>? &lt;sp&gt; RE1 &lt;cr&gt;</td>
<td>0 to 9.99 repeats per minute</td>
</tr>
<tr>
<td>RE2</td>
<td>Zone 2 Reset</td>
<td>? &lt;sp&gt; RE2 &lt;cr&gt;</td>
<td>0 to 9.99 repeats per minute</td>
</tr>
<tr>
<td>RH1</td>
<td>Zone 1 Range High</td>
<td>? &lt;sp&gt; RH1 &lt;cr&gt;</td>
<td>RL1 to max. INP1 type range</td>
</tr>
<tr>
<td>RH2</td>
<td>Zone 2 Range High</td>
<td>? &lt;sp&gt; RH2 &lt;cr&gt;</td>
<td>RL2 to max. INP2 type range</td>
</tr>
<tr>
<td>RL1</td>
<td>Zone 1 Range Low</td>
<td>? &lt;sp&gt; RL1 &lt;cr&gt;</td>
<td>Min. INP1 type range to RH1</td>
</tr>
<tr>
<td>RL2</td>
<td>Zone 2 Range Low</td>
<td>? &lt;sp&gt; RL2 &lt;cr&gt;</td>
<td>Min. INP2 type range to RH2</td>
</tr>
<tr>
<td>RTD</td>
<td>RTD Curve</td>
<td>? &lt;sp&gt; RTD &lt;cr&gt;</td>
<td>0 = DIN 1 = JIS</td>
</tr>
<tr>
<td>RUN</td>
<td>Menu Run</td>
<td>= &lt;sp&gt; RUN &lt;sp&gt; menu &lt;cr&gt;</td>
<td>n = Run Menu n</td>
</tr>
<tr>
<td>SIL</td>
<td>Alarm Silence</td>
<td>? &lt;sp&gt; SIL &lt;cr&gt;</td>
<td>0 = OFF 1 = ON</td>
</tr>
<tr>
<td>STAT</td>
<td>Run Status</td>
<td>? &lt;sp&gt; STAT &lt;cr&gt;</td>
<td>x x; x1=0 idle or 1 run, x2=menu#</td>
</tr>
<tr>
<td>STP</td>
<td>Maximum Steps</td>
<td>? &lt;sp&gt; STP &lt;cr&gt;</td>
<td>1 = 1 Step 2 = 2 Steps 3 = 3 Steps</td>
</tr>
<tr>
<td>STOP</td>
<td>Menu Stop</td>
<td>= &lt;sp&gt; STOP menu &lt;cr&gt;</td>
<td>n = Stop Menu n</td>
</tr>
<tr>
<td>TCMP</td>
<td>Temperature Compensation</td>
<td>? &lt;sp&gt; TCMP &lt;cr&gt;</td>
<td>0 = OFF 1 = ON</td>
</tr>
<tr>
<td>TREM</td>
<td>Time Remaining</td>
<td>? &lt;sp&gt; TREM &lt;cr&gt;</td>
<td>Learn Menu time remaining</td>
</tr>
<tr>
<td>TS</td>
<td>Time Select</td>
<td>? &lt;sp&gt; TS &lt;cr&gt;</td>
<td>0 = minutes : seconds 1 = hours : minutes</td>
</tr>
</tbody>
</table>

Table 5 - Command Summary with Read (?) and Write (=) Simple Syntax and Data Range/Responses.
NAKs and Error Codes

When your message is "not acknowledged" (NAK) in EIA/TIA-422 or EIA/TIA-485 with ANSI X3.28 Protocol, you may clear ER2 codes by reading it. That is, use "?"

Then try the message again; you may have made a syntax error. See the error code listing in Table 5, page 17.

With XON/XOFF protocol and the EIA/TIA-423 interface, the 733/734 sends no feedback on commands. Therefore, you may want to query the status of ER2 after each command you send.

All communications-related error codes are ER2 error codes, that is they are not considered cause for a shutdown of the 733/734 unit itself. There is always a communications error code generated when a <NAK> character is sent under the ANSI X3.28. With XON/XOFF flow control error codes may be generated, but there will be no standard indication of this fact.

User Responsibility

All data communications commands are available on all models of the Series 733/734 which have communications capability. Users must refrain from altering prompts which do not appear on the Series 733/734 front panel. For example, do not send an A1LO command, page 17, to a Series 733/734 not equipped with alarm outputs.

The exception to this rule concerns the MENU command, which requires valid data for SP2 (Set Point 2) and events, even though the hardware is not present in the particular Series 733/734.
733/734 = One or two channel microprocessor-based, time and temperature control; 24V~ (VAC) power input.
*Order power supply and connector kit(s) separately below.

Display Orientation
3 = Horizontal
4 = Vertical

Display Location
A = Integral (local)

Input Type
1 = Single thermocouple (type J, K, E)
2 = Single RTD 1°, curve selectable
4 = Dual thermocouple (type J, K, E); Order output types 1 & 2
5 = Dual RTD 1°, curve selectable; Order output types 1 & 2
6 = Dual Input: Channel 1 thermocouple (type J, K, E); and Channel 2 process (0-5V (VDC), 0-10V (VDC), 0-20mA, 4-20mA), Order output types 1 & 2

Dual-zone units must use ungrounded thermocouples.

Output 1 Type
B = Solid-state relay with RC suppression, form A, 0.4A
C = Switched DC, open collector, non-isolated
D = Mechanical relay, form A, 1A, with suppression
E = Mechanical relay, form A, 1A, without suppression
F = Process, 4-20mA, non-isolated
H = Process, 0-5V (VDC), non-isolated
K = Solid-state relay without RC suppression, form A, 0.4A

Output 2 Type
A = None
B = Solid-state relay with RC suppression, form A, 0.4A
C = Switched DC, open collector, non-isolated
D = Mechanical relay, form A, 1A, with suppression
E = Mechanical relay, form A, 1A, without suppression
F = Process, 4-20mA, non-isolated
H = Process, 0-5V (VDC), non-isolated
K = Solid-state relay without RC suppression, form A, 0.4A

Event Inputs/Outputs
0 = None
1 = 4 Event outputs, switched DC, non-isolated (custom only)

Alarm
A = None
D = Single mechanical relay, form A, 1A, with suppression

Communications (Isolated)
A = None
B = EIA/TIA-422 or EIA/TIA-423
D = EIA/TIA-485

Options
AA = Standard Single Display

Power Supply, Power Connector and Event Input/Output Accessory Kits (Order separately here.)
Part No. Description
A001-0249-0001 = 120V~ (VAC) - 24V~ (VAC), stepdown transformer, Class 2, quick connect terminals included.
A001-0249-0002 = 208/240V~ (VAC) - 24V~ (VAC), stepdown transformer, Class 2, quick connect terminals included.
A001-0250-0012 = Power input connector kit, 12-pin connector assembly, wire not included.
A001-0250-0009 = Event input/output connector kit, 9-pin connector assembly, wire not included.
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