# CHAPTER THREE: *Control by RS-232*

**In this chapter, see how to**

- ✎ *Control WavePro by RS-232-C*
- ✎ *Simulate GPIB messages using RS-232-C*

# Communicate through the RS-232-C Port

Your WavePro oscilloscope can also be controlled remotely through the RS-232-C port, which supports the transfer of all commands for its operation. Nevertheless, RS-232 waveform transfer is only possible in HEX mode, using the default value for COMM_FORMAT, and with the syntax of the response to WF?identical to that for GPIB.

RS-232-C connector pin assignments for connecting WavePro to an external controller are given in Chapter 12, "Use WavePro with PC," of the WavePro *Operator's Manual*.

The RS-232-C port is full-duplex configured. This means that both sides — WavePro oscilloscope and external controller — can send and receive messages at the same time. However, the oscilloscope stops outputting when it receives a new command.

You should transmit long messages to the oscilloscope while it is in a trigger mode, and not while an acquisition is in progress. This is especially important when sending waveforms or front panel setups.

Characters that cannot be printed in ASCII are here represented by their mnemonics. For example:

<LF>                ASCII line feed character whose decimal value is 10.

<BS>                ASCII backspace character whose decimal value is 8.

CTRL_U            The control key and the U key are pressed simultaneously.

Set RS-232-C behavior according to your needs. In addition to the basic setup on the front panel menu, there are "immediate commands," as well as the special command COMM_RS232  for this. Immediate commands consist of the ASCII ESCape character <ESC> (whose decimal value is 27), followed by another character. These commands are interpreted as soon as the second character has been received.

You can have the serial port echo the received characters. This is useful when the oscilloscope is connected to a terminal. Echoing can be turned on or off by sending the two-character sequence <ESC>] or <ESC>[. Echoing is on by default, but the host must not echo characters received from the oscilloscope.

### HANDSHAKE CONTROL

When the oscilloscope intake buffer becomes nearly full, the instrument sends a handshake signal to the host telling it to stop transmitting. When this buffer has enough room to receive more characters, another handshake signal is sent. These signals are either the CTRL-S (or <XOFF>) and CTRL-Q (<XON>) characters, or a signal level on the RTS line. They are selected by sending the two-character sequence <ESC>) for XON/XOFF handshake (the default), or <ESC> for the RTS handshake.

You can control the flow of characters coming from the oscilloscope by either a signal level on the CTS line or the <XON>/<XOFF> pair of characters.

*NOTE: The RS-232-C baud rate, parity, character length, and number of stop bits are among the parameters saved or recalled by the front panel SAVE or RECALL buttons, and by the remote commands \*SAV, \*RCL, or PANEL_SETUP. When recalling by remote, ensure that these parameters are set at the same value on both controller and oscilloscope. Otherwise, the host may no longer be able to communicate with the oscilloscope and a manual reconfiguration would be necessary.*

## EDITING FEATURES

When the oscilloscope is directly connected to a terminal, the following will make correction of typing errors easier:

| | |
|---|---|
| <BS> or <DELETE> | Delete the last character. |
| CTRL_U | Delete the last line. |

## MESSAGE TERMINATORS

Message terminators are markers that indicate to the receiver that a message has been completed. The Program Message Terminator is a character you could select when you input to the oscilloscope. Choose a character never used for anything else, using the command COMM_RS232 and the keyword EI. The default Program Message Terminator is the ASCII character <CR>, whose decimal value is 13.

The oscilloscope appends a Response Message Terminator to the end of each of its responses. This is a string, similar to a computer prompt, which you also choose. This string must not be empty. The default Response Message Terminator is \n\r, which is the same as <LF><CR>.

**Example:** COMM_RS232 EI,3
This command informs the oscilloscope that each message it receives will be terminated with the ASCII character <ETX>, whose decimal value is 3.

**Example:** COMM_RS232 EO,"\r\nEND\r\n"
This command indicates to the oscilloscope that it must append the string "\r\nEND\r\n" to each response.

After you make these settings, a host command will look like this:

TDIV?<ETX>

And the oscilloscope will respond with:

TDIV 1.S

END

TIP: *After it sends a COMM_RS232 command, the host must wait for the oscilloscope to change its behavior before it can send a command in the new mode. Ensure this by including a query on the line that contains the* COMM_RS232 *command (for example,* COMM_RS232 EI,3;*STB?) *and waiting until the response is received.*

## SRQ MESSAGE

Each time the Master Summary Status (MSS) bit of the STatus Byte (STB) is set, the SRQ message (a string of characters) is sent to the host to indicate that the oscilloscope requests service. The RS-232-C SRQ message has the same meaning as the GPIB SRQ message. If the string is empty, no message will be sent. This is the default setting. Note that no response message terminator is added at the end of the SRQ message.

Example: COMM_RS232 SRQ, "\r\n\nSRQ\r\n\a"

When the MSS bit is set, the oscilloscope will send a <CR> followed by two <LF>SRQ, and a <CR> followed by a <LF>. The buzzer will sound.

## LONG LINE SPLITTING

Line splitting is a feature provided for hosts that cannot accept lines with more than a certain number of characters. The oscilloscope may be configured to split responses into many lines. This feature is very useful for waveform or front panel setup transfers although it is applicable to all response messages. Two parameters control this feature:

Line Separator: Off
 - messages will not be split into lines.

<CR>,<LF> or <CR><LF>
 - possible line terminators.

Line Length: the maximum number of characters to a line.

Example: COMM_RS232 LS,LF,LL,40

The line separator is the ASCII character <LF>, the line is a maximum of 40 characters long (excluding the line separator).

If the oscilloscope receives the command PNSU?, it may answer with:

```
PNSU#9000001496

AAAA5555000655AA403000580019000000000001

00000000000000000000000000C1B0100580000

000000000000000000000000000000000000000

. . .
```

**REMARKS**

Long commands sent to the oscilloscope may not be split into lines. If a command sent to the oscilloscope is the response to a previous query, the line-split characters (<LF>, <CR>) must be removed. This also applies to line-split characters inside strings sent to the oscilloscope.

However, hex-ASCII data sent to the oscilloscope may contain line-split characters. If you wish to use line splitting, ensure that neither the input message terminator characters nor the line-split characters occur in the data.

# Simulate GPIB Messages

Use these RS-232-C commands to simulate GPIB 488.1 messages:

| RS232 COMMAND | GPIB MESSAGE | EFFECT AND EQUIVALENCE |
|---|---|---|
| <ESC>C or <ESC>c | Device Clear (DCL) | Clears the input and output buffers. This command has the same meaning as the GPIB DCL or SDC interface messages. |
| <ESC>R or <ESC>r | Remote Enable (REN) | Places the oscilloscope in remote mode. This command's function is the same as the GPIB command asserting the REN line and setting the oscilloscope to listener. |
| <ESC>L or <ESC>l | Go to Local (GTL) | Places the oscilloscope in local mode. The command clears local lockout (see below). It has the same function as GPIB's setting the REN line to false. |
| <ESC>F or <ESC>f | Local Lockout (LLO) | Disables the front panel "LOCAL" button immediately if the oscilloscope is already in remote mode or, if not, when the oscilloscope is next set to remote. This Local Lockout (see Chapter 2, "Control by GPIB") can be cancelled only with the <ESC>L command. <ESC>F has the same meaning as GPIB's LLO interface message. |
| <ESC>T or <ESC>t | Group Execute Trigger (GET) | Rearms the oscilloscope while it is in the STOP mode, but only while the oscilloscope is in remote mode. This command has the same meaning as the *TRG command and GPIB's GET interface message. |

W wavepro