CHAPTER TWELVE: *Use Waverunner with PC*

Operate your Waverunner scope using a personal computer.

In this chapter, see how

To transfer waveforms and data from scope to computer

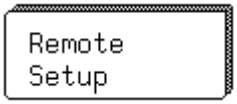
To monitor Waverunner remote control operation

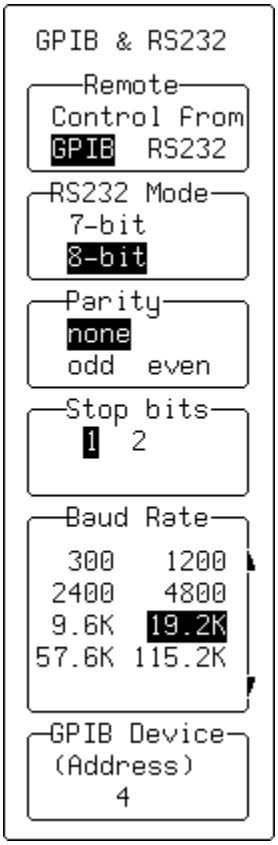
To save in ASCII

To use Waverunner with Spreadsheet, Mathcad and MATLAB

Transfer Data and Images to PC

Connect the Waverunner to a personal computer (PC) through the oscilloscope's rear GPIB or RS-232-C port. Then use LeCroy's handy ScopeExplorer software (see next page) to save data or images to the PC's hard disk. At the same time, the Waverunner's Remote Control Assistant can monitor and debug all your remote control communications (see page 163). But first, follow these steps to set up the scope for communication with the PC:

1. Press UTILITIES  and then the button for 



2. Use these menus to set up communication with the PC via GPIB or RS232.

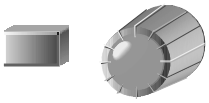
 To select **GPIB** or **RS232**. Select from the other menus according to this.

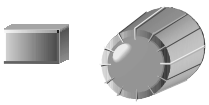
 **RS232:** Press to select seven- or eight-bit word length for RS232. With **RS232** selected above, the GPIB interface is "talk-only." Any change is immediate.

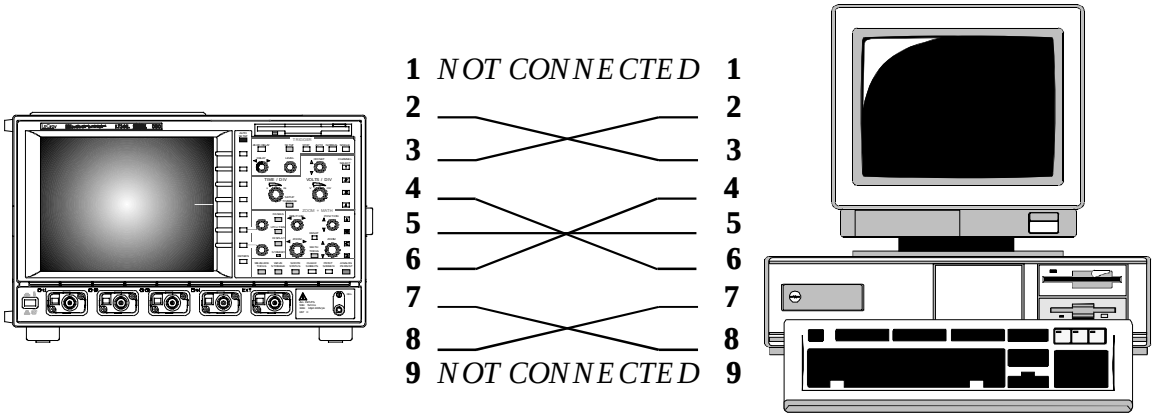
 **RS232:** Press to choose the appropriate RS232 parity.

 **RS232:** Press to select the number of stop bits for RS232.

 **RS232:** Turn the knob to set the Baud Rate for RS232.



 **GPIB:** Press or turn to select the GPIB address.



RS-232 nine-pin communication cabling for connecting Waverunner to PC.

EXPLORE YOUR SCOPE

ScopeExplorer is an easy-to-use and practical software tool for interfacing your Waverunner oscilloscope with computers running Windows. (See also "First Things" section.)

1. Connect the scope to a PC by using either the GPIB — you'll need a PC with GPIB card installed — or PC-standard RS-232-C port on the scope's rear panel.
2. Download ScopeExplorer free at http://www.lecroy.com/scopeexplorer. Or inquire at your LeCroy customer service center.
3. Having installed ScopeExplorer, open it as you would any Windows program. Use its on-line help to:

   Use the teletype-like terminal to send standard remote control commands from computer to oscilloscope. And display the Waverunner response on the PC.

   Control the scope using an interactive, virtual scope front panel!

   Pipe sequences of commands from a file to the scope, then send the scope's responses to another file. (See the *Remote Control Manual* for the commands.)

   Transfer pixel-for-pixel copies of your Waverunner display to PC, view them, print them, or both from the computer. With a single press of a button or key, you can copy bitmap waveform images to the Windows Clipboard, ready to paste into any Windows application.

   Capture Waverunner front panel setups and store them on the computer with a lengthy filename. You can then transfer them back into the scope to reproduce an identical setup.

   Transfer, too, your waveforms to PC, and store them in either the compact LeCroy Binary format, or an ASCII version compatible with PC-based analysis products such as Microsoft's Excel or Mathsoft's MathCad (see page 164).

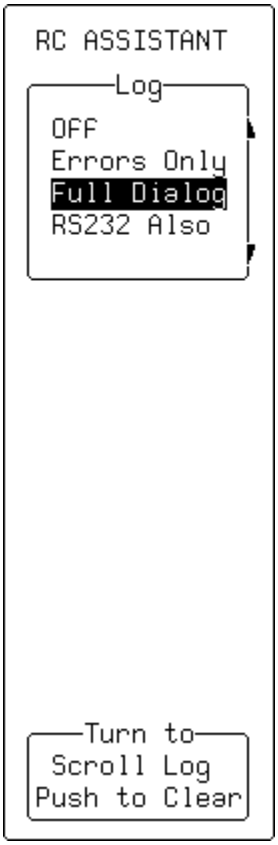
MONITOR YOUR REMOTE CONTROL OPERATIONS

Use the Waverunner Remote Control (RC) Assistant to automatically monitor remote commands received through the GPIB and RS232 ports. RC Assistant helps debug communications with the PC. When activated, it displays a log of the dialog between oscilloscope and PC. And whenever a communication error occurs, it gives the additional message "Remote Control: problem detected and logged."

1. Press 

to display the UTILITIES menus.

2. Press the button for Special Modes then the button for Remote Ctrl. Assistant



These menus will appear:

3. Press either of the top two menu buttons to select one of the following:

Off — the RC Assistant will NOT capture any remote commands.

Errors Only — displays only wrong or incomplete commands received via any remote control port (default after power-on).

Full Dialog — captures all remote commands received via any remote control port and displays up to 100 lines of dialog, after which lines are overwritten on a "first–in, first–out" basis.

RS232 Also — logs the full dialog and sends it to a recording device connected to the RS-232 port. When this is used, commands can only be received via the GPIB port.

(See also the commands `COMM_HELP` and `COMM_HELP_LOG` in the *Remote Control Manual*.)

4. Turn this knob to enable log scrolling; press this button to clear the log entirely.

Save Waveforms in ASCII

When you save waveforms to a Waverunner internal memory (M1, M2, M3, or M4) you save them in LeCroy's special binary format. But you can also store your waveforms in ASCII format to a portable storage device such as floppy disk, PC memory card or hard disk card. You can then transfer the data to a PC for analysis with spreadsheet or math software.

In doing this you will create an output file requiring 10–20 times the disk space of the original LeCroy binary file. A one-megabyte record will typically take up 13–15 MB when stored in ASCII. And ASCII waveforms cannot be recalled back into the scope.

The Waverunner stores waveforms in any of three ASCII formats: Spreadsheet, MathCad, or MATLAB. The following table summarizes the format of the three basic layouts. You'll see how to set up to save in ASCII on the next pages, followed by examples of the use of each format.

FORMAT	HEADER *Format includes some form of header before the data*	TIME VALUES *Format stores time values with each amplitude value*	AMPLITUDE VALUES *Format stores amplitude values*	SEQUENCE TIMES *Header contains sequence time information for each sequence segment*	MULTI-SEGMENT *Format concatenates multiple segments of a sequence waveform*	DUAL ARRAY *Format allows dual-array data (Extrema or complex FFT) to be stored*
Spreadsheet	Yes	Yes	Yes	Yes	Yes	Yes
MathCad	Yes	Yes	Yes	Yes	Yes	Yes
MATLAB	No	No	Yes	No	Yes	No

SAVE IN AN ASCII FORMAT

Store waveforms in ASCII and save them to a floppy disk or optional storage device in the PC Card slot. Save in an ASCII data format such as Spreadsheet. Then transfer the data to PC.

1. Press WAVE STORAGE and then the button for Store WaveForm

2. Press the button to select to: M1 M2 M3 M4 Flpy

3. Then use these and the menus on the next page to save your displayed waveform to a storage device in an ASCII data format.

To select **ASCII**.

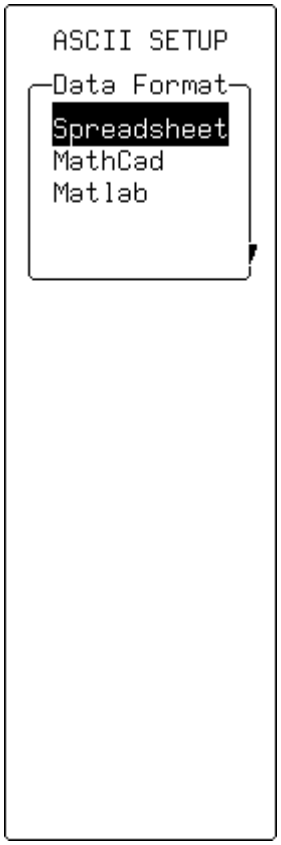
Next, to access the menu shown on the next page and setup for the preferred ASCII format.

To select or turn off automatic storing features: **Wrap** stores continuously, discarding the oldest files on a 'first-in: first-out" basis. **Fill** stores until the storage device is full.

To save the waveform selected to the portable storage device using the menus below.

To select the memory in which the waveform to display is stored.

To select the storage device on which the waveform will be stored: floppy disk (**Flpy**) is standard on all Waverunner models, while a PC memory card or hard disk card in the rear PC Card slot (**Card**) is an option.



This menu is displayed when you select Setup ASCII Format from the menus shown on the previous page.

To select an ASCII format.

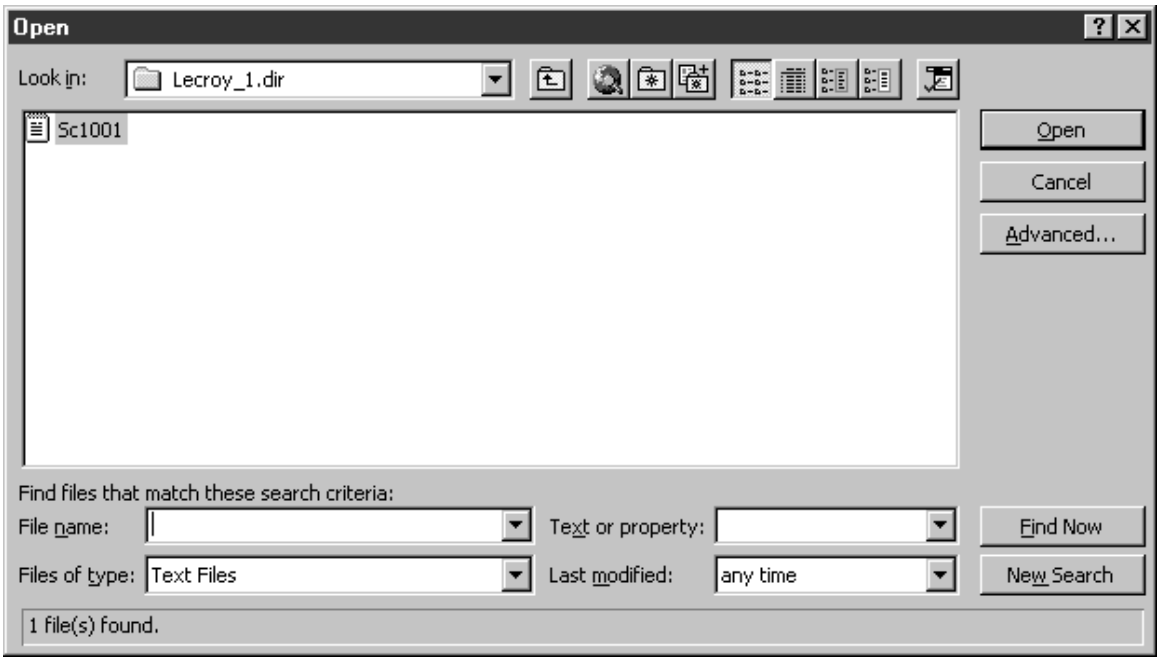
RETURN

To go back to the STORE W'FORM menu and make other selections.

Use ASCII Formats

SAVE TO SPREADSHEET

To read a waveform stored in the Spreadsheet format into Microsoft Excel, use: File -> Open dialog:



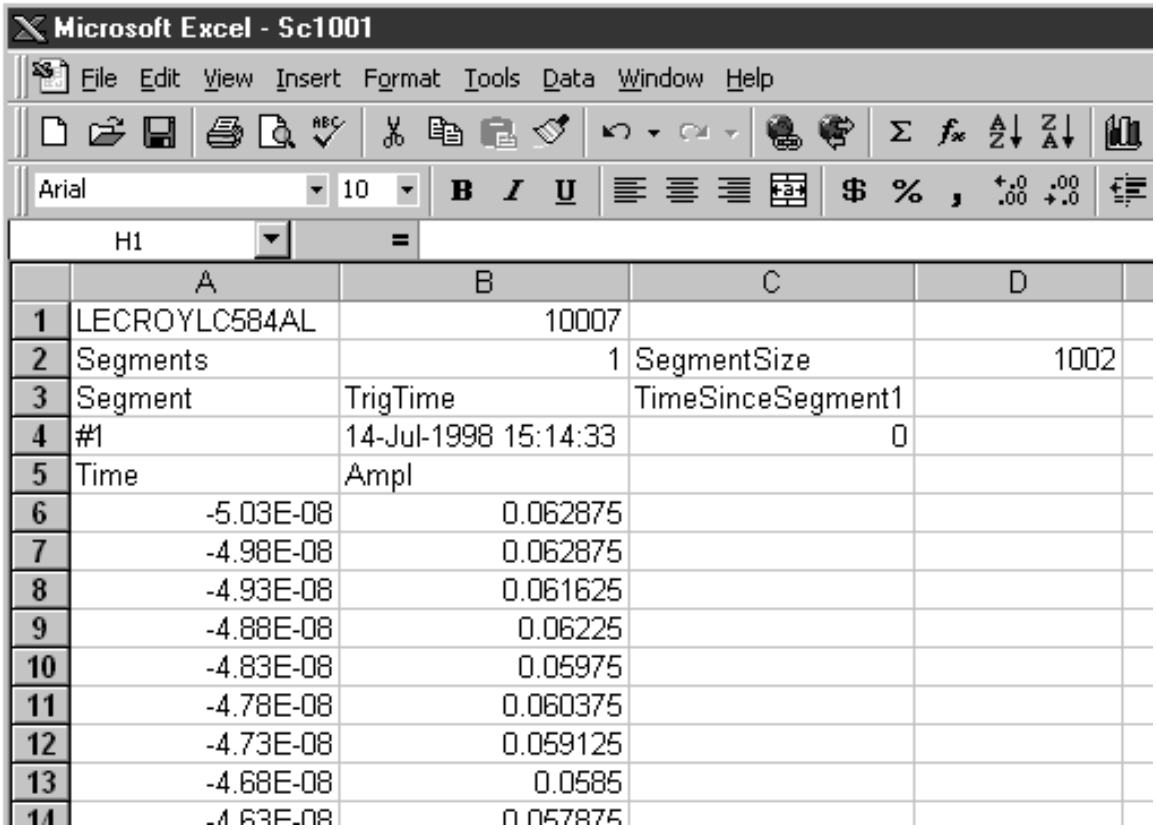
Excel's Text Import Wizard will take you through the following steps:

1. Select **Delimited**.

2. The Spreadsheet format generated by WaveRunner uses "," to delimit columns. Select **Comma** as the delimiter.

3. The third and final step allows you to specify the format of the columns. Select the **General** Column data format (the default).

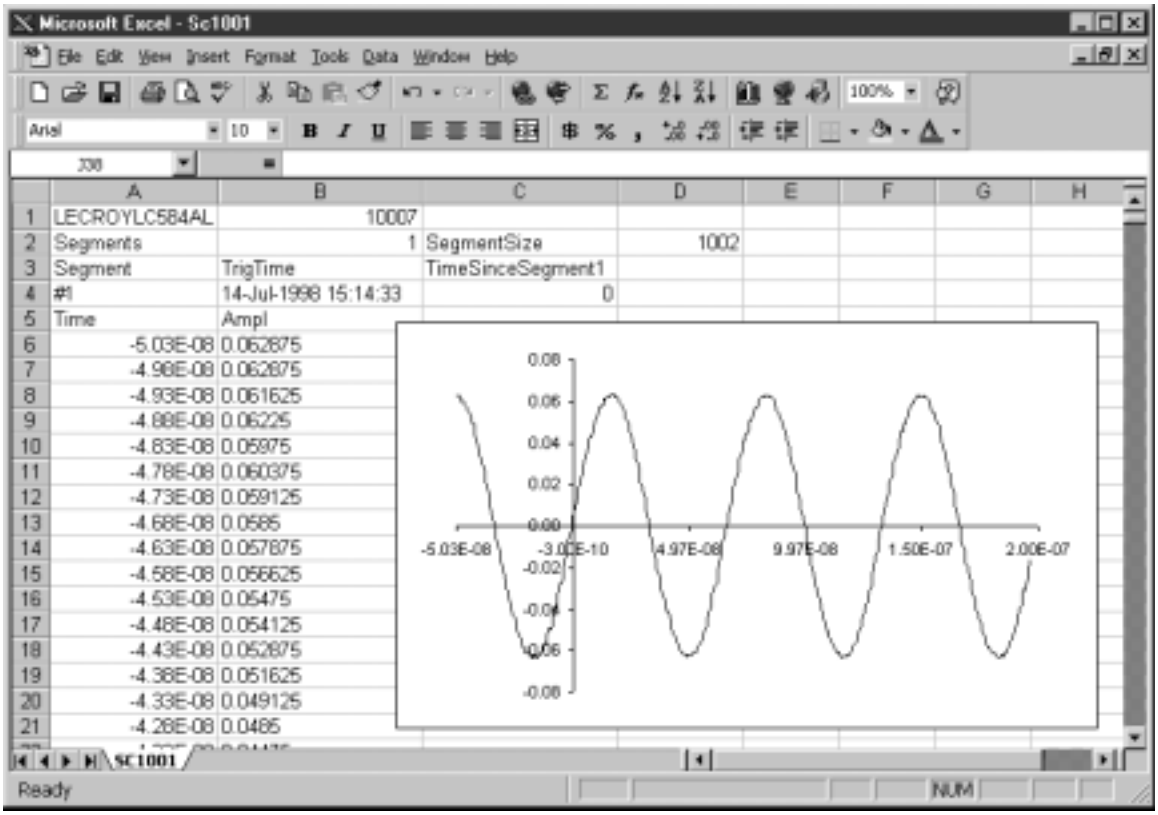
4. Click the **Finish** button: a display similar to this one will be shown:



	A	B	C	D
1	LECROYLC584AL	10007		
2	Segments	1	SegmentSize	1002
3	Segment	TrigTime	TimeSinceSegment1	
4	#1	14-Jul-1998 15:14:33	0	
5	Time	Ampl		
6	-5.03E-08	0.062875		
7	-4.98E-08	0.062875		
8	-4.93E-08	0.061625		
9	-4.88E-08	0.06225		
10	-4.83E-08	0.05975		
11	-4.78E-08	0.060375		
12	-4.73E-08	0.059125		
13	-4.68E-08	0.0585		
14	-4.63E-08	0.057875		

PLOT A WAVEFORM IN SPREADSHEET

Plotting the data from a waveform will demand a scatter plot based on the data in the first two columns, with the first column used as the X values (from row 6 in this example):



	A	B	C	D
1	LECROYLC584AL	10007		
2	Segments	1	SegmentSize	1002
3	Segment	TrigTime	TimeSinceSegment1	
4	#1	14-Jul-1998 15:14:33	0	
5	Time	Ampl		
6	-5.03E-08	0.062875		
7	-4.98E-08	0.062875		
8	-4.93E-08	0.061625		
9	-4.88E-08	0.06225		
10	-4.83E-08	0.05975		
11	-4.78E-08	0.060375		
12	-4.73E-08	0.059125		
13	-4.68E-08	0.0585		
14	-4.63E-08	0.057875		
15	-4.58E-08	0.056625		
16	-4.53E-08	0.05475		
17	-4.48E-08	0.054125		
18	-4.43E-08	0.052875		
19	-4.38E-08	0.051625		
20	-4.33E-08	0.049125		
21	-4.28E-08	0.0485		

The header created for the spreadsheet contains all the information you'll need to extract various elements from a sequence waveform. Use the following formulae to extract information such as the start and end row of the data for a given segment, or the trigger time of a given segment:

SegmentStartRow := (*DesiredSegment* * D2) + B2 + 5

SegmentEndRow := *SegmentStartRow* + D2 –1

TrigTime= INDIRECT(ADDRESS(*DesiredSegment* +3;2;4))

TimeSinceFirstTrig= INDIRECT(ADDRESS(*DesiredSegment* +3;3;4))

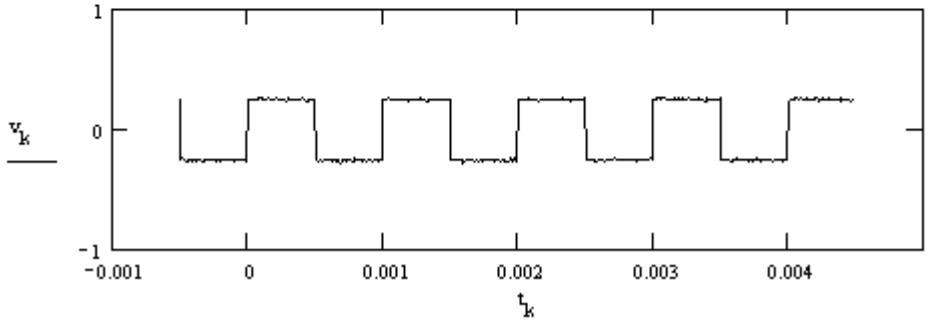
Plotting the data from all segments using a scatter plot will result in all segments overlaid, as in the Waverunner's persistence display of sequence traces.

USE MATHCAD

These examples were created using MathSoft's MathCad for Windows. Shown on this page is the procedure for reading and graphing a file for a single segment; the example on page 172 is for multiple segments.

This single-segment example is valid for MathCad Versions 3.1 to 7:

```
A := READPRN(file)
K := last(A^<0>)
A := submatrix(A, 2, K, 0, 1)      Create a submatrix containing data but no header
t := A^<0>                         Extract time vector
v := A^<1>                         Extract amplitude vector
K := last(t)                       Determine index of last point
k := 0 .. K - 1                    Create a ramp
```



This multi-segment MathCad example demonstrates how to extract data from a given segment. The data consisted of two segments of three samples each, allowing the entire imported matrix to be shown:

Read data from file

$a := READPRN(ac1000)$

$$a = \begin{pmatrix} 2 & 3 \\ 1 & 0 \\ 2 & 999 \\ 1 & 1 \\ 1.1 & 2 \\ 1.2 & 3 \\ 1 & 1.1 \\ 1.1 & 2.1 \\ 1.2 & 3.1 \end{pmatrix}$$

Extracting the first segment only (or only segment if not sequence trace)

$n := (1 + a_{0,0}) .. (a_{0,0} + a_{0,1})$

$n = \begin{pmatrix} 3 \\ 4 \\ 5 \end{pmatrix}$

$m := 0..1$

$firstseg_{n-1-a_{0,0},m} := a_{n,m}$

$$firstseg = \begin{pmatrix} 1 & 1 \\ 1.1 & 2 \\ 1.2 & 3 \end{pmatrix}$$

Extracting a given segment

$numsegments := a_{0,0}$ Total number of segments in trace

$seglen := a_{0,1}$ Number of samples in each segment

$segment := 0$ Desired segment number

$segstart := 1 + numsegments + segment \cdot seglen$ Index of first point in segment

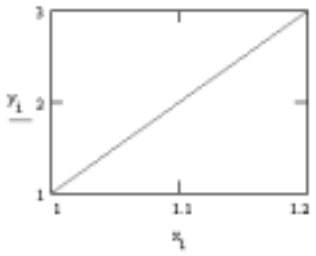
$segend := segstart + seglen - 1$ Index of last point in segment

$segtime := a_{segment+1,1}$ Segment trigger time

$x := a^{\langle 0 \rangle}$

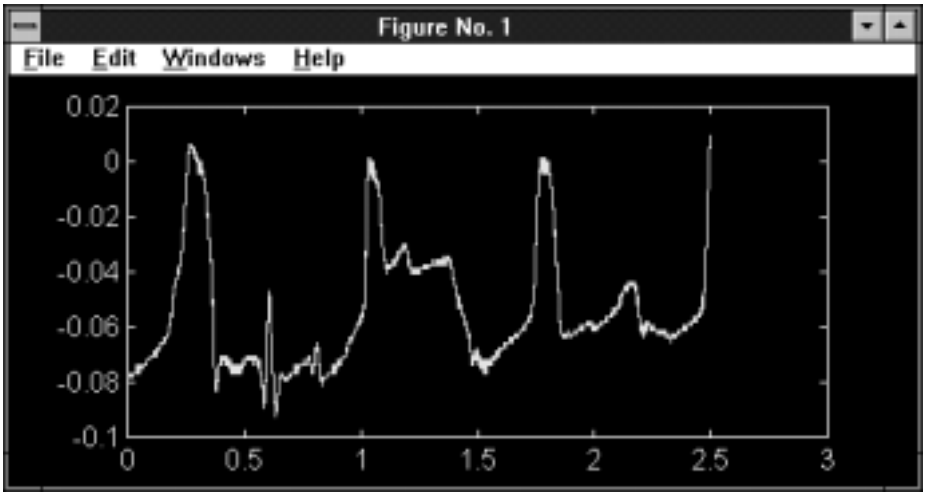
$y := a^{\langle 1 \rangle}$

$i := segstart .. segend$



USE MATLAB

This example was created using MathWorks' MATLAB Version 4.2c.1 for Windows. You can read and graph a waveform in MATLAB by using two simple commands: the first loads the file into a matrix automatically named after the file (command window); the second plots this matrix ("Figure No. 1"):



The MATLAB format is simple: it has no header information, only amplitude values. Multiple segments will be appended without a separator. Only one value from the pair of amplitude values present in a dual-array will be stored.

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