C H A P T E R   F O U R :   *Choose a Measure Tool*

In this chapter, see how

> *To control time cursors*
>
> *To control amplitude cursors*
>
> *To use cursors in standard display*
>
> *To select a standard parameter*

Measure with Cursors

Cursors are important tools that aid you in measuring signal values. Cursors are markers — lines, cross-hairs, or arrows — that you can move around the grid or the waveform itself. Use cursors to make fast, accurate measurements and to eliminate guesswork. There are two basic types:

Time (Frequency) cursors are markers that you move horizontally along the waveform. Place them at a desired location along the time axis to read the signal's amplitude at the selected time.
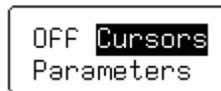
Amplitude (Voltage) cursors are lines that you move vertically on the grid to measure the amplitude of a signal.

CONTROL THE TIME CURSORS

DISPLAY

1.   Press [button] and make sure that **Standard** is selected in the top menu.

MEASURE
TOOLS

2.   Press [button] to display the MEASURE menus.

3.   Press the button to select

```
OFF  Cursors
   Parameters
```

SINGLE

TIP: Press [button] as a smooth way to stop your Waverunner scope and allow measurement of the displayed waveform.

4.   Press the button to select

```
────mode────
    Time
  Amplitude
```

5.   Press the button to select

```
────type────
  Relative
  Absolute
```

6.   Turn the knob for

> cursor
> Position

to move the Absolute Time cursor ┴ .

Watch this cross-hair marker move up and down along your displayed waveform. As it moves, the cursor's time value in relation to the trigger point is shown beneath the grid, and its voltage value in the trace label.

7.   Press the button to select

> ──type──
> **Relative**
> Absolute

> *TIP: Select "Diff & Ref" from the show menu to display in the trace label the absolute amplitude, with respect to ground level, of the two Relative Time cursors.*

8.   Turn the knobs to move the two Relative Time cursors ↑ ↓ along the waveform.

Waverunner shows beneath the grid the relative time and voltage difference between the two cursors. When you use Relative Time cursors, the Reference cursor (upward-pointing arrow) can be changed, and could be different from the trigger point. You might place it, for example, at the falling edge of the captured signal's oscillations. You can move the Difference cursor (downward-pointing arrow) to measure the time difference anywhere on the waveform. **Diff – Ref** shows the subtraction of the reference from the difference amplitudes.
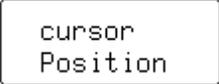
CONTROL THE AMPLITUDE CURSORS
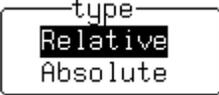
1.   Press the button to select

> ──mode──
> Time
> **Amplitude**

2.   Press the button to select

> ──type──
> Relative
> **Absolute**

> *TIP: Turn Track "On" in the Reference Cursor menu. The difference between the Reference and Difference cursors will remain the same when you turn this menu's knob, and the two cursor bars will move in tandem. Turn the Difference cursor menu knob: only this cursor's position will change. The link between the two cursors is indicated by a vertical bar at the side of the grid. Press the same menu button to turn Track "Off".*

3. Turn the knob for | cursor Position | to move the Absolute Amplitude cursor — · — · — ·

Place it at the top of your displayed waveform. The difference in amplitude between the cursor and the ground level (indicated by the ground level marker at right of grid) is shown in the trace label.
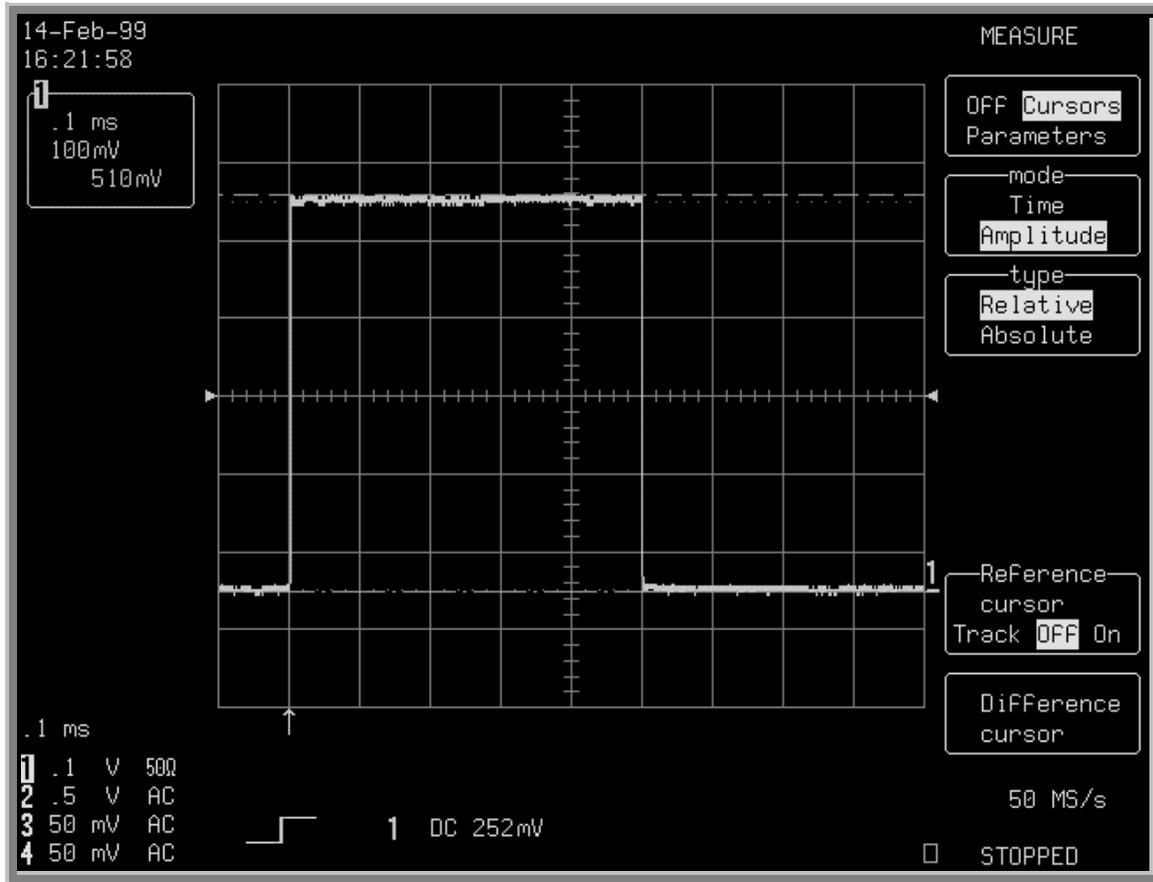
4. Press the button to select | type Relative Absolute | and show two bar cursors: Reference and Difference.

5. Turn the knob for | Reference cursor Track OFF On | to move the Reference — — — — — cursor

6. Turn the knob for | Difference cursor | to move the Difference cursor

When you use Relative Amplitude cursors, the Reference cursor can be made different from the ground level. You might place it, for example, at the base level of a square wave. You could then position the Difference cursor at the top of the waveform. The difference between the two would then give you the signal's amplitude, indicated in the trace label, as illustrated on the next page.

Relative Amplitude cursors mark out the signal's amplitude. Here it is 510 mV, as indicated in the trace label at top-left of screen.

TO USE CURSORS IN STANDARD DISPLAY

You can move **Amplitude** *(Voltage) cursors — broken lines or bars running across the screen — up and down the grid pixel by pixel. Amplitudes are shown in the trace label for each trace.*

Place **Time** *(Frequency) cursors — arrows or cross-hair markers that move along the waveform — at a desired time to read the amplitude of a signal at that time, and move them to every single point acquired.*

When you place a time cursor on a data point, cross-bars appear on the arrow and cross-hair markers � ↓ ↑.

The time is shown below the grid. In Relative mode the frequency corresponding to the time interval between the cursors is also displayed there. When there are few data points displayed, time-cursor positions are linearly interpolated between the data points. Time cursors move up and down along these straight-line segments.

*In **Absolute** mode, you control a single cursor. You can display the cursor location's readings for amplitude (using amplitude cursors) or time and amplitude (using time cursors). Measured voltage amplitudes are relative to ground; measured times are relative to the trigger point.*

*In **Relative** mode, you control a pair of amplitude or time cursors, and get readings on the difference between the two in amplitude, or time and amplitude.*

WHEN IN PERSISTENCE MODE

In persistence mode, amplitude cursors are the same as in Standard display, while time cursors are vertical bars running down the screen and moving across it.

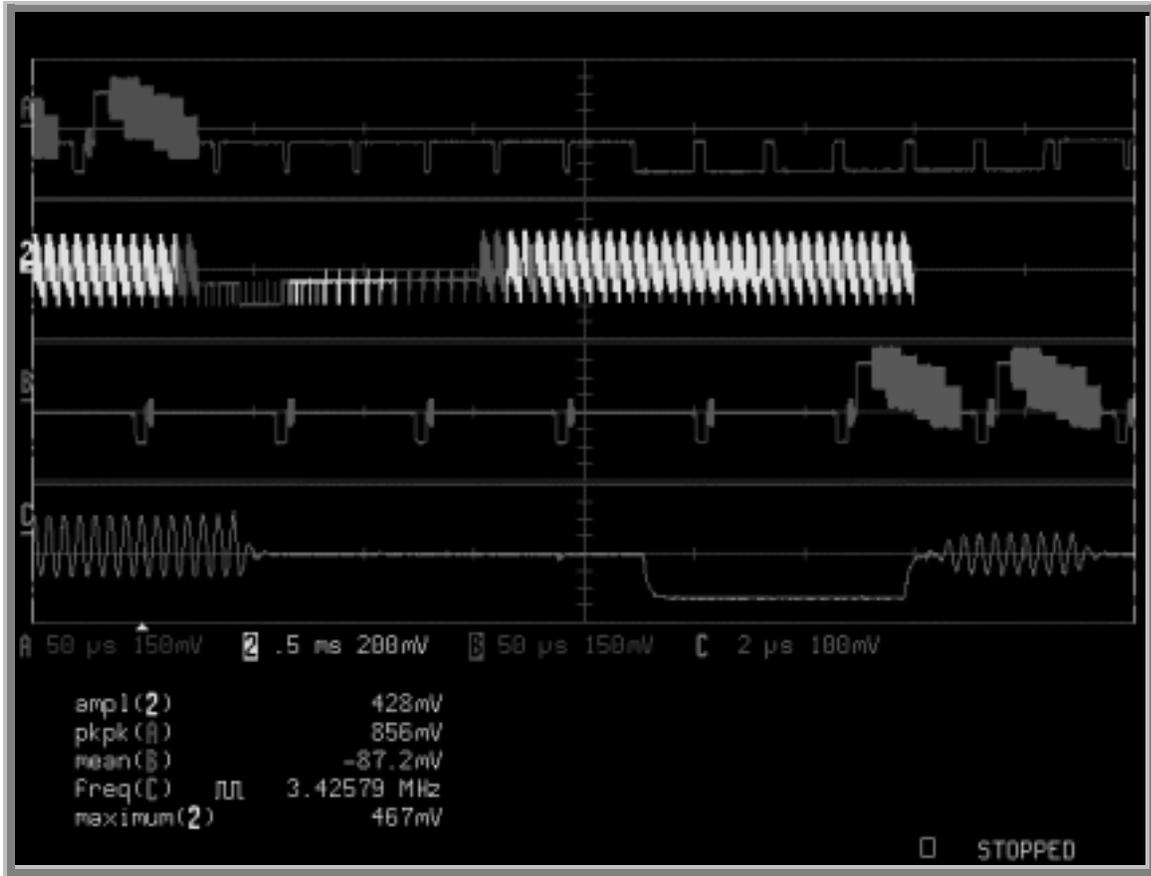**TIP: To set time-cursor amplitude units in volts or decibels...**

UTILITIES

Press   **to access and select Special Modes. Then select the Cursors Measure menu to access and use the** <u>Read time cursor amplitudes in</u> **menu to select the desired unit.**
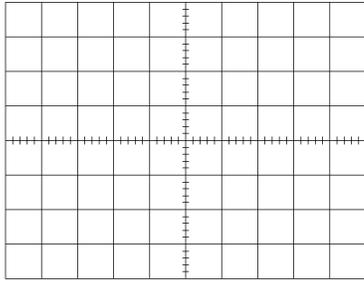
Measure Automatically with Parameters

Parameters are measurement tools that determine a wide range of signal properties. Use them to automatically calculate time and voltage values. There are parameter modes for the amplitude and time domains, custom parameter groups, and parameters for pass and fail testing. You can make common measurements on one signal in either the standard voltage (amplitude) or standard time modes. On more than one signal, select parameters from a Custom category and use them to determine up to five quantities at once. Pass and fail parameters can be customized, too. You can accumulate and display statistics on each parameter's sweeps, average, lowest, highest and standard deviation. See Chapter 11, "Parameter Analysis," for how to customize parameters, and for a description of each.

A special display is automatically used with parameters, whose data are listed beneath the grid (see next page for display setup). Shown here: a Full-Screen, Quad-grid parameter display. Top of facing page: the Standard, Single-grid, parameter display.
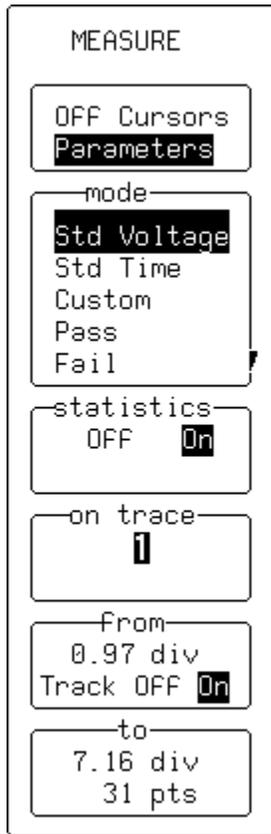
CHOOSE A STANDARD PARAMETER

MEASURE
TOOLS

1. Press   to display the MEASURE menus.

OFF Cursors
Parameters

2. Press the button to select

pkpk(**1**)
mean(**1**)
sdev(**1**)
rms(**1**)
ampl(**1**)

Standard Voltage will be selected by default in the mode menu, shown below, and a list of five parameters will appear beneath the grid. This list will change when **Standard Time** is selected.

MEASURE

OFF Cursors
Parameters

─mode─
Std Voltage
Std Time
Custom
Pass
Fail

─statistics─
OFF **On**

─on trace─
1

─from─
0.97 div
Track OFF **On**

─to─
7.16 div
31 pts

3. Use these menus to set up for parameters.

To enable parameters, cursors or neither. While **Parameters** is selected, statistics accumulation (see below) goes on, even if not shown.

To select the mode. **Standard Voltage** measures for a single signal: peak-to-peak (the amplitude between the maximum and minimum sample values), mean of all sample values, standard deviation, root mean square of all sample values, and signal amplitude. **Standard Time** measures for a single signal: period, width at 50% of amplitude, rise time at 10–90% of amplitude, fall time at 90–10% of amplitude, and the delay from the first trigger to the first 50% amplitude point.
See Chapter 11 for "Custom," "Pass," and "Fail."

To automatically calculate the displayed parameters' average, lowest, highest and standard deviation, and number of sweeps used.

To select the trace on which the parameters are to be measured. This menu indicates those traces displayed.

To set the starting point in screen divisions for parameter measurements, using the knob. Turn Track **On**, using the button. Control of the starting and end points is linked and they can be moved together using the knob.

To set the end point in screen divisions for parameter measurements, using the knob. Also indicates the total number of data points used for the measurements.

DISPLAY

4. Press ☐ to set up the display — to select parameter grid styles, for example — using DISPLAY SETUP. See the preceding chapter.

TURN OFF CURSORS AND PARAMETERS

MEASURE
TOOLS

1. Press ☐ to return to the MEASURE menus.

2. Press the button to select

> ```
> OFF Cursors
> Parameters
> ```

TIP: To clear parameter "statistics" press:

CLEAR
SWEEPS

☐

TO RECOGNIZE PARAMETER SYMBOLS

The algorithms that allow Waverunner to determine pulse-waveform parameters detect the particular situations where the mathematical formulas can be applied.

Sometimes you should interpret the results with caution. In these cases the scope alerts you by displaying a symbol under the grid between the name of the parameter and its value. These symbols act as information or warnings:

The parameter has been determined for several periods (up to 100), and the average of those values has been taken.

The parameter has been determined over an integral number of periods.

The parameter has been calculated on a histogram.

Insufficient data to determine the parameter.

Amplitude histogram is flat within statistical fluctuations; minimum and maximum are used to assign top and base.

Only an upper limit could be estimated (the actual value of the parameter may be smaller than the displayed value).

The signal is partially in overflow.

The signal is partially in underflow.

The signal is partially in overflow and in underflow.