

Probe Attenuation Setting

Probes are available with various attenuation factors which affect the vertical scale of the signal.

To change (or check) the probe attenuation setting, press the VERTICAL MENU button (of the channel you are using), and then press the menu selection next to Probe until the correct setting is displayed.

This setting remains in effect until changed again.

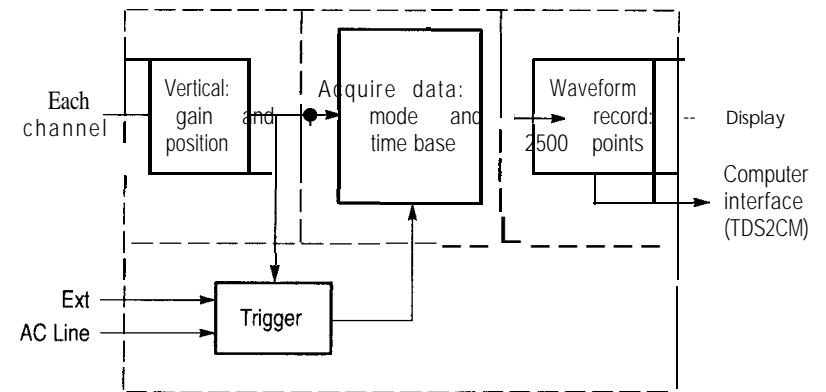
NOTE. The default Probe attenuation setting is 1X when the oscilloscope is shipped.

Basic Concepts

To use your oscilloscope effectively, you must understand the following basic concepts:

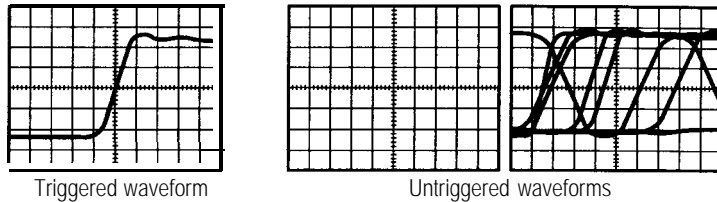
- Triggering
- Acquiring data
- Scaling and positioning waveforms
- Measuring waveforms
- Setting Up the oscilloscope

The figure below shows a block diagram of the various functions of an oscilloscope and their relationship to each other.



Triggering

The trigger determines when the oscilloscope starts to acquire data and display a waveform. When a trigger is set up properly, it can convert unstable displays or blank screens into meaningful waveforms.



When the oscilloscope starts to acquire a waveform, it collects enough data so that it can draw the waveform to the left of the trigger point. The oscilloscope continues to acquire data while waiting for the trigger condition to occur. After it detects a trigger, the oscilloscope continues to acquire enough data so that it can draw the waveform to the right of the trigger point.

Source

You can derive your trigger from various sources: Input channels, AC Line, and External.

Input. The most commonly used trigger source is any one of the input channels. The channel you select as a trigger source will function whether it is displayed or not.

AC Line. You can use this trigger source when you want to look at signals related to the power line frequency, such as lighting equipment and power supply devices. The oscilloscope generates the trigger, so you do not have to input a trigger signal.

External (TDS 210 and TDS 220 Only). You can use this trigger source when you want to acquire data on two channels and trigger from a third. For example, you might want to trigger from an external clock or with a signal from another part of the test circuit.

For the TDS 210 and TDS 220 oscilloscopes, you can connect an external trigger signal to the EXT TRIG connector.

Types

The oscilloscope provides two types of triggers: Edge and Video.

Edge. You can use the edge trigger with analog and digital test circuits. An edge trigger occurs when the trigger input passes through a specified voltage level in the specified direction.

Video. You can use the video trigger on fields or lines of standard video signals. Refer to *Triggering on a Video Signal* on page 52.

Modes

The trigger mode determines how the oscilloscope behaves in the absence of a trigger event. The oscilloscope provides three trigger modes: Auto, Normal, and Single.

Auto. This trigger mode allows the oscilloscope to acquire a waveform even when it does not detect a trigger condition. If no trigger condition occurs while the oscilloscope waits for a specific period (as determined by the time-base setting), it will force itself to trigger.

Refer to *Time Base* on page 16 for more information on time bases.

When forcing invalid triggers, the oscilloscope cannot synchronize the waveform, and the waveform seems to roll across the display. If valid triggers occur, the display becomes stable on the screen.

You can use Auto mode to monitor an amplitude level, such as a power supply output, which may cause the waveform to roll across the display.

Normal. The Normal mode allows the oscilloscope to acquire a waveform only when it is triggered. If no trigger occurs, the oscilloscope will not acquire a new waveform, and the previous waveform, if any, will remain on the display.

Single. The Single mode allows the oscilloscope to acquire one waveform each time you press the RUN button, and the trigger condition is detected.

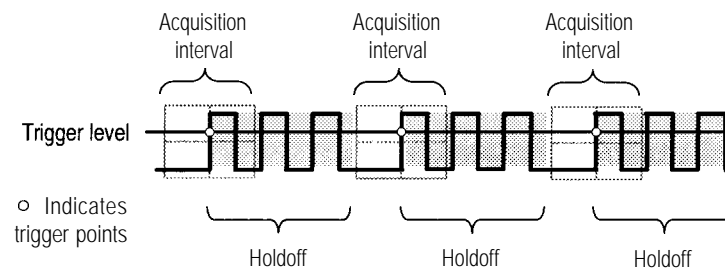
The data that the oscilloscope acquires depends on the acquisition mode. Refer to *Acquisition Modes* on page 15 for more information on the type of data each acquisition mode will acquire.

NOTE. When you use the Single trigger mode with the Average acquisition mode, the number of waveforms specified in the number of averages are acquired before the acquisition stops.

Holdoff

Triggers are not recognized during holdoff time (the period that follows each acquisition). For some signals, you need to adjust the holdoff period to produce a stable display.

The trigger signal can be a complex waveform with many possible trigger points on it, such as a digital pulse train. Even though the waveform is repetitive, a simple trigger might result in a series of patterns on the screen instead of the same pattern each time.



Triggers are not recognized during holdoff time.

For example, you could use the holdoff period to prevent triggering on any other pulse except the first one in a pulse train. This way, the oscilloscope would always display the first pulse.

To access the Holdoff control, press the HORIZONTAL Menu button, select Holdoff, and use the HOLDOFF knob to change the amount of time in the holdoff period.

Coupling

Trigger coupling determines what part of the signal passes on to the trigger circuit. Coupling types include DC, AC, Noise Rejection, High Frequency Rejection, and Low Frequency Rejection.

DC. DC coupling passes both AC and DC components.

AC. AC coupling blocks DC components.

Noise Rejection. Noise Reject coupling lowers the trigger sensitivity and requires more signal amplitude for stable triggering. This reduces the chance of falsely triggering on noise.

High Frequency Rejection. HF Reject coupling blocks the high frequency portion and passes on only the low frequency components.

Low Frequency Rejection. LF Reject coupling does the opposite of high frequency rejection.

Position

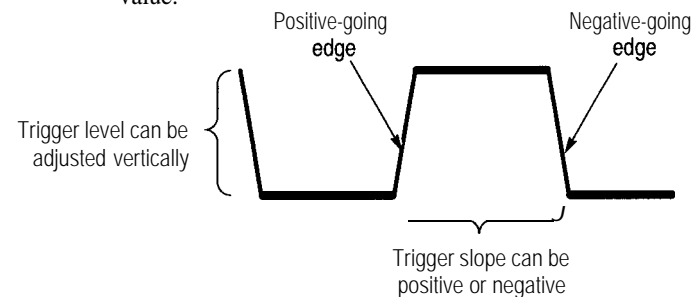
The horizontal position control establishes the time between the trigger and the screen center. Refer to **Horizontal Scale and Position; Pretrigger Information** on page 17 for more information on how to use this control to position the trigger.

Slope and Level

The Slope and Level controls help to define the trigger.

The Slope control determines whether the oscilloscope finds the trigger point on the rising or the falling edge of a signal. To access the trigger slope control, press the TRIGGER Menu button, select Edge, and use the Slope button to select Rising or Falling.

The Level control determines where on the edge the trigger point occurs. To access the trigger level control, press the HORIZONTAL Menu button, select Level, and use the LEVEL knob to change the value.



Acquiring Data

When you acquire analog data, the oscilloscope converts it into a digital form. You can acquire data using three different acquisition modes. The timebase setting affects how rapidly data is acquired.

Acquisition Modes

There are three acquisition modes: Sample, Peak Detect, and Average.

Sample. In this acquisition mode, the oscilloscope samples the signal in evenly spaced intervals to construct the waveform. This mode accurately represents analog signals most of the time.

However, this mode does not acquire rapid variations in the analog signal that may occur between samples. This can result in aliasing (described on page 18) and may cause narrow pulses to be missed. In these cases, you should use the Peak Detect mode to acquire data.

Peak Detect. In this acquisition mode, the oscilloscope finds the highest and lowest values of the input signal over a sample interval and uses these values to display the waveform. In this way, the oscilloscope can acquire and display narrow pulses, which may have otherwise been missed in Sample mode. Noise will appear to be higher in this mode.

Average. In this acquisition mode, the oscilloscope acquires several waveforms, averages them, and displays the resulting waveform. You can use this mode to reduce random noise.

Time Base

The oscilloscope digitizes waveforms by acquiring the value of an input signal at discrete points. The time base allows you to control how often the values are digitized.

To adjust the time base to a horizontal scale that suits your purpose, use the SEC/DIV knob.

Scaling and Positioning Waveforms

You can change the display of waveforms by adjusting their scale and position. When you change the scale, the waveform display will increase or decrease in size. When you change the position, the waveform will move up, down, right, or left.

The channel reference indicator (located on the left of the graticule) identifies each waveform on the display. The indicator points to the ground level of the waveform record.

Vertical Scale and Position

You can change the vertical position of waveforms by moving them up or down on the display. To compare data, you can align a waveform above another or you can align waveforms on top of each other.

You can change the vertical scale of a waveform. The waveform display will contract or expand about the ground level.

Horizontal Scale and Position; Pretrigger Information

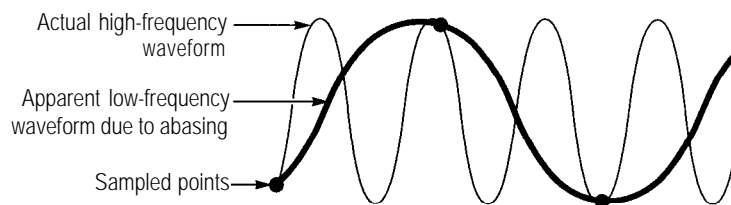
You can adjust the Horizontal Position control to view waveform data before the trigger, after the trigger, or some of each. When you change the horizontal position of a waveform, you are actually changing the time between the trigger and the center of the display. (This appears to move the waveform to the right or left on the display.)

For example, if you want to find the cause of a glitch in your test circuit, you might trigger on the glitch and make the pretrigger period large enough to capture data before the glitch. You can then analyze the pretrigger data and perhaps find the cause of the glitch.

You change the horizontal scale of all the waveforms by using the SEC/DIV knob. For example, you might want to see just one cycle of a waveform to measure the overshoot on its rising edge.

The oscilloscope shows the time per division in the scale readout. Since all active waveforms use the same time base, the oscilloscope only displays one value for all the active channels, except when you use a Window Zone.

Aliasing. Aliasing occurs when the oscilloscope does not sample the signal fast enough to construct an accurate waveform record. When aliasing happens, you see a waveform with a frequency lower than the actual waveform being input or a waveform that is not stable even though the oscilloscope triggered.



One way to check for aliasing is to slowly change the horizontal scale with the SEC/DIV knob. If the shape of the waveform changes drastically, you may have aliasing.

To represent a signal accurately and avoid aliasing, you must sample the signal more than twice as fast as the highest frequency component. For example, a signal with frequency components of 5 MHz would need to be sampled at 10 Megasamples per second or faster.

The next table lists the time bases that you should use to avoid aliasing at various frequencies and the respective sample rate.

Time base	Samples per second	Maximum frequency	Time base	Samples per second	Maximum frequency
1.0 μ s	250.0 MS/s	125.0 MHz	5.0 ms	50.0 kS/s	25.0 kHz
2.5 μ s	100.0 MS/s	50.0 MHz	10.0 ms	25.0 kS/s	12.5 kHz
5.0 μ s	50.0 MS/s	25.0 MHz	25.0 ms	10.0 kS/s	5.0 kHz
10.0 μ s	25.0 MS/s	12.5 MHz	50.0 ms	5.0 kS/s	2.5 kHz
25.0 μ s	10.0 MS/s	5.0 MHz	100.0 ms	2.5 kS/s	1.25 kHz
50.0 μ s	5.0 MS/s	2.5 MHz	250.0 ms	1.0 S/s	500.0 Hz
100.0 μ s	2.5 MS/s	1.25 MHz	500.0 ms	500.0 S/s	250.0 Hz
250.0 μ s	1.0 MS/s	500.0 kHz	1.0 s	250.0 S/s	125.0 Hz
500.0 μ s	500.0 kS/s	250.0 kHz	2.5 s	100.0 S/s	50.0 Hz
1.0 ms	250.0 kS/s	125.0 kHz	5.0 s	50.0 S/s	25.0 Hz
2.5 ms	100.0 kS/s	50.0 kHz			

There are various ways to prevent aliasing: adjust the horizontal scale, push the AUTOSET button, or change the acquisition mode.

NOTE. If aliasing occurs, change to the Peak Detect acquisition mode (described on page 16). This mode samples the highest and lowest values so that the oscilloscope can detect **faster** signals.

Taking Measurements

The oscilloscope displays graphs of voltage versus time and can help you to measure the displayed waveform.

There are several ways to take measurements. You can use the graticule, the cursors, or an automated measurement.

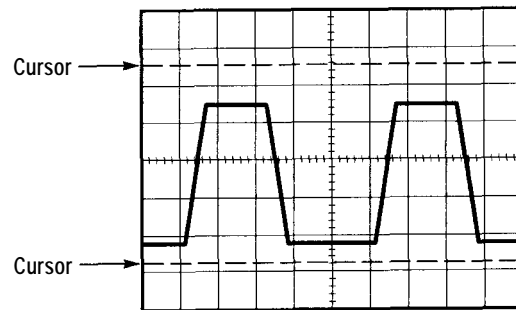
Graticule

This method allows you to make a quick, visual estimate. For example, you might look at a waveform amplitude and determine that it is a little more than 100 mV.

You can take simple measurements by counting the major and minor graticule divisions involved and multiplying by the scale factor.

For example, if you counted five major vertical graticule divisions between the minimum and maximum values of a waveform and knew you had a scale factor of 100 mV/division, then you could easily calculate your peak-to-peak voltage as follows:

$$5 \text{ divisions} \times 100 \text{ mV/division} = 500 \text{ mV.}$$



Cursors

This method allows you to take measurements by moving the cursors, which always appear in pairs, and reading their numeric values from the display readouts. There are two types of cursors: Voltage and Time.

Voltage Cursors. Voltage cursors appear as horizontal lines on the display and measure the vertical parameters.

Time Cursors. Time cursors appear as vertical lines on the display and measure the horizontal parameters.

Automated

When you take automated measurements, the oscilloscope does all the calculating for you. Because these measurements use the waveform record points, they are more accurate than graticule or cursor measurements.

Automated measurements use readouts to show measurement results. These readouts are updated periodically as the oscilloscope acquires new data.

Setting Up the Oscilloscope

You should become familiar with three functions that you will use often when operating your oscilloscope: Autoset, saving a setup, and recalling a setup. Included is a description of the default settings for normal operation of the oscilloscope.

Using Autoset

The Autoset function obtains a stable waveform display for you. It automatically adjusts the vertical and horizontal scaling, as well as the trigger coupling, type, position, slope, level, and mode settings.

Saving a Setup

By default, the oscilloscope saves the setup each time it is powered off. The oscilloscope automatically recalls this setup the next time it is powered on.

NOTE. You should wait at least five seconds after your last change to the setup before you turn off the power: This ensures that the setup is saved properly.

You can also permanently save up to five setups in the memory of the oscilloscope and overwrite setups as needed.

Recalling a Setup

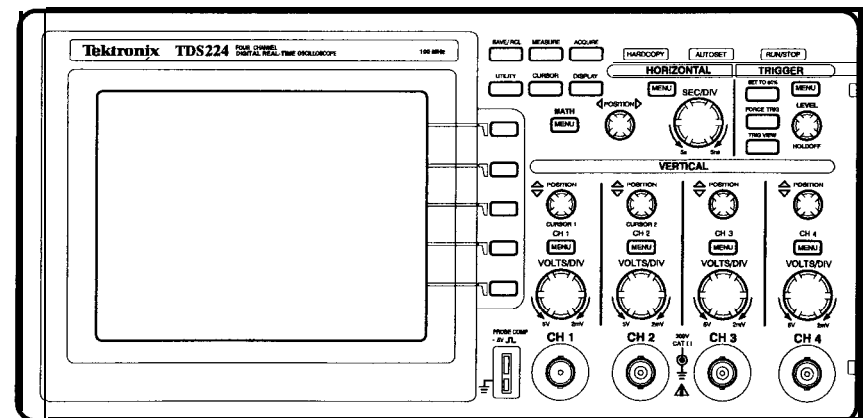
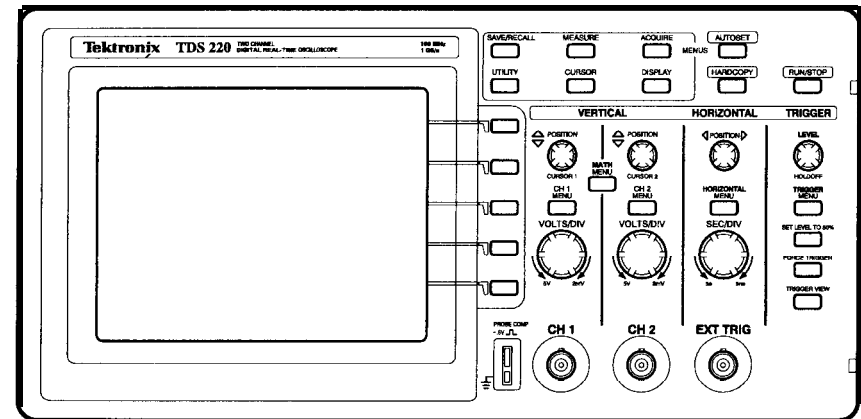
The oscilloscope can recall any of the saved setups or the factory default setup.

Defaults (Factory Setup)

The oscilloscope is set up for normal operation when it is shipped from the factory. You can recall the factory default setup any time you want to operate the oscilloscope using or starting from the factory default settings.

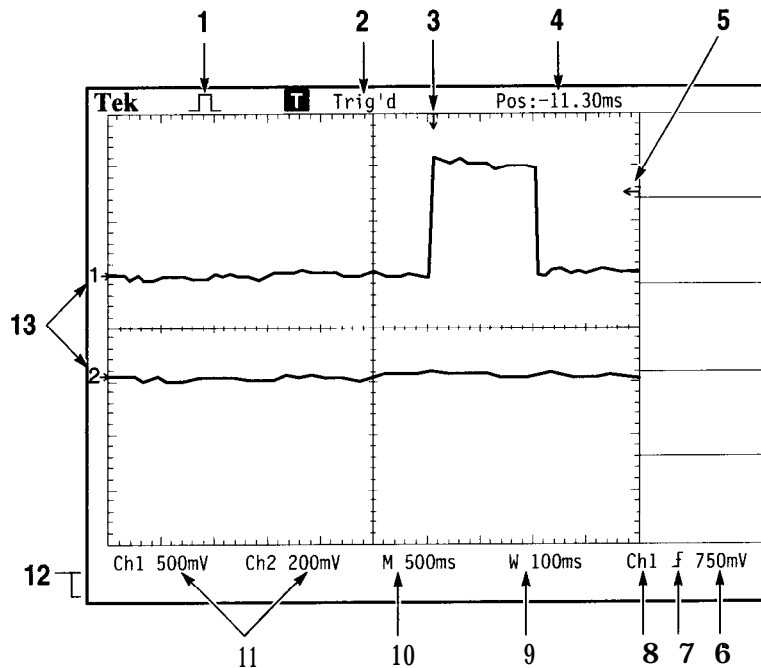
Operating Basics

The front panel is divided into easy to use functional areas. This section provides you with a quick overview of the controls and the information displayed on the screen. The next figure shows the front panels for a TDS 210 or TDS 220, and for a TDS 224 oscilloscope.






Display Area

In addition to displaying waveforms, the display is filled with many details about the waveform and the instrument control settings.



1. Icon display shows acquisition mode.

-  Sample mode
-  Peak detect mode
-  Average mode

2. Trigger status indicates the following:

- Armed. The instrument is acquiring pretrigger data. All triggers are ignored in this state.
- Ready. All pretrigger data has been acquired and the instrument is ready to accept a trigger.
- Tri'd. The instrument has seen a trigger and is acquiring the posttrigger data.
- Auto. The instrument is in auto mode and is acquiring waveforms in the absence of triggers.
- Scan. The instrument is acquiring and displaying waveform data continuously in scan mode.
- Stop. The instrument has stopped acquiring waveform data.





3. Marker shows horizontal trigger position. This is adjusted by the Horizontal Position control.

4. Readout shows the time difference between the center graticule and horizontal trigger position. Center screen equals zero.

5. Marker shows trigger level.

6. Readout shows numeric value of the trigger level.

7. Icon shows selected trigger type as follows:

-  - Edge trigger for the rising edge.
-  - Edge trigger for the falling edge.
-  - Video trigger for line sync.
-  - Video trigger for field sync.

8. Readout shows trigger source used for triggering.
9. Readout shows window time base setting if it is in use,
10. Readout shows main time base setting.
11. Readouts show the vertical scale factors of the channels.
12. Display area shows on-line messages momentarily.
13. On-screen markers show the ground reference points of the displayed waveforms. No marker indicates the channel is not displayed.

Using the Menu System

The user interface of the TDS 200-series oscilloscopes was designed for easy access to specialized functions through the menu structure.

When you press a menu button on the front panel, the associated menu title displays at the top right of the screen. There can be up to five menu boxes below the menu title. To the right of each menu box is a bezel button you can use to change the menu setting.

There are four types of menu boxes you can use to change settings: Circular Lists, Action Buttons, Radio Buttons, and Page Selections.

Circular List Menu Boxes

A Circular List menu box appears with a title on top with the selected choice listed below in reverse video. For example, you can push the menu box button to cycle through the vertical coupling choices in the CH1 Menu.

Action Button Menu Boxes

An Action Button menu box displays the name of the action. For example, you can use the two lowest menu boxes in the DISPLAY menu to increase or decrease the contrast.

Radio Button Menu Boxes

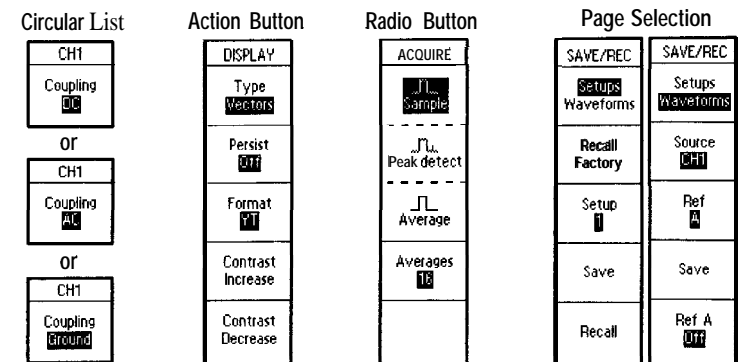
Radio Button menu boxes are separated by dashed lines. The name of the selected menu box displays in reverse video. For example, you can use the top three menu boxes in the ACQUIRE menu to select an acquisition mode.

Page Selection Menu Boxes

A Page Selection menu box contains two menus for a single button on the front panel with the selected menu displayed in reverse video. Each time you press the top menu box button to toggle between the two menus, the menu boxes below also change.

For example, when you press the SAVE/RECALL front panel button, the top Page Selection menu contains the names of two menus: Setups and Waveforms. When you select the Setups menu, you can use the remaining menu boxes to save or recall setups. When you select the Waveforms menu, you can use the remaining menu boxes to save or recall waveforms.

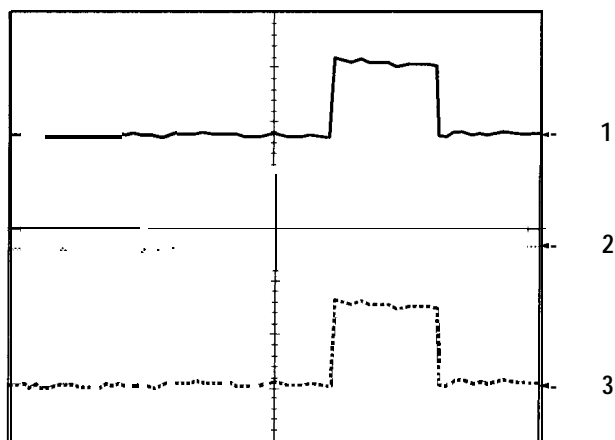
The SAVE/RECALL, MEASURE, and TRIGGER front panel buttons display Page Selection menu boxes.



Waveform Displays

Obtaining a waveform display is dependent on many instrument settings. Once you obtain a waveform, you can take your measurements. But the appearance of these waveforms also provides key information about the waveform.

Depending on the type, waveforms will be displayed in three different styles: black, gray, and broken.

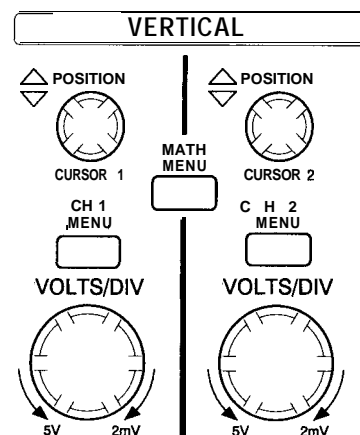


1. A solid black waveform indicates a live waveform display. The waveform remains black when the acquisition is stopped if no controls are changed that make the display accuracy uncertain.

Changing the vertical and horizontal controls is allowed on stopped acquisitions.

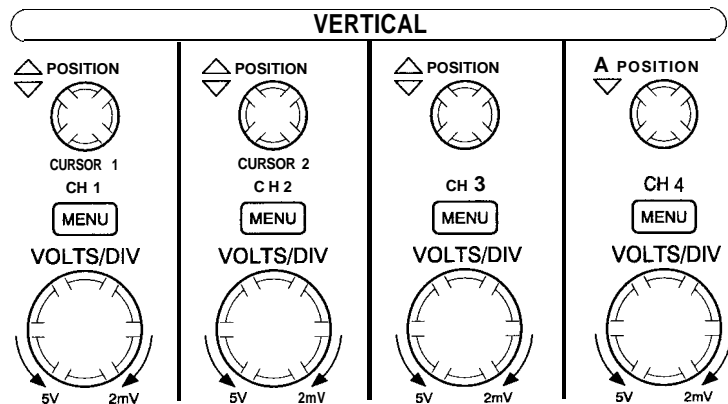
2. Reference waveforms and waveforms with persistence applied appear gray.
3. A broken line appearance indicates the waveform display accuracy is uncertain. This is the result of stopping the acquisition and then changing a control setting that the instrument cannot modify the displayed waveform to match. For example, changing the trigger controls on a stopped acquisition causes a broken-line waveform.

Vertical Controls



TDS 210 and TDS 220

MATH
MENU



TDS 224

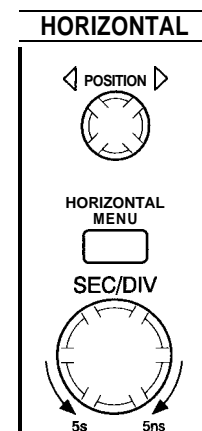
CH 1,2,3 & 4 and CURSOR 1 & 2 POSITION. Positions the waveform vertically. When cursors are turned on and the cursor menu is displayed, these knobs position the cursors.

CH 1, CH 2, CH 3 & CH 4 MENU. Displays the channel input menu selections and toggles the channel display on and off.

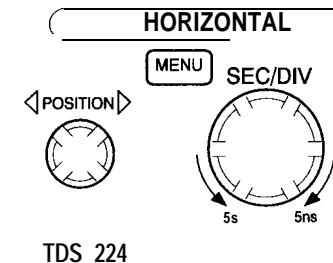
VOLTS/DIV (CH1, CH 2, CH 3 & CH 4). Selects calibrated scale factors.

MATH MENU. Displays waveform math operations menu and can also be used to toggle the math waveform on and off.

Horizontal Controls



TDS 210 and TDS 220



TDS 224

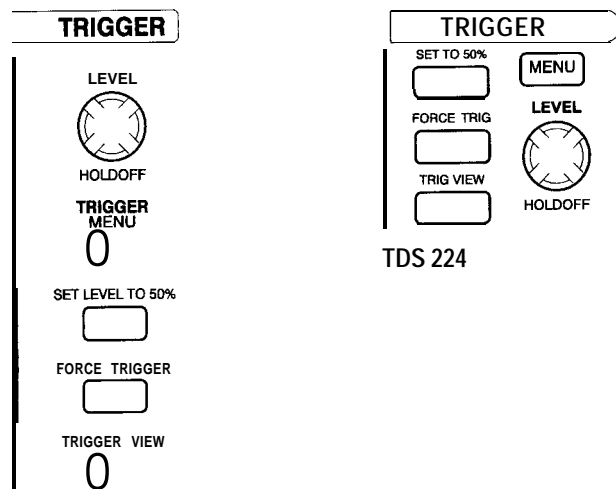
POSITION. Adjusts the horizontal position of all channels and math waveforms. The resolution of this control varies with the time base.

NOTE. To make a large adjustment to the horizontal position, change the SEC/DIV to 50 ms, change the horizontal position, and then change the SEC/DIV back to the previous value.

HORIZONTAL MENU. Displays the horizontal menu.

SEC/DIV. Selects the horizontal time/div (scale factor) for the main or the window time base. When Window Zone is enabled, it changes the width of the window zone by changing the window time base. Refer to page 73 for details about creating and using the Window Zone.

Trigger Controls



TDS 224

TDS 210 and TDS 220

LEVEL and HOLDOFF. This control has a dual purpose. As an edge trigger level control, it sets the amplitude level the signal must cross to cause an acquisition. As a holdoff control, it sets the amount of time before another trigger event can be accepted. Refer to *Holdoff* on page 13 for more information.

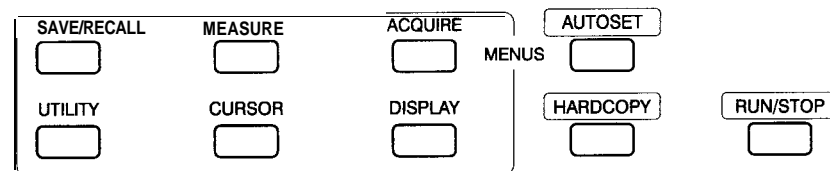
TRIGGER MENU. Displays the trigger menu.

SET LEVEL TO 50%. The trigger level is set to the vertical midpoint between the peaks of the trigger signal.

FORCE TRIGGER. Starts an acquisition regardless of an adequate trigger signal. This button has no effect if the acquisition is already stopped.

TRIGGER VIEW. Displays the trigger waveform in place of the channel waveform while the TRIGGER VIEW button is held down. You can use this to see how the trigger settings affect the trigger signal, such as trigger coupling.

Menu and Control Buttons



TDS 210 and TDS 220



TDS 224

SAVE/RECALL. Displays the save/recall menu for setups and waveforms.

MEASURE. Displays the automated measurements menu.

ACQUIRE. Displays the acquisition menu.

DISPLAY. Displays the display menu.

CURSOR. Displays the cursor menu. Vertical Position controls adjust cursor position while displaying the cursor menu and the cursors are turned on. Cursors remain displayed (unless turned off) after leaving the cursor menu but are not adjustable.

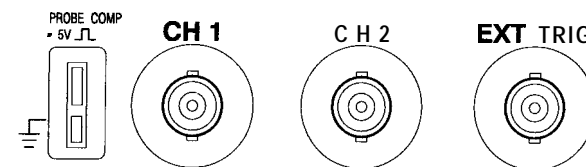
UTILITY. Displays the utility menus.

AUTOSET. Automatically sets the instrument controls to produce a usable display of the input signal.

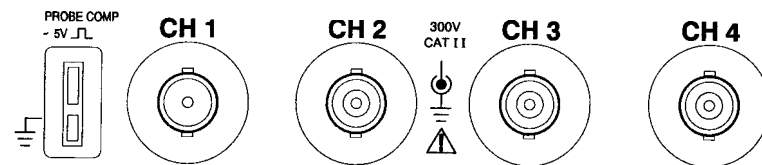
HARDCOPY. Starts print operations. An extension module with a Centronics, RS-232, or GPIB port is required. Refer to *Optional Accessories* on page 98.

RUN/STOP. Starts and stops waveform acquisition.

Connectors



TDS 210 and TDS 220



TDS 224

PROBE COMP. Voltage probe compensation output and ground. Use this to electrically match the probe to the input circuit. Refer to page 6.

The probe compensation ground and BNC shields are connected to earth ground. Do not connect a voltage source to these ground terminals.

CH 1, CH 2, CH 3 & CH 4. Input connectors for waveform display.

EXT TRIG. Input connector for an external trigger source. Use the trigger menu to select the trigger source.

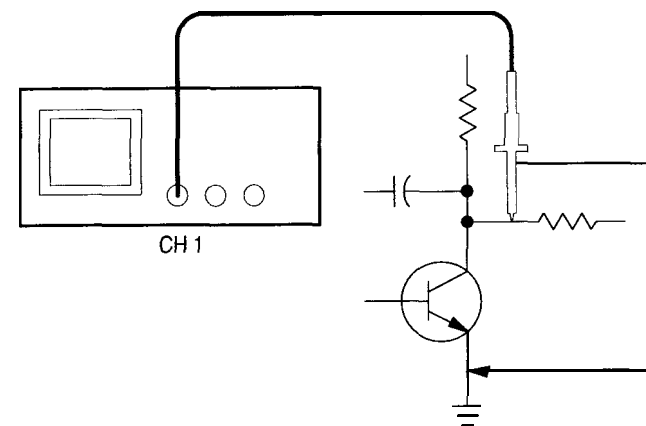
Application Examples

This section presents a series of application examples. These simplified examples highlight the features of the oscilloscope and give you ideas for using it to solve your own test problems.

- Taking simple measurements
 - Using Autoset
 - Using the Measure menu to take automatic measurements
 - Measuring two signals and calculating gain
- Taking cursor measurements
 - Measuring pulse width
 - Measuring rise time
 - Measuring ring frequency and ring amplitude
- Analyzing signal detail
 - Looking at a noisy signal
 - Using the average function to separate a signal from noise
- Triggering on a video signal
 - Triggering on video fields and video lines
 - Using the window function to see waveform details
 - Triggering on odd or even video fields
- Analyzing a differential communication signal
 - Using math functions
- Viewing impedance changes in a network
 - Using XY mode
 - Using persistence

Taking Simple Measurements

You need to see a signal in a circuit, but you do not know the amplitude or frequency of the signal. You want to quickly display the signal and measure the frequency, period, and peak-to-peak amplitude.



Using Autoset

To quickly display a signal, do these steps:

1. Connect the channel 1 probe to the signal.
2. Push the **AUTOSET** button.

The oscilloscope sets the vertical, horizontal, and trigger controls automatically. If you want to optimize the display of the waveform, you can manually adjust these controls.

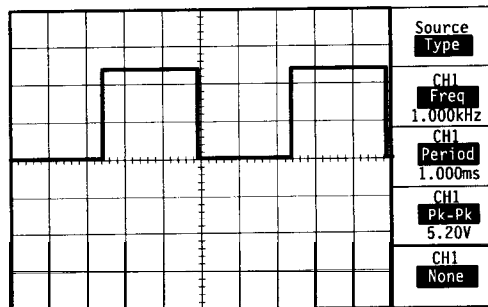
When you use more than one channel, the autoset function sets the vertical controls for each channel and uses the lowest-numbered active channel to set the horizontal and trigger controls.

Taking Automatic Measurements

The oscilloscope can take automatic measurements of most displayed signals. To measure signal frequency, period, and peak-to-peak amplitude, do these steps:

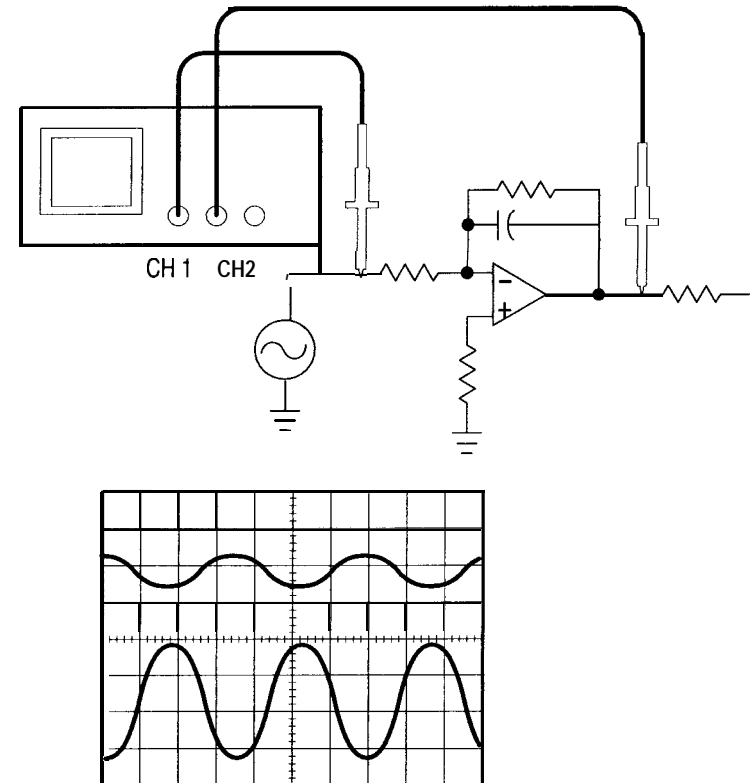
1. Push the **MEASURE** button to see the Measure menu.
2. Push the top menu box button to select **Source**.
3. Select **CH1** for the first three measurements.
4. Push the top menu box button to select **Type**.
5. Push the first **CH1** menu box button to select **Freq.**
6. Push the second **CH1** menu box button to select **Period**.
7. Push the third **CH1** menu box button to select **Pk-Pk**.

The frequency, period, and peak-to-peak measurements are shown in the menu and are updated periodically.



Measuring Two Signals

You are testing a piece of equipment and need to measure the gain of the audio amplifier. You have an audio generator that can inject a test signal at the amplifier input. Connect two oscilloscope channels to the amplifier input and output as shown. Measure both signal levels and use the measurements to calculate the gain.



To activate and display the signals connected to channel 1 and to channel 2, do these steps:

1. If the channels are not displayed, push the **CH 1 MENU** and then **CH 2 MENU** buttons.
2. Push the **AUTOSET** button.

To select measurements for the two channels, do these steps:

1. Select the source channels.
 - a. Push the **MEASURE** button to see the Measure menu.
 - b. Push the top menu box button to select **Source**.
 - c. Push the second menu box button to select **CH1**.
 - d. Push the third menu box button to select **CH2**.
2. Select the type of measurement displayed for each channel.
 - a. Push the top menu box button to select **Type**.
 - b. Push the **CH1** menu box button to select **Pk-Pk**.
 - c. Push the **CH2** menu box button to select **Pk-Pk**.
3. Read the peak-to-peak amplitudes for channel 1 and channel 2 in the menu display.
4. Calculate the amplifier gain using the following equations:

$$\text{Gain} = \frac{\text{output amplitude}}{\text{input amplitude}}$$

$$\text{Gain (dB)} = 20 \times \log(\text{Gain})$$

Taking Cursor Measurements

You can use the cursors to quickly take time and voltage measurements on a waveform.

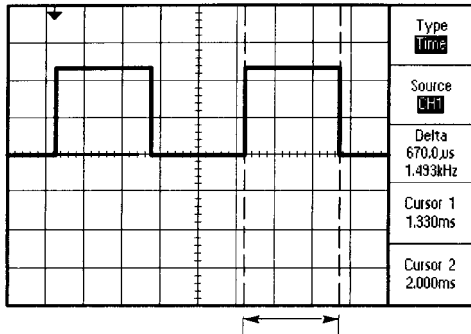
Measuring Pulse Width

You are analyzing a pulse waveform, and you want to know the width of the pulse. To measure the width of a pulse using the time cursors, do these steps:

1. Push the **CURSOR** button to see the Cursor menu.
2. Push the top menu box button to select **Time**.
3. Push the **Source** menu box button to select **CH 1**.
4. Use the **CURSOR 1** knob to place a cursor on the rising edge of the pulse.
5. Use the **CURSOR 2** knob to place the remaining cursor on the falling edge of the pulse.

You can see the following measurements in the Cursor menu:

- The time at Cursor 1, relative to the trigger.
- The time at Cursor 2, relative to the trigger.
- The delta time, which is the pulse width measurement.



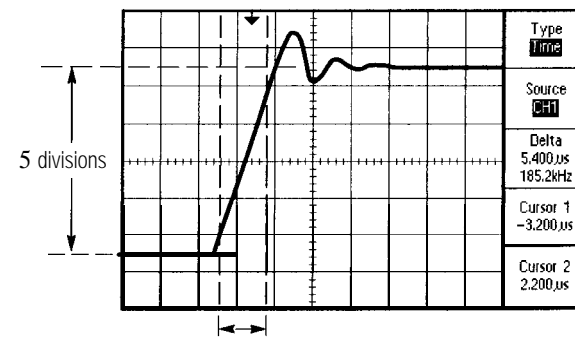
NOTE. The TDS2MM extension module provides pulse width as an automatic measurement.

Measuring Rise Time

After measuring the pulse width, you decide that you need to check the rise time of the pulse. Typically, you measure rise time between the 10% and 90% portion of the waveform. To measure the rise time, do these steps:

1. Adjust the **SEC/DIV** knob to display the rising edge of the waveform.
2. Adjust the **VOLTS/DIV** knob to set the waveform amplitude to about five divisions.
3. Push the **CH 1 MENU** button to see the **CH1** menu if it is not displayed.
4. Push the **Volts/Div** button to select **Fine**.

5. Adjust the **VOLTS/DIV** knob to set the waveform amplitude to exactly five divisions.
6. Use the **VERTICAL POSITION** knob to center the waveform; position the baseline of the waveform 2.5 divisions below the center graticule.
7. Push the **CURSOR** button to see the Cursor menu.
8. Push the top menu box button to set the type to **Time**.
9. Use the **CURSOR 1** knob to place the cursor at the point where the waveform crosses the second graticule line below center screen. This is the 10% point on the waveform.
10. Use the **CURSOR 2** knob to place the second cursor at the point where the waveform crosses the second graticule line above center screen. This is the 90% point on the waveform.
11. The delta readout in the cursor menu is the rise time of the waveform.



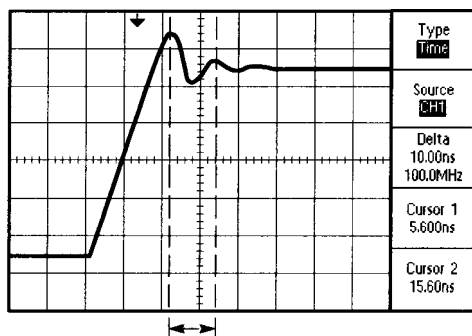
NOTE. The TDS2MM extension module provides rise time as an automatic measurement.

Measuring Ring Frequency

To measure the ring frequency at the rising edge of a signal, do these steps:

1. Push the **CURSOR** button to see the Cursor menu.
2. Push the top menu box button to select **Time**.
3. Use the **CURSOR 1** knob to place a cursor on the first peak of the ring.
4. Use the **CURSOR 2** knob to place a cursor on the second peak of the ring.

You can see the delta time and frequency (the measured ring frequency) in the Cursor menu.



Measuring Ring Amplitude

You measured the ring frequency in the previous example. Now you want to measure the amplitude of the ringing. To measure the amplitude, do these steps.

1. Push the **CURSOR** button to see the Cursor menu.
2. Push the top menu box button to select **Voltage**.
3. Use the **CURSOR 1** knob to place a cursor on the highest peak of the ring.
4. Use the **CURSOR 2** knob to place a cursor on the lowest point of the ring.

You can see the following measurements in the cursor menu:

- The delta voltage (peak-to-peak voltage of the ringing)
- The voltage at Cursor 1
- The voltage at Cursor 2

