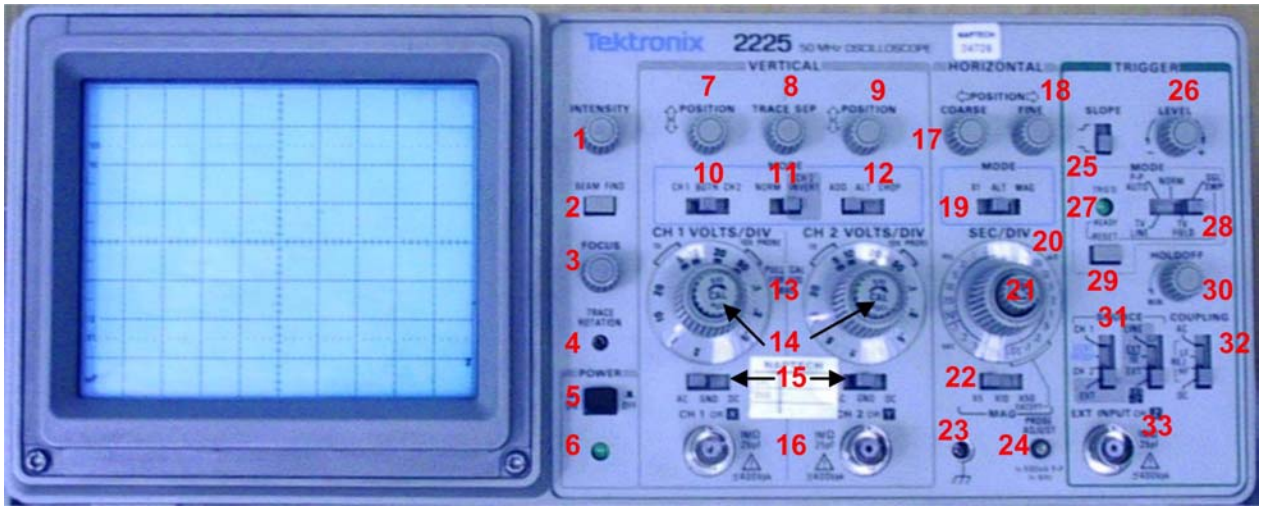
Tektronix 2225 Oscilloscope



1. Summary of Controls, Connectors, and Indicators

No.	Title	Function	Recommended Use
1	INTENSITY	Adjusts trace brightness.	Compensate for ambient lighting, trace speed, trigger frequency.
2	BEAM FIND	Compresses display to within CRT limits.	Locate off-screen phenomena.
3	FOCUS	Adjusts for finest trace thickness.	Optimize display definition.
4	TRACE ROTATION	Adjusts trace parallel to centerline.	Compensate for earth's field.
5	POWER	Turns power on and off.	Control power to the instrument.
6	Power Indicator	Illuminates when power is turned on.	Know power condition.
7,9	POSITION	Moves trace up or down screen.	Position trace vertically and compensate for dc component of signal.
8	TRACE SEP	Moves the magnified trace vertically with respect to the unmagnified trace when HORIZONTAL MODE is set to ALT.	Position unmagnified and horizontally magnified traces for convenient viewing and measurement.
10	CH 1-BOTH - CH2	Selects signal inputs for display.	View either channel independently or both channels simultaneously
11	NORM- INVERT	Inverts the Channel 2 signal display.	Provide for differential (CH 1 - CH 2) or summed (CH 1 + CH 2) signals when ADD is selected.

No.	Title	Function		Recommended Use	
12	ADD-ALT- CHOP	ADD shows algebraic sum of CH 1 and CH 2 signals. ALT displays each channel alternately. CHOP switches between CH 1 and CH 2 signals during the sweep at 500 kHz rate.		Display summed or individual signals.	
13	VOLTS/DIV	Selects vertical sensitivity.		Adjust vertical signal to suitable size.	
14	Variable (CAL)	Provides continuously variable deflection factors between calibrated positions of the VOLTS/DIV switch. Reduces gain by at least 25:1.	The CAL control can be pulled out to vertically magnify the trace by a factor of 1 0. Limits bandwidth to 5 MHz.	Match signals for common mode readings. Adjust height of pulse for rise-time calculations.	Inspecting small signals.
15	AC-GND-DC	In AC, isolates dc component of signal. In GND, gives reference point and allows precharging of input coupling capacitor. In DC, couples all components of signal.		Selects method of coupling input signals to the vertical deflection system.	
16	CH 1 OR X CH 2 ORY	Provides for input signal connections. CH 1 gives horizontal deflection when SEC/DIV is in X-Y.		Apply signals to the vertical deflection system.	
17	POSITION COARSE	COARSE is convenient for moving unmagnified traces		Control trace horizontal	positioning in direction.
18	POSITION FINE	FINE is convenient for moving magnified traces when either ALT or MAG is selected.		Control trace horizontal	positioning in direction.
19	X1 -ALT- MAG	X1 displays only normal (horizontally unmagnified) waveform. ALT displays normal and magnified waveforms alternately. MAG displays only the magnified waveform.		Select normal, comparative or expanded waveforms.	
20	SEC/DIV	Selects time-base speed.		Set horizontal speed most suited to requirements.	
21	Variable (CAL)	Provides continuously variable uncalibrated sweep speeds to at least 2.5 times the calibrated setting.		Extend the slowest speed to at least 1 .25 s/div	
22	MAG(X5-X10-X50)	Selects degree of horizontal magnification.		Examine small phenomena in detail.	
23		Provides safety connection to	earth and direct signal source.	Chassis ground connection.	
24	PROBE ADJUST	Provides approximately 0.5-V,1-kHz square wave.		Match probe capacitance to individual circuit. This source may be used to check the basic functioning of vertical and horizontal circuits but is not intended to check their accuracy.	

No.	Title	Function	Recommended Use
25	SLOPE	Selects the slope of the signal that triggers the sweep.	Provide ability to trigger from positive-going or negative-going signals.
26	LEVEL	Selects trigger-signal amplitude point.	Select actual point of trigger.
27	TRIG'D	Indicator lights when sweep is triggered in P-P AUTO, NORM, or TV FIELD.	Indicate trigger state.
29	RESET	Arms trigger circuit for SQL SWP.	
30	HOLDOFF	Varies sweep holdoff time 1 0:1 .	Improve ability to trigger from aperiodic signals.
31	SOURCE	CH 1,CH2, and EXT trigger signals are selected directly. In VERT MODE, trigger source is determined by the VERTICAL MODE switches as follows: CH 1 : trigger comes from Channel 1 signal. CH 2: trigger comes from Channel 2 signal. BOTH -ADD and BOTH CHOP: trigger is algebraic sum of Channel 1 and Channel 2 signals. BOTH-ALT: trigger comes from Channel 1 and Channel 2 on alternate sweeps.	Select source of signal that is coupled to the trigger circuit.
32	COUPLING	AC blocks dc components and attenuates signals below 15 Hz. LF REJ blocks dc components and attenuates signals below about 30 kHz. HF REJ blocks dc components and attenuates signals above about 30 kHz. DC couples all signal components.	Select how the triggering signal is coupled to the trigger circuit.
33	EXT INPUT	Connection for applying external signal that can be used as a trigger, Connection for applying external signal that can be used for intensity modulation.	Trigger from a source other than vertical signal. Also used for single-shot application. Provide reference blips by intensity modulation from independent source.

2. Learning the Controls

After turning the power on, let the oscilloscope warm up for a few minutes before starting this procedure.

- Set instrument controls as follows:

Display

INTENSITY	Midrange
FOCUS	Midrange

Vertical (both channels)	
POSITION	Midrange
MODE	CH 1
VOLTS/DIV	0.5 V (1 OX PROBE)
VOLTS/DIV Variable	CAL detent (fully clockwise)
Input Coupling	AC
Horizontal	
COARSE POSITION	Midrange
MODE	**X1**
SEC/DIV	0.2 ms
SEC/DIV Variable	CAL detent (fully clockwise)
Trigger	
SLOPE	/
LEVEL	Midrange
MODE	P-PAUTO
HOLDOFF	MIN
SOURCE	CH 1
COUPLING	AC

Connect a probe to the input BNC connector for Channel 1 (labeled CH 1 OR X). Attach the probe ground lead to the collar of the EXT INPUT connector and apply the probe tip to the PROBE ADJUST terminal. If necessary, adjust the TRIGGER LEVEL control to get a stable display.

Change the Channel 1 input coupling switch to GND and use the Channel 1 POSITION control to align the baseline trace to the center horizontal graticule line. This sets the zero reference for the display.

Switch input coupling back to AC. Notice that the square wave is centered vertically on the screen. Now switch input coupling to DC and observe what happens to the waveform. The zero reference is maintained at the center horizontal graticule line.

NOTE: More information about using the controls is contained at the end of this procedure. Refer to it as often as needed while learning the front-panel controls.

Use the following controls and notice the effect each has on the displayed waveform as the settings are changed.

Each POSITION control
CH 1 VOLTS/DIV
CH 1 VOLTS/DIV Variable (CAL)
SEC/DIV
SEC/DIV Variable (CAL)
HORIZONTAL MODE
HORIZONTAL MAG
TRACE SEP
TRIGGER SLOPE

At this point, connect the second probe to the CH 2 OR Y input connector. Set the VERTICAL MODE switch to CH 2 and TRIGGER SOURCE to CH 2, then follow steps 2 through 5 again, using the channel 2 controls.

Now set the VERTICAL MODE switches to BOTH-NORM-ALT and return both VOLTS/DIV switches to 0.5 V (10X PROBE). Rotate all variable controls clockwise to their CAL detents. Set the TRIGGER SOURCE switch to VERT MODE. Then use the VERTICAL POSITION and TRACE SEP controls to position the four traces to convenient locations on the screen.

While watching the Channel 2 waveforms, set the middle VERTICAL MODE switch to CH 2 INVERT and notice the effect. Then set the right MODE switch to ADD. What happens to the waveforms? Finally, return the middle MODE switch to NORM. What waveform is displayed now?

Congratulations! You now know how to use the 2225 front-panel controls to display signals and move them about on the screen. The remainder of this section gives you more information about the controls and offers suggestions for their use.

3. Display Controls

Set the INTENSITY control for comfortable viewing, but no brighter than you need. Use high-intensity settings to observe low-repetition-rate signals, narrow pulses in long time intervals, or occasional variations in fast signals.

4. Vertical Controls

When making voltage measurements, rotate the VOLTS/DIV CAL control fully clockwise (in detent). Best accuracy can be achieved by setting the VOLTS/DIV control for the largest display possible.

A. Input Coupling

For most applications use DC input coupling. This mode is compatible with the standard-accessory, high-impedance probes and it displays logic levels and dc levels of static signals.

Use GND input coupling to show where the 0-volt level will be located when you shift to DC or AC coupling.

Use AC coupling for the special cases where you need to see small signals on large dc voltage levels.

B. Channel Selection

With the three VERTICAL MODE buttons, you can display combinations of the two vertical channels. When CH 1 is selected, the other two MODE switches are not active. When CH 2 is selected, the middle MODE switch (NORM/CH 2 INVERT) becomes active. And when BOTH channels are selected for display, all three MODE switches are active.

C. ADD and INVERT

Select ADD mode to display the algebraic sum of the CH 1 and CH 2 signals. When you use ADD, the CH 1 and CH 2 VOLTS/DIV settings should be equal.

Selecting CH 2 INVERT changes the sense of the CH 2 waveform. This allows you to see the difference between the CH 1 and CH 2 signals on the ADD trace.

D. CHOP or ALT?

When BOTH channels are selected, the display is time-shared. The CHOP mode displays each channel for a short time and multiplexes during the sweep to give the appearance of displaying both channels at once. This mode (CHOP) works better than ALT for sweep speeds slower than 1 ms per division and for low-repetition-rate signals that make the display flicker (up to 2 s/division).

The ALT mode displays each channel for the duration of a complete sweep. It gives a cleaner display of multiple channels than CHOP does and is usually preferred at moderate to high sweep speeds.

E. Increasing the Sensitivity

Pulling the VOLTS/DIV CAL control out (towards you) magnifies the vertical axis by a factor of 10, increasing the sensitivity to 500 (iV per division. This function is useful for investigating small-amplitude signals (in general, less than 5 mV p-p) or small amplitude details on larger signals.

5. Horizontal Controls

A. Sweep-Speed Selection

The unmagnified sweep (MODE set to X1) is the horizontal function needed for most applications. Best measurement accuracy is achieved by setting the SEC/DIV control for the fastest sweep that will display the interval of interest. The variable control (CAL) should be in its detent (fully clockwise).

B. Magnifying Waveform Details

Each of the two magnified modes—ALT or MAG—expands the unmagnified trace. When ALT is chosen, both the unmagnified and the magnified waveforms appear together on the crt screen. Vertical separation between them is adjusted with the TRACE SEP control. If MAG is selected, only the magnified trace is displayed on screen. This is useful for eliminating unwanted clutter from the crt when you are making accurate timing measurements or looking at waveform details. Whenever ALT or MAG is set on the upper HORIZONTAL MODE switch, the amount of waveform expansion is determined by the setting of the HORIZONTAL MAG switch located beneath the SEC/DIV control. Three magnifications are available—5X, 10X, and SOX. Having the ability to select various combinations of waveform expansion and SEC/DIV control setting lets you extend the time-base range out to a maximum of 5 ns per division.

The marker that links the timing of the unmagnified and magnified traces with each other is the center vertical graticule line. The intersections of that line with the unmagnified and the magnified waveforms are the points of equal time duration from sweep start. With the center vertical graticule as the reference line, the investigation of waveform details around any point on the unmagnified trace, as well as the measurement of time with greater accuracy, then become easy tasks.

6. Trigger Controls

For most signals, the trigger-control settings that will yield hands off triggering are:

MODE	P-P AUTO
HOLDOFF	MIN
SOURCE	VERT MODE
COUPLING	DC

A. Which Mode to Use

P-P AUTO/TV LINE—With this mode set, the range of the LEVEL control is confined to the values between the triggering-signal peaks. For example, selecting P-P AUTO and rotating the LEVEL control to the center half of its range establishes a trigger point that is about midway between the peaks of the triggering signal.

In this mode, the absence of a triggering signal causes the sweep to free-run. And with signals below 20 Hz, the P-P AUTO circuit may not find the correct level.

Whenever P-P AUTO is active and VERT MODE source selected, the triggering signal is supplied by the channel that is being displayed—or by Channel 1 in a two-channel display.

The P-P AUTO mode is effective for monitoring logic signals and television lines having at least a 20-Hz repetition rate. Selecting P-P AUTO at the instrument front panel also sets the TV LINE triggering mode.

NORM—This mode produces a sweep only when the triggering signal meets the criteria set by the LEVEL and SLOPE controls. With NORM mode selected, range of the LEVEL control is sufficient to set any voltage threshold that can be displayed by the instrument. In the absence of a triggering signal, there is no sweep.

Use the NORM mode for viewing infrequent events and erratic signals.

SQL SWP—When this mode is selected, the sweep is triggered only once. Press the RESET button once to arm the trigger circuit and illuminate the READY indicator. When a trigger event occurs, the sweep runs once and the READY light extinguishes.

Use the SQL SWP mode to display or photograph non-repetitive or unstable signals.

TV FIELD—This mode triggers the sweep at the beginning of a television field. To change the TV field being displayed, you must interrupt the trigger signal by setting the input coupling switch momentarily to GND then back to either DC or AC until the desired field is displayed.
To display Field 1 and Field 2 at the same time, connect the same television signal to both the CH 1 and CH 2 inputs; set VERTICAL MODE to BOTH and ALT; set the SEC/DIV control to 0.5 ms or faster sweep speed.

If you magnify the vertical display beyond the graticule, the trigger may be degraded. To avoid trigger overload, use either CH 1 or CH 2 for display and use the EXT INPUT channel with an appropriate video signal as the trigger source. A composite sync signal can be used for the trigger source as well as composite video.

B. Source

Choose a single trigger source to correctly display the timing relationships between two channels. Choose the channel with the lowest-frequency signal to avoid ambiguous displays.

With VERT MODE TRIGGER SOURCE and either P-P AUTO TRIGGER MODE or CHOP VERTICAL MODE, the triggering signal is the algebraic sum of the Channel 1 and Channel 2 input signals.

Use a composite trigger source only to compare asynchronous signals. To generate a composite trigger: select VERT MODE TRIGGER SOURCE, BOTH-ALT VERTICAL MODE, and any TRIGGER MODE except P-P AUTO.

C. Coupling

For signals with strongly interfering components, HF Reject and LF Reject coupling give added selectivity. When AC coupling is selected, triggering continues as the dc level of the signal changes.

D. Slope

Use the SLOPE control to select either the rising (/) or the falling *(\)* edge of the signal to trigger the sweep.

E. Level

The LEVEL control gives you complete freedom to choose the most appropriate threshold voltage on a signal to initiate sweeps whenever any trigger mode except P-P AUTO is selected.

F. Holdoff

With irregular signals such as bursts, the HOLDOFF setting can improve display stability. Also, if the signal has a fixed pattern of variation from cycle to cycle, some modes of the signal may be omitted from the display. Changing the HOLDOFF setting can force the instrument to display all the modes of the signal. Normally, the HOLDOFF control should be set at MIN.

7. Calibration Summary

Calibrate the voltage (vertical) and time (horizontal) scales of the scope as follows:

1) Connect a wire from the PROBE ADJUST to CH1 or CH2.

2) Adjust the trace using the position controls until the square wave is located at aconvenient position on the screen.

3) Measure the height of the square wave in volts. You should find that it is 0.5 Voltspeak-to-peak so that the 0.1 V/div scale is appropriate. Make certain that the Variable
(CAL) knob is in its calibrated (detent) position. If the square wave does not measure 0.5 V ask your TA for help.

4) Measure the period of the square wave in seconds. Use a time scale setting that displays several cycles of the square wave. In order to obtain the best accuracy, measure the time for several cycles and divide by the number of cycles. Again make certain that the Variable (Cal) knob for the horizontal sweep (SEC/DIV) is in the calibrated (detent) position. The period should be 10^{-3} seconds.