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HORIZONTAL

Refer to Figure 5 for location of items 17 through 23.

(17) **B DELAY TIME POSITION Control**—Selects the amount of delay time between the start of the A Sweep and the start of the B Sweep. Delay time is variable from 0.5 times to 10 times the A SEC/DIV switch setting.

(18) **A and B SEC/DIV Switches**—Used to select the sweep speeds for the A and B Sweep generators in a 1-2-5 sequence. For calibrated sweep speeds, the A and B SEC/DIV Variable control must be in the calibrated detent (fully clockwise).

A SEC/DIV—The A Sweep speed is shown between the two black lines on the clear plastic skirt. This switch also selects the delay time for delayed-sweep operation (used in conjunction with the B DELAY TIME POSITION control).

B SEC/DIV—The B Sweep speed is set by pulling out the DLY'D SWEEP knob and rotating it clockwise to a setting shown by the white line scribed on the knob. The B Sweep circuit is used only for delayed-sweep operation.

(19) **A and B SEC/DIV Variable Control**—Provides continuously variable, uncalibrated A Sweep speeds to at least 2.5 times the calibrated setting. It extends the slowest sweep speed to at least 1.25 s per division.

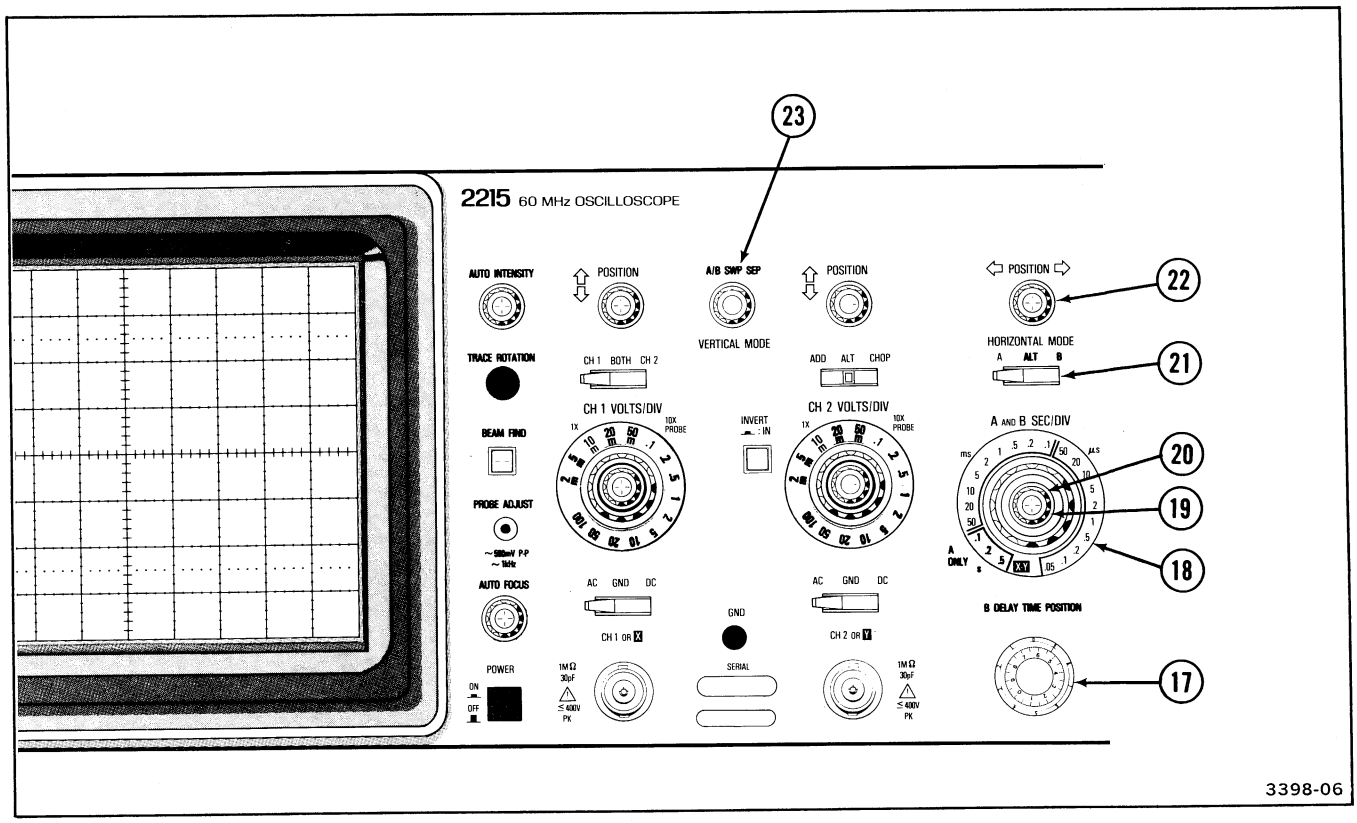


Figure 5. Horizontal controls.

(20) **X10 Magnifier Switch**—To increase displayed sweep speed by a factor of 10, pull out the A and B SEC/DIV Variable knob. The fastest sweep speed can be extended to 5 ns per division. Push in the A and B SEC/DIV Variable control knob to regain the X1 sweep speed.

(21) **HORIZONTAL MODE Switch**—This three-position switch determines the mode of operation for the horizontal deflection system.

A—Horizontal deflection is provided by the A Sweep generator at a sweep speed determined by the A SEC/DIV switch setting.

B—Horizontal deflection is provided by the B Sweep generator at a sweep speed determined by the setting of the B SEC/DIV switch. The start of the B Sweep is delayed from the start of the A Sweep by a time determined by the settings of both the A SEC/DIV switch and the B DELAY TIME POSITION control.

ALT—Alternates the horizontal displays between the A Sweep (with an intensified zone) and the B Delayed Sweep. The A Sweep speed is determined by the setting of the A SEC/DIV switch. The length of the intensified zone on the A Sweep (the B Sweep speed) is determined by the setting of the B SEC/DIV switch.

(22) **POSITION Control**—Positions the display horizontally for the A Sweep and the B Sweep. In the X-Y mode, horizontally positions the X-axis.

(23) **A/B SWP SEP Control**—Vertically positions the B Sweep trace with respect to the A Sweep trace when ALT HORIZONTAL MODE is selected.

TRIGGER

Refer to Figure 6 for locations of items 24 through 33.

(24) **EXT INPUT Connector**—Provides a means of introducing external signals into the A Trigger generator.

(25) **A EXT COUPLING Switch**—Determines the method used to couple external signals to the A Trigger circuit.

AC—Signals above 60 Hz are capacitively coupled to the input of the A Trigger circuit. Any dc components are blocked, and signals below 60 Hz are attenuated.

DC—All components of the signal are coupled to the A Trigger circuitry. This position is useful for displaying low-frequency or low-repetition-rate signals.

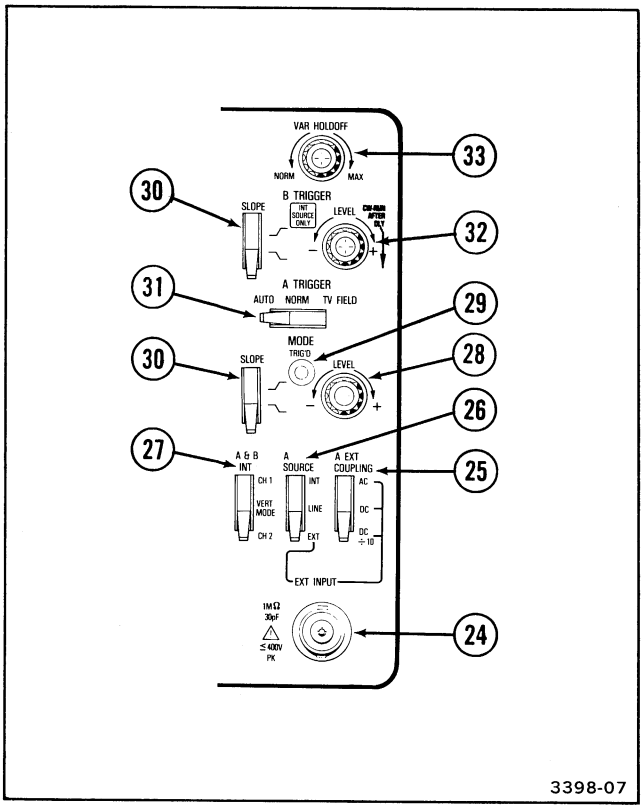


Figure 6. Trigger controls, connector, and indicator.

@

DC÷10—External trigger signals are attenuated by a factor of 10.

(26) **A SOURCE Switch**—Determines the source of the trigger signal that is coupled to the input of the A Trigger circuit.

INT—Permits triggering on signals that are applied to the CH 1 OR X and CH 2 OR Y input connectors. The source of the internal signal is selected by the A & B INT switch.

LINE—Provides a triggering signal from a sample of the ac-power-source waveform. This trigger source is useful when channel-input signals are time related (multiple or submultiple) to the frequency on the power-source-input voltage.

EXT—Permits triggering on signals applied to the EXT INPUT connector.

(27) **A & B INT Switch**—Selects the source of the triggering signal when the A SOURCE switch is set to INT.

CH 1—The signal applied to the CH 1 OR X input connector is the source of the trigger signal.

VERT MODE—The internal trigger source is determined by the signals selected for display by the VERTICAL MODE switches.

CH 2—The signal applied to the CH 2 OR Y input connector is the source of the trigger signal.

(28) **A TRIGGER LEVEL Control**—Selects the amplitude point on the trigger signal at which the sweep is triggered.

(29) **TRIG'D Indicator**—The light-emitting diode (LED) illuminates to indicate that the A Sweep is triggered.

(30) **SLOPE Switches**—Used to select the slope of the signal that triggers the sweep.

⎍—Sweep is triggered on the positive-going portion of the trigger signal.

⎏—Sweep is triggered on the negative-going portion of the trigger signal.

(31) **A TRIGGER MODE Switch**—Determines the trigger mode for the A Sweep.

AUTO—Permits triggering on waveforms having repetition rates of at least 20 Hz. Sweep free-runs in the absence of an adquate trigger signal or when the repetition rate is below 20 Hz. The range of the A TRIGGER LEVEL control is automatically set to the peak-to-peak range of the trigger level.

NORM—Sweep is initiated when an adequate trigger signal is applied. In the absence of a trigger signal, no baseline trace will be present. Triggering on television lines is accomplished in this mode.

TV FIELD—Permits triggering on television field signals.

(32) **B TRIGGER LEVEL Control**—Selects the amplitude point on the trigger signal at which the sweep is triggered. When fully clockwise (CW-RUN AFTER DLY), the B Sweep circuit runs immediately following the delay time selected by the A SEC/DIV switch and the B DELAY TIME POSITION control.

(33) **VAR HOLDOFF Control**—Provides continuous control of holdoff time between sweeps. Increases the holdoff time by at least a factor of four. This control improves the ability to trigger on aperiodic signals (such as complex digital waveforms).

REAR PANEL

Refer to Figure 7 for location of item 34.

(34) **EXT Z AXIS Connector**—Provides a means of connecting external signals to the Z-axis amplifier to intensity modulate the crt display. Applied signals do not affect display waveshape. Signals with fast rise times and fall times provide the most abrupt intensity change, and a 5-V p-p signal will produce noticeable modulation. The Z-axis signals must be time-related to the display to obtain a stable presentation on the crt.

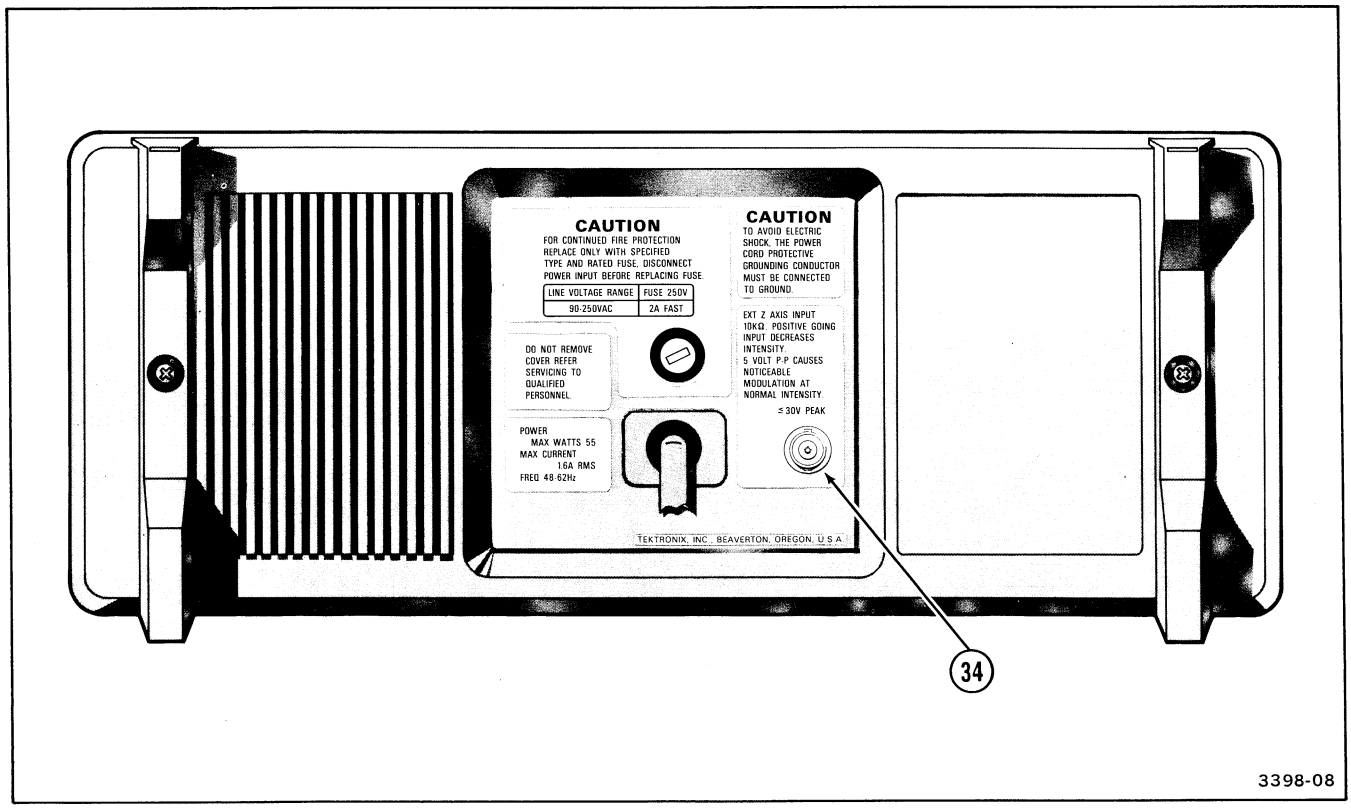


Figure 7. Rear-panel connector.

OPERATING CONSIDERATIONS

This section contains basic operating information and techniques that should be considered before attempting any measurements.

GRATICULE

The graticule is internally marked on the faceplate of the crt to enable accurate measurements without parallax error (see Figure 8). It is marked with eight vertical and ten horizontal major divisions. Each major division is divided into five subdivisions. The vertical deflection factors and horizontal timing are calibrated to the graticule so that accurate measurements can be made directly from the crt. Also, percentage markers for the measurement of rise and fall times are located on the left side of the graticule.

GROUNDING

The most reliable signal measurements are made when the 2215 and the unit under test are connected by a common reference (ground lead), in addition to the signal lead or probe. The probe's ground lead provides the best grounding method for signal interconnection and ensures the maximum amount of signal-lead shielding in the probe cable. A separate ground lead can also be connected from the unit under test to the oscilloscope GND connector located on the front panel.

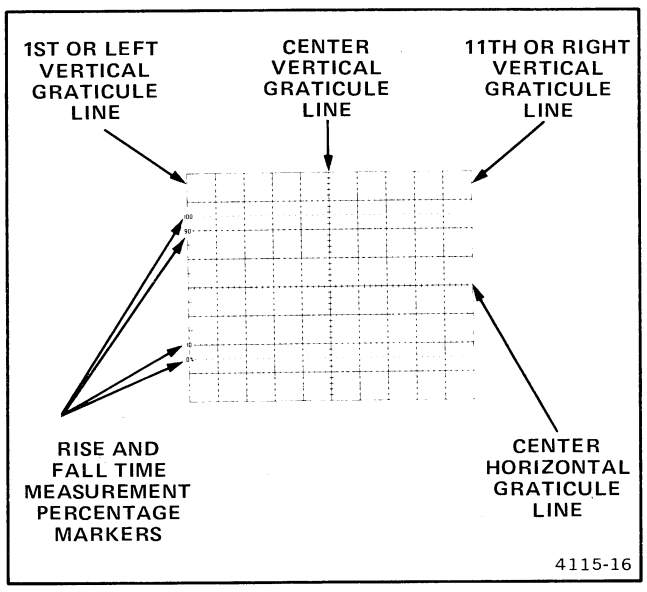


Figure 8. Graticule measurement markings.

SIGNAL CONNECTIONS

Generally, probes offer the most convenient means of connecting an input signal to the instrument. They are shielded to prevent pickup of electromagnetic interference, and the supplied 10X probe offers a high input impedance that minimizes circuit loading. This allows the circuit under test to operate with a minimum of change from its normal condition as measurements are being made.

Coaxial cables may also be used to connect signals to the input connectors, but they may have considerable effect on the accuracy of a displayed waveform. To maintain the original frequency characteristics of an applied signal, only high-quality, low-loss coaxial cables should be used. Coaxial cables should be terminated at both ends in their characteristic impedance. If this is not possible, use suitable impedance-matching devices.

INPUT COUPLING CAPACITOR PRECHARGING

When the input coupling switch is set to GND, the input signal is connected to ground through the input coupling capacitor in series with a 1-MΩ resistor to form a precharging network. This network allows the input coupling capacitor to charge to the average dc-voltage level of the signal applied to the probe. Thus, any large voltage transients that may accidentally be generated will not be applied to the amplifier input when the input coupling switch is moved from GND to AC. The precharging network also provides a measure of protection to the external circuitry by reducing the current levels that can be drawn from the external circuitry during capacitor charging.

The following procedure should be used whenever the probe tip is connected to a signal source having a different dc level than that previously applied, especially if the dc-level difference is more than 10 times the VOLTS/DIV switch setting:

1. Set the AC-GND-DC switch to GND before connecting the probe tip to a signal source.

2. Insert the probe tip into the oscilloscope GND connector.

3. Wait several seconds for the input coupling capacitor to discharge.

4. Connect the probe tip to the signal source.

5. Wait several seconds for the input coupling capacitor to charge.

6. Set the AC-GND-DC switch to AC. The display will remain on the screen, and the ac component of the signal can be measured in the normal manner.

INSTRUMENT COOLING

To maintain adequate instrument cooling, the ventilation holes on both sides and rear panel of the equipment cabinet must remain free of obstructions.

INSTRUMENT FAMILIARIZATION

INTRODUCTION

The procedures in this section are designed to assist you in quickly becoming familiar with the 2215. They provide information which demonstrates the use of all the controls, connectors, and indicators and will enable you to efficiently operate the instrument.

Before proceeding with these instructions, verify that the POWER switch is OFF (push button out), then plug the power cord into the ac-power-input-source outlet.

If during the performance of these procedures an improper indication or instrument malfunction is noted, first verify correct operation of associated equipment. Should the malfunction persist, refer the instrument to qualified service personnel for repair or adjustment.

The equipment listed in Table 1, or equivalent equipment, is required to complete these familiarization procedures.

Table 1

Equipment Required for Instrument Familiarization Procedure

Description	Minimum Specification
Calibration Generator	Standard-amplitude accuracy: ±0.25%. Signal amplitude: 2 mV to 50 V. Output signal: 1-kHz square wave. Fast-rise repetition rate: 1 to 100 kHz. Rise time: 1 ns or less. Signal amplitude: 100 mV to 1 V. Aberrations: ±2%.
Dual-Input Coupler	Connectors: bnc-female-to-dual-bnc-male.
Cable (2 required)	Impedance: 50 Ω. Length: 42 in. Connectors: bnc.
Adapter	Connectors: bnc-female-to-bnc female.
Termination	Impedance: 50 Ω. Connectors: bnc.

BASELINE TRACE

First obtain a baseline trace, using the following procedure.

1. Preset the instrument front-panel controls as follows:

Display

AUTO INTENSITY	Fully counterclockwise (minimum)
AUTO FOCUS	Midrange

Vertical (Both Channels)

AC-GND-DC	AC
VOLTS/DIV	50 m (1X)
VOLTS/DIV Variable	CAL detent (fully clockwise)
VERTICAL MODE	CH 1
INVERT	Off (button out)
POSITION	Midrange

Horizontal

A and B SEC/DIV	Locked together at 0.5 ms
A and B SEC/DIV Variable	Calibrated detent (fully clockwise)
HORIZONTAL MODE	A
X10 Magnifier	Off (variable knob in)
POSITION	Midrange
B DELAY TIME POSITION	Fully counterclockwise
A/B SWP SEP	Midrange

A Trigger

VAR HOLDOFF	NORM (fully counter-clockwise)
SLOPE	⎍ (lever up)
LEVEL	Midrange
MODE	AUTO
A EXT COUPLING	AC
A SOURCE	INT
A & B INT	VERT MODE

B Trigger

SLOPE	⎍ (lever up)
LEVEL	Fully clockwise

2. Press in the POWER switch button (ON) and allow the instrument to warm up for 20 minutes.

3. Adjust the AUTO INTENSITY control for desired display brightness.

4. Adjust the Vertical and Horizontal POSITION controls to center the trace on the screen.

NOTE

Normally, the resulting trace will be parallel with the center horizontal graticule line and should not require adjustment. If trace alignment is required, see the "Trace Rotation" adjustment procedure under "Operator's Adjustments."

DISPLAYING A SIGNAL

After obtaining a baseline trace, you are now ready to connect an input signal and display it on the crt screen.

1. Connect the calibration generator standard-amplitude output to both the CH 1 and CH 2 inputs as shown in Figure 9.

2. Set the calibration generator for a standard-amplitude 1-kHz square-wave signal and adjust its output to obtain a vertical display of 4 divisions.

3. Adjust the Channel 1 POSITION control to center the display vertically on the screen.

4. Adjust the A TRIGGER LEVEL control, if necessary, to obtain a stable triggered display.

NOTE

The TRIG'D indicator should illuminate to indicate that the A Sweep is triggered.

5. Rotate the AUTO FOCUS control between its maximum clockwise and counterclockwise positions. The display should become blurred on either side of the optimum control setting.

6. Set the AUTO FOCUS control for a sharp, well-defined display over the entire trace length.

7. Move the display off the screen using the Channel 1 POSITION control.

8. Press in and hold the BEAM FIND push button; the display should reappear on the screen. Adjust the Channel 1 and Horizontal POSITION controls to center the trace both vertically and horizontally. Release the BEAM FIND button; the display should remain within the viewing area.

9. Adjust the AUTO INTENSITY control counterclockwise until the display disappears.

10. Press in and hold the BEAM FIND push button; the display should reappear. Release the BEAM FIND button and adjust the AUTO INTENSITY control to desired display brightness.

Using the Vertical Section

1. Set the Channel 1 AC-GND-DC switch to GND.

2. Adjust the trace to the center horizontal graticule line.

3. Set the Channel 1 AC-GND-DC switch to DC.

4. Observe that the bottom of the display remains at the center horizontal graticule line (ground reference).

5. Set the Channel 1 AC-GND-DC switch to AC.

6. Observe that the display is centered approximately at the center horizontal line.

7. Set the CH 1 VOLTS/DIV switch to 0.1 (1X) and observe that a 2-division vertical display appears.

8. Rotate the CH 1 VOLTS/DIV Variable control fully counterclockwise.

9. Observe that minimum vertical deflection occurs when the VOLTS/DIV Variable contol is fully counterclockwise.

10. Rotate the CH 1 VOLTS/DIV Variable control fully clockwise to the CAL detent.

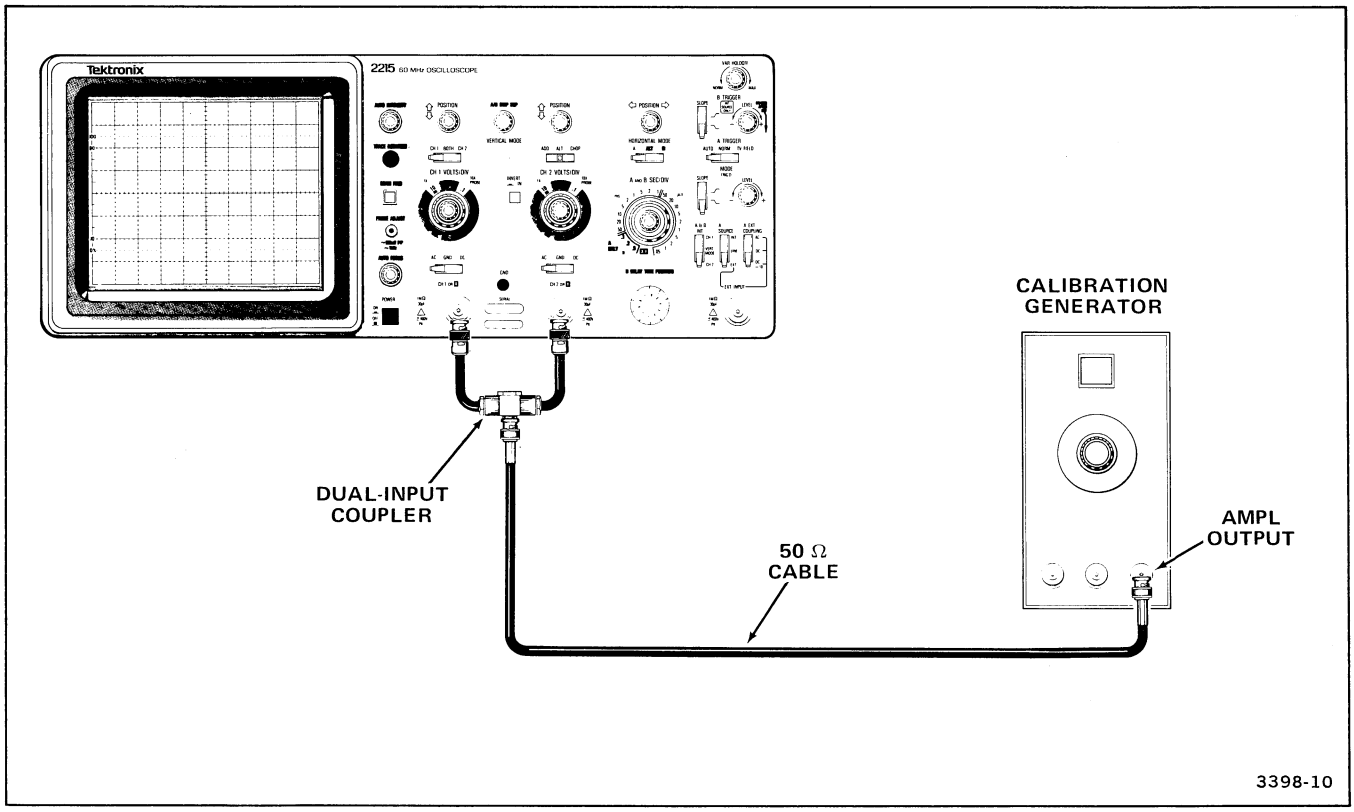


Figure 9. Initial setup for instrument familiarization procedure.

11. Select CH 2 VERTICAL MODE and again perform preceding steps 1 through 10 using Channel 2 controls. Performance should be similar to Channel 1.

12. Set both Channel 1 and Channel 2 AC-GND-DC switches to DC. Ensure that both CH 1 and CH 2 VOLTS/DIV switches are set to 0.1 (1X) for 2-division displays.

13. Select BOTH and ADD VERTICAL MODE and observe that the resulting display is 4 divisions in amplitude. Both Channel 1 and Channel 2 POSITION controls should move the display. Recenter the display on the screen.

14. Press in the Channel 2 INVERT push button to invert the Channel 2 signal.

15. Observe that the display is a straight line, indicating that the algebraic sum of the two signals is zero.

16. Set the CH 2 VOLTS/DIV switch to 50 m (1X).

17. Observe the 2-division display, indicating that the algebraic sum of the two signals is no longer zero.

18. Press in the Channel 2 INVERT push button again to release it. Observe a noninverting display having a 6-division signal amplitude.

19. Set both Channel 1 and Channel 2 AC-GND-DC switches to GND.

20. Set the CH 1 VOLTS/DIV switch to 50 m (1X).

21. Select ALT VERTICAL MODE. Position the Channel 1 trace two divisions above the center graticule line and position the Channel 2 trace two divisions below the center graticule line.

22. Rotate the A SEC/DIV switch throughout its range (except X-Y). The display will alternate between channels at all sweep speeds. This mode is most useful for sweep speeds from 0.05 μs to 0.2 ms per division.

23. Select CHOP VERTICAL MODE and rotate the A SEC/DIV switch throughout is range (except X-Y). A dual-trace display will be presented at all sweep speeds, but unlike the ALT mode, both Channel 1 and Channel 2 signals are displayed for each sweep speed on a time-shared basis. This mode is most useful for sweep speeds from 0.5 ms to 0.5 s per division.

24. Select CH 1 VERTICAL MODE and set Channel 1 AC-GND-DC switch to DC. Recenter the display on the screen.

Using the Horizontal Section

1. Return the A SEC/DIV switch to 0.5 ms and note the display for future comparison in step 3.

2. Set the A SEC/DIV switch to 5 ms and pull the A and B SEC/DIV Variable control knob out to obtain X10 sweep magnification.

3. Observe that the display is similar to that obtained in step 1.

4. Rotate the Horizontal POSITION control throughout its range. Observe that the display can be positioned to either side of the center vertical graticule line.

5. Push in the A and B SEC/DIV Variable control knob to obtain a X1 sweep.

6. Return the A and B SEC/DIV switches to 0.5 ms.

7. Rotate the VAR HOLDOFF control to its maximum clockwise position.

8. Observe that the crt trace starts to flicker as the holdoff between sweeps is increased.

9. Return the VAR HOLDOFF control to its NORM position (fully counterclockwise). Note the display for future comparison in step 11.

10. Rotate the A and B SEC/DIV Variable control out of the CAL detent to its maximum counterclockwise position.

11. Observe that the sweep speed is approximately 2.5 times slower than in step 9, as indicated by more cycles displayed on the screen.

12. Return the A and B SEC/DIV Variable control to the CAL detent (fully clockwise).

Using the A Trigger Section

1. Rotate the A TRIGGER LEVEL control between its maximum clockwise and counterclockwise positions. The display will remain triggered over the full range of the A TRIGGER LEVEL control.

2. Return the A TRIGGER LEVEL control to the mid-range position.

3. Set the A TRIGGER SLOPE switch to ⎺_ (lever down). Observe that the display starts on the negative-going slope of the applied signal.

4. Return the A TRIGGER SLOPE switch to _/⎺ (lever up). Observe that the display starts on the positive-going slope of the applied signal.

5. Set the A & B INT switch to CH 1, the VERTICAL MODE switch to CH 2, and the Channel 1 AC-GND-DC switch to GND. Observe that the display free-runs.

6. Return the Channel 1 AC-GND-DC switch to AC.

7. Set the A & B INT switch to CH 2, the VERTICAL MODE switch to CH 1, and the Channel 2 AC-GND-DC switch to GND. Observe that the display free-runs.

8. Return the Channel 2 AC-GND-DC switch to AC and set the A & B INT switch to VERT MODE.

9. Set the A TRIGGER MODE switch to NORM.

10. Rotate the A TRIGGER LEVEL control between its maximum clockwise and counterclockwise positions. Observe that the TRIG'D light illuminates only when the display is correctly triggered.

11. Set the A TRIGGER SOURCE switch to EXT. Move the calibration signal from the CH 2 OR Y input connector to the EXT INPUT connector.

12. Set the CH 1 VOLTS/DIV switch to 0.5 (1X) and adjust the output of the calibration generator to provide a 4-division display. Adjust the A TRIGGER LEVEL control for a stable display and note the range over which a stable display can be obtained (for comparison in step 14).

13. Set the A TRIGGER SOURCE switch to EXT÷10.

14. Observe that adjustment of the A TRIGGER LEVEL control provides a triggered display over a narrower range than in preceding step 12, indicating trigger-signal attenuation.

15. Set the A TRIGGER MODE switch to AUTO.

16. Move the calibration signal from the EXT INPUT connector to the CH 2 OR Y input connector. Set the A SOURCE switch to INT and adjust the A TRIGGER LEVEL control to the midrange position.

Using the Delayed-Sweep Controls

1. Set the B SEC/DIV switch to 50 μs.

2. Select ALT HORIZONTAL MODE. Ensure that the B TRIGGER LEVEL control is fully clockwise (CW-RUN AFTER DLY) and that the B DELAY TIME POSITION control is fully counterclockwise.

3. Adjust the Channel 1 POSITION and the A/B SWP SEP controls as required to display the A Sweep (with the intensified zone) above the B Delayed Sweep. The displays alternate between the A Sweep (upper) and the B Delayed Sweep (lower). Adjust the AUTO INTENSITY control as necessary to view the two displays.

4. Observe that the intensified zone is approximately 1 division in length at the start of the A Sweep and that the B Delayed Sweep displays the intensified portion of the A Sweep.

5. Rotate the B DELAY TIME POSITION control; both the intensified zone of the A Sweep and the B Delayed Sweep display will move continuously across the screen.

6. Select the B HORIZONTAL MODE and observe that only the B Delayed Sweep is now displayed on the crt screen.

7. Observe that the display moves continuously across the screen as you rotate the B DELAY TIME POSITION control. Return the B DELAY TIME POSITION control to the fully counterclockwise position.

8. Select the B HORIZONTAL MODE and set the B SEC/DIV switch to 0.5 ms.

Using the B Trigger Section

1. Rotate the B TRIGGER LEVEL control counterclockwise to the midrange position and adjust it for a stable display.

2. Observe that both the intensified zone and the B Delayed Sweep display disappear and reappear as the B TRIGGER LEVEL control approaches midrange. Adjust the B TRIGGER LEVEL control for a stable display at the midrange position.

3. Rotate the B DELAY TIME POSITION control throughout its range. Observe that the intensified zone of the A Sweep appears to jump between the positive slopes of the display.

4. Set the B TRIGGER SLOPE switch to ⎽╲ (lever down) and observe that the intensified portion begins on the negative slope.

5. Observe that the B Delayed Sweep length decreases when the B DELAY TIME POSITION control is rotated clockwise and increases when the control is rotated counterclockwise.

6. Select the A HORIZONTAL MODE.

Using the X-Y Mode

1. Set both the CH 1 and CH 2 VOLTS/DIV switches to 1 (1X) and adjust the generator output to provide a 5-division display.

2. Select X-Y mode by switching the A SEC/DIV switch to its fully counterclockwise position.

3. Adjust the AUTO INTENSITY control for desired display brightness. Observe that two dots are displayed diagonally. This display can then be positioned horizontally with the Horizontal POSITION control and vertically with the Channel 2 POSITION control. Note that the dots are separated by 5 horizontal divisions and 5 vertical divisions.

4. Set both the CH 1 and CH 2 VOLTS/DIV switches to 2 (1X). Note that the dots are now separated by 2.5 horizontal divisions and 2.5 vertical divisions.

5. Return the A SEC/DIV switch to 0.5 ms and adjust the AUTO INTENSITY control for desired display brightness.

Using the Z-Axis Input

1. Disconnect the dual-input coupler from the CH 2 input connector and connect a bnc-female-to-bnc-female adapter to the disconnected end of the coupler.

2. Connect a 42-inch, 50-Ω bnc cable from the Z-AXIS INPUT connector (located on the rear panel) to the dual-input coupler via the bnc-female-to-bnc-female adapter.

3. Set the Channel 1 VOLTS/DIV switch to 1 (1X) and adjust the output of the calibration generator to provide a 5-division display.

4. Observe that the positive peaks of the waveform are blanked, indicating intensity modulation (adjust AUTO INTENSITY control as necessary).

5. Disconnect the 50-Ω cable from the Z-AXIS INPUT connector and disconnect the dual-input coupler from the CH 1 input connector.

OPERATOR'S ADJUSTMENTS

INTRODUCTION

Two adjustments should be performed before making measurements with your oscilloscope: Trace Rotation and Probe Compensation. Before proceeding with the following adjustment instructions, verify that the correct line fuse is installed (refer to the "Preparation for Use" information). Verify that the POWER switch is OFF (button out), then plug the power cord into the ac-power-input source. Push in the POWER switch (ON) and allow a 20-minute warm-up time before starting these adjustments.

TRACE ROTATION

1. Preset instrument controls and obtain a baseline trace (refer to "Instrument Familiarization").

2. Use the Channel 1 POSITION control to move the baseline trace to the center horizontal graticule line.

NOTE

Normally, the resulting trace will be parallel to the center horizontal graticule line, and the Trace Rotation adjustment should not be required.

3. If the resulting trace is not parallel to the center horizontal graticule line, use a small flat-bit screwdriver to adjust the TRACE ROTATION control and align the trace with the center horizontal graticule line.

PROBE COMPENSATION

Misadjustment of probe compensation is one of the sources of measurement error. Most attenuator probes are equipped with a compensation adjustment. To ensure optimum measurement accuracy, always compensate the oscilloscope probes before making measurements. Probe compensation is accomplished as follows:

1. Preset instrument controls and obtain a baseline trace (refer to "Instrument Familiarization").

2. Connect the two 10X probes (supplied with the instrument) to the CH 1 and CH 2 input connectors.

3. Set both VOLTS/DIV switches to 0.1 (10X PROBE) and set both AC-GND-DC switches to DC.

4. Select CH 1 VERTICAL MODE and insert the tip of the Channel 1 probe into the PROBE ADJUST output jack.

5. Using the approximately 1-kHz PROBE ADJUST square-wave signal as the input, obtain a display of the signal (refer to "Instrument Familiarization").

6. Set the A SEC/DIV switch to display several cycles of the PROBE ADJUST signal. Use the Channel 1 POSITION control to vertically center the display.

7. Check the waveform presentation for overshoot and rolloff (see Figure 10). If necessary, adjust the probe compensation for flat tops on the waveforms. Refer to the instructions supplied with the probe for details of compensation adjustment.

8. Select CH 2 VERTICAL MODE and connect the Channel 2 probe tip to the PROBE ADJUST output jack.

9. Use the Channel 2 POSITION control to vertically center the display and repeat step 7 for the Channel 2 probe.

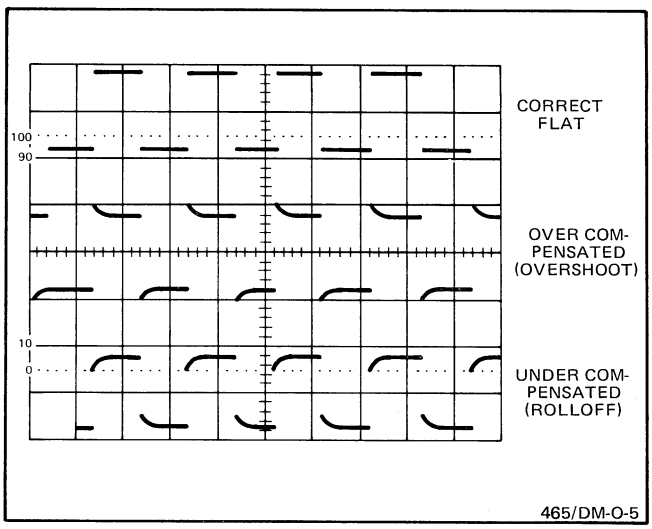


Figure 10. Probe compensation.

BASIC APPLICATIONS

NONDELAYED MEASUREMENTS

After becoming familiar with all the capabilities of the 2215 Oscilloscope, the operator can then adopt a convenient method for making a particular measurement. The following information describes the recommended procedures and techniques for making basic measurements with your instrument. When a procedure first calls for presetting instrument controls and obtaining a baseline trace, refer to the "Instrument Familiarization" section and perform steps 1 through 4 under "Baseline Trace."

AC Peak-to-Peak Voltage

To perform a peak-to-peak voltage measurement, use the following procedure:

NOTE

This procedure may also be used to make voltage measurements between any two points on the waveform.

1. Preset instrument controls and obtain a baseline trace.

2. Apply the ac signal to either vertical-channel input connector and set the VERTICAL MODE switch to display the channel used.

3. Set the appropriate VOLTS/DIV switch to display about five divisions of the waveform, ensuring that the VOLTS/DIV Variable control is in the CAL detent.

4. Adjust the A TRIGGER LEVEL control to obtain a stable dispaly.

5. Set the A SEC/DIV switch to a position that displays several cycles of the waveform.

6. Vertically position the display so that the negative peak of the waveform coincides with one of the horizontal graticule lines (see Figure 11, Point A).

7. Horizontally position the display so that one of the positive peaks coincides with the center vertical graticule line (see Figure 11, Point B).

8. Measure the vertical deflection from peak to peak (see Figure 11, Point A to Point B).

NOTE

If the amplitude measurement is critical or if the trace is thick (as a result of hum or noise on the signal), a more accurate value can be obtained by measuring from the top of a peak to the top of a valley. This will eliminate trace thickness from the measurement.

9. Calculate the peak-to-peak voltage, using the following formula:

$$\text{Volts (p-p)} = \begin{matrix}\text{vertical}\\ \text{deflection}\\ \text{(divisions)}\end{matrix} \times \begin{matrix}\text{VOLTS/DIV}\\ \text{switch}\\ \text{setting}\end{matrix} \times \begin{matrix}\text{probe}\\ \text{attenuation}\\ \text{factor}\end{matrix}$$

EXAMPLE: The measured peak-to-peak vertical deflection is 4.6 divisions (see Figure 11) with a VOLTS/DIV switch setting of 0.5, using a 10X probe.

Substituting the given values:

Volts (p-p) = 4.6 div x 0.5 V/div x 10 = 23 V.

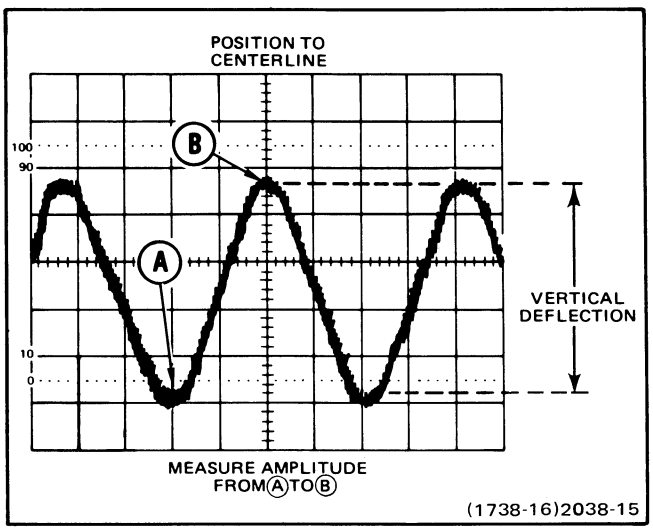


Figure 11. Peak-to-peak waveform voltage.

Instantaneous DC Voltage

To measure the dc level at a given point on a waveform, use the following procedure:

1. Preset instrument controls and obtain a baseline trace.

2. Apply the signal to either vertical-channel input connector and set the VERTICAL MODE switch to display the channel used.

3. Verify that the VOLTS/DIV Variable control is in the CAL detent and set the AC-GND-DC switch to GND.

4. Vertically position the baseline trace to the center horizontal graticule line.

5. Set the AC-GND-DC switch to DC. If the waveform moves above the centerline of the crt, the voltage is positive. If the waveform moves below the centerline of the crt, the voltage is negative.

NOTE

If using Channel 2, ensure that the Channel 2 INVERT switch is in its noninverting mode (push button out).

6. Set the AC-GND-DC switch to GND and position the baseline trace to a convenient reference line, using the Vertical POSITION control. For example, if the voltage to be measured is positive, position the baseline trace to the bottom graticule line. If a negative voltage is to be measured, position the baseline trace to the top graticule line. Do not move the Vertical POSITION control after this reference line has been established. The ground reference line can be checked at any later time by switching the AC-GND-DC switch to GND.

7. Set the AC-GND-DC switch to DC.

8. If the voltage-level measurement is to be made with respect to a voltage level other than ground, apply the reference voltage to the unused vertical-channel input connector. Then position its trace to the reference line.

9. Adjust the A TRIGGER LEVEL control to obtain a stable display.

10. Set the A SEC/DIV switch to a position that displays several cycles of the signal.

11. Measure the divisions of vertical deflection between the reference line and the desired point on the waveform at which the dc level is to be determined (see Figure 12).

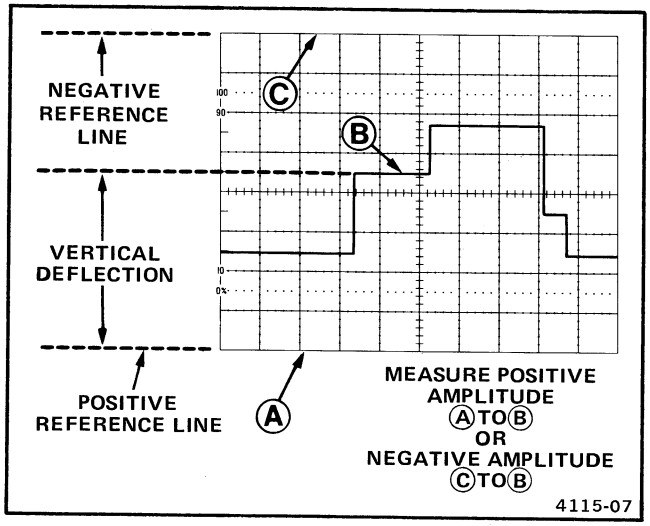


Figure 12. Instantaneous voltage measurement.

12. Calculate the instantaneous voltage, using the following formula:

$$\text{Instantaneous Voltage} = \text{vertical deflection (divisions)} \times \text{polarity (+ or −)} \times \text{VOLTS/DIV switch setting} \times \text{probe attenuation factor}$$

EXAMPLE: The measured vertical deflection from the reference line is 4.6 divisions (see Figure 12), the waveform is above the reference line, the VOLTS/DIV switch is set to 2, a 10X attenuator probe is being used, and the A TRIGGER SLOPE switch is set to ⎍ (plus).

Substituting the given values:

Instantaneous Voltage = 4.6 div x (+1) x 2 V/div x 10 = 92 V.

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