

Instruction Manual

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Tektronix

**TAS 475 & TAS 485
Analog Oscilloscopes**

070-8688-01

Instruction Manual

Tektronix

TAS 475 & TAS 485 Analog Oscilloscopes

070-8688-01

Warning

The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to the Safety Summary prior to performing service.

Please check for change information at the rear of this manual.

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Preface

This is the Instruction Manual for the TAS 475 and TAS 485 Analog Oscilloscopes. This manual provides you with both operation and limited service information.

Use the *Introduction* section to learn what the TAS 475 and TAS 485 Analog Oscilloscopes can do and about the available options and accessories.

Use the *Getting Started* section to learn about applying power. This section also contains brief examples of how to use the controls.

Use the *Operation* section to learn about each of the front panel controls and how to perform certain tasks to help you understand typical steps involved to obtain stable, usable displays and take measurements.

Use the *Specifications* section as a reference for all nominal, warranted, and typical characteristics for the TAS 475 and TAS 485 Analog Oscilloscopes.

Use the *Theory* section to help you understand the operation of the oscilloscope to the block level.

Use the *Performance Verification* section to verify the functionality and warranted characteristics of the oscilloscope.

Use the *Adjustment* section to bring the TAS 475 and TAS 485 Analog Oscilloscopes into conformance with the warranted characteristics listed in the *Specifications* section. You should adjust the oscilloscope if indicated by the *Performance Verification* procedures.

Use the *Maintenance* section to learn how to perform general maintenance of your product. Procedures to replace cosmetic parts of the oscilloscope (such as knobs and panels) are also located in this section.

Use the *Replaceable Parts* section for a list of the replaceable cosmetic parts.

Use the *Appendix* section to learn about each of the menus. The *Appendix* also contains a list of the controls affected when using the **AUTOSET** feature.

Related Manuals

Other documentation for the TAS 475 and TAS 485 Analog Oscilloscopes include:



- The *Reference* (Tektronix part number 070–8720–00) gives you a quick overview of how to operate your TAS 400 Series Analog Oscilloscopes.
- The *Service* manual (Tektronix part number 070–8878–00) provides extended service information not contained in the Instruction manual. Items included are a detailed Theory of Operation, Schematics, and a complete electrical and mechanical parts list.
- The *XYZs of Analog and Digital Oscilloscopes* (Tektronix part number 070–8690–01) provides you with a basic understanding of oscilloscopes and their use.

Safety Summary

Please take a moment to review these safety precautions. They are provided for your protection and to prevent damage to the oscilloscope. This safety information applies to all operators and service personnel.

Symbols and Terms

These two terms appear in manuals:

-  statements identify conditions or practices that could result in damage to the equipment or other property.
-  statements identify conditions or practices that could result in personal injury or loss of life.

These two terms appear on equipment:

- *CAUTION* indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.
- *DANGER* indicates a personal injury hazard immediately accessible as one reads the marking.

This symbol appears in manuals:



Static-Sensitive Devices

These symbols appear on equipment:



DANGER
High Voltage



Protective
ground (earth)
terminal



ATTENTION
Refer to
manual

Specific Precautions

Observe all of the following precautions to ensure your personal safety and to prevent damage to either the TAS 475 and TAS 485 Analog Oscilloscopes or equipment connected to them.

Do Not Perform Service While Alone

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

Use Care When Servicing With Power On

Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections or components while power is on. Disconnect power before removing protective panels, soldering, or replacing components.

Power Source

The TAS 475 and TAS 485 Analog Oscilloscopes are intended to operate from a power source that will not apply more than 250 V_{RMS} between the supply conductors or between either supply conductor and ground. A protective ground connection, through the grounding conductor in the power cord, is essential for safe system operation.

Grounding the Oscilloscope

The TAS 475 and TAS 485 Analog Oscilloscopes are grounded through the power cord. To avoid electric shock, plug the power cord into a properly wired receptacle where earth ground has been verified by a qualified service person. Do this before making connections to the input or output terminals of the oscilloscope.

Without the protective ground connection, all parts of the TAS 475 and TAS 485 Analog Oscilloscopes are potential shock hazards. This includes knobs and controls that may appear to be insulators.

Use the Proper Power Cord

Use only the power cord and connector specified for your product. Use only a power cord that is in good condition.

Use the Proper Fuse

To avoid fire hazard, use only the fuse specified in the parts list for your product. It must be identical in type, voltage rating, and current rating.

Do Not Remove Covers or Panels

To avoid personal injury, do not operate the TAS 475 or TAS 485 without the panels or covers.

Do Not Operate in Explosive Atmospheres

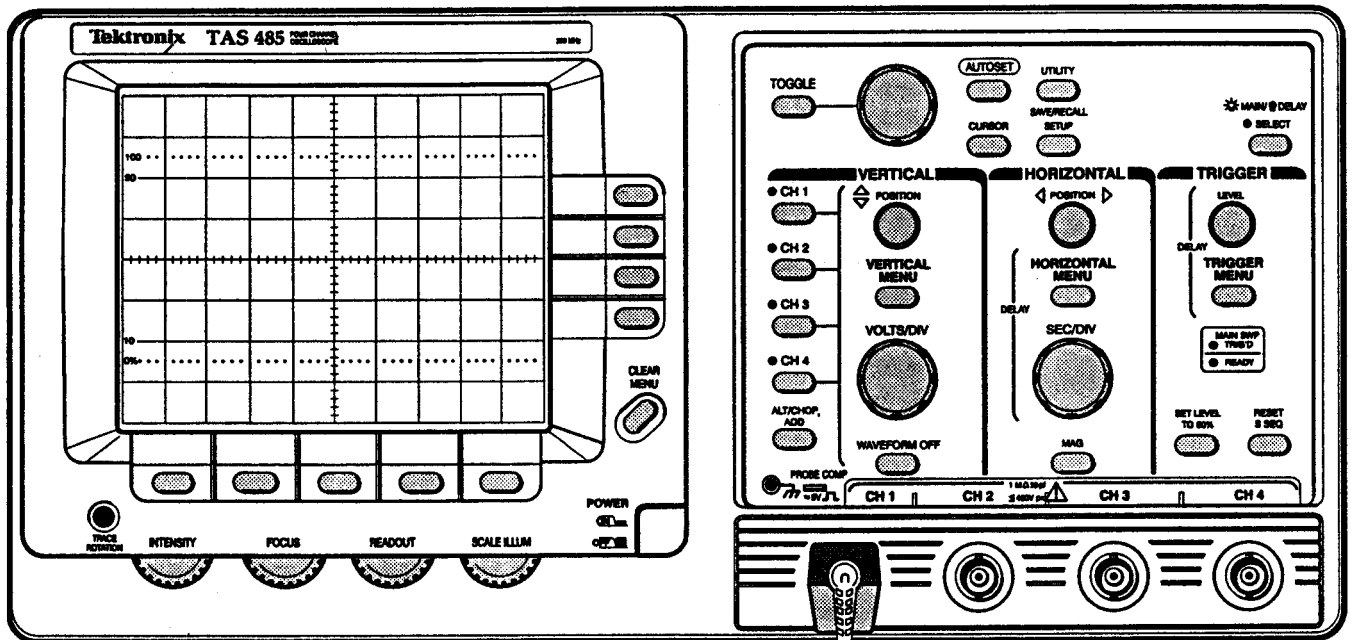
The TAS 475 or TAS 485 provide no explosion protection from static discharges or arcing components. Do not operate the TAS 475 or TAS 485 in an atmosphere of explosive gasses.

Electric Overload

Never apply a voltage to a connector on the TAS 475 or TAS 485 that is outside the range specified for that connector.

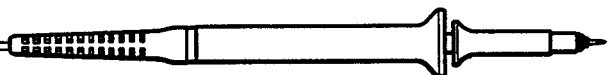
Introduction

Product Description



Your Tektronix TAS 475 and TAS 485 Analog Oscilloscopes are superb tools for processing and displaying electrical signals. Their performance addresses the needs of both benchtop and portable applications with the following features:

- 100 MHz minimum bandwidth (TAS 475)
200 MHz minimum bandwidth (TAS 485)
- Four-channel input
- Complete cursor measurement system
 - Voltage
 - Time
 - Frequency
- Delayed time base
- AUTOSSET feature
- Front panel setup memory



The features of the TAS 475 and TAS 485 Analog Oscilloscopes are briefly described here to help get you acquainted with the operating systems.

User Interface

This oscilloscope uses a combination of front-panel buttons, knobs, and on-screen menus to control its many functions. The front-panel controls are grouped according to function: vertical, horizontal, trigger, and special. Within each group, any function adjusted often, such as vertical positioning or the time base setting, is set directly by its own front-panel control.

AUTOSET

The **AUTOSET** button provides you with a usable, triggered display of a signal applied to an input channel. Many instrument controls and menus are set to a pre-defined state, providing you with a known starting point for your measurements. Page A-9 lists the actions taken by pressing the **AUTOSET** button.

Menus

Those functions for which control settings changed less often, such as vertical coupling and trigger mode, are set indirectly. That is, pressing a front-panel button, such as **VERTICAL MENU**, displays a menu of functions at the bottom of the screen related to that button. (For the button **VERTICAL MENU**, the menu displayed contains functions such as coupling and bandwidth.) The buttons below this main menu select a function, such as coupling and displays a sub menu of settings for that function, such as DC, AC, or GND, at the right side of the screen. The buttons to the right of the menu select a setting, such as DC.

General Purpose Knob and TOGGLE

Some menus assign the General Purpose Knob to a selected adjustment. The method employed is the same as for *selecting* a function, except the final selection in the side menu causes the General Purpose Knob to *adjust* some function, such as the position of measurement cursors on screen. Pressing the **CLEAR MENU** button clears the assignment of the General Purpose Knob except when assigned to adjust cursors or delay time.

The **TOGGLE** button works in conjunction with the General Purpose Knob when positioning cursors. Each press of the **TOGGLE** button switches which cursor is active, and therefore controlled by the General Purpose Knob,

Save/Recall Setups

You can store up to four complete front panel setups in memory. Once you complete a complex setup and then save it in one of the four memory locations, you can retrieve it at any time. Saved front panel settings do not include the assignment of the General Purpose Knob.

Vertical System

The vertical system provides four vertical channels with calibrated vertical scale factors from 2 mV to 5 V per division.

All channels can be displayed, vertically positioned, bandwidth limited (to either Full or 20 MHz), inverted, and vertical coupling specified.

Besides the four channels, math waveforms are available for display. (A math waveform results when you add two channels.)

Horizontal System

There are three horizontal display modes: main, delayed, and XY.

The main display is the standard horizontal display mode with calibrated sec/div scales.

The delayed display can be delayed by time with respect to the main trigger. The delayed display can also be set to display at the first valid trigger after the delay. The delayed display also has a calibrated sec/div scale.

XY mode is useful to measure the phase difference of two signals.

Trigger System

The triggering system comprises a complete set of features for triggering the horizontal system. You can configure trigger for source, slope, coupling, mode, and holdoff. Video triggers are available for triggering on video signals.

You can adjust the trigger level or automatically set it to 50% of the trigger signal with the press of a button.

Measurement Cursors

Once you have set up to take your measurements, the cursors can help you take those measurements quickly.

The TAS 475 and TAS 485 Oscilloscopes have two types of cursors for taking measurements on the displayed waveforms: delta (difference) and absolute. The General Purpose Knob controls the placement of the cursors. The **TOGGLE** button selects which cursor is active.

Delta voltage measures the voltage between the horizontal bar cursors. Delta time measures the time between vertical bar cursors. These are delta measurements; that is, measurements based on the difference between two cursors.

Absolute voltage measures the voltage position of a single horizontal bar cursor. The displayed voltage level readout is made with respect to the ground reference level of the channel.

The bar cursors remain displayed even if you change the function of the General Purpose Knob. This allows you to use them as reference points or markers to easily identify if measurement signals remain within the parameters set by the cursors. Remove the cursor display by turning the cursor measurement off.

Options

Several options are available for the TAS 475 and TAS 485 Analog Oscilloscopes. A description of each option follows.

Options A1 – A5: International Power Cords

Besides the standard North American, 110 V, 60 Hz power cord, Tektronix ships any of five alternate power cord configurations. See Table 1-1.

Table 1-1: International Power Cords

Option	Power Cord
A1	Universal European — 220 V, 50 Hz
A2	UK — 240 V, 50 Hz
A3	Australian — 240 V, 50 Hz
A4	North American — 240 V, 60 Hz
A5	Switzerland — 220 V, 50 Hz

Warranty-Plus Service Options

The following options add to the services available with the standard warranty. (The standard warranty appears following the title page in this manual.)

- **Option M2:** Tektronix provides five years of warranty/remedial service.
- **Option M3:** Tektronix provides five years of warranty/remedial service and four oscilloscope calibrations.
- **Option M8:** Tektronix provides four calibrations and four performance verifications, one of each in the second through the fifth years of service.

Option 3R: Rackmounted

With this option, Tektronix ships the oscilloscope with a rackmount kit, providing all the necessary hardware to adapt the oscilloscope for installation into a standard 19 inch instrument rack. Customers with instruments can order a rackmount kit (Tektronix part number 016-1166-00) for conversion with instructions.

Option 02: Front Cover and Pouch

With this option, Tektronix ships a protective front cover to prevent damage to the front panel of the oscilloscope while not in use. An attachable pouch (attaches to the instrument top) provides storage for the manuals and probes supplied with your oscilloscope plus other additional accessories you may want to keep with your oscilloscope.

Option 22: Additional Probes

With this option, Tektronix ships two additional probes identical to the two standard-accessory probes normally shipped with the instrument (P6109B for the TAS 475 and P6111B for the TAS 485). This provides one probe for each front-panel input.

Option 23: Additional Probes — (TAS 475)

With this option, Tektronix ships two P6129B 1X — 10X switchable passive probes in addition to the two standard-accessory P6109B probes normally shipped with the instrument.

Option 9C: Certificate of Calibration and Test Data Report

Tektronix ships a Certificate of Calibration that states this instrument meets or exceeds all warranted specifications and has been calibrated using standards and instruments whose accuracies are traceable to the National Institute of Standards and Technology, an accepted value of a natural physical constant or a ratio calibration technique. The calibration is in compliance with U.S. MIL–STD–45662A. This option also includes a test data report for the instrument.

Accessories

This section provides a list of both standard and optional accessories for the TAS 475 and TAS 485 Analog Oscilloscopes.

Standard Accessories

Table 1-2 lists the standard accessories included with the TAS 475 and TAS 485 Analog Oscilloscopes

Table 1-2: Standard Accessories

Accessory	Part Number
Instruction Manual	070–8688–01
Reference	070–8720–00
XYZs of Analog and Digital Oscilloscopes	070–8690–01
U.S. Power Cord	161–0230–01

Table 1-2: Standard Accessories (Cont.)

Accessory	Part Number
Fuse (250 V, 3 A Fast)	159-0277-00
Probes (quantity two), 10X Passive; 100 MHz (TAS 475)	P6109B (single unit)
Probes (quantity two), 10X Passive; 200 MHz (TAS 485)	P6111B (single unit)
P6109B Probe Manual (TAS 475)	070-7849-02
P6111B Probe Manual (TAS 485)	070-8543-00

Optional Accessories

Table 1-3 lists a few of the optional accessories available for use with the TAS 475 and TAS 485 Analog Oscilloscopes.

Table 1-3: Optional Accessories

Accessory	Part Number
Oscilloscope Cart	K212
Rack Mount Kit (for field conversion)	016-1166-00
Service Manual	070-8878-00
Accessory Pouch	016-1159-00
Fuse (250 V, 1.5 A Fast)	159-0311-00
Fuse (250 V, 3.15 A Fast)	159-0190-00
Front Cover	200-3232-00
Oscilloscope Camera	C-9 Option 06
Oscilloscope Camera Adapter	016-1154-00
Soft-sided Carrying Case	016-1158-00
Transit Case	016-1157-00

User manuals for the TAS 475 and TAS 485 Oscilloscopes and the XYZs of *Analog and Digital Oscilloscopes* are available in several languages. Table 1-4 provides a list of these manuals.

Table 1-4: Available Languages

Manual	Language	Part Number
TAS 475 and TAS 485 Analog Oscilloscopes User Manual	French	070-8889-00
	Spanish	070-8888-00
	German	070-8892-00
XYZs of Analog and Digital Oscilloscopes	French	070-8070-01
	Spanish	070-8819-01
	German	070-8071-01

Accessory Probes

The following is a list of optional accessory probes to enhance the use of your oscilloscope:

- P6046 Active, differential probe, 100 MHz
- P6007 Passive, high voltage probe, 100X, 1500 VDC + Peak AC
- P6015A Passive high voltage probe, 1000X, 20 kVDC + Peak AC (40 kV peak for less than 100 ms)
- P6101B 1X, 15 MHz, Passive probe
- P6129B 1X — 10X switchable, 100 MHz, Passive probe
- P6408 20 MHz, 17 bit, Word Recognizer/Logic probe
- TVC 501 Time-to-Voltage Converter (time delay, pulse width, and period measurements)
- P6021 AC Current probe, 120 Hz to 60 MHz
- P6022 AC Current probe, 935 kHz to 120 MHz
- AM 503S — DC/AC Current Probe System, AC/DC (uses A6302 Current Probe)

Getting Started

Power On

Before you begin using the TAS 475 and TAS 485 Analog Oscilloscopes, ensure proper installation.

Installation

Perform this procedure to properly install and power on the TAS 475 and TAS 485 Analog Oscilloscopes.

1. Check that you have the proper electrical connections. The TAS 475 and TAS 485 Analog Oscilloscopes require 90 to 132 VAC_{RMS} or 180 to 250 VAC_{RMS}, continuous range at 48 Hz to 440 Hz. A maximum of 85 Watts may be required.
2. Check that the Line Voltage Range switch (Figure 2-1) is at the proper setting for your power system.
3. Check the fuse to ensure it is the proper type and rating (the rear panel provides you with this information). The TAS 475 and TAS 485 Analog Oscilloscopes are shipped with the UL approved fuse installed. Figure 2-2 illustrates how to open the fuse drawer.
4. Connect the proper power cord from the rear-panel power connector (Figure 2-1) to the power system.

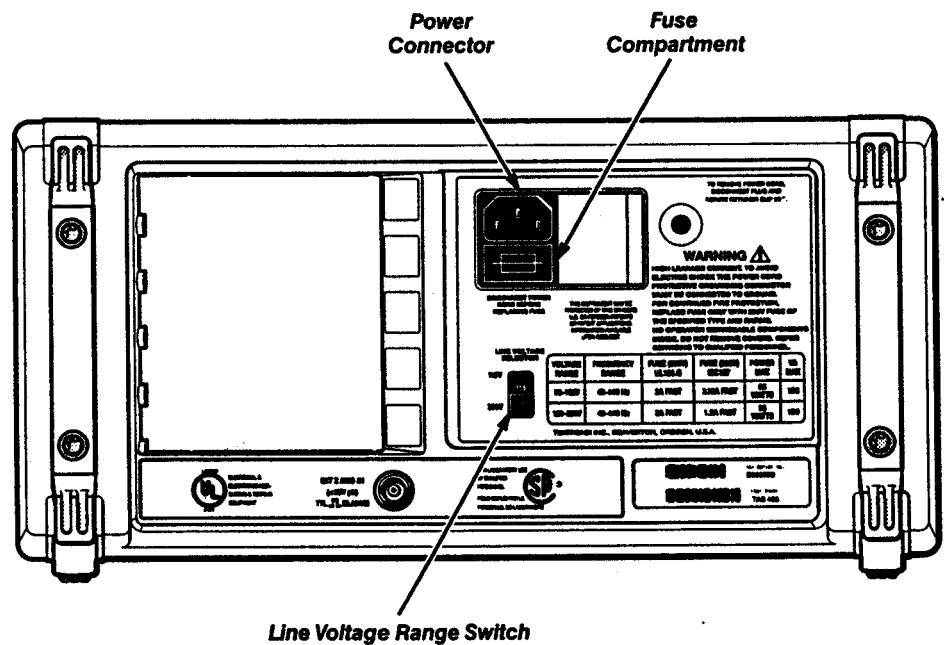


Figure 2-1: Rear Panel

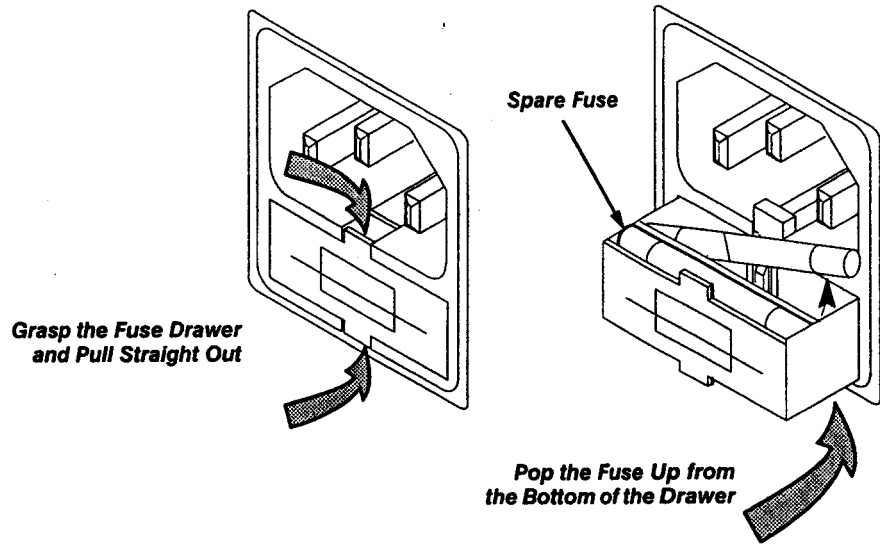


Figure 2-2: Fuse Compartment

5. Be sure you have the appropriate operating environment. Specifications for temperature, relative humidity, altitude, vibrations, and emissions are in Section 4, *Specifications*.
6. Leave space for cooling. Do this by verifying that the air intake and exhaust holes on the sides of the cabinet are free of any airflow obstructions. Leave at least 5.1 cm (2 in.) free on each side.
7. Press the **POWER** button to power on the oscilloscope.

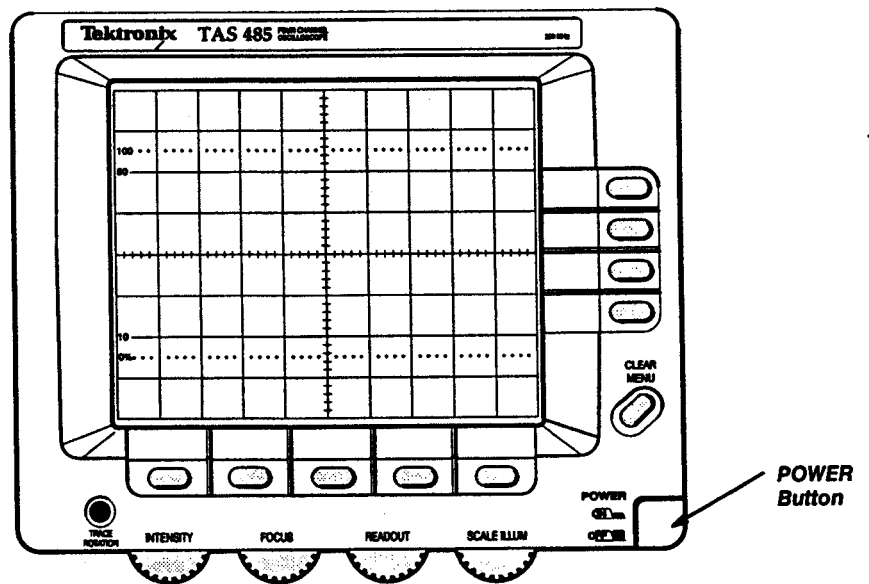


Figure 2-3: POWER Button

Quick Start

This section helps you get acquainted with basic controls and operating systems of the TAS 475 and TAS 485 Analog Oscilloscopes once you have power applied. Review *At a Glance* in Section 3 if you want an overview of all controls and connectors.

Selecting and Deselecting Input Channels

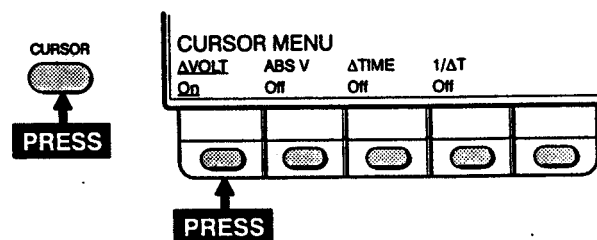
The TAS 475 and TAS 485 Oscilloscopes have four input channels. You can display the channels separately or simultaneously. The following steps demonstrate how to select and deselect channels for display.

1. Power on the oscilloscope and wait for the self tests to complete.
2. Press the **CH 1** button located on the front panel. The **CH 1** indicator lights, channel 1 is displayed, and vertical controls and menus are assigned to channel 1.
3. Press the **CH 2** button located on the front panel. The **CH 2** indicator lights, channel 2 is displayed, and controls and menus are assigned to channel 2.
4. Press the **CH 1** button, assigning control to channel 1.
5. Press the **WAVEFORM OFF** button, removing channel 1 from the display and leaving channel 2 displayed.

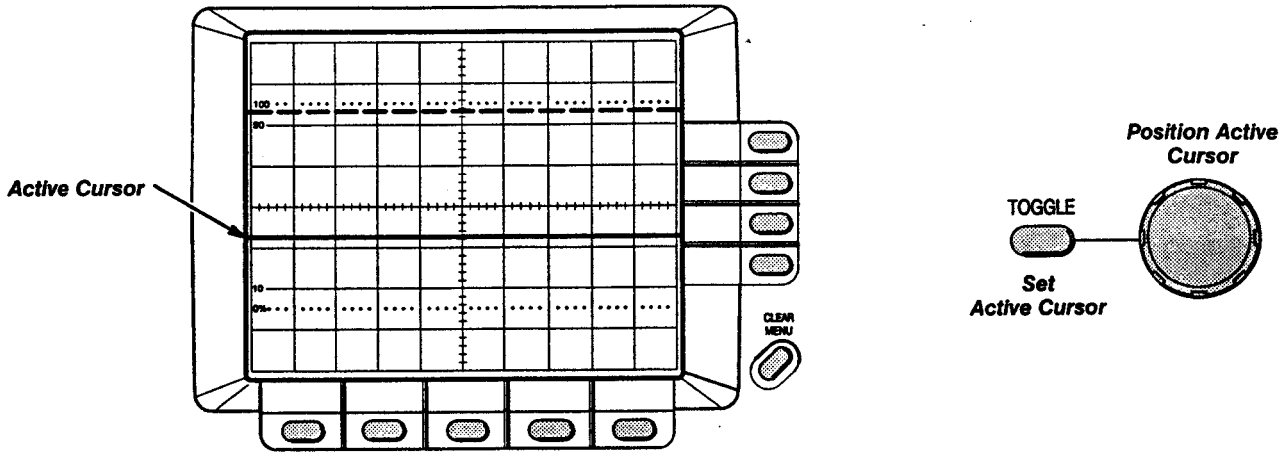
Using the Menus

The TAS 475 and TAS 485 Oscilloscopes use menus for many instrument settings. In the following steps, you will set only channel 1 on and turn the cursors on.

1. Press the **WAVEFORM OFF** button until only channel 1 is displayed.
2. Press the **CURSOR** menu button.
3. Set the delta volts (Δ VOLT) cursors on (using the following guide).



- Now two horizontal bar cursors are displayed. The active (movable) one is a solid line and the inactive one is a dashed line. Use the General Purpose Knob to move the active cursor and use the **TOGGLE** button to select which cursor is active.



Connecting a Signal

The TAS 475 and TAS 485 Oscilloscopes accept signals through the front panel input connectors labeled **CH 1**, **CH 2**, **CH 3**, and **CH 4**. The probes you use for taking measurements should only be those supplied with the TAS 475 and TAS 485 Oscilloscopes. Connecting signals to the TAS 475 and TAS 485 Oscilloscopes is also possible with the use of 50 Ω coaxial cables.

Before using any probe to take measurements, compensate the probe to match the input channel. See *Compensating the Probe* on page 2-5.

Using AUTOSET

The **AUTOSET** feature of the TAS 475 and TAS 485 Oscilloscopes automatically sets most of the front panel controls.

- Connect the probe compensation signal (from the **PROBE COMP** connector on the front panel) to either channel of the oscilloscope and display that channel (see Figure 2-5). Turn all other channels off.
- Press the **AUTOSET** button on the front panel. Wait one to three seconds to allow the instrument to adjust all the control settings.

The instrument will trigger on the waveform, display at least one complete cycle, and center it horizontally on the CRT. The baseline of the waveform will be at the center horizontal graticule line. The intensity level is increased if set too low for a viewable display.

See Table A-2 on page A-9 for a complete list of **AUTOSET** default control settings.

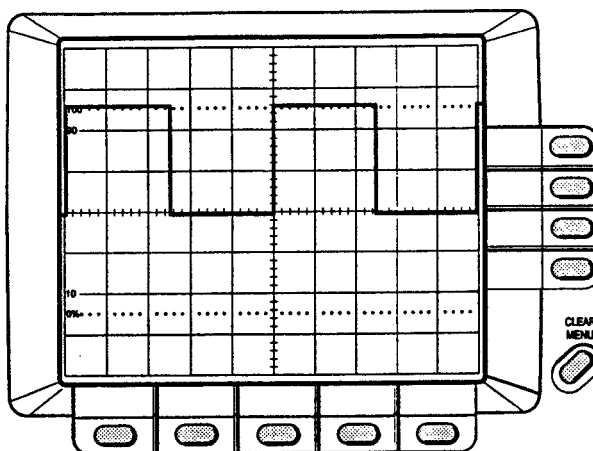


Figure 2-4: Probe Compensation Signal Displayed after AUTASET

Compensating the Probe

Passive probes require compensation to ensure maximum distortion-free input to the TAS 475 and TAS 485 Oscilloscopes. Before taking any measurements using a probe, first check the compensation of the probe and adjust it to match the channel inputs. The signal source for this check is the front-panel **PROBE COMP** signal (Figure 2-5).

1. Attach the probe to one of the channel input connectors along the lower right of the front panel.
2. Attach the probe tip to the **PROBE COMP** connector.

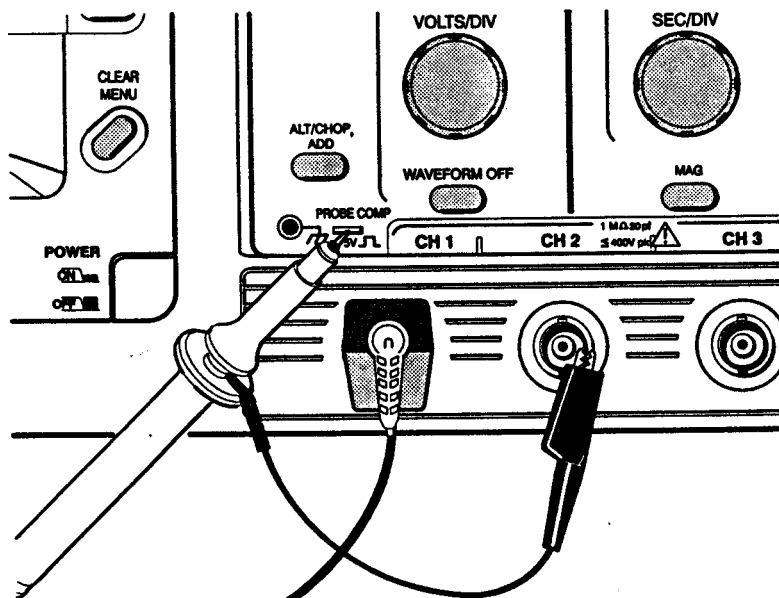
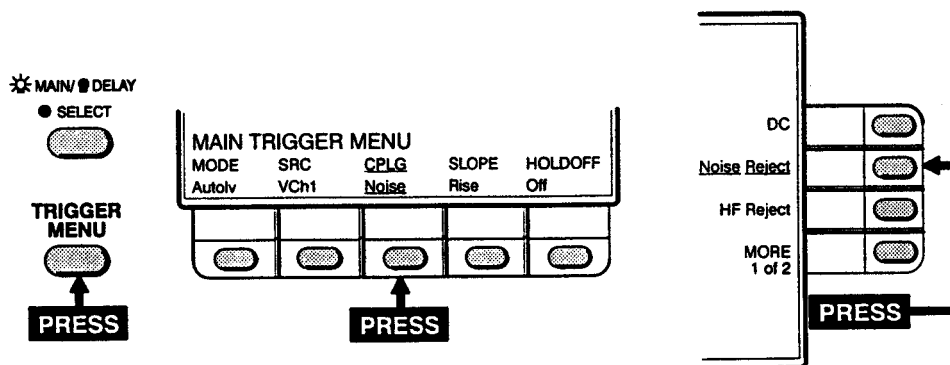
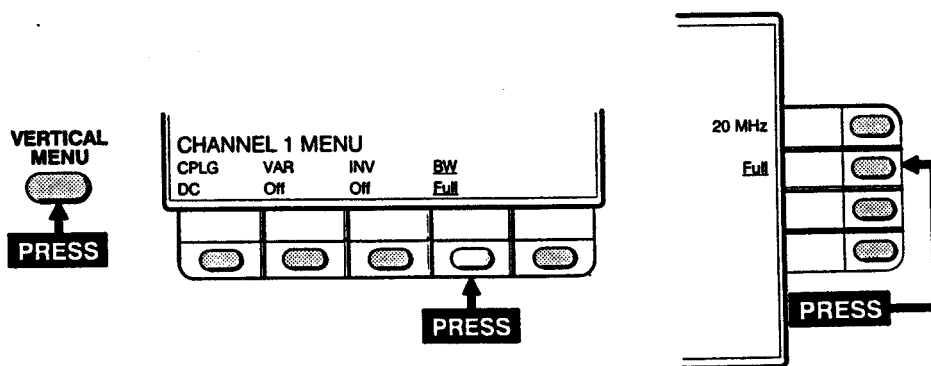


Figure 2-5: Connections for Compensating a Probe

3. Select the appropriate input channel by pressing either the **CH 1**, **CH 2**, **CH 3**, or **CH 4** front-panel button.
4. With the probe attached between an input channel and the probe compensation output of the oscilloscope, press the **AUTOSET** button on the front panel.
5. Set the vertical scale to 1 V using the **VOLTS/DIV** control.
6. Center the waveform vertically using the vertical **POSITION** control.
7. Set the horizontal scale to 200 μ s using the **SEC/DIV** control.
8. Set the trigger coupling to **Noise Reject** (use the following guide).



9. Set the vertical bandwidth to **Full** (use the following guide).



10. Check that the displayed waveform is a square wave with flat tops and bottoms. See Figure 2-6 for illustrations indicating proper and improper probe compensation.

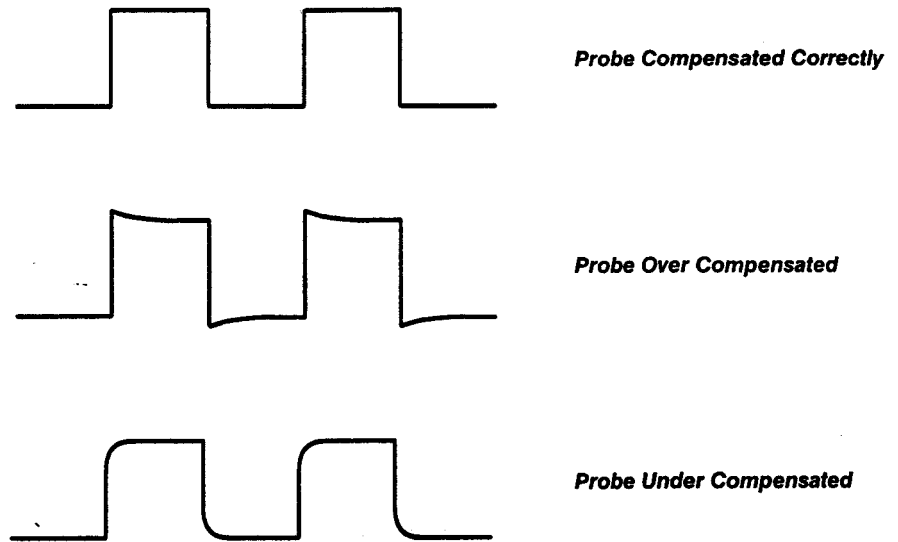


Figure 2-6: How Probe Compensation Affects Signals

11. Adjust the low frequency compensation adjustment, located in the probe body, for the best possible square wave. See Figure 2-7 for the location of the low frequency adjustment.

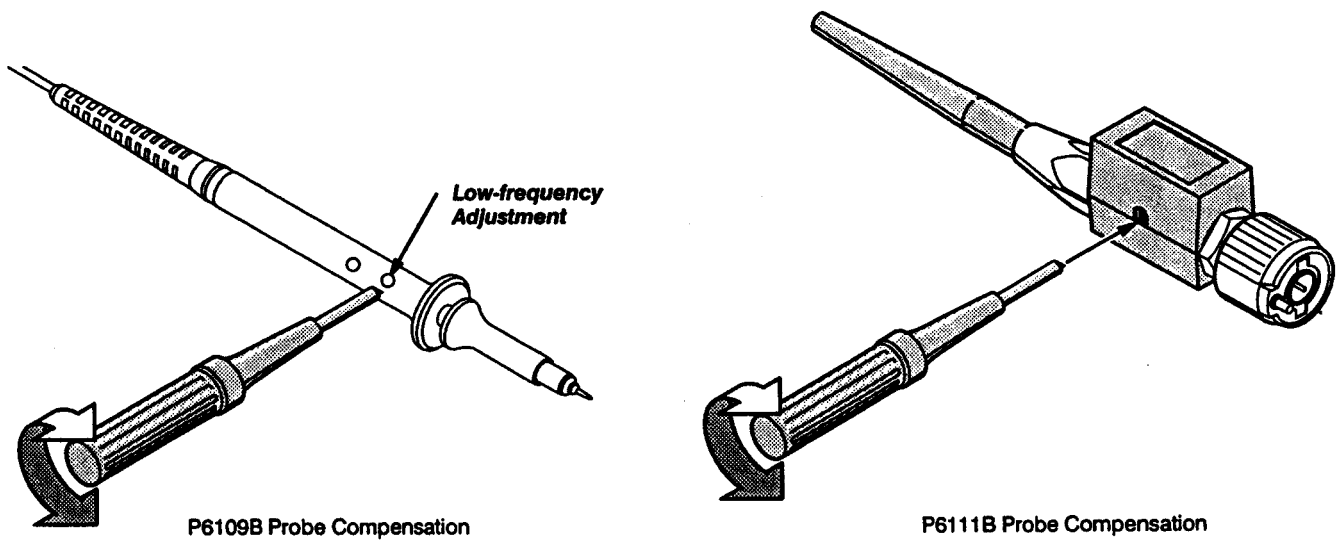


Figure 2-7: Location of Probe Head Adjustment

Adjusting Your Display Environment

You need to consider three oscilloscope operating systems to obtain the best possible display. **AUTOSET** adjusts many of these features for you with the press of a button.

Vertical System

You can change the vertical components of the displayed waveform by adjusting several features of the vertical operating system. Consider the following when setting up the vertical system for display:

- Vertical scale (volts/div)
- Input coupling
- Signal invert
- Input bandwidth

Horizontal System

You can change the horizontal components of the displayed waveform by adjusting several features of the horizontal operating system. Consider the following when setting up the horizontal system for display:

- Horizontal scale (sec/div)
- Magnification

Trigger System

You can modify the triggering system in a variety of ways to create the best possible triggered display, depending on the components of the input waveform. Consider the following when setting up the triggering system:

- Mode
- Source
- Coupling
- Slope

Operation

At a Glance

The TAS 475 and TAS 485 Oscilloscopes were designed for ease of use. To reduce the clutter of knobs and buttons on the front panel, many instrument control functions are now menu driven. The menus access instrument functions typically set once before taking measurements. The front panel controls access instrument functions you might need to adjust during measurements.

The menus are easy to use. For example, pressing the **VERTICAL MENU** button displays the menu choices for the vertical operating system.

This section of the manual illustrates each control and connector and contains a brief description of its use or function. Figure 3-1 shows the front panel of the TAS 485 Analog Oscilloscope.

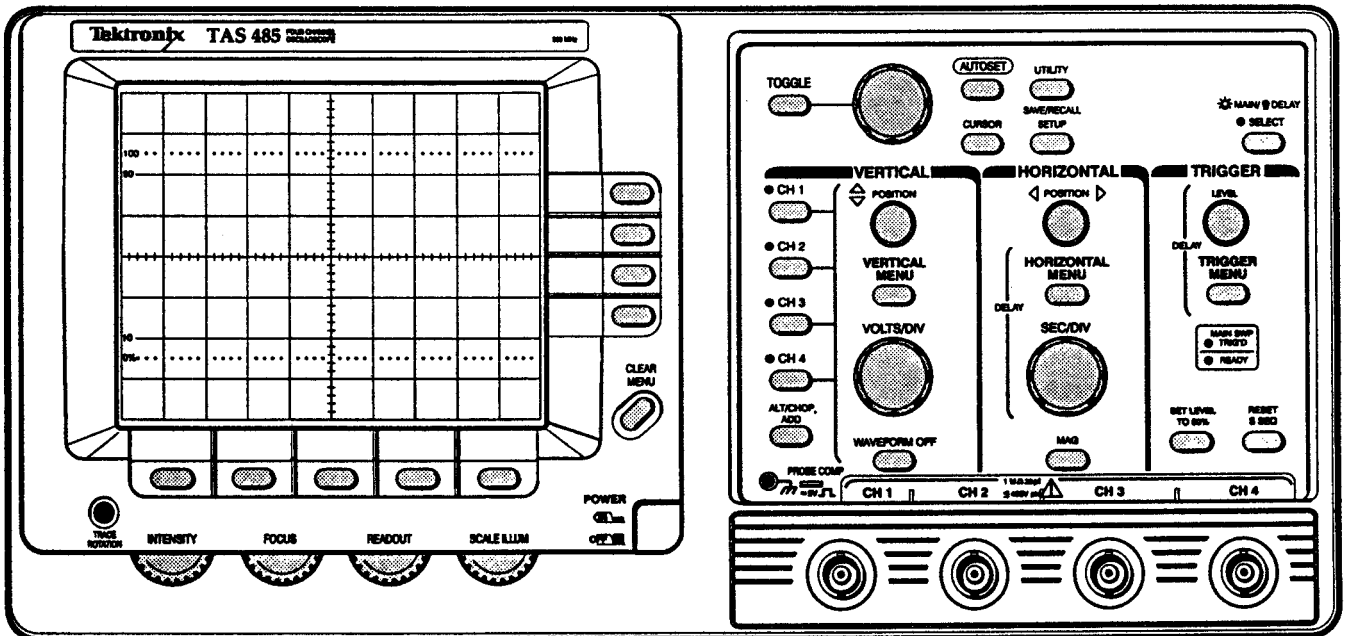
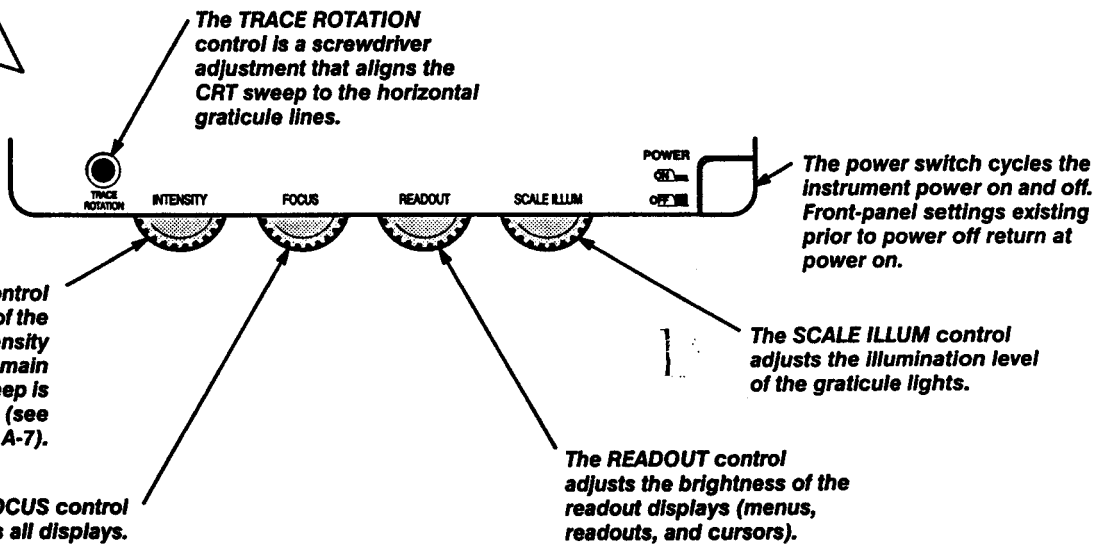
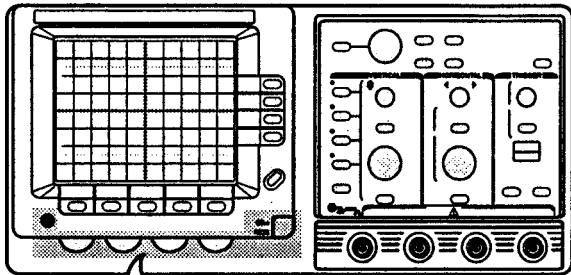


Figure 3-1: The TAS 485 Analog Oscilloscope Front Panel

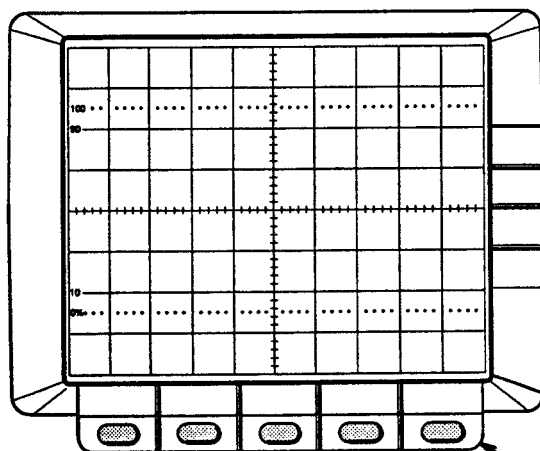
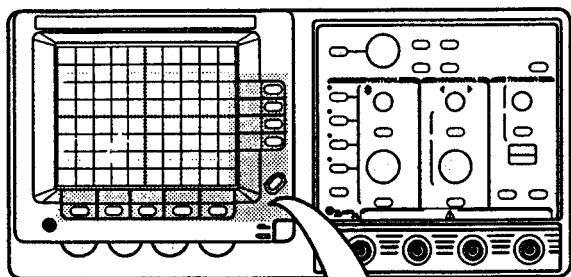
Power and Display Controls

The power and display controls allow you to cycle the power on and off and adjust the CRT display.



Menu Select Buttons

Use the menu buttons to choose corresponding items from the menus when displayed.



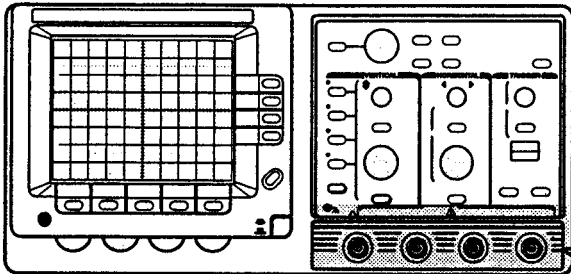
The submenu buttons select items from a corresponding list on the display.

The CLEAR MENU button clears the displayed menus.

The main menu buttons select items from a corresponding list on the display.

Signal Inputs and Outputs

Use the input connectors to apply signals to the TAS 475 and TAS 485 Oscilloscopes. The outer contact rings on the CH 1, CH 2, CH 3, and CH 4 connectors recognize attenuation factors of coded attenuator probes. A probe compensation signal and a chassis ground contact are also provided.

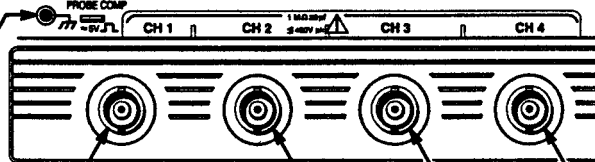


The PROBE COMP signal provides a 5 V, 1 kHz square wave signal (into a 1 MΩ load) for compensating voltage probes. See page 2-5 for further information.

This connector provides contact with the chassis ground.

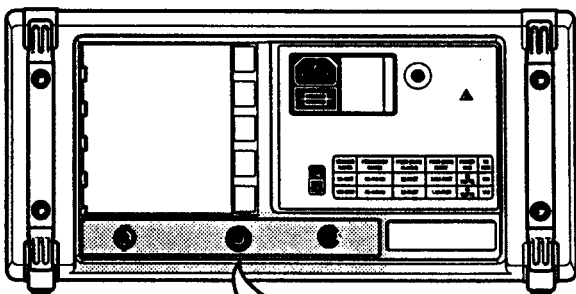
The CH 1 input connector connects signals to the input of the channel 1 vertical system.

A signal connected to the CH 1 input connector produces the horizontal deflection (X-axis) when horizontal mode XY is selected.



The CH 2, CH 3, and CH 4 input connectors connects signals to each channel's vertical system.

A signal connected to one of these input connectors provides the vertical deflection (Y-axis) when horizontal mode XY is selected.

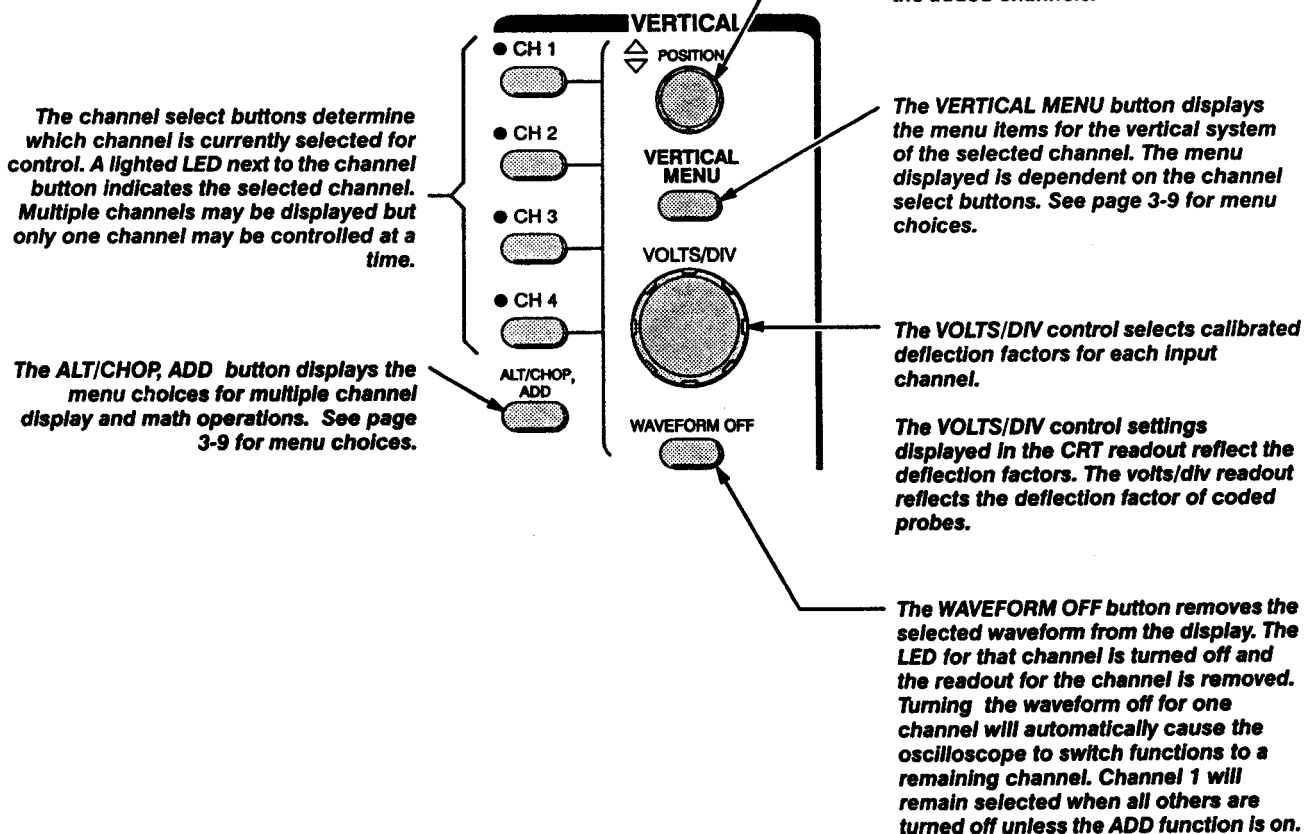
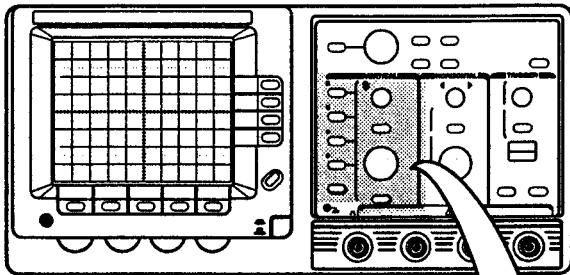


The EXT Z AXIS IN connector allows the application of an external signal to modulate the display intensity.



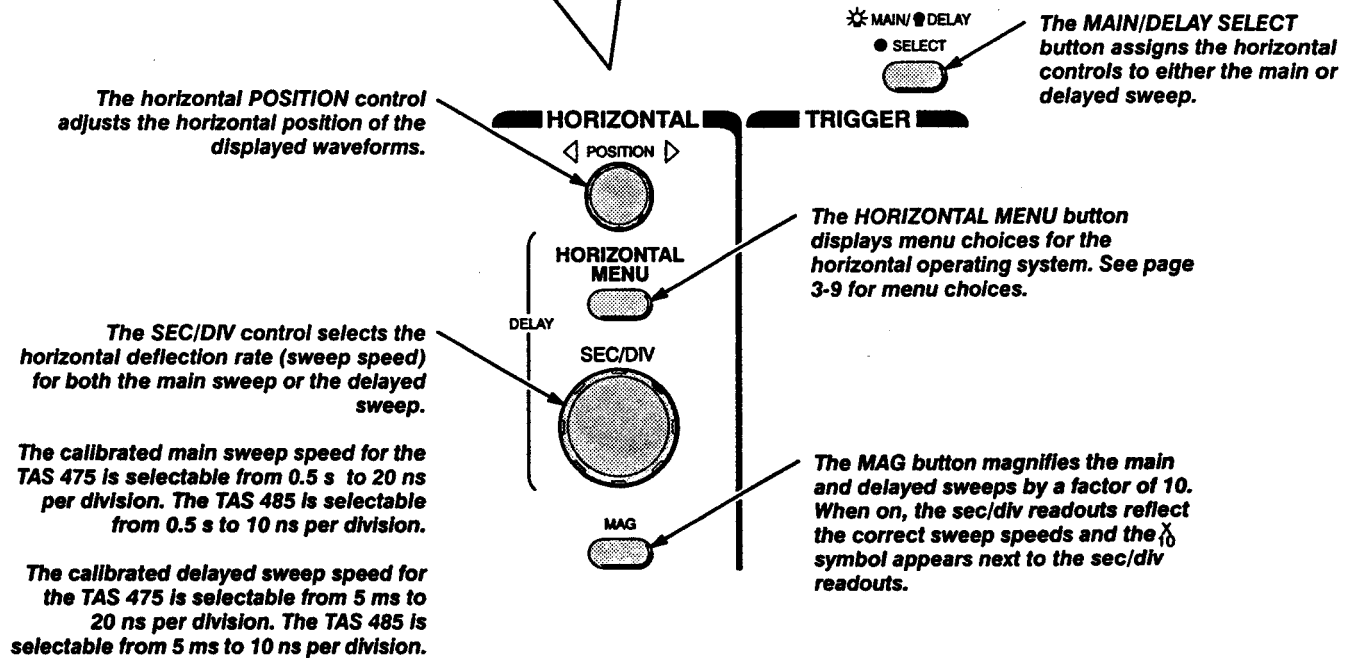
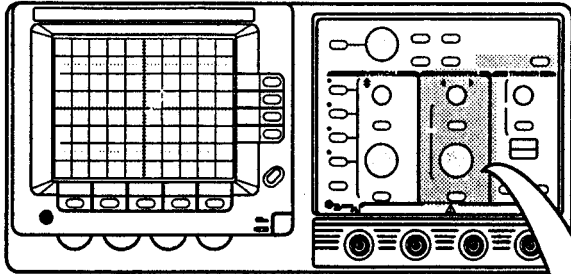
Vertical Controls

Use the vertical controls to access the features of the vertical operating system.



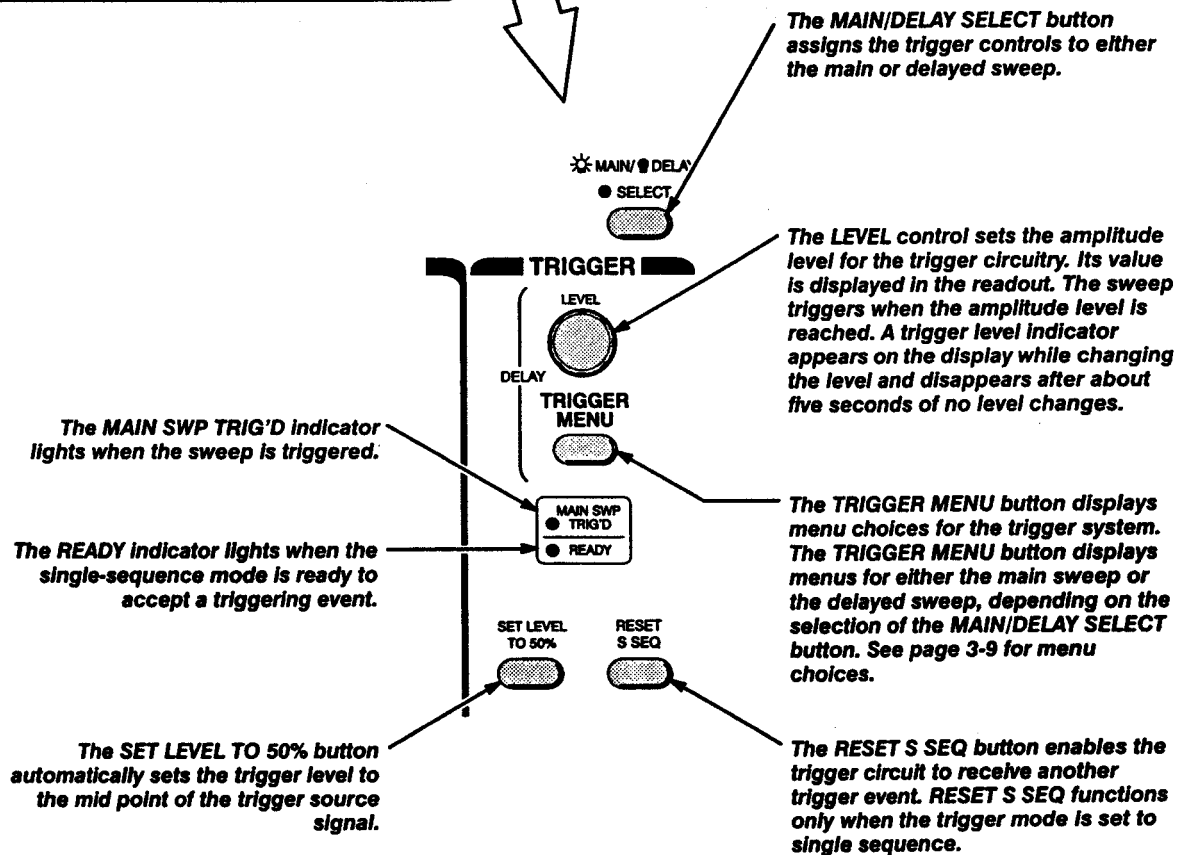
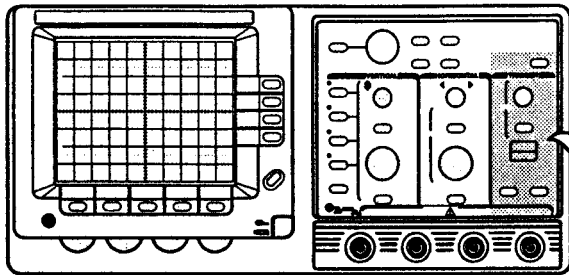
Horizontal Controls

Use the horizontal (sweep) controls to access the features of the horizontal system for both the main and delayed sweeps.



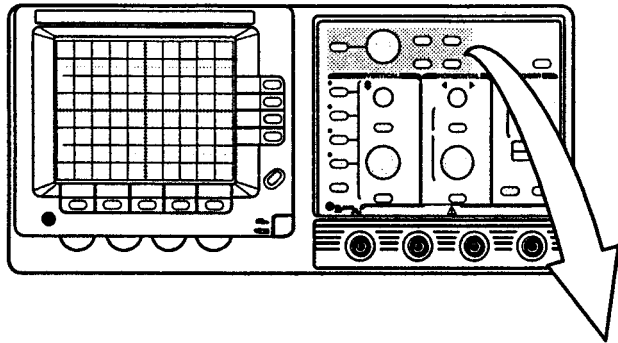
Trigger Controls

The trigger controls provide access to the features of the trigger system for both the main and delayed sweeps.



Miscellaneous Controls

The buttons described here either have a relationship with many instrument functions or perform specific tasks.



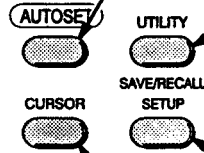
TOGGLE

The TOGGLE button selects which cursor the General Purpose Knob controls.

The General Purpose Knob is assigned to various operations, depending on the last applicable menu operation:

- Positioning cursors
- Adjusting time for delay events
- Variable volts/div and sec/div
- Delayed trace separation
- Calibration routines

If no menu is visible, the knob controls the last applicable menu selection.



The AUTOSET button sets the front-panel controls to obtain a usable display of an applied signal for all channels displayed.

The UTILITY button displays menus used to configure operating systems and perform calibration routines. See page 3-9 for menu choices.

The SAVE/RECALL SETUP button displays menus that allow four complete front-panel setups to be stored for later recall. See page 3-9 for menu choices.

The CURSOR button displays the measurement cursors. Use the General Purpose Knob to position the cursors. See page 3-9 for menu choices.

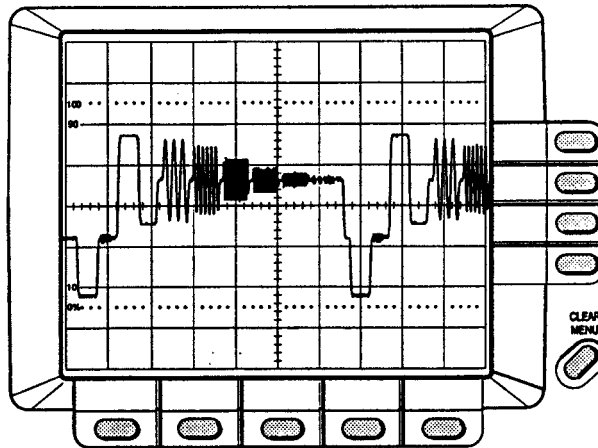


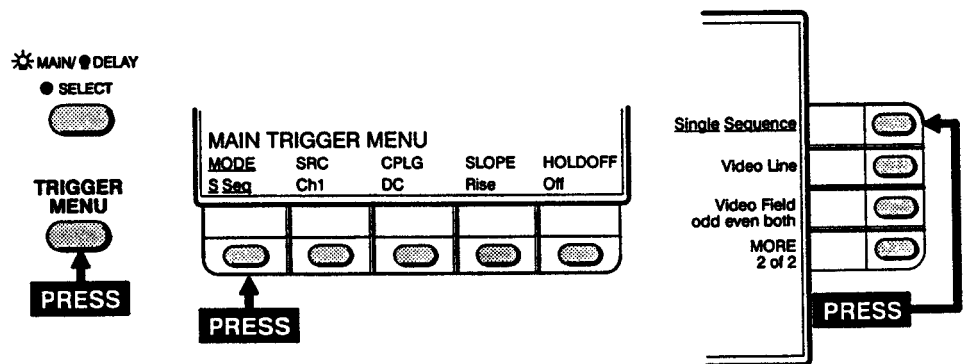
Figure 3-7: Multiburst Signal Triggered in TV Line

Using Single Sequence

The single sequence trigger mode allows one sweep of all displayed channels to occur for each trigger event. Another sweep cannot occur until the trigger circuit is re-armed.

Use single sequence mode to display and photograph either nonrepetitive signals or signals that cause unstable displays.

1. Set the vertical and horizontal controls as desired.
2. Press the **TRIGGER MENU** button to display the trigger menu choices and set the **MODE** to **Single Sequence** (use the following guide).



3. Set the readout and cursors display options by pressing the **UTILITY** button and selecting the appropriate choices with the menu select buttons. See page A-7 for a description of the utility menus.
4. Press the **RESET S SEQ** button, lighting the **READY** LED. The LED will remain lit until the instrument receives an appropriate trigger signal.

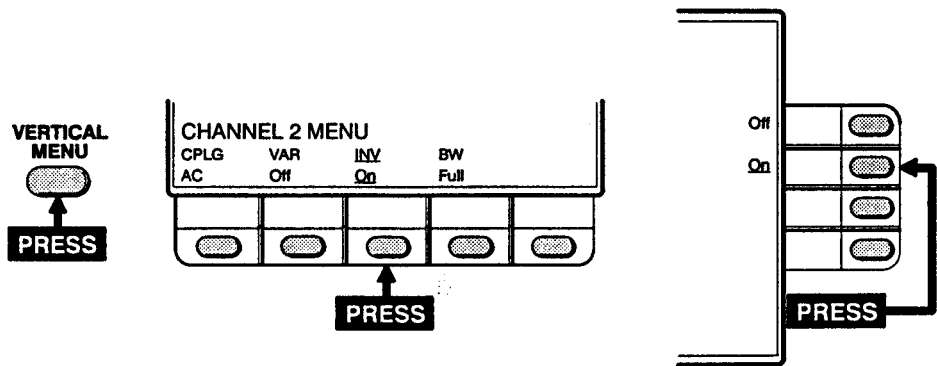
The **MAIN SWP TRIG'D** LED lights to indicate an adequate trigger signal is present for the main sweep.

Performing Waveform Math

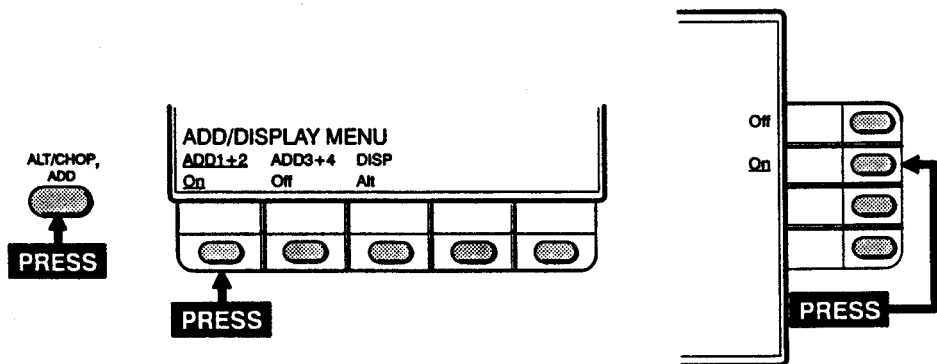
The TAS 475 and TAS 485 Oscilloscopes provide a feature that allows you to add two separate signals, creating a third signal. With this feature you can see the results of adding two signals together or removing unwanted components of a signal. A + symbol appears to the left of the channel 2 readout when adding channels 1 and 2. A + symbol appears to the left of the channel 4 readout when adding channels 3 and 4.

This procedure demonstrates how to use the add feature of the TAS 475 and TAS 485 Oscilloscopes by solving a common problem of having an AC line-frequency component mixed with another signal.

1. Using channel 1, obtain the signal containing the unwanted AC line-frequency component mixed with another signal.
2. Using channel 2, obtain the AC line-frequency component only.
3. Invert the channel 2 signal (use the following guide). The invert indicator \downarrow appears in the channel 2 readout display.



4. Add channels 1 and 2 together (use the following guide).



The instrument displays a third waveform that shows the result of adding the two waveforms together. Figure 3-8 shows an example of subtracting (using invert) waveforms.

Vertical position of the added waveform is affected by the vertical position of the added channels.

Menu Map

Figure 3-2 is a complete map of the menus; it will help you locate menu driven functions and their available settings. Refer to *Detailed Menu Descriptions*, beginning on page A-1, for operating information about each menu.

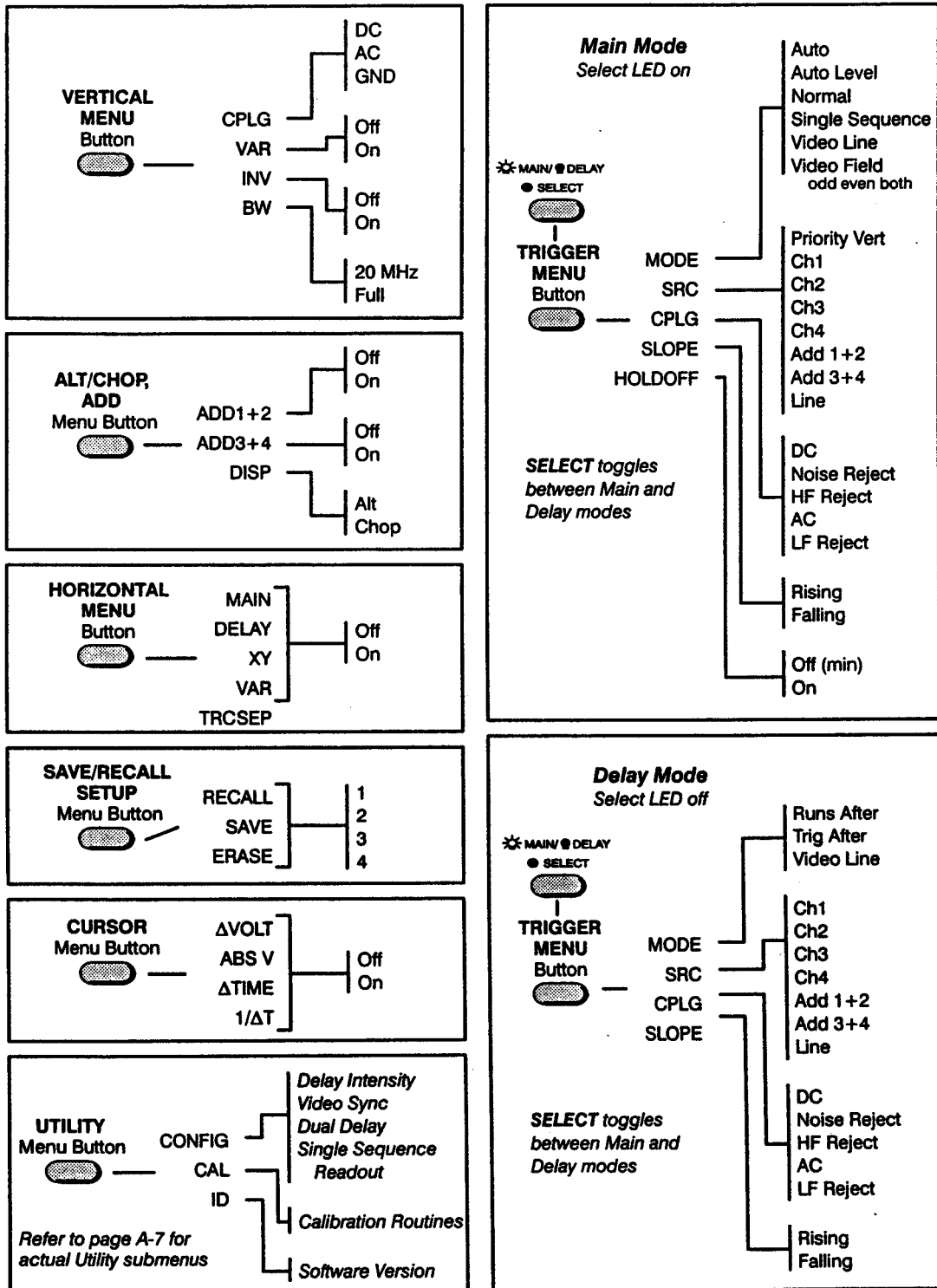


Figure 3-2: Menu Map

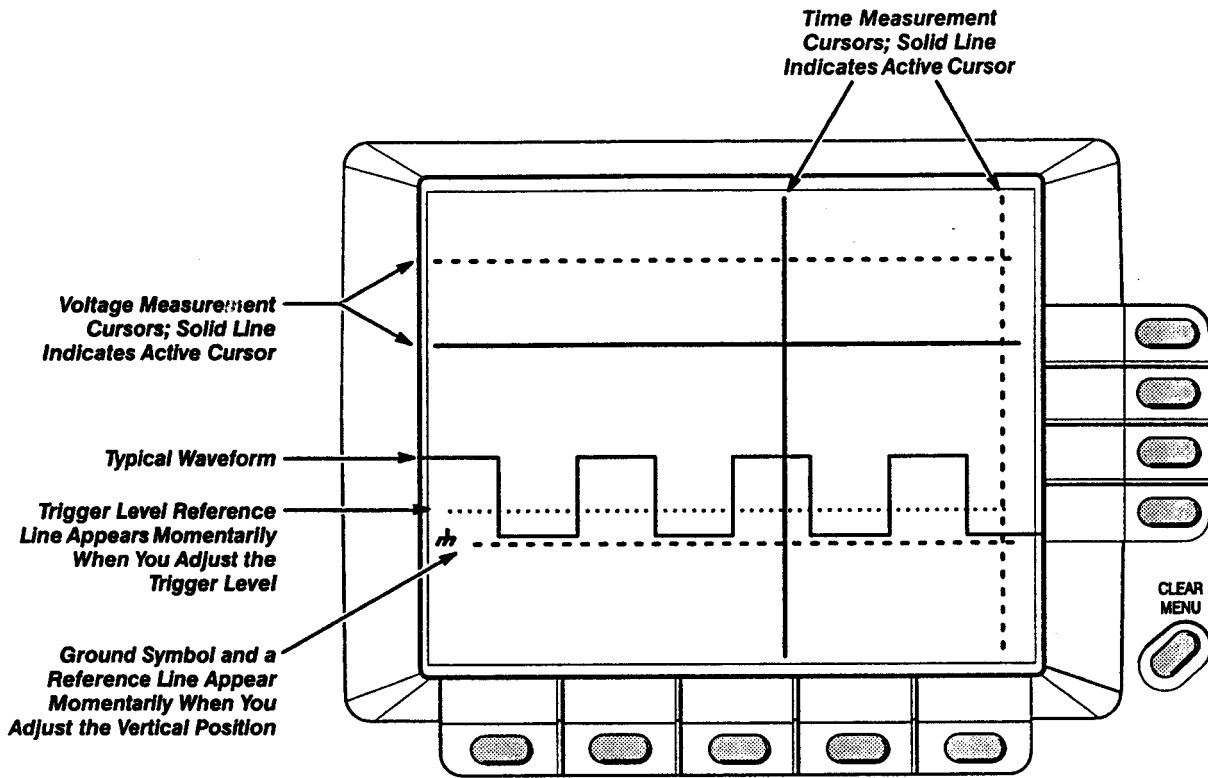


Figure 3-5: Waveform References

Using Basic Features

This section provides step-by-step instructions for using several basic features of the TAS 475 and TAS 485 Analog Oscilloscopes.

Displaying Repetitive Signals

Repetitive signals have a recurring pattern, where the amplitude and frequency do not change from one cycle to the next. The following steps describe how to display a repetitive signal, although pressing the **AUTOSET** button performs these tasks for you.

1. Adjust the vertical **POSITION** control to display the waveform at vertical center and the **VOLTS/DIV** control to provide the resolution desired.
2. Press the **TRIGGER MENU** button and set your triggering environment as desired from the menu choices.
3. Press the **VERTICAL MENU** button and set your vertical environment as desired from the menu choices.
4. Adjust the horizontal **POSITION** control to center the display horizontally and adjust the **SEC/DIV** control to display at least one complete cycle of the waveform.

Magnifying Your Signal

The **MAG** button horizontally magnifies the sweep by a factor of ten. This can be very useful in viewing a fast signal transition.

1. Connect the probe to the **PROBE COMP** output on the front panel and press **AUTOSET**.
2. Adjust the volts/div scale to obtain one complete cycle of the waveform for every horizontal division.
3. Press the **MAG** button, expanding the waveform horizontally by a factor of ten.

Take all measurements as usual, noting that the displayed readout for the sec/div scale has now increased by a factor of ten and the $\times 10$ indicator appears next to the sec/div scale.

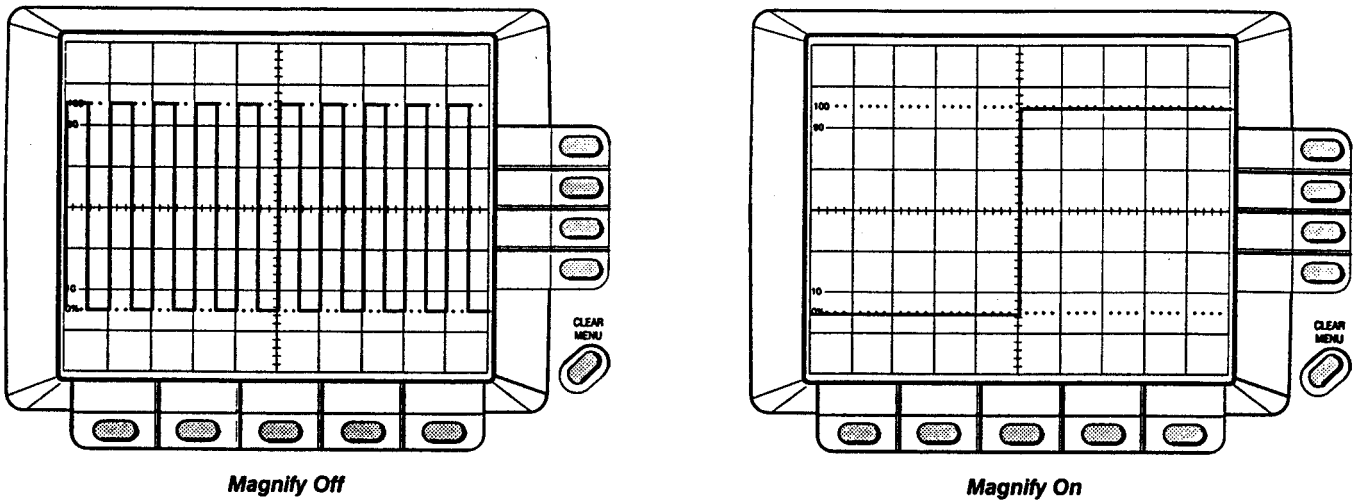
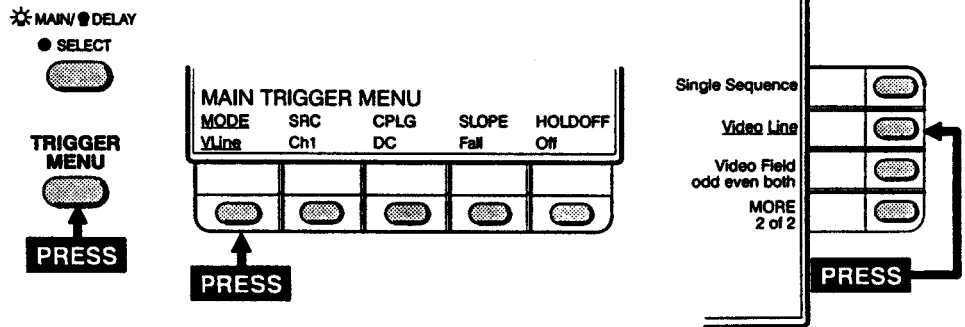


Figure 3-6: Horizontal Magnification

Displaying Video Signals

Video signals contain both horizontal and vertical sync pulses. The trigger system has modes to identify either of these pulses and produce a trigger.

1. Set the trigger mode to video line or video field (use the following guide).



2. Set the **SRC** to the appropriate trigger source.
3. Set the **SLOPE** to **Falling** for a standard composite video signal. Select **Rising** for inverted video signals.
4. Set the vertical and horizontal controls to produce the desired display. Figure 3-7 illustrates a typical triggered TV signal.

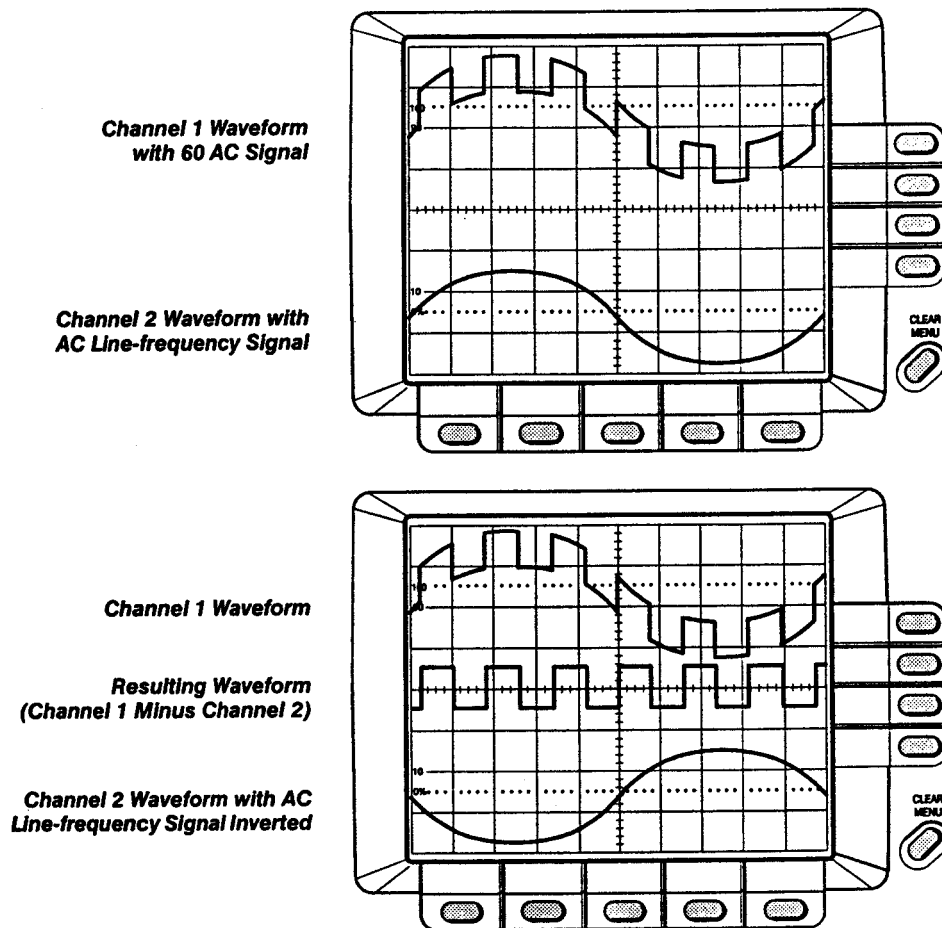


Figure 3-8: Subtracting Components of a Waveform

Using the Delayed Sweep with Delayed Triggering

Delayed triggering allows you to set a time delay from the triggering event for the main sweep to start the delayed sweep. This enables you to effectively increase the resolution of a portion of the main sweep by displaying a segment of the main sweep using the delayed sweep.

1. Connect **CH 1** to the **PROBE COMP** signal using the standard accessory probe.
2. Press the **AUTOSET** button.
3. Use the **SEC/DIV** control to set the sec/div scale to 2 ms.
4. Turn the delayed sweep on (use the following guide).

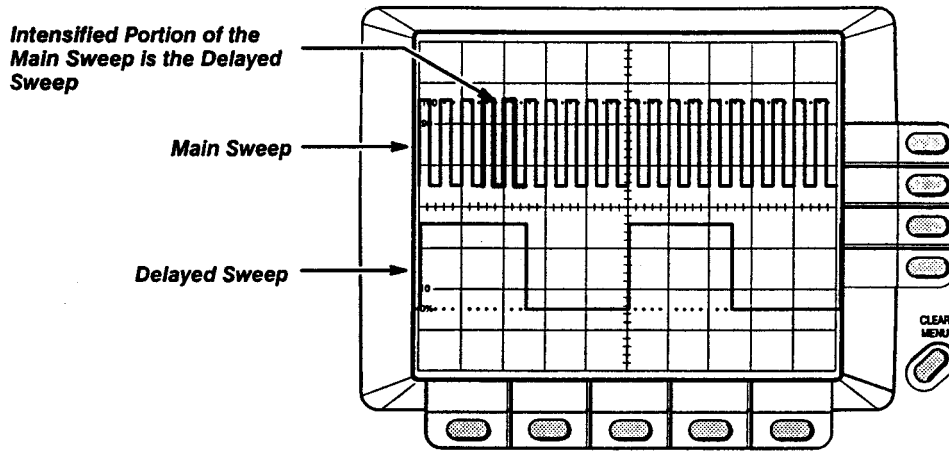
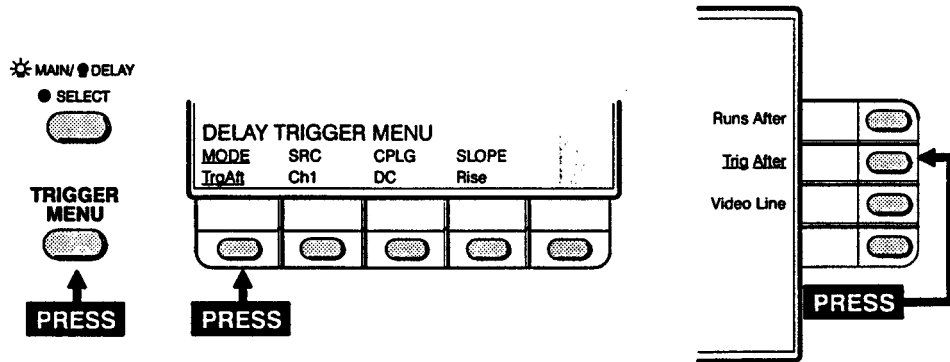


Figure 3-9: Using the Delayed Sweep

11. Set the trigger mode to trig after, causing the delayed sweep to start after the delay setting and an appropriate trigger (use the following guide).

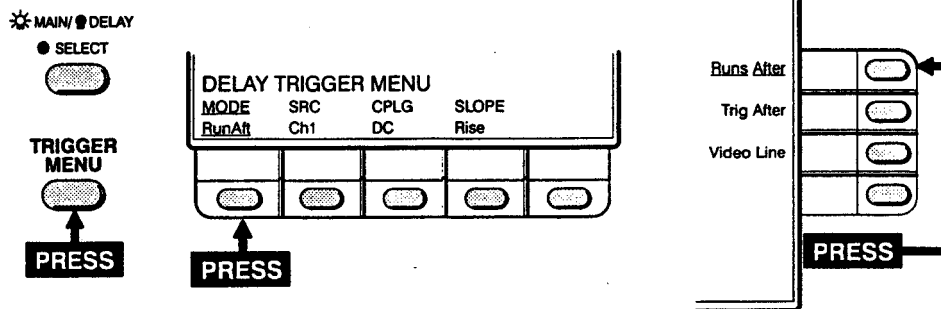


At this point, the two waveforms are still displayed, since an appropriate trigger signal is available. Adjusting the trigger **LEVEL** control out of the range of the waveform causes the delayed sweep to stop, since an appropriate trigger signal is no longer available.

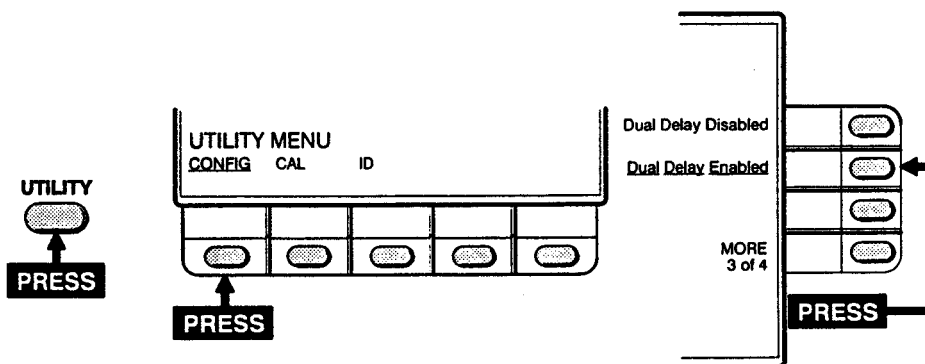
Using Dual Delay

Dual delay displays two intensified zones on the main sweep, each defining the start point of a delayed sweep. This method more accurately measures time between two points on the main sweep than obtained with the measurement cursors.

1. Set the trigger mode to runs after (use the following guide).

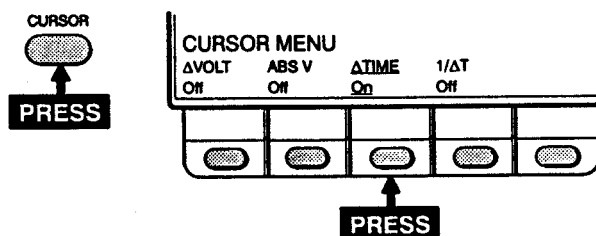


2. Press the **UTILITY** button and select **CONFIG** from the main menu.
3. Select **MORE** until you can select **Dual Delay Enabled** (use the following guide).



4. Press the **CURSOR** button and set Δ TIME to On (use the following guide).

Notice that turning a measurement cursor on automatically turns a previously selected measurement cursor off.



5. Set the delay sec/div scale to 100 μ s.
You now have two intensified zones displayed on the main sweep.
6. Adjust the position of the intensified zones using the General Purpose Knob. Use the **TOGGLE** button to select which zone to move.

Notice that the delayed sweep now consists of two delayed sweeps, each representing one of the intensified zones. When the two delayed sweeps appear as one, the intensified zones are at exactly the same position of the cycle of the main sweep. Figure 3-10 shows the intensified portions on the main sweep and the delayed sweeps positioned together.

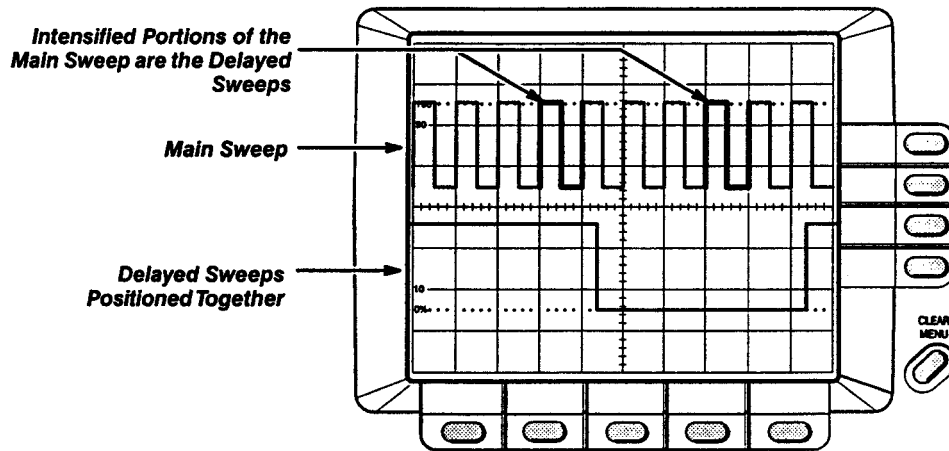


Figure 3-10: Using Dual Delay

Saving and Recalling Front Panel Setups

The TAS 475 and TAS 485 Oscilloscopes provide four locations for you to store front-panel settings. This feature is very helpful when you have completed a complex front panel setup and you want to be able to recall the setup later.

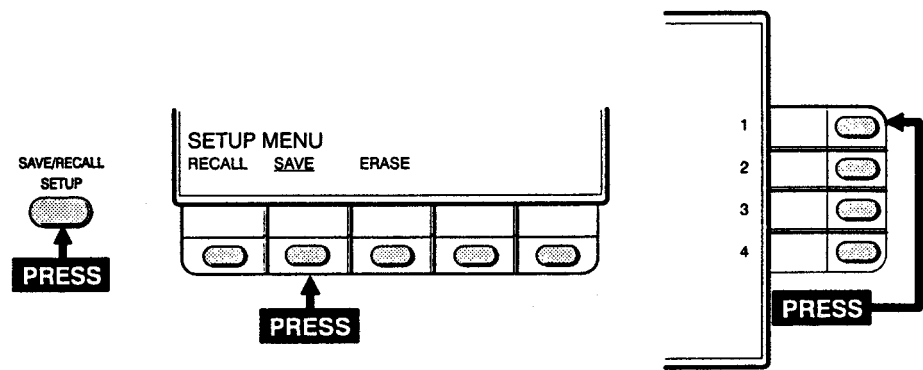
Saving a Setup

Use this procedure to save a front-panel setup.

1. Press the **SAVE/RECALL SETUP** button to display the setup menu.
2. Select **SAVE** and memory location 1, placing the setup in memory location one (use the following guide).

NOTE

Selecting a location previously used will replace the old settings with the new settings. Setup locations underscored contain a stored front-panel setup.



Once you have saved a particular front-panel setup, you can change the settings as you wish, knowing that you can retrieve the original setup at any time.

Recalling a Setup

Use this procedure to recall a front-panel setup.

1. Press the **SAVE/RECALL SETUP** button to display the setup menu.
2. Select **RECALL** with the menu buttons.
3. Select the location from which you want to retrieve the front-panel settings (setup 1 through setup 4). Setup locations underscored contain a front-panel setup.

The oscilloscope returns the front-panel settings to those in the selected setup location.

Erasing a Setup

If you wish, you can erase any setup location.

1. Press the **SAVE/RECALL SETUP** button to display the setup menu.
2. Select **ERASE** with the menu buttons.
3. Select the location you wish to erase (setup 1 through setup 4). Setup locations underscored contain a front-panel setup.

The selected setup location is now empty.

Taking Measurements

This section provides procedures for taking several different types of measurements related to time and voltage. Since the cursor measurement system takes measurements easily and quickly, all measurements discussed in this section use the cursors.

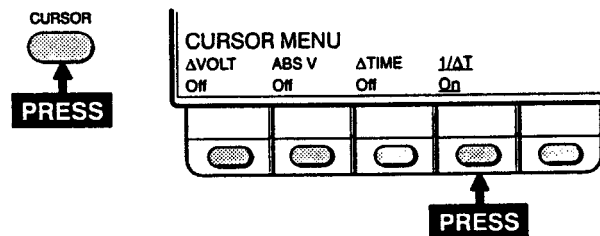
Taking Time Related Measurements

You can take frequency, period, and time between event measurements with the cursor measurement system. The following procedures provide you with quick and easy methods to take these measurements.

Measuring the Frequency and Period

Measuring the frequency and period of a waveform are both time related measurements. You measure frequency in hertz (Hz) and period in seconds.

1. Obtain a stable display with at least one complete cycle of the waveform displayed.
2. Turn the $1/\Delta T$ cursors on to measure frequency (use the following guide).



3. Using the General Purpose Knob, move the active cursor along the waveform to a starting point for the measurement. A good place for this first cursor is midway on the rising portion of the waveform.
4. Press the **TOGGLE** button to activate the second cursor. Using the General Purpose Knob, move this second cursor to the same position on the waveform that is one complete cycle away. See Figure 3-11 for placement of cursors.
5. After you place the cursors, read the frequency of the waveform displayed in Hz on the CRT.

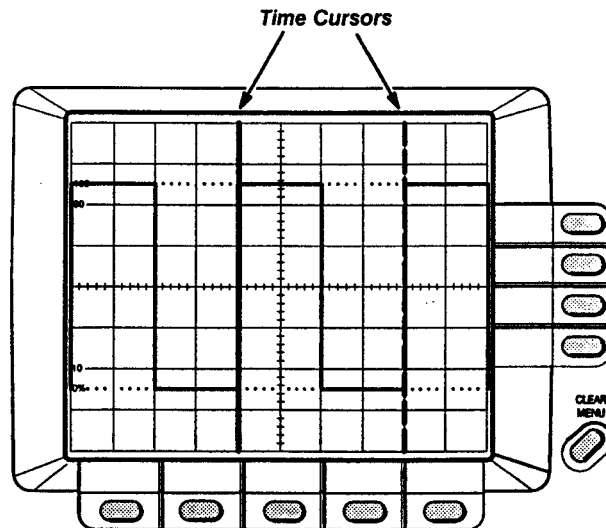
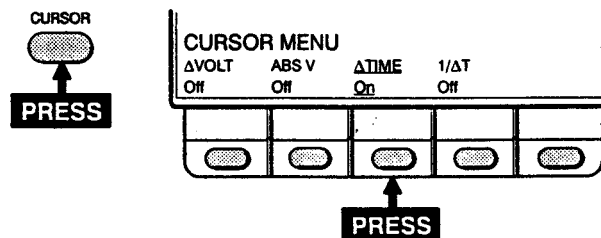


Figure 3-11: Measuring the Frequency of a Waveform

- Change the displayed measurement from frequency to time by turning the Δ TIME cursors on (use the following guide).



NOTE

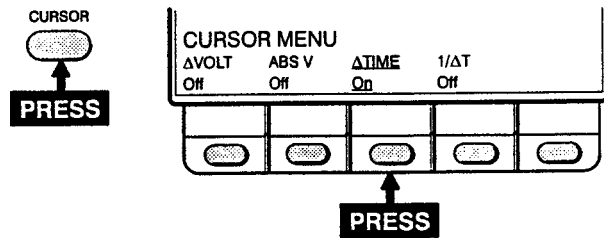
Do not move the placement of the cursors. Use the same waveform and cursor placement, as used in the frequency measurement, to measure the period.

- Read the period of the waveform displayed in seconds on the CRT.

Measuring Pulse Width

You can measure a pulse width with the time measurement cursors.

- Obtain a stable display with at least one complete cycle of the waveform displayed.
- Turn the Δ TIME cursors on (use the following guide).



3. Use the General Purpose Knob to move the active cursor along the waveform to a starting point for the measurement.
4. Press the **TOGGLE** button to activate the second cursor. Use the General Purpose Knob to move this second cursor to the place on the waveform where you want to measure time in relation to the first cursor.

Placing the cursors at the rising edge and the falling edge gives the pulse width measurement. See Figure 3-12 for placement of cursors.

5. The time (pulse width) in seconds appears on the CRT.

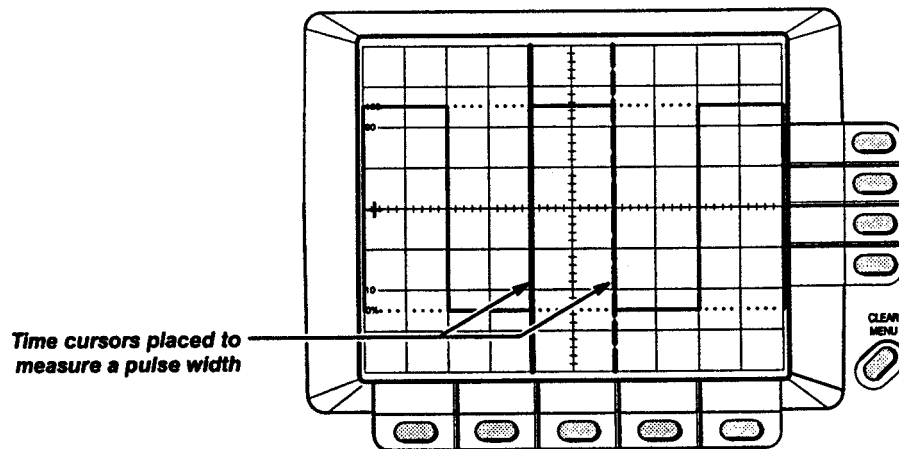
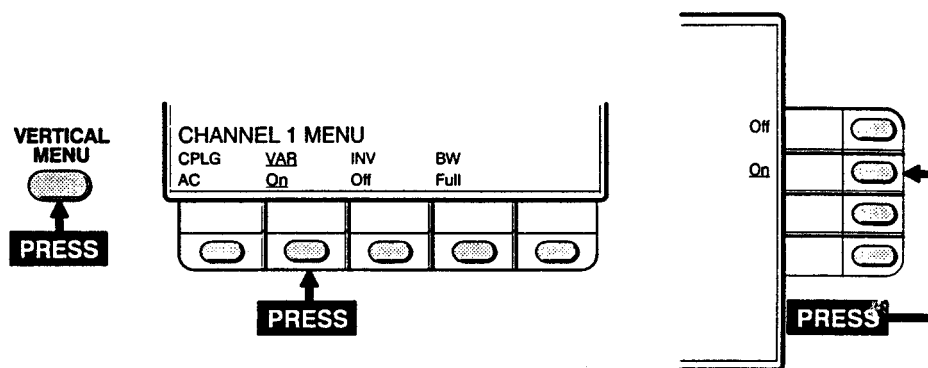


Figure 3-12: Taking Time Measurements

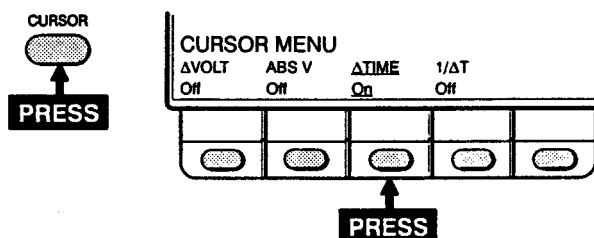
Taking Rise/Fall Time Measurements

Typically, you measure the rise and fall times between the 10% and 90% portions of the waveform. See Figure 3-13 to help take these measurements.

1. Obtain a stable display with at least one complete cycle of the waveform displayed.
2. Adjust the sec/div scale to display the rising or falling edge of the waveform.
3. Set the variable volts/div to on (use the following guide).



4. Adjust the volts/div scale, vertical position, and the General Purpose Knob (to adjust the variable gain) to obtain a centered six-division signal.
5. Set the time measurement cursors on (use the following guide).



6. Use the General Purpose Knob to move the active cursor to the point on the waveform where it crosses the 10% location of the waveform. This location is marked on the CRT graticule. See Figure 3-13 for placement of cursors.

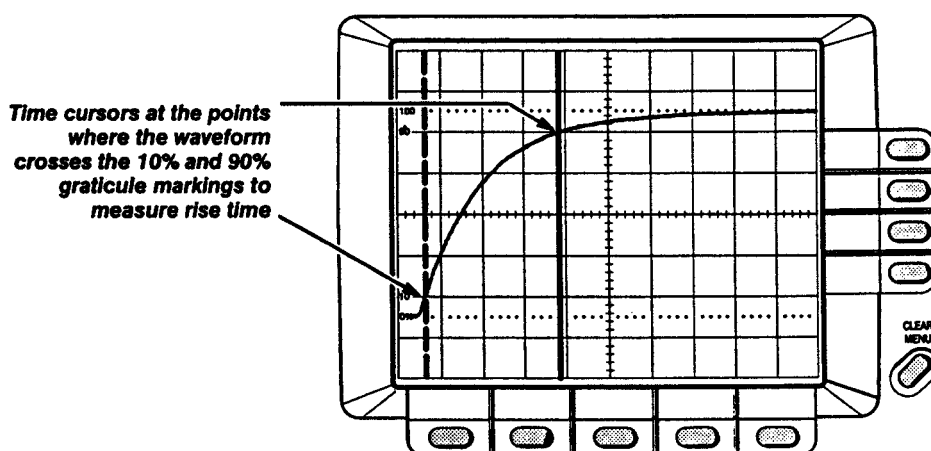


Figure 3-13: Taking Rise/Fall Time Measurements

7. Press the TOGGLE button to activate the second cursor. Using the General Purpose Knob, move this second cursor to the 90% location of the waveform. This location is marked on the CRT graticule.

- The rise time in seconds appears on the CRT.

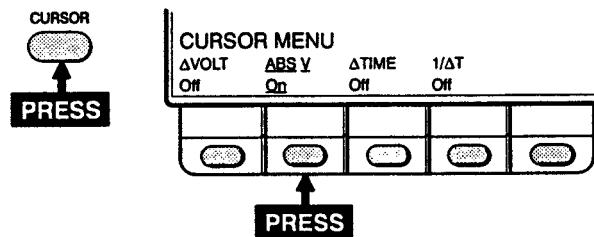
Taking Voltage Related Measurements

You can take voltage measurements either as an absolute value or a differential (delta) value. Absolute voltage measurement is the voltage referenced to ground. Differential voltage measurement is the difference between the two cursors, typically referred to as the delta (Δ) value.

Absolute Voltage Measurement

The absolute volts measurement measures the DC value of a signal or a plain DC voltage. Only one cursor is active for this type of measurement.

- Obtain a stable display.
- Set vertical coupling to DC and adjust the volts/div scale and position to view the waveform.
- Set the cursors to measure the absolute voltage (use the following guide).



- Using the General Purpose Knob, move the cursor along the waveform to obtain the DC voltage level referenced to ground. See Figure 3-14 for placement of cursor.
- The voltage appears on the CRT.

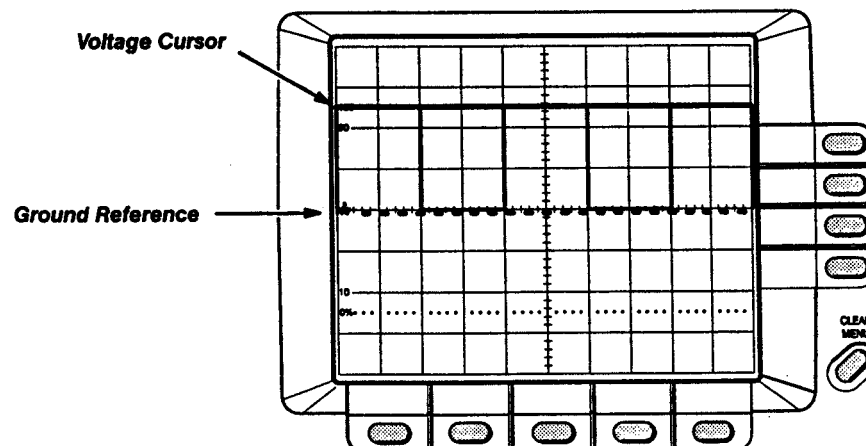
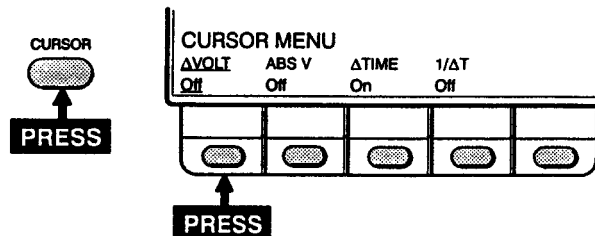


Figure 3-14: Taking an Absolute Voltage Measurement

Delta Voltage Measurement

The delta volts measurement measures the volts between the two horizontal cursors.

1. Obtain a stable display.
2. Set the cursors to measure delta volts (use the following guide).



3. Use the General Purpose Knob to move the first cursor along the waveform as a reference point for the measurement.
4. Press the **TOGGLE** button to activate the second cursor. Use the General Purpose Knob to move this second cursor along the waveform to the point where you want to make the measurement in reference to the placement of the first cursor. See Figure 3-15 for placement of cursors.
5. The delta voltage appears on the CRT.

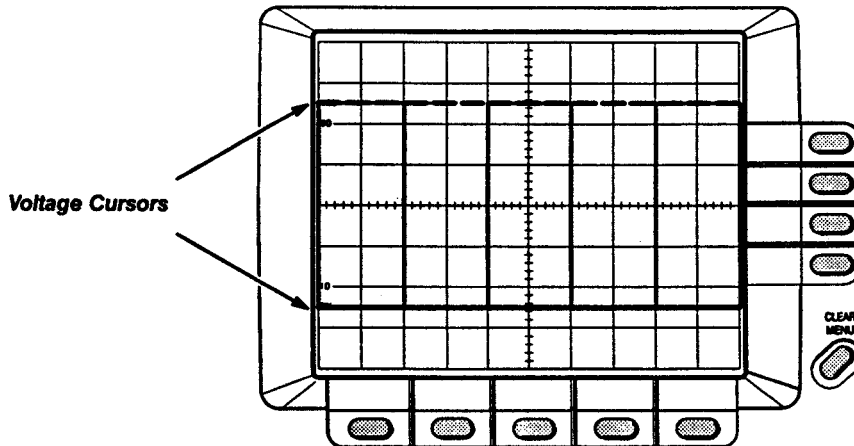


Figure 3-15: Taking a Delta Voltage Measurement

Specifications

1111

Nominal Traits

This subsection contains a collection of tables that list the various *nominal traits* that describe the TAS 475 and TAS 485 Analog Oscilloscopes. Included are electrical and mechanical traits.

Nominal traits are described using simple statements of fact such as “Four, all identical” for the trait “Number of Input Channels,” rather than in terms of limits that are performance requirements.

Table 4-1: Nominal Traits — Vertical Deflection System

Name	Description
Number of Input Channels	Four, all identical, called CH 1, CH 2, CH 3, and CH 4.
Input Coupling	DC, AC, or GND. GND input coupling disconnects the input connector from the attenuator and connects a ground reference to the input of the attenuator.
Sensitivity Range	2 mV/div to 5 V/div. The sensitivity ranges from 2 mV/div to 5 V/div in a 1–2–5 sequence.
Trace Separation Control Range	≥ ±4 divisions.
Bandwidth Selections	20 MHz and FULL, selected independently for each channel.
TAS 475 Rise Time	≤ 3.5 ns. Nominal rise times are calculated from the following formula:
$\text{Rise Time (ns)} = \frac{350}{\text{BW (MHz)}}$	
TAS 485 Rise Time	≤ 1.75 ns. Nominal rise times are calculated from the following formula:
$\text{Rise Time (ns)} = \frac{350}{\text{BW (MHz)}}$	
Vertical Position Range	≥ ±10 divisions from graticule center.
TekProbe Interface	Detects 1X, 10X, and 100X attenuator probes.

Table 4-2: Nominal Traits — Time Base System

Name	Description
TAS 475 Main Seconds/Division Range	20 ns/div to 0.5 s/div. The seconds/division ranges from 20 ns/div to 0.5 s/div in a 1–2–5 sequence of settings. The X10 magnifier extends the maximum sweep speed to 2 ns/div.
TAS 485 Main Seconds/Division Range	10 ns/div to 0.5 s/div. The seconds/division ranges from 10 ns/div to 0.5 s/div in a 1–2–5 sequence of settings. The X10 magnifier extends the maximum sweep speed to 1 ns/div.
TAS 475 Delayed Seconds/Division Range	20 ns/div to 5 ms/div. The seconds/division ranges from 20 ns/div to 5 ms/div in a 1–2–5 sequence of settings. The X10 magnifier extends the maximum sweep speed to 2 ns/div.
TAS 485 Delayed Seconds/Division Range	10 ns/div to 5 ms/div. The seconds/division ranges from 10 ns/div to 5 ms/div in a 1–2–5 sequence of settings. The X10 magnifier extends the maximum sweep speed to 1 ns/div.
Sweep Length	> 10 divisions.
Delay Control Range	0.15 division to 10 times the Main seconds/division setting. The maximum value can not exceed the end of the Main sweep.
Delta Time Control Range	0 to 10 divisions to the right of setting of the delay control, but maximum value does not exceed end of the Main sweep.

Table 4-3: Nominal Traits — Triggering System

Name	Description						
Trigger Level or Threshold Ranges	The ranges are as follows: <table border="1" data-bbox="603 1377 1444 1576"> <thead> <tr> <th>Source</th> <th>Range</th> </tr> </thead> <tbody> <tr> <td>Internal</td> <td>±15 divisions from center of screen with ground at center graticule.</td> </tr> <tr> <td>Line</td> <td>±400 V.</td> </tr> </tbody> </table>	Source	Range	Internal	±15 divisions from center of screen with ground at center graticule.	Line	±400 V.
Source	Range						
Internal	±15 divisions from center of screen with ground at center graticule.						
Line	±400 V.						

Table 4-4: Nominal Traits — Video Triggering System

Name	Description
Slope Selection	Slope selection must match the polarity of the sync (i.e., for negative going sync, negative slope must be selected). A default slope selection for TV trigger modes can be entered in the scope configuration menu.

Table 4-5: Nominal Traits — Cursors

Name	Description
Cursor Functions	Δ Time, 1/ Δ Time, Absolute Volts, Δ Volts, Track Trig Level, Ground.

Table 4-6: Nominal Traits — XY Operation

Name	Description
Sensitivity Range	Same as Vertical Deflection System. Volts/div variables in calibrated settings.

Table 4-7: Nominal Traits — Setup Memory Characteristics

Name	Description
Nonvolatile Setup Memory	4 Setups.

Table 4-8: Nominal Traits — Power Fuse

Name	Description									
Fuse Rating	Either of two fuses may be used. Fuse types are as follows:									
	<table border="1"> <thead> <tr> <th><i>Voltage Range</i></th> <th><i>Fuse (250 V) UL 198.6 (5 × 20 mm)</i></th> <th><i>Fuse (250 V) IEC 127 (5 × 20 mm)</i></th> </tr> </thead> <tbody> <tr> <td>90 — 132 VAC</td> <td>3 A Fast.</td> <td>3.15 A Fast.</td> </tr> <tr> <td>180 — 250 VAC</td> <td>3 A Fast.</td> <td>1.5 A Fast.</td> </tr> </tbody> </table>	<i>Voltage Range</i>	<i>Fuse (250 V) UL 198.6 (5 × 20 mm)</i>	<i>Fuse (250 V) IEC 127 (5 × 20 mm)</i>	90 — 132 VAC	3 A Fast.	3.15 A Fast.	180 — 250 VAC	3 A Fast.	1.5 A Fast.
<i>Voltage Range</i>	<i>Fuse (250 V) UL 198.6 (5 × 20 mm)</i>	<i>Fuse (250 V) IEC 127 (5 × 20 mm)</i>								
90 — 132 VAC	3 A Fast.	3.15 A Fast.								
180 — 250 VAC	3 A Fast.	1.5 A Fast.								

Table 4-10: Warranted Characteristics — Vertical Deflection System (Cont.)

Name	Description												
TAS 475 Bandwidth at the BNC Input	100 MHz.												
TAS 485 Bandwidth at the BNC input	The limits are as follows:												
	<table border="1"> <thead> <tr> <th>Condition</th> <th>Bandwidth</th> </tr> </thead> <tbody> <tr> <td>-10° C to +35° C</td> <td></td> </tr> <tr> <td>5 mV/div to 5 V/div ranges</td> <td>200 MHz.</td> </tr> <tr> <td>2 mV/div range</td> <td>180 MHz.</td> </tr> <tr> <td>+35° C to +55° C</td> <td></td> </tr> <tr> <td>All ranges</td> <td>Subtract 1 MHz/°C above +35° C.</td> </tr> </tbody> </table>	Condition	Bandwidth	-10° C to +35° C		5 mV/div to 5 V/div ranges	200 MHz.	2 mV/div range	180 MHz.	+35° C to +55° C		All ranges	Subtract 1 MHz/°C above +35° C.
Condition	Bandwidth												
-10° C to +35° C													
5 mV/div to 5 V/div ranges	200 MHz.												
2 mV/div range	180 MHz.												
+35° C to +55° C													
All ranges	Subtract 1 MHz/°C above +35° C.												
TAS 475 Bandwidth at the probe tip, using the Standard-Accessory Probe	The limits are as follows:												
	<table border="1"> <thead> <tr> <th>Condition</th> <th>Bandwidth</th> </tr> </thead> <tbody> <tr> <td>+15° C to +35° C</td> <td>100 MHz.</td> </tr> <tr> <td>-10° C to +15° C and +35° C to +55° C</td> <td>90 MHz.</td> </tr> </tbody> </table>	Condition	Bandwidth	+15° C to +35° C	100 MHz.	-10° C to +15° C and +35° C to +55° C	90 MHz.						
Condition	Bandwidth												
+15° C to +35° C	100 MHz.												
-10° C to +15° C and +35° C to +55° C	90 MHz.												
TAS 485 Bandwidth at the probe tip, using the Standard-Accessory Probe	The limits are as follows:												
	<table border="1"> <thead> <tr> <th>Condition</th> <th>Bandwidth</th> </tr> </thead> <tbody> <tr> <td>+15° C to +35° C</td> <td>200 MHz.</td> </tr> <tr> <td>-10° C to +15° C and +35° C to +55° C</td> <td>180 MHz.</td> </tr> </tbody> </table>	Condition	Bandwidth	+15° C to +35° C	200 MHz.	-10° C to +15° C and +35° C to +55° C	180 MHz.						
Condition	Bandwidth												
+15° C to +35° C	200 MHz.												
-10° C to +15° C and +35° C to +55° C	180 MHz.												
Lower Frequency Limit, AC Coupled	<p>≤ 10 Hz with 1X probe.</p> <p>The AC Coupled Lower Frequency Limits are reduced by a factor of 10 when 10X, passive probes are used.</p>												
TAS 475 Crosstalk (Channel Isolation)	≥ 50 dB at 10 MHz, ≥ 35 dB at 100 MHz.												
TAS 485 Crosstalk (Channel Isolation)	≥ 50 dB at 10 MHz, ≥ 32 dB at 200 MHz.												
Delay Between Channels, Full Bandwidth	≤ 200 ps between any two channels with equal volts/div and coupling settings.												
Common-mode Rejection Ratio (CMRR)	≥ 10:1 at ≤ 50 MHz.												

Table 4-10: Warranted Characteristics — Vertical Deflection System (Cont.)

Name	Description	
Trace Shift	The limits are as follows:	
	<i>Condition</i>	<i>Allowable Trace Shift</i>
	Changing volts/div settings	$< \pm(0.1 \text{ division} + 0.2 \text{ mV})$.
	Selecting invert	$\leq 0.5 \text{ division}$.
	Changing from bandwidth limit to full bandwidth	$\leq 0.1 \text{ division}$.
Maximum Input Voltage	$\pm 400 \text{ V}$ (DC + peak AC); derate at 20 dB/decade from 100 kHz to 13 V at 3 MHz.	
Low Frequency Linearity	Within $\pm 5\%$.	

Table 4-11: Warranted Characteristics — Time Base System

Name	Description	
Time Base Accuracy, Magnify Off	The limits are as follows:	
	<i>Conditions</i>	<i>Time Measurement Accuracy</i>
	+15° C to +35° C	$\pm 2\%$.
	-10° C to +15° C and +35° C to +55° C	$\pm 3\%$.
	Sweep accuracy applies over the center eight divisions. Excludes the greater of either the first $\frac{1}{4}$ division or 25 ns from the sweep start of the magnified sweep and anything beyond the 100th magnified division.	

Table 4-11: Warranted Characteristics — Time Base System (Cont.)

Name	Description								
TAS 475 Time Base Accuracy, Magnify On	The limits are as follows:								
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th data-bbox="608 348 738 379"><i>Conditions</i></th> <th data-bbox="1031 348 1382 379"><i>Time Measurement Accuracy</i></th> </tr> </thead> <tbody> <tr> <td data-bbox="608 404 826 430">-10° C to + 55° C</td> <td data-bbox="1031 462 1102 488">± 4%.</td> </tr> <tr> <td data-bbox="608 540 839 567">+15° C to + 35° C</td> <td data-bbox="1031 598 1102 625">± 3%.</td> </tr> <tr> <td data-bbox="608 654 892 710">-10° C to + 15° C and +35° C to + 55° C</td> <td data-bbox="1031 741 1102 768">± 5%.</td> </tr> </tbody> </table>	<i>Conditions</i>	<i>Time Measurement Accuracy</i>	-10° C to + 55° C	± 4%.	+15° C to + 35° C	± 3%.	-10° C to + 15° C and +35° C to + 55° C	± 5%.
	<i>Conditions</i>	<i>Time Measurement Accuracy</i>							
	-10° C to + 55° C	± 4%.							
+15° C to + 35° C	± 3%.								
-10° C to + 15° C and +35° C to + 55° C	± 5%.								
Sweep accuracy applies over the center eight divisions. Excludes the greater of either the first ¼ division or 25 ns from the sweep start of the magnified sweep and anything beyond the 100th magnified division.									
TAS 485 Time Base Accuracy, Magnify On	The limits are as follows:								
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th data-bbox="608 990 738 1021"><i>Conditions</i></th> <th data-bbox="1031 990 1382 1021"><i>Time Measurement Accuracy</i></th> </tr> </thead> <tbody> <tr> <td data-bbox="608 1046 826 1073">-10° C to + 55° C</td> <td data-bbox="1031 1104 1102 1131">± 4%.</td> </tr> <tr> <td data-bbox="608 1183 839 1210">+15° C to + 35° C</td> <td data-bbox="1031 1241 1102 1268">± 3%.</td> </tr> <tr> <td data-bbox="608 1297 892 1353">-10° C to + 15° C and +35° C to + 55° C</td> <td data-bbox="1031 1384 1102 1411">± 7%.</td> </tr> </tbody> </table>	<i>Conditions</i>	<i>Time Measurement Accuracy</i>	-10° C to + 55° C	± 4%.	+15° C to + 35° C	± 3%.	-10° C to + 15° C and +35° C to + 55° C	± 7%.
	<i>Conditions</i>	<i>Time Measurement Accuracy</i>							
	-10° C to + 55° C	± 4%.							
+15° C to + 35° C	± 3%.								
-10° C to + 15° C and +35° C to + 55° C	± 7%.								
Sweep accuracy applies over the center eight divisions. Excludes the greater of either the first ¼ division or 25 ns from the sweep start of the magnified sweep and anything beyond the 100th magnified division.									
Horizontal Position Control Range	The position control is able to move the start of the sweep to the right of the center vertical graticule and able to move a time mark corresponding to the tenth division on an unmagnified sweep to the left of the graticule center.								
Variable Control Range	Continuously variable between calibrated seconds/division settings. Extends both the Main and Delayed sweep seconds/division settings by a factor of 2.5 times.								

Table 4-11: Warranted Characteristics — Time Base System (Cont.)

Name	Description
Delay Accuracy, Main Sweep Trigger Point to Start of Delayed Sweep	$\pm(0.5\% \text{ of reading} + 5\% \text{ of 1 division of the Main sweep} + 25 \text{ ns})$.
Delta Delay Accuracy	$\pm(0.5\% \text{ of reading} + 5\% \text{ of 1 division of the Main sweep} + 10 \text{ ns})$.

Table 4-12: Warranted Characteristics — Triggering System

Name	Description												
TAS 475 Edge-Type Trigger Sensitivity, DC Coupled	The limits are as follows:												
	<table border="1"> <thead> <tr> <th>Trigger Source</th> <th>Sensitivity</th> </tr> </thead> <tbody> <tr> <td>Any Channel</td> <td>0.30 division from DC to 25 MHz, increasing to 1 div at 150 MHz.</td> </tr> </tbody> </table>	Trigger Source	Sensitivity	Any Channel	0.30 division from DC to 25 MHz, increasing to 1 div at 150 MHz.								
	Trigger Source	Sensitivity											
Any Channel	0.30 division from DC to 25 MHz, increasing to 1 div at 150 MHz.												
TAS 485 Edge-Type Trigger Sensitivity, DC Coupled	The limits are as follows:												
	<table border="1"> <thead> <tr> <th>Trigger Source</th> <th>Sensitivity</th> </tr> </thead> <tbody> <tr> <td>Any Channel</td> <td>0.30 division from DC to 25 MHz, increasing to 1.5 div at 250 MHz.</td> </tr> </tbody> </table>	Trigger Source	Sensitivity	Any Channel	0.30 division from DC to 25 MHz, increasing to 1.5 div at 250 MHz.								
	Trigger Source	Sensitivity											
Any Channel	0.30 division from DC to 25 MHz, increasing to 1.5 div at 250 MHz.												
Trigger Level or Threshold Accuracy	The limits are as follows for signals having rise and fall times $\geq 20 \text{ ns}$:												
	<table border="1"> <thead> <tr> <th>Coupling</th> <th>Source</th> <th>Accuracy</th> </tr> </thead> <tbody> <tr> <td>DC</td> <td>All except Line</td> <td>$\pm(5\% \text{ of reading} + 0.4 \text{ division} + 1 \text{ mV})$.</td> </tr> <tr> <td>Noise Reject</td> <td>All except Line</td> <td>$\pm(5\% \text{ of reading} + 1.1 \text{ division} + 1 \text{ mV})$.</td> </tr> <tr> <td>HF Reject</td> <td>All except Line</td> <td>$\pm(5\% \text{ of reading} + 0.35 \text{ division} + 1 \text{ mV})$.</td> </tr> </tbody> </table>	Coupling	Source	Accuracy	DC	All except Line	$\pm(5\% \text{ of reading} + 0.4 \text{ division} + 1 \text{ mV})$.	Noise Reject	All except Line	$\pm(5\% \text{ of reading} + 1.1 \text{ division} + 1 \text{ mV})$.	HF Reject	All except Line	$\pm(5\% \text{ of reading} + 0.35 \text{ division} + 1 \text{ mV})$.
	Coupling	Source	Accuracy										
	DC	All except Line	$\pm(5\% \text{ of reading} + 0.4 \text{ division} + 1 \text{ mV})$.										
	Noise Reject	All except Line	$\pm(5\% \text{ of reading} + 1.1 \text{ division} + 1 \text{ mV})$.										
HF Reject	All except Line	$\pm(5\% \text{ of reading} + 0.35 \text{ division} + 1 \text{ mV})$.											

Table 4-13: Warranted Characteristics — Video Triggering

Name	Description
Sensitivity	0.75 divisions of composite sync will achieve a stable display.
60 Hz Rejection	Stable video trigger with up to 4 divisions of 60 Hz on the video signal.
Sync Offset	Stable video trigger if sync tip is ± 15 divisions, referenced to input ground.
Sync Separation	Stable trigger on positive or negative composite horizontal sync (lines) video, for all 525/60 and 625/50 video systems which include: NTSC, PAL, and SECAM.
Field Interval	Stable trigger on vertical sync interval $> 20 \mu\text{s}$.

Table 4-14: Warranted Characteristics — Cursors

Name	Description						
Δ Time Cursor to Signal Accuracy	Same as Time Base Accuracy + 0.1 division.						
1/ Δ Time Accuracy	Readouts calculated using Δ Time cursor difference.						
Absolute Volts Accuracy	Accuracies are as follows:						
	<table border="1"> <thead> <tr> <th>Condition</th> <th>Accuracy</th> </tr> </thead> <tbody> <tr> <td>$-10^\circ \text{ C to } +30^\circ \text{ C}$</td> <td>$\pm (1\% \text{ of reading} + 2\% \text{ of one vertical division} + \text{HF display errors} + 0.5 \text{ mV} + \text{trace shift errors})$.</td> </tr> <tr> <td>$+30^\circ \text{ C to } +55^\circ \text{ C}$</td> <td>$\pm (1\% \text{ of reading} + 2\% \text{ of one vertical division} + \text{HF display errors} + 4 \text{ mV} + \text{trace shift errors})$.</td> </tr> </tbody> </table>	Condition	Accuracy	$-10^\circ \text{ C to } +30^\circ \text{ C}$	$\pm (1\% \text{ of reading} + 2\% \text{ of one vertical division} + \text{HF display errors} + 0.5 \text{ mV} + \text{trace shift errors})$.	$+30^\circ \text{ C to } +55^\circ \text{ C}$	$\pm (1\% \text{ of reading} + 2\% \text{ of one vertical division} + \text{HF display errors} + 4 \text{ mV} + \text{trace shift errors})$.
Condition	Accuracy						
$-10^\circ \text{ C to } +30^\circ \text{ C}$	$\pm (1\% \text{ of reading} + 2\% \text{ of one vertical division} + \text{HF display errors} + 0.5 \text{ mV} + \text{trace shift errors})$.						
$+30^\circ \text{ C to } +55^\circ \text{ C}$	$\pm (1\% \text{ of reading} + 2\% \text{ of one vertical division} + \text{HF display errors} + 4 \text{ mV} + \text{trace shift errors})$.						
Δ Volts Cursor to Signal Accuracy	$\pm (1.6\% \text{ of reading} + 2\% \text{ of one vertical division} + \text{HF display errors})$.						

Table 4-15: Warranted Characteristics — XY Operation

Name	Description
XY Accuracy	$\pm 4\%$.
X Bandwidth	DC to at least 3 MHz.
Phase Difference Between X and Y Amplifiers	$\pm 3^\circ$, DC to 150 kHz.

Table 4-16: Warranted Characteristics — Power Requirements

Name	Description
Source Voltage and Frequency	90–132 VAC _{RMS} continuous range for 48 through 440 Hz. 180–250 VAC _{RMS} continuous range for 48 through 440 Hz.
Power Consumption	≤ 85 watts (150 VA).

Table 4-17: Warranted Characteristics — Environmental and Safety

Name	Description
Third Party Certifications	This product shall conform to and be certified where appropriate according to the following requirements: <i>Certification</i>
	Underwriter's Laboratories (UL) Listed or Recognized Component, Electrical and Electronic Measuring and Testing Equipment UL 1244.
	Canadian Standards CSA Association (CSA) Category Certified Electronic Development and Test Equipment, CSA 22.2 no. 231.
	Self-Certification International Electro-Technical Commission (IEC) Self-certified by Tektronix to comply with IEC 348 recommendation.
Temperature: Operating and Nonoperating	Operating: –10° C to +55° C. Nonoperating: –51° C to +71° C.
Humidity: Operating and Nonoperating	To 95% relative humidity at or below +40° C to 75% relative humidity form +41° C to +55° C. A more sever test than stated in MIL–T–28800E, para. 4.5.5.1.1.2.
Altitude: Operating and Nonoperating	Operating: To 4572 m (15,000 ft.). Nonoperating: To 12192 m (40,000 ft.).
Random Vibration: Nonoperating	2.46 g _{RMS} , from 5 to 500 Hz, 10 minutes each axis.
Random Vibration: Operating	0.31 g _{RMS} , from 5 to 500 Hz, 10 minutes each axis.
Emissions	The instrument meets or exceeds the EMC requirements of the following standards: <ul style="list-style-type: none"> ■ VFG 243. ■ FCC Code of Federal Regulations, 47 CFR, Part 15, Subpart B, Class A.
Electrostatic Discharge Susceptibility	IEC 801–2.

Typical Characteristics

This subsection contains tables that lists the various *typical characteristics* that describe the TAS 475 and TAS 485 Analog Oscilloscopes.

Typical characteristics are described in terms of typical or average performance. Typical characteristics are not warranted.

This subsection lists only typical characteristics. A list of warranted characteristics starts on page 4-5.

Table 4-18: Typical Characteristics — Vertical Deflection System

Name	Description	
Upper-Frequency Limit, 20 MHz Bandwidth Limited	20 MHz.	
Trace Shift Leakage	The typical amount of trace shift while changing the input coupling between GND and 1 M Ω DC is as follows:	
	<i>Condition</i>	<i>Typical Trace Shift</i>
	-10° C to +35° C	<0.5 mV.
	+35° C to +55° C	<2 mV.
Variable Volts/Div Offset	0.5 division trace shift while changing the variable volts/div setting.	
Chop Mode Clock Rate	>500 kHz, <1 MHz. Chop mode is allowed from 0.5 s to 10 μ s sec/div settings.	
TAS 475 Noise (measured tangentially)	<ul style="list-style-type: none"> ■ ≤ 0.06 div at ≥ 10 mV/div (600 μV). ■ ≤ 0.10 div at 5 mV/div (500 μV). ■ ≤ 0.14 div at 2 mV/div (280 μV). 	
TAS 485 Noise (measured tangentially)	<ul style="list-style-type: none"> ■ ≤ 0.06 div at ≥ 10 mV/div (600 μV). ■ ≤ 0.10 div at 5 mV/div (500 μV). ■ ≤ 0.15 div at 2 mV/div (300 μV). 	

Table 4-19: Typical Characteristics — Time Base System

Name	Description
Time Base Linearity	<p>±5%.</p> <p>Sweep linearity applies over the center eight divisions. Excludes the greater of either the first ¼ division or 25 ns from the sweep start of the magnified sweep and anything beyond the 100th magnified division.</p>
Delay Jitter	<p>≤ 1 part in 10,000 (20,000 for 1 ms and slower) + 2 ns, peak-to-peak during a two-second time interval. Exclude the first 0.15 divisions of the Main sweep.</p>

Table 4-20: Typical Characteristics — Triggering System

Name	Description		
TAS 475 Edge-Type Trigger Sensitivity, Not DC Coupled	The typical sensitivities are as follows:		
	<i>Trigger Source</i>	<i>Typical Signal Level for Stable Triggering</i>	
	Noise Reject	1.2 divisions from DC to 25 MHz, increasing to 2.2 divisions at 150 MHz. 0.5 division or less will not trigger.	
	HF REJ	0.30 division from DC to 10 kHz; attenuates signals above the upper –3 dB cut-off frequency of 50 kHz.	
	LF REJ	0.30 division from 100 kHz to 25 MHz, increasing to 1.0 division at 150 MHz; attenuates signals below the lower –3 dB cutoff frequency of 50 kHz.	
	AC	0.30 division from 350 Hz to 25 MHz, increasing to 1.0 division at 150 MHz; attenuates signals below the –3 dB cut-off frequency of 160 Hz.	

Table 4-20: Typical Characteristics — Triggering System (Cont.)

Name	Description										
TAS 485 Edge-Type Trigger Sensitivity, Not DC Coupled	The typical sensitivities are as follows:										
	<table border="1"> <thead> <tr> <th><i>Trigger Source</i></th> <th><i>Typical Signal Level for Stable Triggering</i></th> </tr> </thead> <tbody> <tr> <td>Noise Reject</td> <td>1.2 divisions from DC to 25 MHz, increasing to 3.5 divisions at 250 MHz. 0.5 division or less will not trigger.</td> </tr> <tr> <td>HF REJ</td> <td>0.30 division from DC to 10 kHz; attenuates signals above the upper -3 dB cut-off frequency of 50 kHz.</td> </tr> <tr> <td>LF REJ</td> <td>0.30 division from 100 kHz to 25 MHz, increasing to 1.4 division at 250 MHz; attenuates signals below the lower -3 dB cutoff frequency of 50 kHz.</td> </tr> <tr> <td>AC</td> <td>0.30 division from 350 Hz to 25 MHz, increasing to 1.4 division at 250 MHz; attenuates signals below the -3 dB cut-off frequency of 160 Hz.</td> </tr> </tbody> </table>	<i>Trigger Source</i>	<i>Typical Signal Level for Stable Triggering</i>	Noise Reject	1.2 divisions from DC to 25 MHz, increasing to 3.5 divisions at 250 MHz. 0.5 division or less will not trigger.	HF REJ	0.30 division from DC to 10 kHz; attenuates signals above the upper -3 dB cut-off frequency of 50 kHz.	LF REJ	0.30 division from 100 kHz to 25 MHz, increasing to 1.4 division at 250 MHz; attenuates signals below the lower -3 dB cutoff frequency of 50 kHz.	AC	0.30 division from 350 Hz to 25 MHz, increasing to 1.4 division at 250 MHz; attenuates signals below the -3 dB cut-off frequency of 160 Hz.
<i>Trigger Source</i>	<i>Typical Signal Level for Stable Triggering</i>										
Noise Reject	1.2 divisions from DC to 25 MHz, increasing to 3.5 divisions at 250 MHz. 0.5 division or less will not trigger.										
HF REJ	0.30 division from DC to 10 kHz; attenuates signals above the upper -3 dB cut-off frequency of 50 kHz.										
LF REJ	0.30 division from 100 kHz to 25 MHz, increasing to 1.4 division at 250 MHz; attenuates signals below the lower -3 dB cutoff frequency of 50 kHz.										
AC	0.30 division from 350 Hz to 25 MHz, increasing to 1.4 division at 250 MHz; attenuates signals below the -3 dB cut-off frequency of 160 Hz.										
Lowest Frequency for Successful Operation of "Set Level to 50%" Function	50 Hz with 1 division.										
Holdoff Control Range	Increases Main sweep holdoff time by a factor of 10.										

Table 4-21: Typical Characteristics — Video Triggering System

Name	Description
Field Separation	Stable trigger on odd or even fields in interlaced video systems with line rates between 12 kHz and 17 kHz.

Table 4-22: Typical Characteristics — Z-Axis

Name	Description						
Sensitivity	The sensitivity is as follows:						
	<table border="1"> <thead> <tr> <th><i>Condition</i></th> <th><i>Sensitivity</i></th> </tr> </thead> <tbody> <tr> <td>DC to 2 MHz</td> <td>Positive voltage decreases intensity; +2 V blanks a maximum intensity trace.</td> </tr> <tr> <td>2 MHz to 20 MHz</td> <td>+2 V modulates a normal intensity trace. +2 V (DC to 20 MHz) blanks a 1 μA CRT beam.</td> </tr> </tbody> </table>	<i>Condition</i>	<i>Sensitivity</i>	DC to 2 MHz	Positive voltage decreases intensity; +2 V blanks a maximum intensity trace.	2 MHz to 20 MHz	+2 V modulates a normal intensity trace. +2 V (DC to 20 MHz) blanks a 1 μ A CRT beam.
<i>Condition</i>	<i>Sensitivity</i>						
DC to 2 MHz	Positive voltage decreases intensity; +2 V blanks a maximum intensity trace.						
2 MHz to 20 MHz	+2 V modulates a normal intensity trace. +2 V (DC to 20 MHz) blanks a 1 μ A CRT beam.						
Rise Time	<15 ns.						

Typical Characteristics

Table 4-22: Typical Characteristics — Z-Axis (Cont.)

Name	Description
Input Resistance	10 kΩ ±10%.
Maximum Input Voltage	±25 V peak; 25 V _{p-p} AC at 10 kHz or less.

Table 4-23: Typical Characteristics — Probe Compensator

Name	Description	
Probe Compensator Output Voltage and Frequency	The limits are as follows:	
	<i>Characteristic</i> <i>Limits</i>	
	Output Voltage	5 V (base-top) ±10% into a 1 MΩ load.
	Frequency	1 kHz ±5%.

Table 4-24: Typical Characteristics — Setup Memory

Name	Description
Nonvolatile Memory Retention Time	Internal batteries, installed at time of manufacture, have a life of ≥ 10 years when operated and/or stored at an ambient temperature from 0° C to +50° C. Retention time of the nonvolatile memories is equal to the remaining life of the batteries. Battery life can be reduced when the instrument is stored for extended time above +50° C. Retained data may be lost when stored for extended time below 0° C.

WARNING

The following servicing instructions are for use only by qualified personnel. To avoid personnel injury, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so. Refer to General Safety Summary and Service Safety Summary prior to performing any service.

Theory of Operation

Circuit Description

This section describes the electrical operation of the Tektronix TAS 475 and TAS 485 Analog Oscilloscopes, using major circuit blocks.

This section has two main parts:

- **Logic Conventions** describes how logic functions are discussed and represented in this manual.
- **Module Overview** describes circuit operation from a functional-circuit block perspective.

Logic Conventions

The TAS 475 and TAS 485 Analog Oscilloscopes contains digital logic circuits. This manual refers to these circuits with standard logic symbols and terms. Unless otherwise stated, all logic functions are described using the positive-logic convention: the more positive of the two logic levels is the high (1) state, the more negative level is the low (0) state. Signal states may also be described as “true” (meaning their active state) or “false” (meaning their non-active state).

Module Overview

This module overview describes the basic operation of each functional circuit block as shown in Figure 5-1.

General

The Tektronix TAS 475 and TAS 485 Analog Oscilloscopes are portable, four-channel instruments. Each channel provides a calibrated vertical scale factor.

Input Signal Path

A signal enters the oscilloscope through a probe connected to a BNC on the A1 Analog board.

Attenuators — Circuitry on the attenuator hybrid, including the vertical preamplifier IC, selects the input coupling, attenuation factor, variable gain, and the invert function. The processor system controls and calibrates the attenuators.

Probe Coding Interface — Probe coding interface signals pass through the A1 Analog board to the A5 CPU board and then to the A04 Front Panel board. The probe interface signals are digitized on the Front Panel board and communicated to the processor system.

Analog Board — The input signals are routed to the highly integrated analog acquisition hybrid which does the analog processing required to provide vertical, horizontal, and z-axis signals to the A03 Display Driver board. Under control of the processor, the hybrid provides vertical signal processing, triggers, sweeps, sequencing logic, and intensity control.

Processor System

The processor board is a microcontroller design. It consists of a microcontroller as the core of the circuit, operating at 16 MHz. The primary function of the processor is to receive input from the front panel, display the readout, and control the Analog board.

Display Assembly

All information (waveforms, text, and cursors) is displayed by the A03 Display Driver board. It generates the high voltages necessary to drive the CRT. It also contains the vertical and horizontal amplifier circuitry.

Vertical Termination (TAS 485 only) — The A10 Vertical Termination hybrid provides the correct impedance for the vertical deflection plates in the CRT.

Front Panel

The processor system sends and receives information to and from the A04 Front Panel board. The Front Panel board reads the front-panel controls and changes in their settings are reported to the processor system. The Front Panel Processor turns the LEDs on and off, generates the probe compensation signal, and processes the probe coding interface signals.

Menu Switches — Front-panel menu switches are read by the Front Panel board and changes in menu selections are sent to the processor system.

Rear Panel

The External Z-Axis connector provides the ability to modulate the z-axis amplifier circuit on the A03 Display Driver board, thus modulating or blanking the intensity of the CRT display.

Low Voltage Power Supply

The low voltage power supply is a switching power converter. It supplies power to all oscilloscope circuitry.

The **POWER** switch, located on the front panel, controls all power to the oscilloscope including the power supply.

Fan

The fan provides forced air cooling for the oscilloscope. It connects to +12 V on the A63 Power Supply board.

Circuit Description

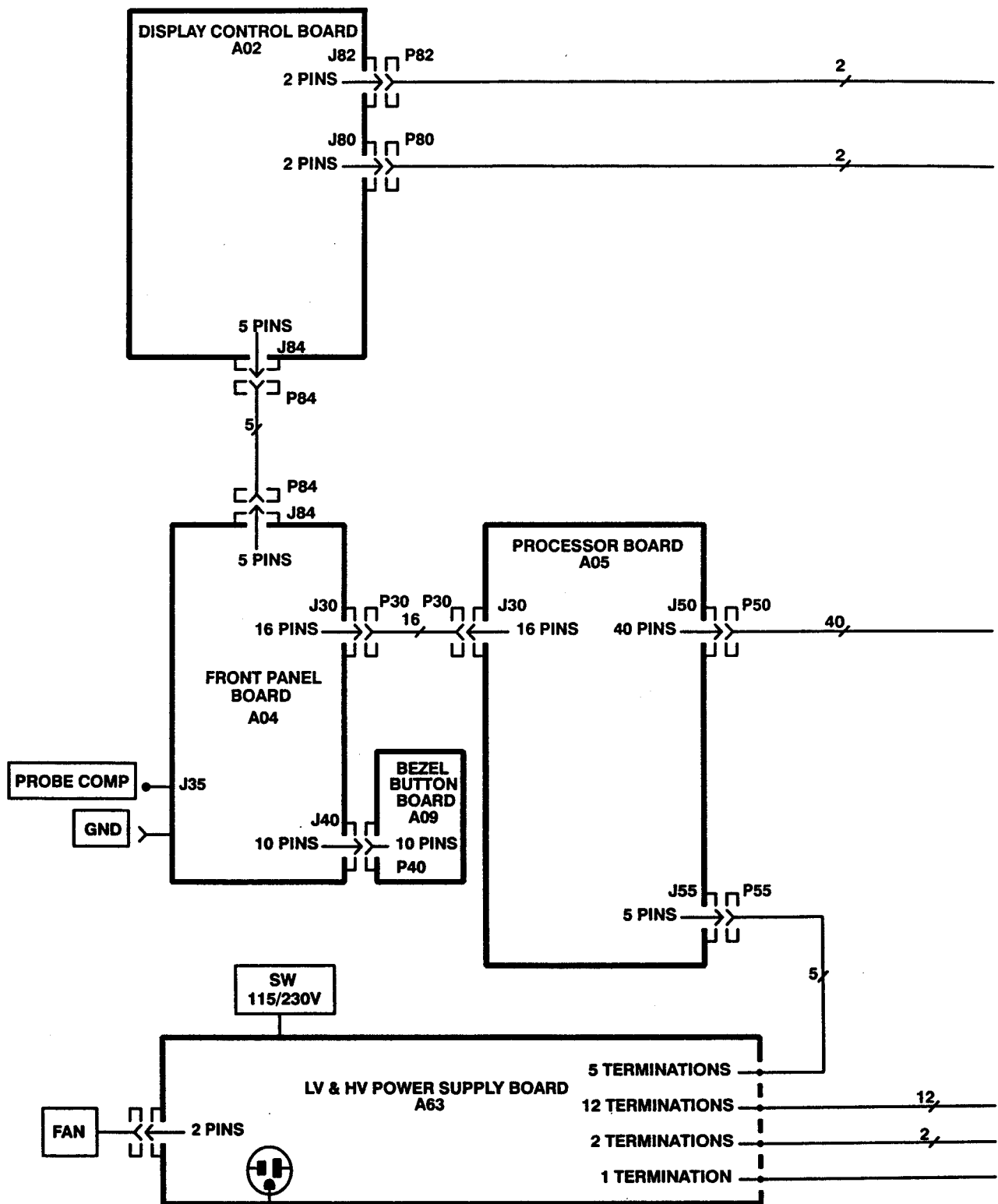


Figure 5-1: Block Diagram

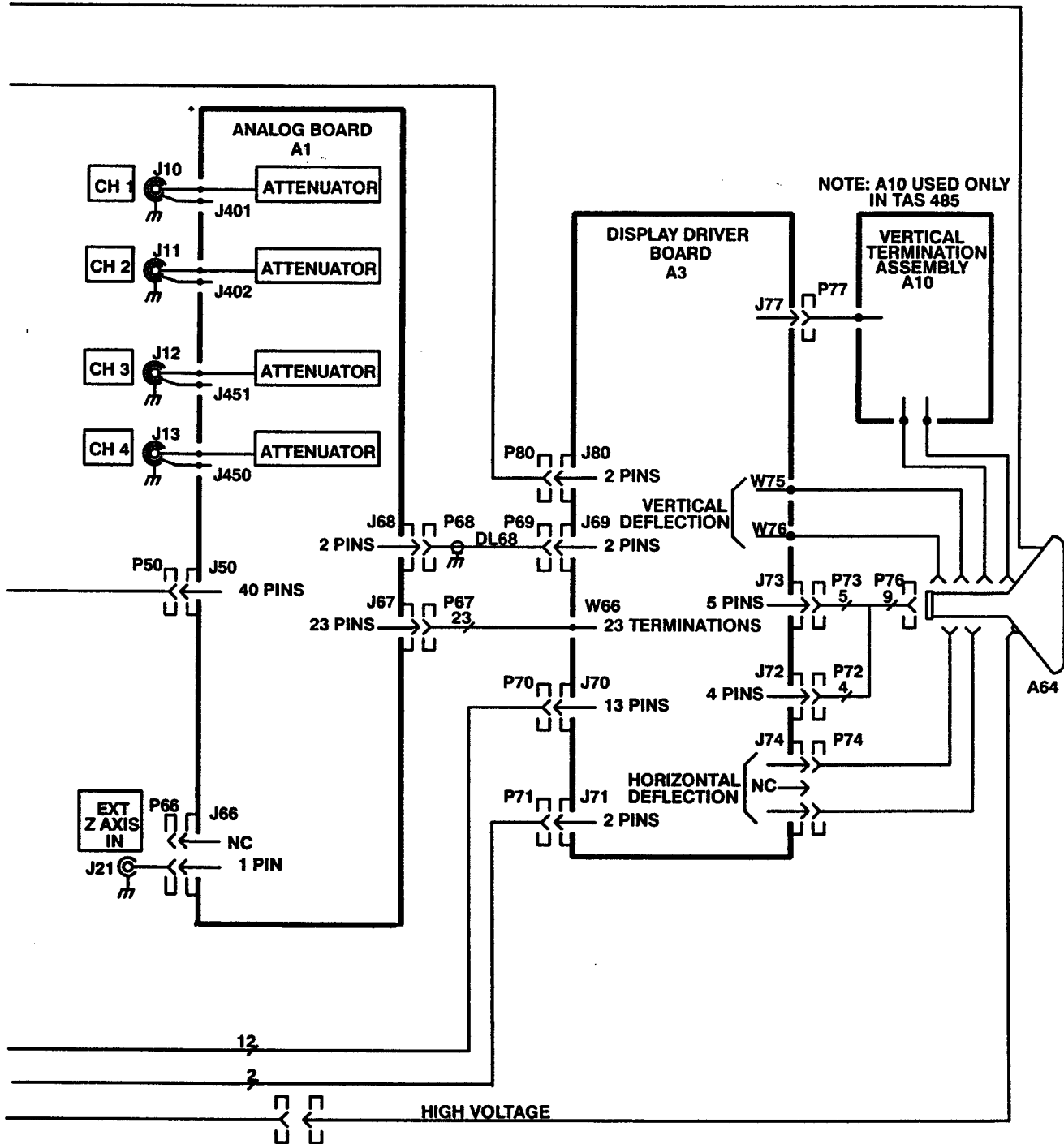


Figure 5-1: Block Diagram (Cont.)

Performance Verification

General Instructions

This Performance Verification section is divided into two subsections, *Brief Performance Checks* and *Performance Tests*.

The *Brief Performance Checks* section contains procedures to verify the operation of the TAS 475 and TAS 485 Analog Oscilloscopes.

The *Performance Tests* section contains procedures to confirm the performance of the TAS 475 and TAS 485 Oscilloscopes to its warranted specifications.

If you are not familiar with operating this oscilloscope, read Section 2, *Getting Started* in this manual to acquaint you with the use of the front-panel controls and the menu system.

Figure 3-3 on page 3-10 provides a display map of the CRT to familiarize you with the readout locations for the TAS 475 and TAS 485 Oscilloscopes.

Using the Brief Performance Checks Procedures

The *Brief Performance Checks* contain three procedures: Power-On Self Tests, Functional Tests, and Temperature Compensation Calibrations. Completing these checks takes approximately one hour.

The *Self Tests* are performed each time the oscilloscope is powered on.

The *Functional Tests* use the probe compensation output on the front panel as a test-signal source for further verifying that the oscilloscope functions properly. A standard-accessory probe, included with this oscilloscope, is the only equipment required.

To rapidly confirm that this oscilloscope functions and was adjusted properly, perform the procedures in the *Functional Tests* section; which begin on page 6-3.

Advantages: These procedures are quick to do, require no external equipment or signal sources, and provide high confidence that the oscilloscope will perform properly. These also provide hands-on experience to become familiar with the controls and menus.

The *Temperature Compensation Calibrations* allow you to adjust the display accuracy of the oscilloscope.

Using the Performance Tests Procedures

The *Performance Tests* confirm that the TAS 475 and TAS 485 Oscilloscopes perform as specified. The *Performance Tests* begin on page 6-13. Completing these tests takes approximately two hours and requires suitable test equipment. (See *Equipment Required* on page 6-13.)

Advantages: These procedures add direct checking of warranted specifications.

Conventions

The procedures in this section provide the following information:

- Title of test
- Equipment required (if applicable)
- Procedure

Where instructed to use a front-panel control or select from a menu, the name appears in boldface type. For example, "press **VERTICAL MENU**;" then "set **CPLG** to **DC**."



The symbol at the left is accompanied by information you must read to do the procedure properly.

These procedures make references to the graticule lines. For example, "position the cursor to the second vertical graticule line." Figure 6-1 shows how to interpret the references.

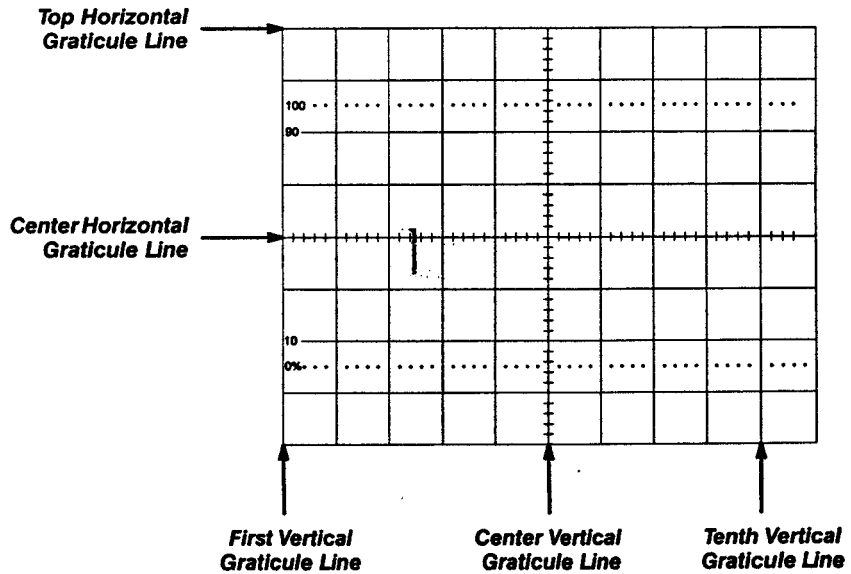


Figure 6-1: Graticule References

These procedures may ask you to check for a stable display. A stable display is consistent. The display should not have its trigger point switching slopes (double trigger) nor should it "free-run." The **MAIN SWP TRIG'D LED** should remain lit.

Brief Performance Checks

This section contains three brief procedures: two that verify the operation of the TAS 475 and TAS 485 Analog Oscilloscopes and one to perform a brief calibration to compensate for temperature variances.

The *Power-On Self Tests* use internal routines (performed at each power on) to confirm basic functionality and proper adjustment.

The *Functional Tests* further verify that the oscilloscope functions properly. These tests utilize the front panel **PROBE COMP** signal and a standard accessory probe.

The *Temperature Compensation Calibrations* use internal routines and actions from you to adjust the display accuracy of the oscilloscope. These adjustments are typically necessary only when the operating temperature and the last calibration temperature varies more than 5° C. However, performing these compensations before making a critical measurement ensures optimum accuracy.

If any of these tests return a failed message or do not perform as stated, contact your local Tektronix service center or sales engineer for more information.

Power-On Self Tests

These tests verify that the internal power-on diagnostics passed by confirming no error messages are reported on-screen.

Functional Tests

The purpose of these procedures is to confirm that this oscilloscope functions properly. The only equipment required is a standard accessory probe.



These procedures verify function; that is, they verify that oscilloscope *operates*. They do *not* verify that it operates within limits.

Therefore, when the instructions in the functional tests that follow call for you to verify that a signal appears on screen “that is about five divisions in amplitude” or “has a period of about six horizontal divisions”, do *not* interpret the quantities given as limits. Operation within limits is checked in *Performance Tests*, which begin on page 6-13.



DO NOT make changes to the front-panel settings that are not called out in the procedures. Each verification procedure requires you to set the oscilloscope to certain default settings before verifying functions. If you make changes to these default settings, other than those called out in the procedure, you may obtain invalid results. In this case, begin the procedure again from step 1.

Functional Tests Prerequisites

1. Power on the oscilloscope and allow a 20 minute warm-up before performing this procedure; adjust the **READOUT** control to display the readout and the **INTENSITY** control to display waveforms.
2. Disable the dual delay with the following menu selections.
 - a. Press the **UTILITY** button and select **CONFIG** from the main menu.
 - b. Select **MORE** until you can select **Dual Delay Disabled**.
3. Press the **ALT/CHOP, ADD** button and set **ADD1+2** and **ADD3+4** to **Off**.
4. Install the probe on **CH 1**. Connect the probe tip to **PROBE COMP** on the front-panel; connect the probe ground to the ground barrel of an unused input BNC (see Figure 6-2).

Some functional checks require that you install the probe on connectors other than **CH 1**. All functional checks use the **PROBE COMP** on the front-panel as the signal source.

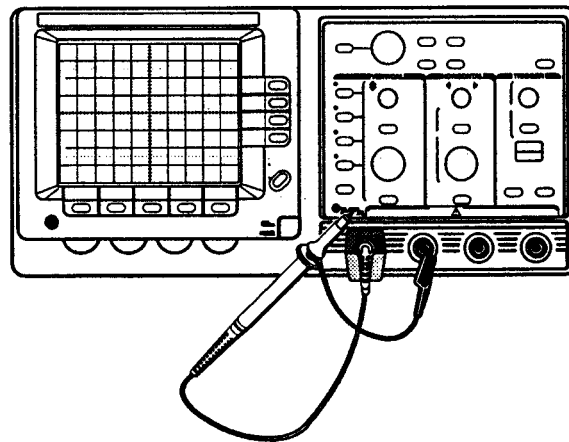


Figure 6-2: Test Hookup for Functional Tests

Verify the Probe Compensator Output

1. Press the **WAVEFORM OFF** button until the readout indicates that only channel 1 is selected.
2. Press the **AUTOSET** button.
3. Press the **VERTICAL MENU** button and set **CPLG** to **DC**.
4. Set the volts/div scale to 1 V and vertically center the display.
5. Set the sec/div scale to 500 μ s.
6. Press the **CURSOR** button and set **Δ VOLT** to **On**.

7. Align the active cursor to the top of the signal using the General Purpose Knob.
8. Press the **TOGGLE** button and align the active cursor to the bottom of the signal using the General Purpose Knob.
9. Verify that the Δ Volts readout is about 5.2 V.
10. Set $1/\Delta T$ to **On**.
11. Align the active cursor to a rising edge of the signal using the General Purpose Knob.
12. Press the **TOGGLE** button and align the active cursor to the next rising edge of the signal using the General Purpose Knob.
13. Verify that the $1/\Delta T$ readout is about 1 kHz.
14. Set Δ TIME to **On**.
15. Verify that the Δ Time readout is about 1 ms.

Verify the Input Channels

1. Display the channel to be verified and turn all others off.
2. Install the probe on the channel to be verified.
3. Press the **AUTOSET** button.
4. Press the **VERTICAL MENU** button and set **CPLG** to **DC**.
5. Verify that the channel is operational, confirming the following statements are true.
 - The vertical scale readout is set to 2 V for the channel under test and a square wave signal about 2.6 divisions in amplitude is on-screen.
 - Pressing the **SET LEVEL TO 50%** button sets the trigger level readout to approximately 2.7 V.
 - The vertical **POSITION** control moves the signal up and down the screen when rotated. Return the bottom portion of the displayed waveform to the center horizontal graticule line.
 - Turning the **VOLTS/DIV** control counterclockwise and clockwise decreases and increases the amplitude of the waveform. Return the volts/div scale to 2 V.

6. Press the **VERTICAL MENU** button and select **CPLG**. Select the following coupling types and verify the display.
 - Select **DC** coupling and verify that the waveform amplitude is positive-going from the center horizontal graticule line.
 - Select **AC** coupling, press the **SET LEVEL TO 50%** button, and verify that the waveform is centered at about the center horizontal graticule line.
 - Select **GND** coupling and verify that a straight line is displayed (no waveform).
7. Return the coupling to **DC** and press the **CLEAR MENU** button.
8. Repeat this procedure until all input channels are verified.

Verify the Alt/Chop and Add Functions

1. Install the probe on **CH 1**.
2. Press the **WAVEFORM OFF** button until the readout indicates channel 1 is the only selected channel.
3. Press the **AUTOSET** button.
4. Press the **CH 2** button, then position the channel 2 trace to the bottom horizontal graticule line.
5. Press the **WAVEFORM OFF** button, removing the channel 2 display.
6. Press the **ALT/CHOP, ADD** button and set **ADD1+2** to **On**.
7. Verify that a second waveform of approximately 2.6 divisions amplitude has been added to the display.
8. Set **ADD1+2** to **Off**.
9. Install the probe on **CH 3**.
10. Press the **CH 3** button.
11. Press the **CH 1** button, then the **WAVEFORM OFF** button, removing the channel 1 display.
12. Press the **CH 2** button, then the **WAVEFORM OFF** button, removing the channel 2 display.
13. Press the **AUTOSET** button.
14. Press the **CH 4** button, then position the channel 4 display to the bottom horizontal graticule line.
15. Press the **WAVEFORM OFF** button, removing the channel 4 display.
16. Press the **ALT/CHOP, ADD** button and set **ADD3+4** to **On**.
17. Verify that a second waveform of approximately 2.6 divisions amplitude has been added to the display.
18. Set **DISP** to **Chop**.

19. Set the sec/div scale to 100 ms.
20. Verify that the two waveforms are displayed simultaneously.
21. Set **DISP** to **Alt**.
22. Verify that the two waveforms are displayed alternately.
23. Set **ADD3+4** to **Off**.
24. Press the **CLEAR MENU** button.

Verify the Time Base

1. Press the **WAVEFORM OFF** button until the readout indicates channel 1 is the only selected channel.
2. Install the probe on **CH 1**.
3. Press the **AUTOSET** button.
4. Verify that the main time base is operational, confirming the following statements are true.
 - One period of the square wave is about five horizontal divisions.
 - Rotate the **SEC/DIV** control clockwise and verify that the waveform expands (more horizontal divisions per period of waveform) and that counterclockwise rotation contracts it.
 - Set the sec/div scale to 1 ms and verify that approximately one period of waveform per horizontal division is displayed.
 - Rotate the horizontal **POSITION** control and verify that the waveform moves left and right on-screen.
 - Pressing the **MAG** button changes the sec/div scale from 1 ms to 100 μ s and one period of the square wave is about ten horizontal divisions. Return to a non-magnified display by pressing the **MAG** button again.
5. Press the **HORIZONTAL MENU** button and set **DELAY** to **On**.
6. Set the delayed sec/div scale to 500 μ s.
7. Press the **TRIGGER MENU** button and set **MODE** to **Runs After**.
8. Press the **HORIZONTAL MENU** button.
9. Select **TRCSEP** from the main menu and vertically position the delayed time base below the main time base using the General Purpose Knob.
10. Select **DELAY** from the main menu.

11. Verify that the delayed time base is operational, confirming the following statements are true.
 - The main sweep has an intensified zone of approximately 5.5 horizontal divisions. Adjust the **INTENSITY** level if necessary to view the entire intensified zone.
 - Rotating the General Purpose Knob clockwise moves the intensified zone to the right on-screen. Position the intensified portion to the center of the screen.
12. Adjust the delayed sec/div scale to 200 μ s.
13. Set **MAIN** to **Off** and confirm that only the delayed sec/div scale is displayed and the period of the square-wave signal is about five horizontal divisions.
14. Set **MAIN** to **On** and **DELAY** to **Off**.

Verify the Trigger System

1. Press the **WAVEFORM OFF** button until the readout indicates channel 1 is the only selected channel.
2. Press the **AUTOSET** button.
3. Set the sec/div scale to 1 ms.
4. Press the **TRIGGER MENU** button and set **MODE** to **Auto**.
5. Verify that the main trigger is operational, confirming that the following statements are true.
 - Rotating the trigger **LEVEL** control changes the main trigger level readout.
 - Rotating the trigger **LEVEL** control through its range triggers and untriggers the display. Leave the signal untriggered.
 - Pressing the **SET LEVEL TO 50%** button triggers the signal and the trigger level readout indicates approximately 2.7 V.
6. Press the **HORIZONTAL MENU** button and set **DELAY** to **On**.
7. Set the delayed sec/div scale to 500 μ s.
8. Verify that the delayed sweep is operational, confirming that an intensified zone appears on the main sweep.
9. Press the **TRIGGER MENU** button and set **MODE** to **Trig After** and **SRC** to **Ch1**.

10. Verify that the delayed trigger is operational, confirming that the following statements are true.
 - Rotating the trigger **LEVEL** control changes the delayed trigger level readout.
 - Rotating the trigger **LEVEL** control through its range triggers and untriggers (intensified zone displayed and not displayed) the delayed sweep. Leave the signal untriggered.
 - Pressing the **SET LEVEL TO 50%** button triggers the signal, the trigger level readout indicates approximately 2.7 V, and the intensified zone is displayed.
11. Press the **HORIZONTAL MENU** button and set **DELAY** to **Off**.
12. Set the sec/div scale to 50 ms.
13. Press the **TRIGGER MENU** button and set **MODE** to **Single Sequence** and confirm the following statements are true.
 - There is no waveform displayed.
 - Pressing the **RESET S SEQ** button causes one sweep of the waveform display to occur.
14. Set the sec/div scale to 1 ms.
15. Set **MODE** to **Auto Level**.
16. Disconnect the probe from the oscilloscope.

Temperature Compensation Calibrations

The procedures that follow allow you to quickly compensate the calibration of the oscilloscope for any external temperature variations. This ensures the most accurate measurements. No test equipment is required to perform these procedures.



Optimum instrument performance depends on the recommended 20 minute minimum warm-up time prior to performing the following calibration routines. All calibration routines require a successful completion (no "failed" message).



The Temperature Compensation Calibrations affect the accuracy of the display system; therefore, they should only be performed by a qualified technician.

Horizontal Sweep Path

1. Press the **AUTOSET** button.
2. Press the **UTILITY** button and select **CAL** from the main menu.
3. Select **Horizontal Sweep Path** from the sub menu, initiating the routine.

The **Horizontal Sweep Path** routine takes about 20 seconds to complete its initial calibrations. Once complete, two dots are displayed. The displayed dots are used for the next horizontal calibration steps.

NOTE

*The following steps use both the General Purpose Knob and the **TOGGLE** button to make adjustments. The General Purpose Knob performs two functions: to adjust gain and centering. Pressing the **TOGGLE** button selects the function of the General Purpose Knob.*

4. Use a combination of the **TOGGLE** button and the General Purpose Knob to position the two dots eight divisions apart, centered horizontally (see Figure 6-3).

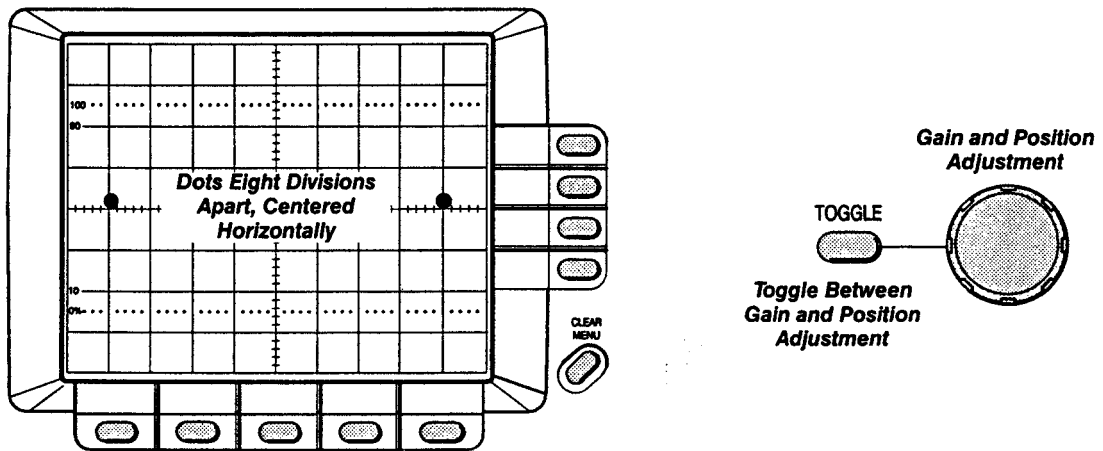


Figure 6-3: Horizontal Adjustments (One)

5. Select **Done** when you have the appropriate display.
6. Again, use a combination of the **TOGGLE** button and the General Purpose Knob to position the two dots eight divisions apart, centered horizontally (see Figure 6-3).
7. Select **Done** when you have the appropriate display.
8. One dot is now displayed.
9. Use a combination of the **TOGGLE** button and the General Purpose Knob to horizontally center the single dot at the center of the screen (see Figure 6-4).

Continue to press the **TOGGLE** button and adjusting the dot to center screen with the General Purpose Knob until the dot stays horizontally centered while pressing the **TOGGLE** button.

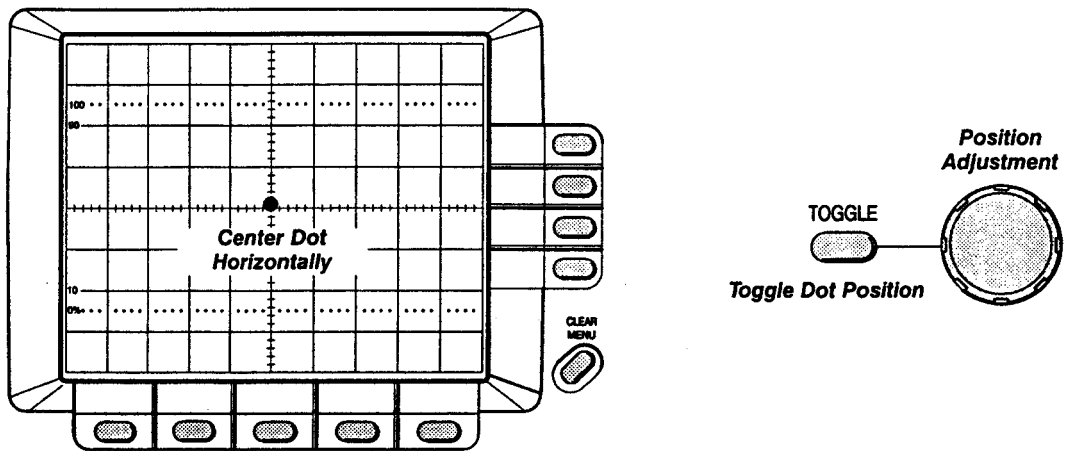


Figure 6-4: Horizontal Adjustments (Two)

10. Select **Done** when you have the appropriate display.
11. Two vertical lines are now displayed.

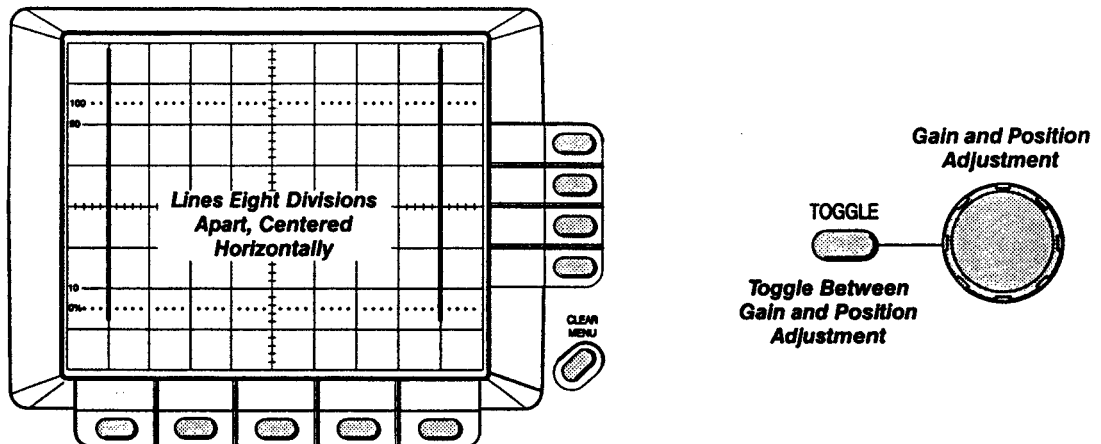


Figure 6-5: Horizontal Adjustments (Three)

12. Use a combination of the **TOGGLE** button and the General Purpose Knob to position the two lines eight divisions apart, centered horizontally (see Figure 6-5).
13. Select **Done** when you have the appropriate display.
14. A *pass* or *failed* status appears on the screen.
15. Select **Done** to exit the routine, displaying a **Calibration Finished** message.

Vertical Signal Path

1. Press the **AUTOSET** button.
2. Press the **UTILITY** button and select **CAL** from the main menu.
3. Select **Vertical Signal Path** from the sub menu, initiating the routine.
4. Remove any input signals from the oscilloscope.
5. Select **Done**.

The **Vertical Signal Path** routine takes less than two minutes to complete. When finished, a *pass* or *failed* status will appear on the screen.

6. Press **Done** to exit the routine, displaying a **Calibration Finished** message.
7. Press the **CLEAR MENU** button.

Performance Tests

This subsection contains procedures to verify that the TAS 475 and TAS 485 Analog Oscilloscopes perform as warranted.

The procedures are arranged in three logical groupings: *Vertical Checks*, *Horizontal Checks*, and *Trigger Checks*. They check all the characteristics that are designated as checked in Section 4, *Specifications*. (The checked characteristics appear in **boldface** type under *Warranted Characteristics* in section 4.)

These procedures *extend* the confidence level provided by the *Brief Performance Checks* in this section.

Performance Tests Prerequisites



The tests in this subsection comprise an extensive, valid confirmation of performance and functionality when the following requirements are met.

- The cabinet must be installed on the oscilloscope.
- The *Power-On Self Tests* show no failures.
- You must have completed the *Temperature Compensation Calibrations*, beginning on page 6-9.
- The oscilloscope must have an operating warm-up period of at least 20 minutes at an ambient temperature between -10°C and $+55^{\circ}\text{C}$.
- Set the **INTENSITY** and **READOUT** controls for nominal viewing levels.
- Set the delayed sweep intensity to **Intensity Delay > Main** in the Utility Configure menu.

Related Information — Read *General Instructions* that start on page 6-1. If you are not familiar with operating this oscilloscope, read Section 2, *Getting Started*, before performing these procedures.

Equipment Required

These procedures use external, traceable signal sources to directly check warranted characteristics. Table 6-1 lists the required test equipment.

Table 6-1: Test Equipment

Item Number and Description	Minimum Requirements	Example	Purpose
1 Attenuator, 2X ³	Ratio: 2X; Impedance 50 Ω ; Connectors: female BNC input, male BNC output	Tektronix part number 011-0069-02	Signal attenuation
2 Attenuator, 10X	Ratio: 10X; Impedance 50 Ω ; Connectors: female BNC input, male BNC output	Tektronix part number 011-0059-02	Signal attenuation
3 Termination, 50 Ω	Impedance 50 Ω ; Connectors: female BNC input, male BNC output	Tektronix part number 011-0049-01	Signal interconnection
4 Termination, 75 Ω	Impedance 75 Ω ; Connectors: female BNC input, male BNC output	Tektronix part number 011-0102-01	Signal interconnection, video
5 Cable, Precision Coaxial	50 Ω , 36 in, male-to-male BNC connectors	Tektronix part number 012-0482-00	Signal interconnection
6 Cable, Coaxial	75 Ω , 36 in, male-to-male BNC connectors	Tektronix part number 012-1338-00	Signal interconnection, video
7 Coupler, Dual-Input (three required)	Female-BNC-to-dual-male-BNC	Tektronix part number 067-0525-02	Signal interconnection
8 Generator, Levelled Sine Wave	200 kHz to 250 MHz; Variable amplitude from 5 mV to 4 V _{p-p} into 50 Ω	TEKTRONIX SG 503 Levelled Sine Wave Generator ¹	Trigger and bandwidth checks
9 Generator, Time Mark	Variable marker frequency from 10 ms to 10 ns; accuracy within 2 ppm	TEKTRONIX TG 501A Time Mark Generator ¹	Timing accuracy checks
10 Generator, Pulse	High Amplitude pulse with variable amplitude of 60 V to 100 V	TEKTRONIX PG 506A Calibration Generator ^{1,2}	Gain accuracy checks
11 Generator, DC Calibration	DC voltage levels from 100 mV to 10 V	TEKTRONIX PG 506A Calibration Generator ^{1,2}	Gain accuracy checks
12 Probe, 10X, included with this instrument	Standard accessory probe	TEKTRONIX P6109B (TAS 475) or TEKTRONIX P6111B (TAS 485)	Signal interconnection
13 Generator, Video Signal	Provides NTSC compatible outputs	TEKTRONIX TSG 100	Video trigger check
14 Adjustment Tool ³	0.1 inch hex on both ends	GC Electronics #8606	Internal adjustments

¹ Requires a TM 500 or TM 5000 Series Power Module Mainframe.

² The PG 506A must have the internal Square-Wave/DC switch repositioned depending on the requirements of the procedure.

³ This item is used only when performing the Adjustment Procedures.

Vertical System Checks

These procedures check those characteristics that relate to the vertical system and are listed as checked under *Warranted Characteristics* in Section 4, *Specifications*.

Check DC Gain and Voltage Measurement Accuracy

Equipment Required: One pulse generator (item 10) and one precision coaxial cable (item 5).

1. Display the channel to be verified, turning all others off.
2. Press the **AUTOSET** button.
3. Set the sec/div scale to 500 μ s.
4. Press the **TRIGGER MENU** button and set **CPLG** to **Noise Reject**.
5. Press the **CURSOR** button and set Δ Volt to **On**.
6. Press the **VERTICAL MENU** button and make the following selections:
 - Set **CPLG** to **DC**
 - Set **BW** to **20 MHz**
7. Set the volts/div scale to 2 mV.
8. Position the trace three divisions below the center horizontal graticule line.
9. Connect the standard amplitude output of the pulse generator to the input of the channel to be verified as shown in Figure 6-6.

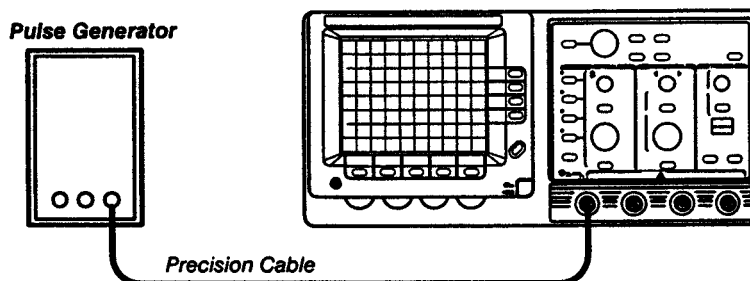


Figure 6-6: Gain and Voltage Test Setup

10. Set the pulse generator for 10 mV amplitude output.
11. Use the General Purpose Knob and **TOGGLE** button to precisely align the cursors to the signal peaks.
12. Check the Displayed Signal Accuracy and Volts Readout Accuracy while setting the Volts/Div Scale and the Input Amplitude given in Table 6-2.

Table 6-2: DC Gain and Delta Volts Accuracy

Volts/Div Scale	Input Amplitude	Displayed Signal Accuracy	Delta Volts Readout Accuracy
2 mV	10 mV	4.87 to 5.13 div	9.80 mV to 10.2 mV
5 mV	20 mV	3.9 to 4.1 div	19.6 mV to 20.4 mV
10 mV	50 mV	4.87 to 5.13 div	49.0 mV to 51.0 mV
20 mV	0.1 V	4.87 to 5.13 div	98.0 mV to 102 mV
50 mV	0.2 V	3.9 to 4.1 div	196 mV to 204 mV
100 mV	0.5 V	4.87 to 5.13 div	490 mV to 510 mV
1 V	5 V	4.87 to 5.13 div	4.90 V to 5.10 V

13. Return the volts/div scale to 2 mV and set the pulse generator for 10 mV amplitude output.
14. Press the **VERTICAL MENU** button and set **VAR** to **On**.
15. Check that rotating the General Purpose Knob counterclockwise reduces the displayed signal amplitude to two divisions or less. Set **VAR** to **Off**.
16. Disconnect the test setup from the oscilloscope.
17. Repeat this procedure until you have verified all input channels.
18. Press the **CURSOR** button and set Δ Volt to **Off**.

Check Trigger Level Accuracy

Equipment Required: One DC calibration generator (item 11) and one precision coaxial cable (item 5).

1. Display channel 1, turning all others off.
2. Press the **AUTOSET** button.
3. Set the sec/div scale to 500 μ s.
4. Press the **TRIGGER MENU** button and make the following selections:
 - Set **CPLG** to **DC**
 - Set **SLOPE** to **Rising**
5. Press the **VERTICAL MENU** button and make the following selections:
 - Set **CPLG** to **DC**
 - Set **BW** to **20 MHz**
6. Set the volts/div scale to 50 mV.
7. Position the trace three divisions below the center horizontal graticule line.

8. Connect the DC calibration generator to the CH 1 input as shown in Figure 6-7.

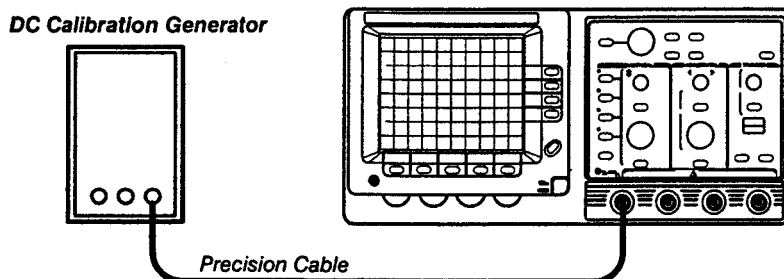


Figure 6-7: Trigger Level Test Setup

9. Set the DC calibration generator for a 200 mV output.
10. Press the **SET LEVEL TO 50%** button.
11. Check that the Trigger Level Accuracy readout is in the range of 169 mV to 231 mV.
12. Press the **TRIGGER MENU** button and set **SLOPE** to **Falling**.
13. Press the **SET LEVEL TO 50%** button.
14. Check that the Trigger Level Accuracy readout is in the range of 169 mV to 231 mV.
15. Press the **MAIN/DELAY SELECT** button, displaying the delay trigger menu.
16. Set **MODE** to **Runs After** and **SRC** to **Ch1**.
17. Press the **SET LEVEL TO 50%** button.
18. Check that the Trigger Level Accuracy readout is in the range of 169 mV to 231 mV.
19. Disconnect the test setup from the oscilloscope.
20. Press the **MAIN/DELAY SELECT** button and set **SLOPE** to **Rising**.
21. Press the **HORIZONTAL MENU** button and set **DELAY** to **Off**.

Check DC Coupling Bandwidth

Equipment Required: One leveled sine wave generator (item 8), one precision coaxial cable (item 5), and one 50 Ω termination (item 3).

1. Display the channel to be verified, turning all others off.
2. Connect the output of the sine wave generator to the channel to be verified as shown in Figure 6-8.

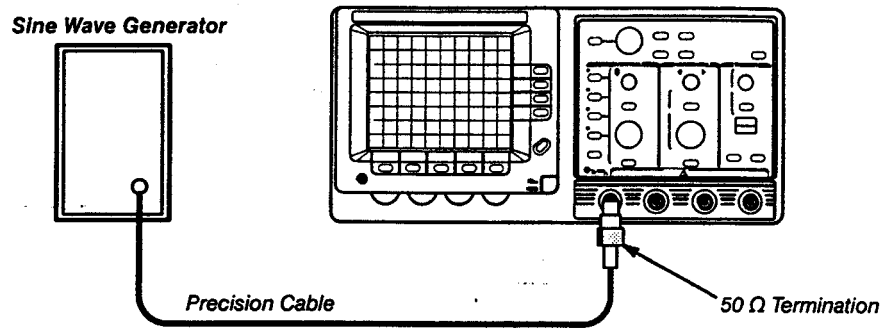


Figure 6-8: Bandwidth Test Setup

3. Press the **AUTOSET** button.
4. Set the volts/div scale to 2 mV.
5. Set the sec/div scale to 200 μ s.
6. Set the sine wave generator for a 50 kHz reference frequency and adjust the amplitude for a six division display.
7. Press the **TRIGGER MENU** button and set **CPLG** to **Noise Reject**.
8. Use the following substeps (a to c) and the settings and limits given in Table 6-3 to confirm the bandwidth of the input channels.
 - a. Set the volts/div scale as indicated.
 - b. Set the signal generator for the specified amplitude at the reference frequency.
 - c. While confirming the Display Amplitude remains greater than the minimum number of divisions, increase the signal generator frequency to 100 MHz or 200 MHz, depending on the instrument model.

Table 6-3: DC Coupled Bandwidth

Volts/Div Scale	50 kHz Reference Amplitude	Display Amplitude	
		TAS 475 To 100 MHz	TAS 485 To 200 MHz
2 mV	6 division	≥ 4.2 division	≥ 4.2 division
5 mV	6 division	≥ 4.2 division	≥ 4.2 division
10 mV	6 division	≥ 4.2 division	≥ 4.2 division
20 mV	6 division	≥ 4.2 division	≥ 4.2 division
50 mV	6 division	≥ 4.2 division	≥ 4.2 division
100 mV	6 division	≥ 4.2 division	≥ 4.2 division
1 V	5 division	≥ 3.5 division	≥ 3.5 division

9. Disconnect the test setup from the oscilloscope.
10. Repeat this procedure until all input channels are verified.

Check X-Axis Gain

Equipment Required: One pulse generator (item 10) and one precision coaxial cable (item 5).

1. Display channel 1, turning all others off.
2. Connect the output of the pulse generator to the **CH 1** input as shown Figure 6-9.

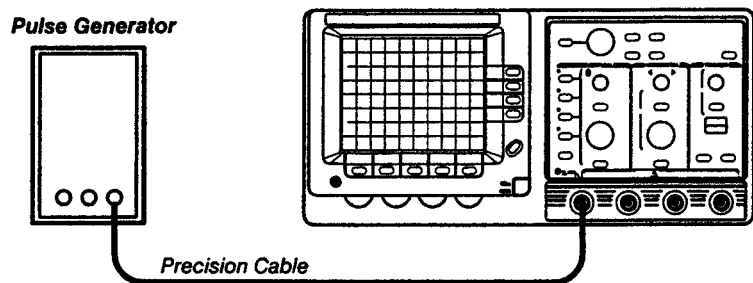


Figure 6-9: X-Axis Gain Test Setup

3. Set the output of the pulse calibration generator for 50 mV.
4. Press the **AUTOSET** button.
5. Set the volts/div scale to 10 mV.
6. Center the display using the vertical **POSITION** control.
7. Press the **HORIZONTAL MENU** button and set **XY** to **On**.
8. Check that the amplitude of the X-axis signal is 4.8 to 5.2 divisions.
9. Set **XY** to **Off**.
10. Disconnect the test setup from the oscilloscope.

Horizontal System Checks

These procedures check those characteristics that relate to the horizontal system and are listed as checked under *Warranted Characteristics* in Section 4, *Specifications*.

Check Time Base and Time Cursor Accuracy

Equipment Required: One time marker generator (item 9), one precision coaxial cable (item 5), and one 50 Ω termination (item 3).

1. Display channel 1, turning all others off.

2. Connect the output of the time marker generator to the **CH 1** input as shown in Figure 6-10.

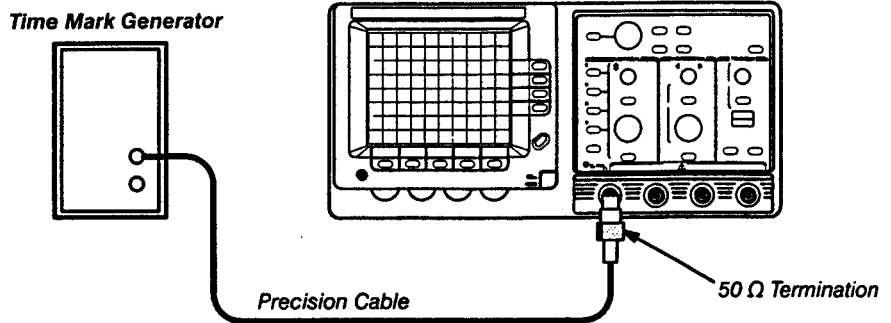


Figure 6-10: Timing Test Setup

3. Set the output of the generator as follows:
 - TAS 475 — 20 ns markers
 - TAS 485 — 10 ns markers
4. Press the **AUTOSET** button.
5. Set the sec/div scale as follows:
 - TAS 475 — 20 ns
 - TAS 485 — 10 ns
6. Set the volts/div scale to 500 mV.
7. Center the time mark display vertically.
8. Press the **CURSOR** button and set **ΔTIME** to On.
9. Position the rising edge of the second time mark to the second vertical graticule line.
10. Align the active cursor to the second time mark at the point the rising edge intersects the center horizontal graticule line using the General Purpose Knob.
11. Press the **TOGGLE** button and align the second cursor to the tenth time mark at the point the rising edge intersects the center horizontal graticule line using the General Purpose Knob.
12. Check that the Time-mark to Graticule Accuracy and the Time Cursor Readout Accuracy over the center eight divisions are within the limits shown for each Sec/Div Scale listed in Table 6-4.

Table 6-4: Time Base and Cursor Accuracies (Mag Off)

Sec/Div Scale (Mag Off)	Time Mark Setting	Time-mark to Graticule Accuracy	Time Cursor Readout Accuracy
		Over Center 8 Divisions	2nd and 10th Time Marks
10 ns ¹	20 ns	±0.16 division	78.4 ns to 81.6 ns
20 ns	20 ns	±0.16 division	157 ns to 163 ns
50 ns	50 ns	±0.16 division	392 ns to 408 ns
100 ns	0.1 µs	±0.16 division	784 ns to 816 ns
200 ns	0.2 µs	±0.16 division	1.57 µs to 1.63 µs
500 ns	0.5 µs	±0.16 division	3.92 µs to 4.08 µs
1 µs	1 µs	±0.16 division	7.84 µs to 8.16 µs
2 µs	2 µs	±0.16 division	15.7 µs to 16.3 µs
5 µs	5 µs	±0.16 division	39.2 µs to 40.8 µs
10 µs	10 µs	±0.16 division	78.4 µs to 81.6 µs
20 µs	20 µs	±0.16 division	157 µs to 163 µs
50 µs	50 µs	±0.16 division	392 µs to 408 µs
100 µs	0.1 ms	±0.16 division	784 µs to 816 µs
200 µs	0.2 ms	±0.16 division	1.57 ms to 1.63 ms
500 µs	0.5 ms	±0.16 division	3.92 ms to 4.08 ms
1 ms	1 ms	±0.16 division	7.84 ms to 8.16 ms
2 ms	2 ms	±0.16 division	15.7 ms to 16.3 ms
5 ms	5 ms	±0.16 division	39.2 ms to 40.8 ms

¹The 10 ns sec/div scale is only available on the TAS 485.

13. Set Δ TIME to Off.

14. Set the time mark generator as follows:

- TAS 475 — 20 ns markers
- TAS 485 — 10 ns markers

15. Set the main sec/div scale as follows:

- TAS 475 — 20 ns
- TAS 485 — 10 ns

16. Press the **HORIZONTAL MENU** button and set **DELAY** to On and **MAIN** to Off.

17. Set the delayed sec/div scale as follows:
 - TAS 475 — 20 ns
 - TAS 485 — 10 ns
18. Using the General Purpose Knob, set the delay time as follows:
 - TAS 475 — 3 ns
 - TAS 485 — 1.5 ns
19. Position the edge of the second time mark to the second vertical graticule line.
20. Check that the Time Mark to Graticule Accuracy over the center eight divisions are within the limits shown for each sec/div scale listed in Table 6-4 (disregard the Time Cursor Readout Accuracy column).
21. Set **MAIN** to **On**.
22. Set the main sec/div scale as follows:
 - TAS 475 — 20 ns
 - TAS 485 — 10 ns
23. Set **MAIN** to **Off**.
24. Press the **MAG** button, turning magnification on.
25. Set the time mark generator for 5 ns markers.
26. Set the volts/div scale to 200 mV.
27. Check that the timing accuracies at the beginning, middle, and end of sweep over the center eight divisions are within the limits shown for each of the sec/div scales given in Table 6-5. Exclude the first and last five divisions of the magnified sweep for accuracy measurements.

Table 6-5: Time Base Accuracy (Mag On)

Sec/Div Scale (Mag On)	Time Marker Setting	Time Mark to Graticule Over Center 8 Divisions
1 ns ⁴	5 ns ¹	±0.24 division ³
2 ns	5 ns ¹	±0.24 division ²
5 ns	5 ns ¹	±0.24 division
10 ns	10 ns	±0.24 division
100 ns	0.1 μs	±0.24 division
100 μs	0.1 ms	±0.24 division

¹ Change the volts/div scale as necessary to maintain vertical amplitude.

² At this setting, two cycles of the signal are displayed for every five horizontal divisions.

³ At this setting, one cycle of the signal is displayed for every five horizontal divisions.

⁴ The 1 ns sec/div scale is only available on the TAS 485.

28. Set **MAIN** to **On** and **DELAY** to **Off**.
29. Set the sec/div scale as follows:
 - TAS 475 — 2 ns
 - TAS 485 — 1 ns
30. Set the time mark generator for 5 ns markers.
31. Check that the timing accuracies at the beginning, middle, and end of sweep over the center eight divisions are within the limits shown for each Sec/Div Scale given in Table 6-5. Exclude the first and last five divisions of the magnified sweep for accuracy measurements.
32. Press the **MAG** button, turning magnification off.

Check Dual Delay Accuracy

Equipment Required: One time marker generator (item 9), one precision coaxial cable (item 5), and one 50 Ω termination (item 3).

1. Display channel 1, turning all others off.
2. Connect the output of the time marker generator to the CH 1 input as shown in Figure 6-11.

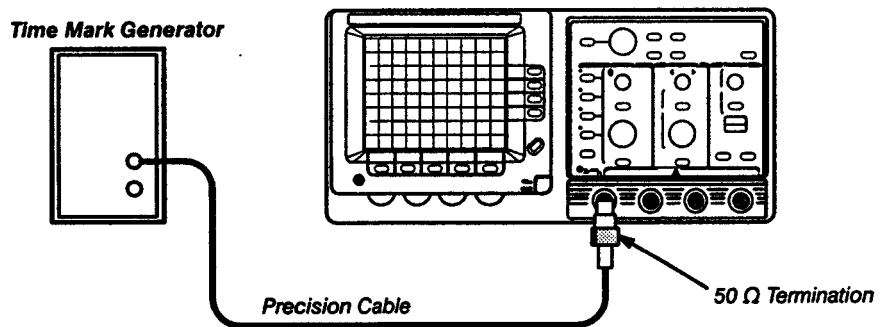


Figure 6-11: Dual Delay Test Setup

3. Set the output of the time marker generator for 0.5 ms markers.
4. Press the **AUTOSET** button.
5. Set the sec/div scale to 500 μ s.
6. Set the volts/div scale to 500 mV.
7. Position the time marker display to the upper half of the graticule and align the first time marker to the second vertical graticule line.
8. Press the **TRIGGER MENU** button and then the **MAIN/DELAY SELECT** button.
9. Set **MODE** to **Runs After**.
10. Set the delayed sec/div scale to 50 μ s.

11. Press **HORIZONTAL MENU**.
12. Select **TRCSEP** and position the delayed time marker display to the lower half of the graticule using the General Purpose Knob.
13. Select **DELAY**.
14. Using the General Purpose Knob, position the intensified zone on the main sweep to the second time marker; then, slightly adjust the General Purpose Knob until the delayed sweep time marker is at the graticule center.
15. Press the **UTILITY** button and select **CONFIG** from the main menu.
16. Select **MORE** until you can select **Dual Delay Enabled** from the sub menu.
17. Press the **CURSOR** button and set Δ **TIME** to **On**.
18. Using the General Purpose Knob, position the second intensified zone on the main sweep to the third time marker; then, slightly adjust the General Purpose Knob to superimpose the delayed sweep time markers at the graticule center. Press the **TOGGLE** button to assign the General Purpose Knob to the second intensified zone if necessary.
19. Check the Dual Delay Accuracy Reading for each time marker pair listed in Table 6-6.

Table 6-6: 500 μ s Dual Delay Accuracy

Time Markers Intensified	Dual Delay Accuracy Reading Limits
Second and third	473 μ s to 527 μ s
Second and fourth	970 μ s to 1.03 ms
Second and sixth	1.97 ms to 2.03 ms
Second and tenth	3.96 ms to 4.04 ms

20. Press the **MAIN/DELAY SELECT** button and set the main sec/div scale to 200 ns.
21. Press the **MAIN/DELAY SELECT** button and set the delayed sec/div scale to 20 ns.
22. Set the time mark generator for 0.2 μ s markers.
23. Using the General Purpose Knob, position the second intensified zone on the main sweep to the tenth time marker; then, slightly adjust the General Purpose Knob to superimpose the delayed sweep time markers at the graticule center.
24. Check the dual delay accuracy (Δ Time) reading is in the range of 1.58 μ s to 1.62 μ s.
25. Press the **CURSOR** button and set Δ **TIME** to **Off**.

26. Press the **UTILITY** button and select **Dual Delay Disabled**.
27. Press the **HORIZONTAL MENU** button and set **DELAY** to **Off**
28. Disconnect the test setup from the oscilloscope.

Trigger System Checks

These procedures check those characteristics that relate to the trigger system and are listed as checked under *Warranted Characteristics* in Section 4, *Specifications*.

Check Trigger Sensitivity

Equipment Required: One sine wave generator (item 8), one 10X attenuator (item 2), one precision coaxial cable (item 5), one dual-input coupler (item 7), and one 50 Ω termination (item 3).

Low Frequency — The following steps check trigger sensitivity at 25 MHz.

1. Display channel 1, turning all others off.
2. Connect the output of the sine wave generator to the **CH 1** input as shown in Figure 6-12.

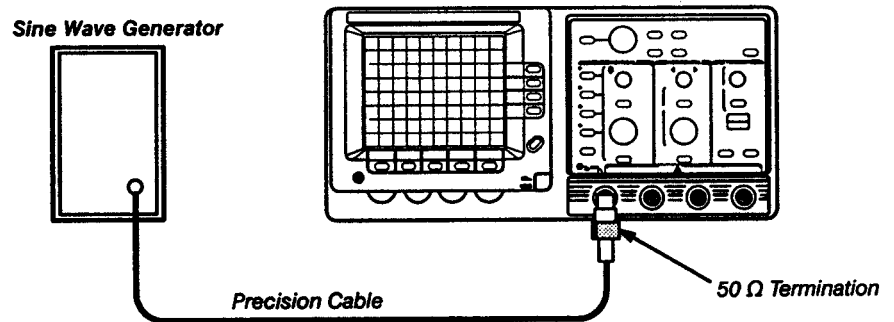


Figure 6-12: Trigger Sensitivity Test Setup (One)

3. Set the frequency of the sine wave generator to 25 MHz.
4. Press the **AUTOSSET** button.
5. Set the volts/div scale to 50 mV.
6. Set the sec/div scale to 100 ns.
7. Press the **VERTICAL MENU** button and set **CPLG** to **DC**

8. Press the **TRIGGER MENU** button and make the following selections from the main trigger menu:
 - Set **MODE** to **Auto**
 - Set **SRC** to **Ch1**
 - Set **CPLG** to **DC**
 - Set **SLOPE** to **Rising**
9. Press the **MAIN/DELAY SELECT** button and make the following selections from the delay trigger menu:
 - Set **MODE** to **Runs After**
 - Set **SRC** to **Ch1**
 - Set **CPLG** to **DC**
 - Set **SLOPE** to **Rising**
10. Set the delayed sec/div scale to 50 ns.
11. Press the **HORIZONTAL MENU** button and select **DELAY**.
12. Set the delay time to 15 ns using the General Purpose Knob.
13. Set **DELAY** to **Off**.
14. Adjust the sine wave generator amplitude for a three division display.
15. Add a 10X attenuator to the test setup as shown in Figure 6-13.

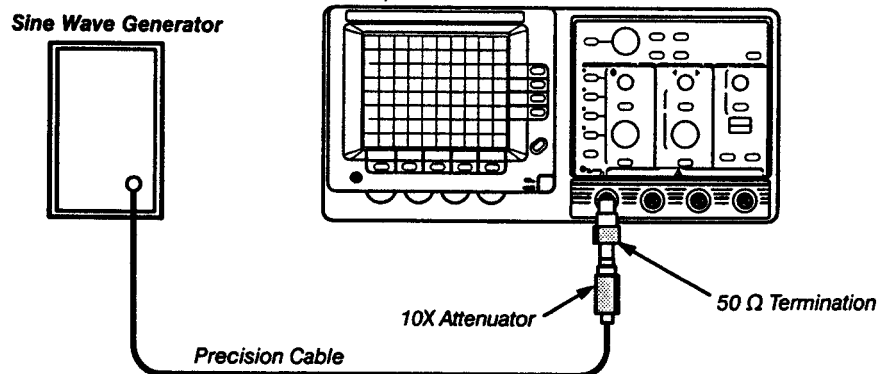


Figure 6-13: Trigger Sensitivity Test Setup (Two)

16. Press the **SET LEVEL TO 50%** button and confirm a stable display.
17. Press the **TRIGGER MENU** button and set **SLOPE** to **Falling**.
18. Press the **SET LEVEL TO 50%** button and confirm a stable display.
19. Press the **HORIZONTAL MENU** button and set **DELAY** to **On**.
20. Select **TRCSEP** and position the delayed sweep below the main sweep using the General Purpose Knob.

21. Press the **TRIGGER MENU** button and set **MODE** to **Trig After**.
22. Press the **SET LEVEL TO 50%** button and confirm a stable delayed sweep display.
23. Set **SLOPE** to **Falling**.
24. Press the **SET LEVEL TO 50%** button and confirm a stable delayed sweep display.
25. Press the **HORIZONTAL MENU** button and set **DELAY** to **Off**.

High Frequency — The following steps check trigger sensitivity at 150 MHz (TAS 475) or 250 MHz (TAS 485).

1. Remove the 10X attenuator from the test setup. Reconnect as shown in Figure 6-14.

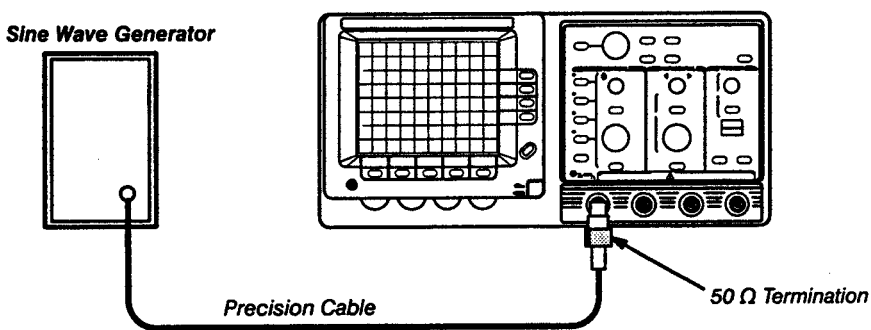


Figure 6-14: Trigger Sensitivity Test Setup (Three)

2. Set the sine wave generator frequency as follows:
 - TAS 475 — 150 MHz
 - TAS 485 — 250 MHz
3. Press the **MAG** button.
4. Set the volts/div scale to 50 mV.
5. Adjust the sine wave generator amplitude as follows:
 - TAS 475 — adjust for a one division display
 - TAS 485 — adjust for a 1.5 division display
6. Press the **SET LEVEL TO 50%** button and confirm a stable display.
7. Set **SLOPE** to **Rising**.
8. Press the **SET LEVEL TO 50%** button and confirm a stable display.
9. Press the **MAIN/DELAY SELECT** button (selecting delay).
10. Press the **SET LEVEL TO 50%** button and confirm a stable delayed sweep display (see the following note).

NOTE

*A slight adjustment of the delay time may be necessary to obtain a stable delayed sweep display. Press the **Horizontal Menu** button and adjust the delay time using the **General Purpose Knob**. Press the **Trigger Menu** button after confirming a stable display.*

11. Set **SLOPE** to **Rising**.
12. Press the **SET LEVEL TO 50%** button and confirm a stable delayed sweep display.

NOTE

*A slight adjustment of the delay time may be necessary to obtain a stable delayed sweep display. Press the **Horizontal Menu** button and adjust the delay time using the **General Purpose Knob**.*

13. Press the **HORIZONTAL MENU** button and set **DELAY** to **Off**.
14. Disconnect the test setup from the oscilloscope.

Video Trigger — The following steps check the video trigger sensitivity.

Equipment Required: One NTSC Television signal generator (item 13), one 75 Ω termination (item 4), and one 75 Ω coaxial cable (item 6).

1. Display channel 1, turning all others off.
2. Connect the composite sync output of the television signal generator to the **CH 1** input as shown in Figure 6-15.

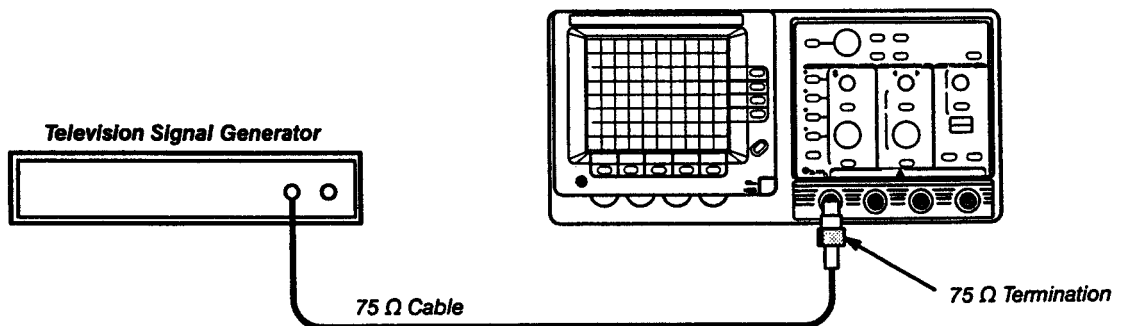


Figure 6-15: Video Trigger Test Setup

3. Press the **AUTOSET** button.
4. Set the volts/div scale to 200 mV.
5. Set the sec/div scale to 100 μ s.
6. Press the **UTILITY** button and select **CONFIG**.

7. Select **MORE** until you can select **Video Sync Negative** from the sub menu.
8. Press the **TRIGGER MENU** button and make the following selections:
 - Set **MODE** to **Video Field <odd>**
 - Set **SLOPE** to **Falling**
9. Confirm a stable display of the video field.
10. Set **MODE** to **Video Field <even>**.
11. Confirm a stable display of the video field.
12. Disconnect the test setup from the oscilloscope.

Adjustment

Adjustment Procedures

This section contains information needed to adjust the TAS 475 and TAS 485 Analog Oscilloscopes.

Description — The *Adjustment Procedures* are divided into two parts:

- General information about adjusting the oscilloscope
- Written procedures for oscilloscope calibration

Purpose — Use this procedure to return the oscilloscope to conformance with its *Warranted Characteristics* as listed in Section 4, *Specifications*. It also optimizes the performance of the oscilloscope.

This procedure is *not* required to verify the oscilloscope conforms with its warranted characteristics. Performance verification procedures are found in Section 6, *Performance Verification*.

Adjustment Interval — As a general rule, perform these adjustments after every 2,000 hours of operation or once a year if used infrequently.

Requirements for Performance

Before you perform this procedure, you need to address the following requirements.

Personnel

This procedure is only to be performed by trained service technicians.

Access to Adjustments

The cabinet must be removed to perform the adjustment procedure. Refer to Section 8, *Maintenance*, for procedures to remove the cabinet. The adjustment procedures make references to adjustments located on internal circuit boards. Figure 7-1 shows the location of each board with adjustments. The end of this section contains figures that show the location of each adjustment for each circuit board.

Warm-Up Period

This oscilloscope requires a 20 minute warm-up period in a 20° C to 30° C environment before performing this adjustment procedure. Adjustments performed before the operating temperature has stabilized may cause errors in performance.

Adjustment Instructions

The following instructions will guide you through each of the adjustments outlined in *Complete Adjustments*. Each adjustment section lists all necessary equipment required to perform the adjustments.

CRT Adjustments

Equipment Required: One time marker generator (item 9), one precision coaxial cable (item 5), and one 50 Ω termination (item 3).

Adjustment Locations: This procedure requires adjustments to the Display Driver board. See Figures 7-14 and 7-15 on pages 7-18 and 7-19 for the location of the adjustments.

1. Disconnect all signal inputs from the oscilloscope.
2. Display channel 1, turning all others off.
3. Press the **AUTOSET** button.
4. Set the volts/div scale to 50 mV.
5. Set the sec/div scale to 2 μ s.
6. Press the **VERTICAL MENU** button and make the following selections from the menu:
 - Set **CPLG** to **GND**
 - Set **BW** to **20 MHz**
7. Position the channel 1 trace to the center horizontal graticule line and adjust the **FOCUS** control for a well-defined display.
8. Adjust the **TRACE ROTATION** control (screw-driver adjustment) to align the trace with the center horizontal graticule line.
9. Press the **HORIZONTAL MENU** button and set **XY** to **On**.
10. Set the **INTENSITY** control fully counterclockwise (off).
11. Adjust R322 on the Display Driver board until the dot is visible, then re-adjust R322 until the dot just extinguishes.
12. Set **XY** to **Off**.
13. Connect the output of the time mark generator to the **CH 1** input as shown in Figure 7-2.

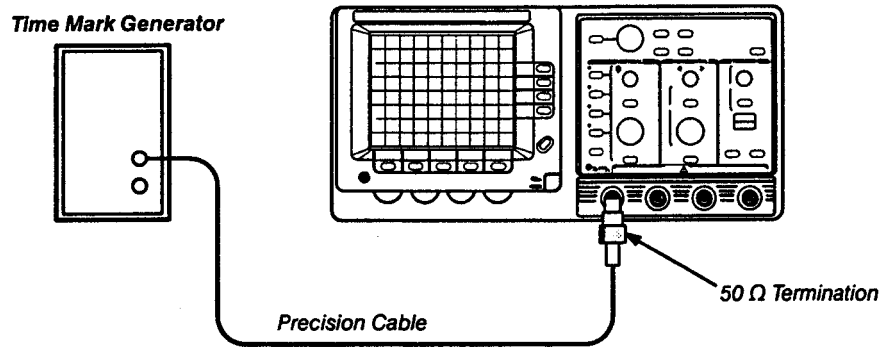


Figure 7-2: CRT Adjustments Calibration Setup

14. Set the time mark generator for 1 μ s markers.
15. Set the **INTENSITY** control to view the display.
16. Press the **VERTICAL MENU** button and set **CPLG** to **DC**
17. Press the **SET LEVEL TO 50%** button.
18. Adjust the **FOCUS** and R321 on the Display Driver board for the best focus of the time mark display and readout display.
19. Set the vertical **POSITION** control counterclockwise, moving the baseline of the time mark display down off the graticule area.
20. Set the **READOUT INTENSITY** control fully counterclockwise (off).
21. Adjust R323 on the Display Driver for the best geometry (minimum bowing) of the time mark display across the entire graticule area.
22. Set the **READOUT INTENSITY** control to view the readout.
23. Disconnect the calibration setup from the oscilloscope.

Low Frequency Output Compensation

Equipment Required: One pulse generator (item 10), one precision coaxial cable (item 5), one 50 Ω termination (item 3), and one dual-input coupler (item 7).

Adjustment Locations: This procedure requires adjustments to the Display Driver board. See Figures 7-14 and 7-15 on pages 7-18 and 7-19 for the location of the adjustments.

1. Display channel 1, turning all others off.
2. Press the **AUTOSET** button.
3. Set the volts/div scale to 50 mV.
4. Set the sec/div scale to 1 ms.
5. Press the **ALT/CHOP, ADD** button and set **DISP** to **Alt**.

6. Press the **VERTICAL MENU** button and set **CPLG** to **AC**.
7. Connect the positive fast rise pulse output of the pulse generator to the **CH 1** and **CH 2** input connectors as shown in Figure 7-3.

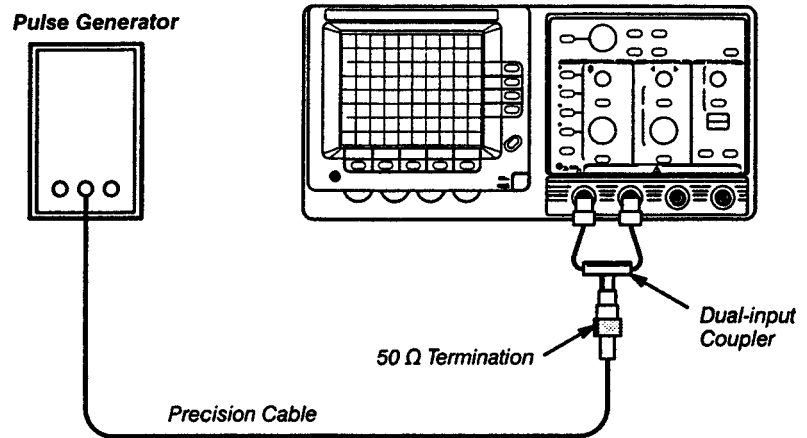


Figure 7-3: Low Frequency Output Compensation Calibration Setup

8. Set the pulse generator for fast rise period of 1 ms and a 4 division display.
9. Press the **SET LEVEL TO 50%** button.
10. Press the **CURSOR** button and set **ΔVOLT** to **On**.
11. Set the cursors 5 divisions apart using the General Purpose Knob and the **TOGGLE** button.
12. Set the volts/div scale to 20 mV.
13. Press the **CH 2** button.
14. Set the channel 2 volts/div scale to 20 mV.
15. Press the **VERTICAL MENU** button and make the following selections from the menu (channel 2):
 - Set **CPLG** to **GND**
 - Set **VAR** to **Off**
 - Set **INV** to **Off**
 - Set **BW** to **Full**
16. Position the channel 2 trace to the center vertical graticule line.
17. Set **CPLG** to **AC**.
18. Adjust R111 located on the Display Driver board for minimum vertical movement of the readout (over the entire graticule area).
19. Disconnect the test setup from the oscilloscope.

Factory Horizontal Cal

Equipment Required: One time mark generator (item 9), one precision coaxial cable (item 5), and one 50 Ω termination (item 3).

Prerequisites: CRT adjustment procedure.

1. Disconnect all signal inputs from the oscilloscope.
2. Press the **UTILITY** button to display the Utility menu.
3. Select **CAL** from the main menu.
4. Select **Factory Horizontal Cal**, initiating the calibration routine.

This routine takes about 20 seconds to complete its initial calibrations. Once complete, 2 dots are displayed and the message "Toggle to set 8div about center" appears. The displayed dots are used for the next horizontal calibration steps.

NOTE

*The following steps use both the General Purpose Knob and the **TOGGLE** button to make adjustments. The General Purpose Knob performs two functions: to adjust horizontal gain and centering. The **TOGGLE** button selects the function of the General Purpose Knob.*

5. Use a combination of the **TOGGLE** button and the General Purpose Knob to position the dots 8 divisions apart, centered horizontally (see Figure 7-4).
6. Select **Done** when you have the appropriate display.

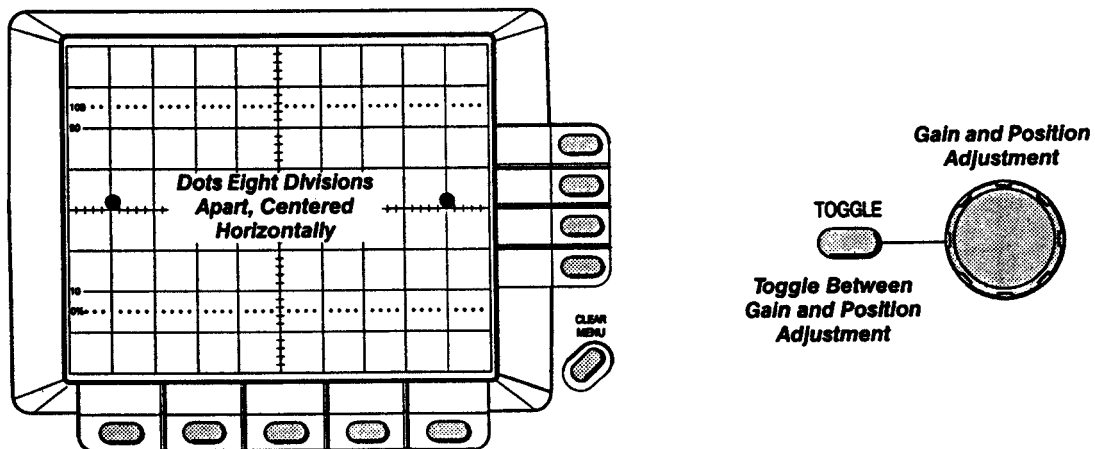


Figure 7-4: Horizontal Adjustments (One)

7. Again, use a combination of the **TOGGLE** button and the General Purpose Knob to position the dots 8 divisions apart, centered horizontally (see Figure 7-4).

8. Select **Done** when you have the appropriate display.
9. One dot is displayed.
10. Use a combination of the **TOGGLE** button and the General Purpose Knob to center the single dot at the center of the screen (see Figure 7-5).

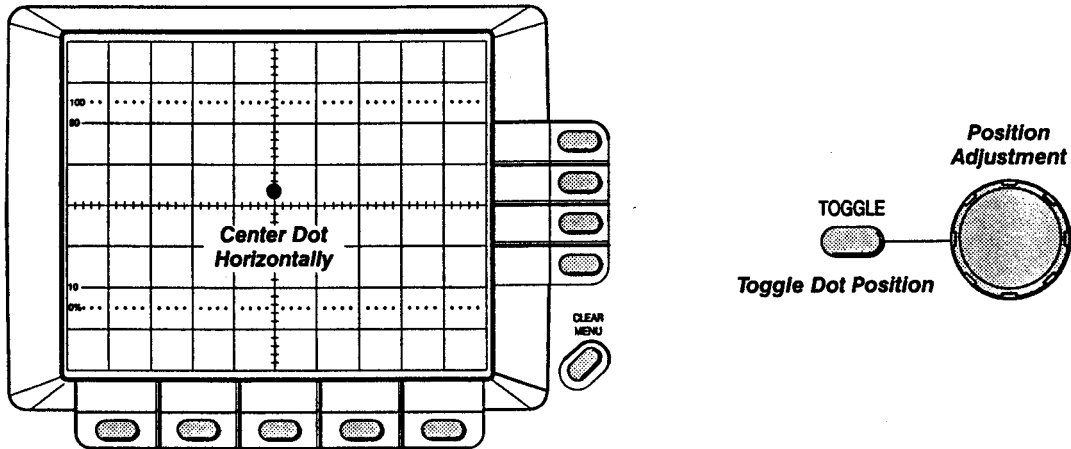


Figure 7-5: Horizontal Adjustments (Two)

11. Continue to press the **TOGGLE** button and adjusting the dot to center screen with the General Purpose Knob until the dot stays centered while pressing the **TOGGLE** button.
12. Select **Done** when you have the appropriate display.
13. Two vertical cursor lines are displayed.
14. Use a combination of the **TOGGLE** button and the General Purpose Knob to position the vertical lines 8 divisions apart, centered horizontally (see Figure 7-6).

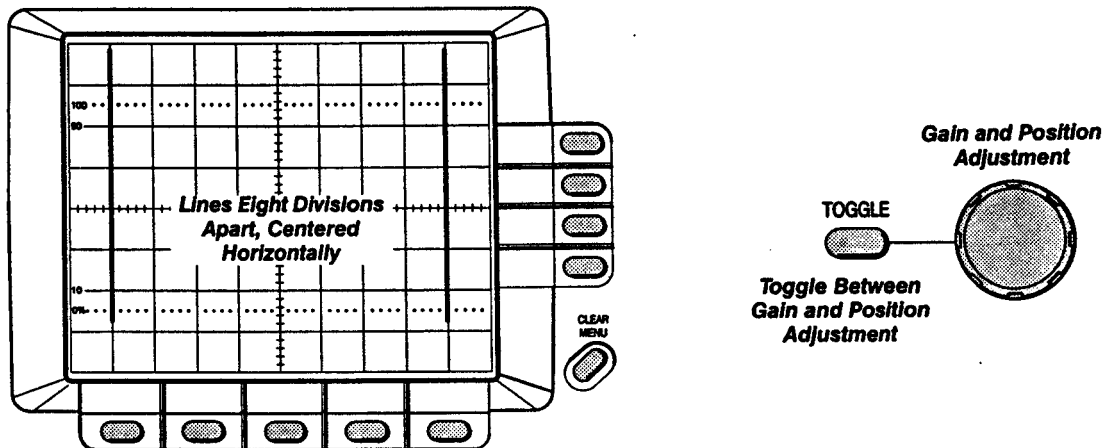


Figure 7-6: Horizontal Adjustments (Three)

15. Select **Done** with the menu button when you have the appropriate display.

NOTE

*At this time, the calibration routine can be terminated by selecting **Abort** instead of **Done**. The abort option appears through the remainder of this Factory Horizontal Cal routine.*

16. Select **Done** to continue or **Abort** to terminate the calibration routine.
17. Connect the output of the time mark generator to the CH 1 input as shown in Figure 7-7.

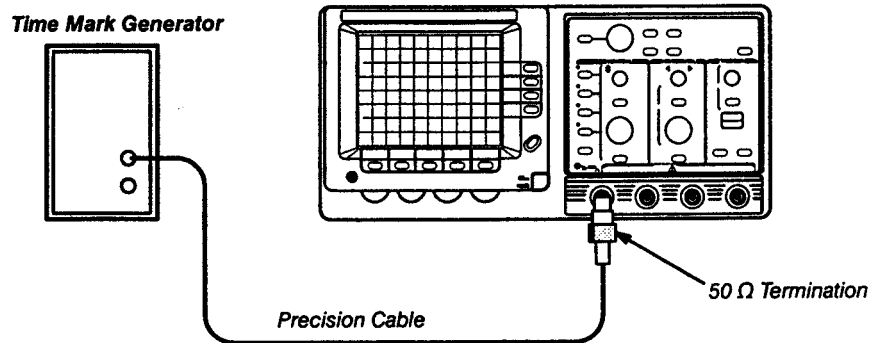


Figure 7-7: Horizontal Output Calibration Setup

18. Set the time mark generator for 5 ns markers.
19. Select **Done** when completed.
20. Adjust the 2 ns main sweep accuracy by performing these substeps.
 - a. Using the General Purpose Knob, adjust the display for 2 time markers per 5 divisions over the center 8 divisions.
 - b. Select **Done** when adjusted.
21. Adjust the 2 ns delay sweep accuracy by performing these substeps.
 - a. Using the General Purpose Knob, adjust the display for 2 time markers per 5 divisions over the center 8 divisions.
 - b. Select **Done** when adjusted. If adjusting the TAS 475, a **Cal Passed** message appears and you can skip to step 24. If adjusting the TAS 485 continue this procedure.
22. **TAS 485 Only** — Adjust the 1 ns main sweep accuracy by performing these substeps.
 - a. Using the General Purpose Knob, adjust the display for 2 time markers per 8 divisions over the center 8 divisions.
 - b. Select **Done** when adjusted.

23. **TAS 485 Only** — Adjust the 1 ns delay sweep accuracy by performing these substeps.
 - a. Using the General Purpose Knob, adjust the display for 2 time markers per 8 divisions over the center 8 divisions.
 - b. Select **Done** when adjusted; a **Cal Passed** message appears.
24. Select **Done** to exit the routine.
25. Disconnect the test setup from the oscilloscope.

Factory Vertical Cal

Equipment Required: One DC calibration generator (item 11), one precision coaxial cable (item 5), and three dual-input couplers (item 7).

Prerequisites: Low Frequency Output Compensation adjustment and Self Cal Horizontal adjustment procedures.

1. Press the **UTILITY** button.
2. Select **CAL** from the main menu.
3. Select **Factory Vertical Cal**, initiating the calibration routine.

The calibration routine displays user prompts on-screen throughout this procedure.

NOTE

*At this time, the calibration routine can be terminated by selecting **Abort**. The abort option appears through the remainder of this Factory Vertical Cal routine.*

4. Set the DC calibration generator for 10 VDC output and connect to the **CH 1**, **CH 2**, **CH 3**, and **CH 4** inputs as shown in Figure 7-8.

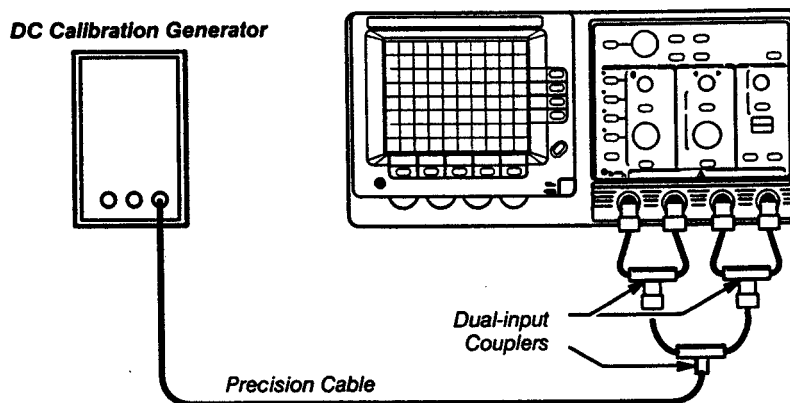


Figure 7-8: Factory Vertical Calibration Setup

5. Select **Done** when completed.

6. Set the DC calibration generator for 1 VDC output.
7. Select **Done** when completed.
8. Set the DC calibration generator for 100 mVDC output.
9. Select **Done** when completed.
10. Disconnect the test setup.
11. Select **Done** when completed.

This portion of the routine takes less than two minutes to complete.

NOTE

*The following steps use both the General Purpose Knob and the **TOGGLE** button to make adjustments. The General Purpose Knob performs two functions: adjust horizontal gain and centering. The **TOGGLE** button selects the function of the General Purpose Knob.*

12. Use a combination of the **TOGGLE** button and the General Purpose Knob to position the dots 6 divisions apart, centered horizontally (see Figure 7-9).

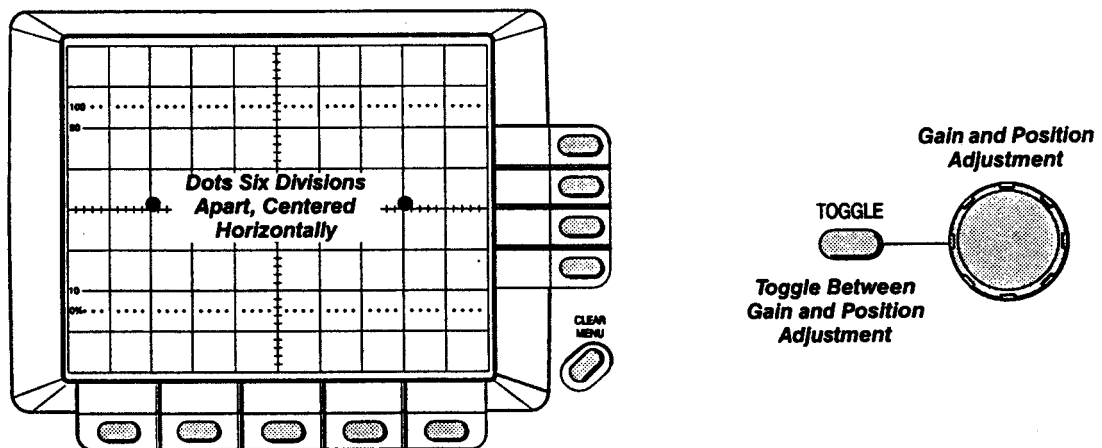


Figure 7-9: Vertical Adjustments

13. Select **Done** when you have the appropriate display.
14. Adjust R112 (vertical gain) and R154 (vertical centering) on the Display Driver board, setting the horizontal cursors 6 divisions apart, centered vertically (see Figure 7-10).

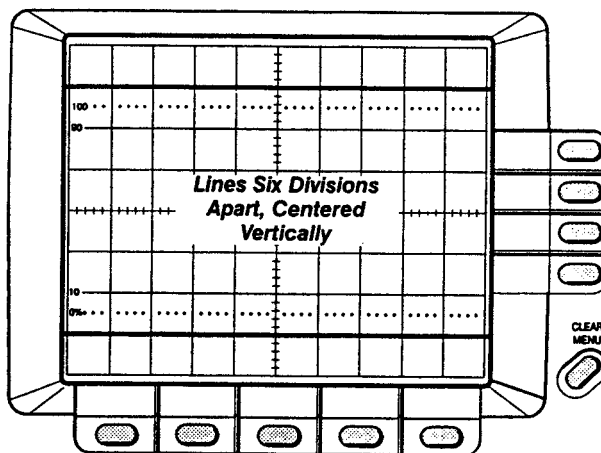


Figure 7-10: Adjusting Vertical Gain and Centering

15. Select **Done** when you have completed the adjustments.
16. Select **Done** again to exit the routine.

High Frequency Step Response

Equipment Required: One pulse generator (item 10), one precision coaxial cable (item 5), one 2X attenuator (item 1), and one 50 Ω termination (item 3).

Adjustment Locations: This procedure requires adjustments to the Display Driver board and the Vertical Termination hybrid. See Figures 7-14 and 7-15 on pages 7-18 and 7-19 for the location of the Display Driver board adjustments. See Figure 7-13 on page 7-17 for the location of the Vertical Termination hybrid adjustment.

Prerequisites: Factory Vertical Cal adjustment procedure.

1. Display channel 1, turning all others off.
2. Connect the positive fast rise pulse output of the pulse generator to the CH 1 input as shown in Figure 7-11.

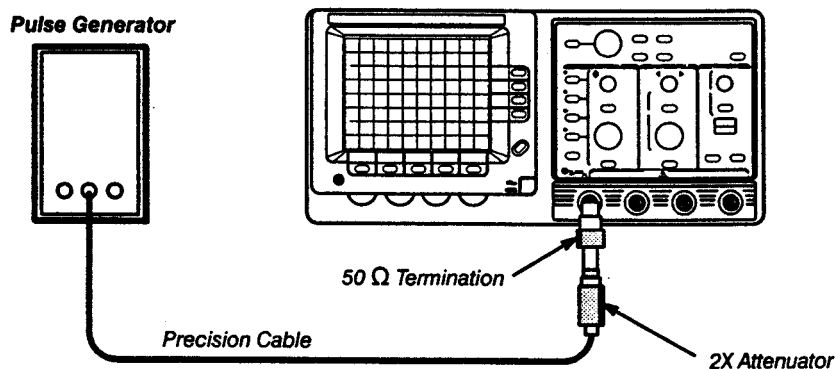


Figure 7-11: High Frequency Step Response Test Setup

3. Set the pulse generator fast rise period to 1 μ s and pulse amplitude to mid-range.
4. Press the **AUTOSET** button.
5. Use the following substeps to adjust the TAS 475. If adjusting the TAS 485, proceed to step 6.
 - a. Set the volts/div scale to 10 mV.
 - b. Set the sec/div scale to 200 ns.
 - c. Press the **VERTICAL MENU** button and set **CPLG** to **DC**.
 - d. Adjust the vertical **POSITION** control and the generator pulse amplitude to obtain a 5 division, vertically centered, display.
 - e. Adjust R141 and C122 on the Display Driver board for flattest long term response of the pulse front corner.
 - f. Set the sec/div scale to 20 ns.
 - g. Adjust R140 and C121 on the Display Driver board for minimum signal aberrations of the pulse front corner.

NOTE

Some interaction of the adjustments made in steps e through g may occur. For optimum oscilloscope performance, these steps should be rechecked after making adjustments.

6. Use the following substeps to adjust the TAS 485.
 - a. Set the volts/div scale to 100 mV.
 - b. Set the sec/div scale to 200 ns.
 - c. Press the **VERTICAL MENU** button and set **CPLG** to **DC**.
 - d. Adjust the vertical **POSITION** control and the generator pulse amplitude to obtain a 5 division, vertically centered, display.
 - e. Adjust R141 and C122 on the Display Driver board for flattest long term response of the pulse front corner.
 - f. Adjust R142 on the Display Driver board for flattest long term response of the pulse front corner.
 - g. Set the sec/div scale to 20 ns.
 - h. Adjust R140 and C121 on the Display Driver board for 1 minor graticule division of signal aberrations on the pulse front corner.
 - i. Adjust the termination on the Vertical Termination hybrid for flattest long term response of the pulse front corner.

NOTE

The position of the leads from the Vertical Termination hybrid to the CRT affect the high frequency step response. Unless the leads have been repositioned, it may not be necessary to adjust them.

Some interaction of the adjustments made in steps e through i may occur. For optimum oscilloscope performance, these steps should be rechecked after making adjustments.

7. Disconnect the calibration setup from the oscilloscope.

Attenuator Compensation

Equipment Required: One pulse generator (item 10), one precision coaxial cable (item 5), one 50 Ω termination (item 3), and three dual-input couplers (item 7).

Adjustment Locations: This procedure requires adjustments to the Analog board. See Figure 7-16 on page 7-20 for the location of the adjustments.

Prerequisites: Low Frequency Output Compensation adjustment procedure.

1. Display channel 1, turning all others off.
2. Connect the high amplitude output of the pulse generator to the CH 1, CH 2, CH 3, and CH 4 inputs as shown in Figure 7-12.

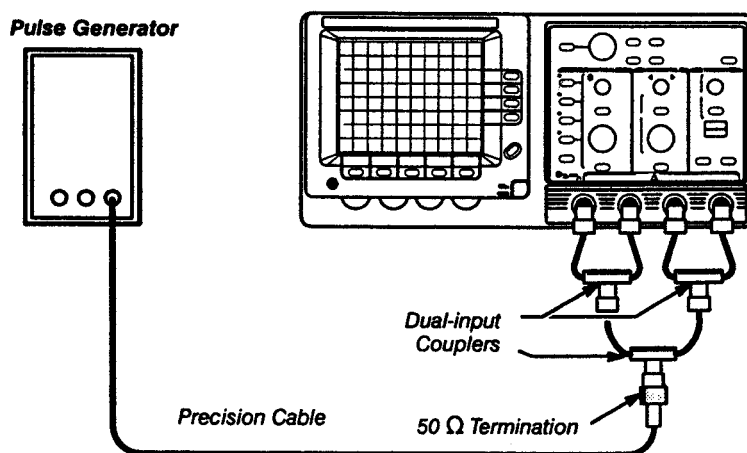


Figure 7-12: Attenuator Compensation Test Setup

3. Set the pulse generator high amplitude period to 1 ms.
4. Press the **AUTOSET** button.
5. Press the **VERTICAL MENU** button and set **CPLG** to **DC**.

6. Set the volts/div scale to 200 mV.
7. Set the sec/div scale to 200 μ s.
8. Using the vertical **POSITION** control and the generator pulse amplitude, obtain a 5 division, vertically centered display of channel 1.
9. Set the volts/div scale to 100 mV.
10. Press the **CH 2** button.
11. Press the **VERTICAL MENU** button and make the following selections from the menu:
 - Set **CPLG** to **DC**
 - Set **VAR** to **Off**
 - Set **INV** to **Off**
 - Set **BW** to **Full**
 - Set the volts/div scale to 100 mV
 - Position the channel 2 display approximately 0.5 divisions below the channel 1 display
12. Press the **CH 3** button.
13. Press the **VERTICAL MENU** button and make the following selections from the menu:
 - Set **CPLG** to **DC**
 - Set **VAR** to **Off**
 - Set **INV** to **Off**
 - Set **BW** to **Full**
 - Set the volts/div scale to 100 mV
 - Position the channel 3 display approximately 0.5 divisions below the channel 2 display
14. Press the **CH 4** button.
15. Press the **VERTICAL MENU** button and make the following selections from the menu:
 - Set **CPLG** to **DC**
 - Set **VAR** to **Off**
 - Set **INV** to **Off**
 - Set **BW** to **Full**
 - Set the volts/div scale to 100 mV
 - Position the channel 4 display approximately 0.5 divisions below the channel 3 display

16. Press the **CH 1** button.
17. Adjust Ch 1 10X on the Analog board for the flattest response of the most positive portion of the channel 1 waveform.
18. Set the channel 1 volts/div scale to 1 V.
19. Press the **CH 2** button.
20. Adjust Ch 2 10X adjustment on the Analog board for the flattest response of the most positive portion of the channel 2 waveform.
21. Set the channel 2 volts/div scale to 1 V.
22. Press the **CH 3** button.
23. Adjust Ch 3 10X adjustment on the Analog board for the flattest response of the most positive portion of the channel 2 waveform.
24. Set the channel 3 volts/div scale to 1 V.
25. Press the **CH 4** button.
26. Adjust Ch 4 10X adjustment on the Analog board for the flattest response of the most positive portion of the channel 2 waveform.
27. Set the channel 4 volts/div scale to 1 V.
28. Set the pulse generator amplitude to maximum.
29. Adjust Ch 4 100X on the Analog board for the flattest response of the channel 4 waveform.
30. Adjust Ch 3 100X on the Analog board for the flattest response of the channel 3 waveform.
31. Adjust Ch 2 100X on the Analog board for the flattest response of the channel 2 waveform.
32. Adjust Ch 1 100X on the Analog board for the flattest response of the channel 1 waveform.
33. Disconnect the test setup from the oscilloscope.

Vertical Gain Adjust (Cabinet On)

Equipment Required: None.

Adjustment Locations: This procedure requires adjustments to the Display Driver board. See Figures 7-14 and 7-15 on pages 7-18 and 7-19 for the location of the adjustments.

Prerequisites: Low Frequency Output Compensation, Factory Vertical Cal, and Attenuator Compensation adjustment procedures.

1. Slide the cabinet on the instrument and allow a 20-minute warm-up.
2. Press the **CURSOR** button and set Δ VOLT to **On**.
3. Set the volts/div scale to 1 V.

4. Position the cursors 6 divisions apart, centered vertically and check that the Δ Volts readout is between 5.96 V and 6.04 V.

NOTE

If the readout in step 4 is within the limits given, stop here. The calibration is complete.

If the readout is outside the limits, continue with this procedure.

5. Adjust the cursors until the Δ Volts readout is 6 V.
6. Note the cursor display error (are the cursors more or less than six divisions apart).
7. Slide the cabinet off the instrument and adjust R112 on the Display Driver board to compensate for the display error noted in step 6.

For example, if you noted in step 6 that the with the Δ Volts readout at 6 V, the cursor display equaled 6.2 divisions. Compensate by adjusting the cursor display to 5.8 divisions with R112.
8. Slide the cabinet on the instrument and repeat this procedure until the cursor display matches the Δ Volts readout.

Adjustment Complete

The adjustment procedure is complete. Install the cabinet and rear cover.

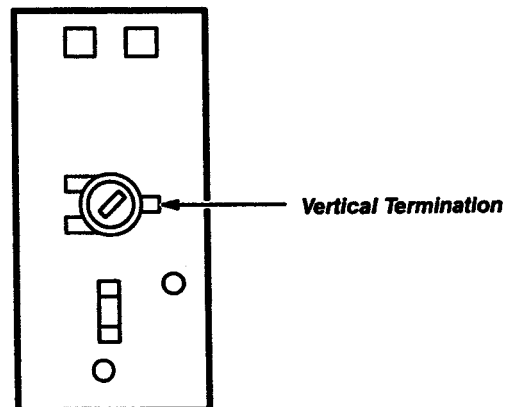


Figure 7-13: TAS 485 Vertical Termination Hybrid Adjustment

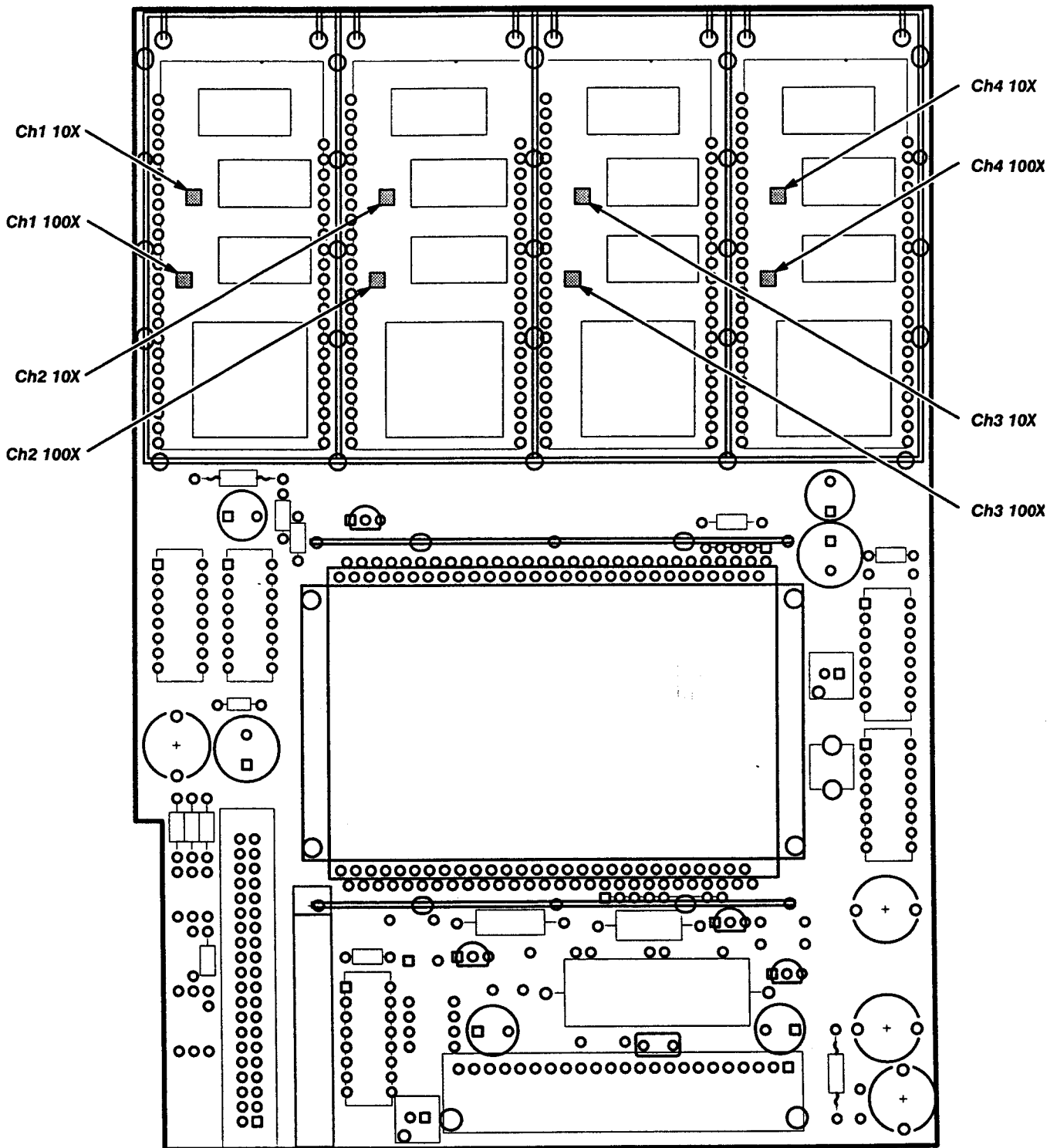


Figure 7-16: Analog Board Adjustment Locations

Maintenance

Maintenance Information

This section contains the information needed to do periodic maintenance on the TAS 475 and TAS 485 Analog Oscilloscopes.

- **Maintenance Information** — This subsection. It includes this introduction, servicing information, plus general information on preventing damage to internal modules when doing maintenance.
- **Inspection and Cleaning** — Information and procedures for inspecting the oscilloscope and cleaning its external and internal modules.
- **Parts Replacement Procedures** — Procedures for removing and installing the replaceable parts.

Before Servicing

This manual is for limited servicing of the TAS 475 and TAS 485 Analog Oscilloscopes. To prevent injury to yourself or damage to the oscilloscope, do the following before you attempt service.

- Be sure you are a qualified service person.
- Read the *Safety Summary* found at the beginning of this manual.
- Read *Start Up* in section 2.

When using this manual for servicing, be sure to heed all warnings, cautions, and notes.

Tektronix Service

Tektronix provides service to cover repair under warranty as well as other services that may provide a cost-effective answer to your service needs.

Whether providing warranty repair service or any of the other services listed below, Tektronix service technicians, trained on Tektronix products, are best equipped to service your TAS 475 and TAS 485 Analog Oscilloscopes. Tektronix technicians are apprised of the latest information on improvements to the product as well as the latest new options.

Warranty Service

Tektronix warrants this product for three years from date of purchase, excluding probes for which the warranty is one year. (The warranty appears on the back of the title page in this manual.) Tektronix technicians provide warranty service at most Tektronix service locations worldwide. Your Tektronix product catalog lists all service locations worldwide.

Repair or Calibration Service

Tektronix offers several types of service contracts that you may purchase to tailor repair and/or calibration of your TAS 475 and TAS 485 Analog Oscilloscopes to fit your requirements.

Refer to the *Introduction*, Section 1, for a list of the available service contracts for the TAS 475 and TAS 485 Analog Oscilloscopes.

Self Service

For information, contact your local Tektronix service center or sales engineer on any repair services.

Preventing ESD

When performing any service which requires internal access to the oscilloscope, adhere to the following precautions to avoid damaging internal modules and their components due to electrostatic discharge (ESD).



Static discharge can damage any semiconductor component in this oscilloscope.

1. Minimize handling of static-sensitive modules.
2. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules. All service must be done at a static-free work station.
3. Do not remove the oscilloscope cabinet unless you have met precaution number 2, above. Consider all internal modules static-sensitive.
4. Remove anything capable of generating or holding a static charge from the work station surface.
5. Do not slide the modules over any surface.
6. Do not use high-velocity compressed air when cleaning dust from modules.

Inspection and Cleaning

Inspection and Cleaning describes how to inspect and clean the TAS 475 and TAS 485 Analog Oscilloscopes. Inspection and cleaning are preventive maintenance. Preventive maintenance, when done regularly, may prevent oscilloscope malfunction and enhance its reliability.

Preventive maintenance consists of visually inspecting and cleaning the oscilloscope and using general care when operating it.

How often to do maintenance depends on the severity of the environment in which you use the oscilloscope. A proper time to perform preventive maintenance is just before oscilloscope adjustment.

General Care

The cabinet helps keep dust out of the oscilloscope and it is a major component of its cooling system. It should normally be in place when operating the oscilloscope. The oscilloscope's front cover protects the front panel and display from dust and damage. Install it when storing or transporting the oscilloscope.

Inspection and Cleaning Procedures

Inspect and clean the oscilloscope as often as operating conditions require. The collection of dirt on components inside can cause them to overheat and breakdown. (Dirt acts as an insulating blanket, preventing efficient heat dissipation.) Dirt also provides an electrical conduction path that could cause an oscilloscope failure, especially under high-humidity conditions.



Avoid the use of chemical cleaning agents that might damage the plastics used in this oscilloscope. Use a 75% isopropyl alcohol solution as a cleaner and rinse with deionized water. Use only deionized water when cleaning the menu buttons or front-panel buttons. Before using any other type of cleaner, consult your Tektronix Service Center or representative.

Avoid the use of high pressure compressed air when cleaning dust from the interior of this instrument. (High pressure air can cause ESD.) Instead, use low pressure compressed air (about 9 psi).

Inspection — Exterior

Inspect the outside of the oscilloscope for damage, wear, and missing parts. Use Table 8-1 as a guide. Oscilloscopes that appear to have been dropped or otherwise abused should be checked thoroughly to verify correct operation and performance. Repair defects that could cause personal injury or lead to further damage to the oscilloscope immediately.

Table 8-1: External Inspection Check List

Item	Inspect For	Repair Action
Cabinet, front panel, and cover	Cracks, scratches, deformations, damaged hardware or gaskets.	Replace defective module.
Front-panel knobs	Missing, damaged, or loose knobs.	Repair or replace missing or defective knobs.
Connectors	Broken shells, cracked insulation, and deformed contacts. Dirt in connectors.	Replace defective modules. Clear or wash out dirt.
Carrying handle and cabinet feet	Correct operation.	Repair or replace defective module.
Accessories	Missing items or parts of items, bent pins, broken or frayed cables, and damaged connectors.	Replace damaged or missing items, frayed cables, and defective modules.

Cleaning Procedure — Exterior

1. Remove loose dust on the outside of the oscilloscope with a lint free cloth.
2. Remove remaining dirt with a lint free cloth dampened in a general purpose detergent-and-water solution. Do not use abrasive cleaners.



To prevent getting moisture inside the oscilloscope during external cleaning, use only enough liquid to dampen the cloth or applicator.

3. Clean the CRT screen with a lint-free cloth dampened with either a 75% isopropyl alcohol solution or, preferably, a gentle, general purpose detergent-and-water solution.

NOTE

If the CRT Implosion Shield needs further cleansing, refer to the procedure on page 8-5.

Cleaning Procedure — Interior



If, after doing steps 1 and 2, a module is clean upon inspection, skip the remaining steps.

1. Blow off dust with dry, low-pressure, deionized air (approximately 9 psi).
2. Remove any remaining dust with a lint free cloth dampened in isopropyl alcohol (75% solution) and rinse with a warm deionized water. (A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards.)
3. If steps 1 and 2 do not remove all the dust or dirt, the oscilloscope may be spray washed using a solution of 75% isopropyl alcohol by doing steps 4 through 8.
4. Gain access to the parts to be cleaned by removing easily accessible shields and panels (see "Removal and Installation Procedures").
5. Spray wash dirty parts with the isopropyl alcohol solution and wait 60 seconds for the majority of the alcohol to evaporate.
6. Use hot deionized water to thoroughly rinse them.
7. Dry all parts with low-pressure, deionized air.
8. Dry all components and assemblies in an oven or drying compartment using low-temperature (+50° C to +60° C) circulating air.

Cleaning the CRT Implosion Shield



This procedure describes how to clean both sides of the CRT Implosion Shield, thus requiring its removal. Perform this procedure only if cleaning the backside of the Implosion Shield is necessary.

1. Remove the Implosion Shield as described in the Removal and Replacement procedures beginning on page 8-16.
2. Clean the shield with a lint free cloth dampened in a general purpose detergent-and-water solution. Do not use abrasive cleaners.
3. Remove any static charge that may have accumulated by holding the shield in a deionized air flow.
4. Install the shield as described in the Removal and Replacement procedures beginning on page 8-16.

Parts Replacement Procedures

This subsection contains procedures for removing and installing all replaceable parts. Illustrations accompany the procedures identifying the different parts by name.

For further identification of each part, refer to Section 9, *Replaceable Parts*. That section contains indexed illustrations that correspond to a list of part numbers. Use these part numbers when ordering replacement parts.

Equipment Required

Table 8-2 lists the tools required for the removal and installation procedures.

Table 8-2: Tools Required for Module Removal

Item No.	Name	Description
1	Screwdriver handle	Accepts Torx®-driver bits.
2	T-15 Torx tip	Torx®-driver bit for T-15 size screw heads.
3	Angle-tip tweezers	Used for knob and shaft removal.
4	Flat-bladed spudger	A nylon rod with a tip like a flat bladed screwdriver. Used to remove the front-panel trim without marring any surfaces.
5	Slip-jaw pliers	Used for removing the front feet from the cabinet.

Replacing Assemblies

Figure 8-1 identifies the replaceable parts.

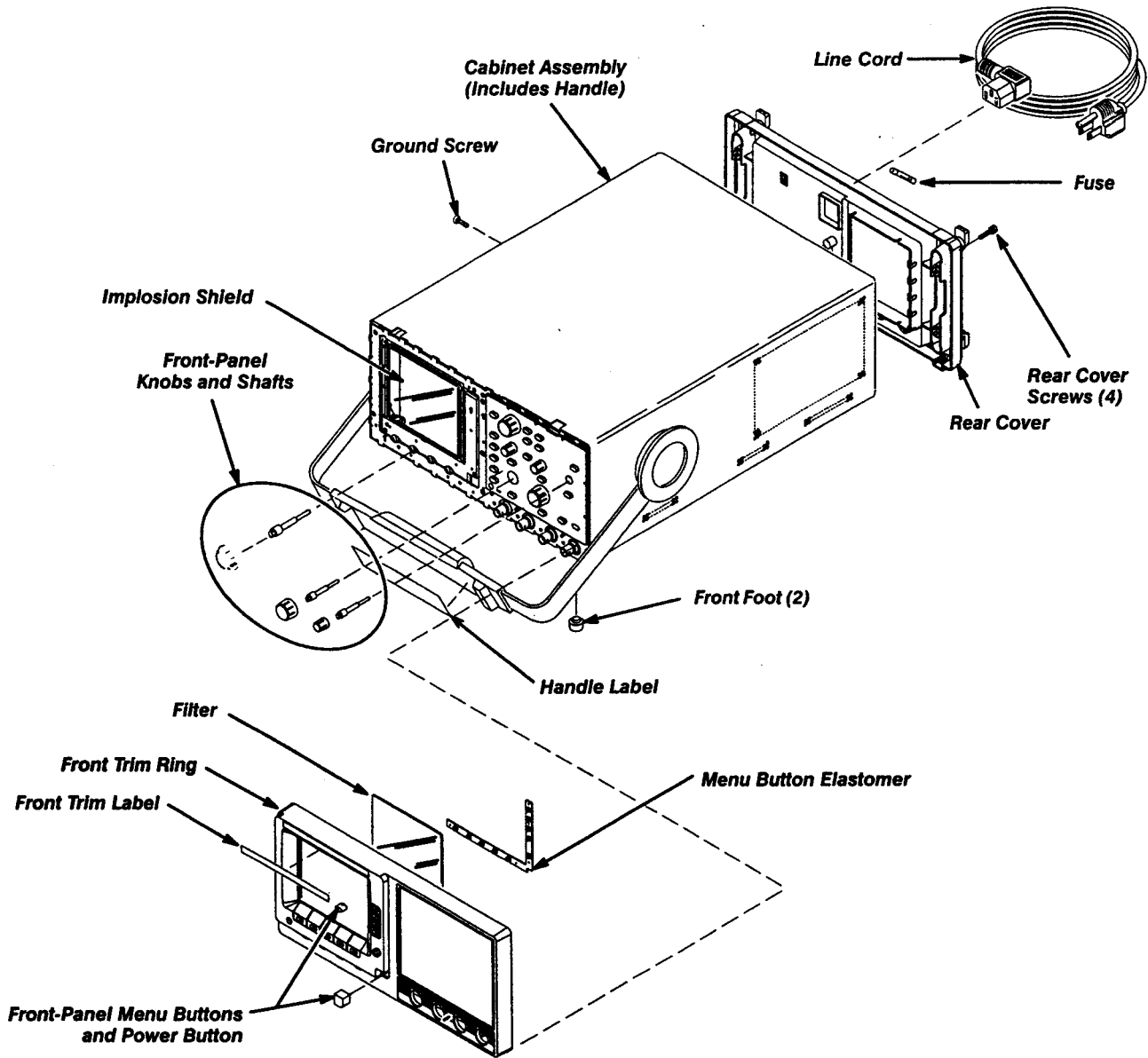


Figure 8-1: Replaceable Parts

Line Cord and Line Fuse

The following procedures describe how to remove and install the line cord and line fuse located on the back side of the oscilloscope.

WARNING

Unplug the line cord from the line voltage power source before continuing. Failure to do so can cause injury or death.

Prepare the oscilloscope by positioning the bottom side down on the work surface and facing the back side toward you. Refer to Figure 8-2.

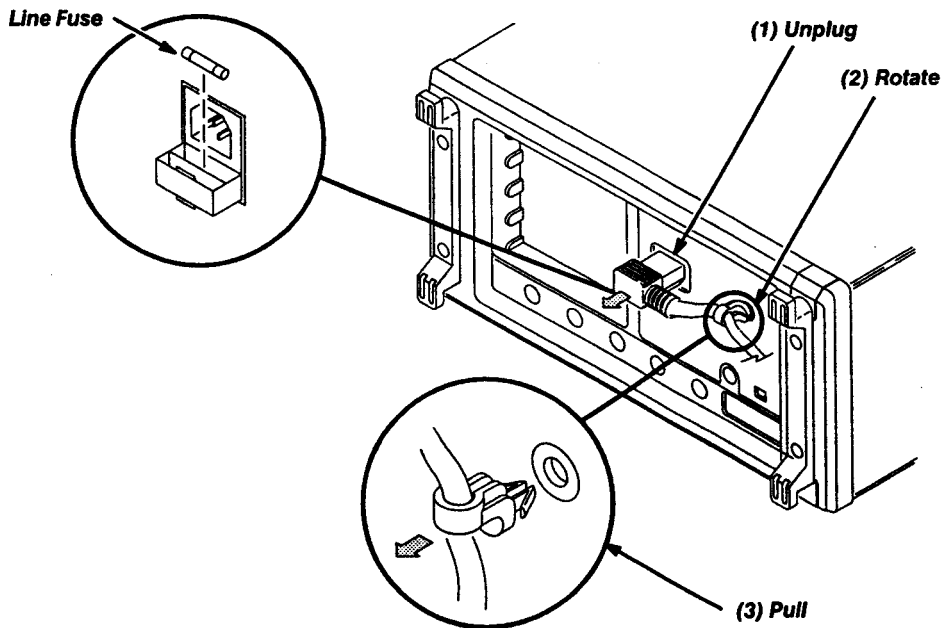


Figure 8-2: Line Fuse and Line Cord Removal

Line Cord — Use the following steps to remove and install the line cord.

1. Unplug the line cord from the power source.
2. Unplug the other end of the line cord from the back of the oscilloscope.
3. Grasp the end of the line cord and retaining clamp and rotate them 90 degrees counterclockwise (Figure 8-2).
4. Pull the line cord and clamp away from the back of the oscilloscope.
5. Perform this procedure in reverse order to install the power cord on the oscilloscope.

Line Fuse — Use the following steps to remove and install the line fuse.

1. Unplug the line cord from the power source.
2. Pull out the fuse holder drawer and remove the fuse (Figure 8-2).
3. Perform this procedure in reverse order to install the fuse.

Front-Panel Knobs and Shafts

Use the following procedures to remove and install front-panel knobs and shafts.

Prepare the oscilloscope by setting it bottom side down on the work surface and facing the front side toward you.

Removing Front-Panel Knobs and Shafts — Use the following steps to remove the knobs and shafts.

1. Remove any knob by slightly pulling it straight out from the front panel. This creates a small amount of clearance between the base of the knob and the front panel.
2. Insert the angle-tip tweezers between the knob and front panel and use them to remove the knob and attaching shaft (see Figure 8-3).
3. Pull the shaft out of the knob to separate the two pieces.

Installing Front-Panel Knobs and Shafts — Use the following steps to install the knobs and shafts.

1. Align the inside of the knob to the end of the shaft and push it in until it snaps.
2. Insert the shaft of the assembly into the proper hole on the front panel and push it in until it stops.
3. Lightly push in the knob and rotate it until the shaft slips into place.
4. Push the knob all the way in to seat the assembly.

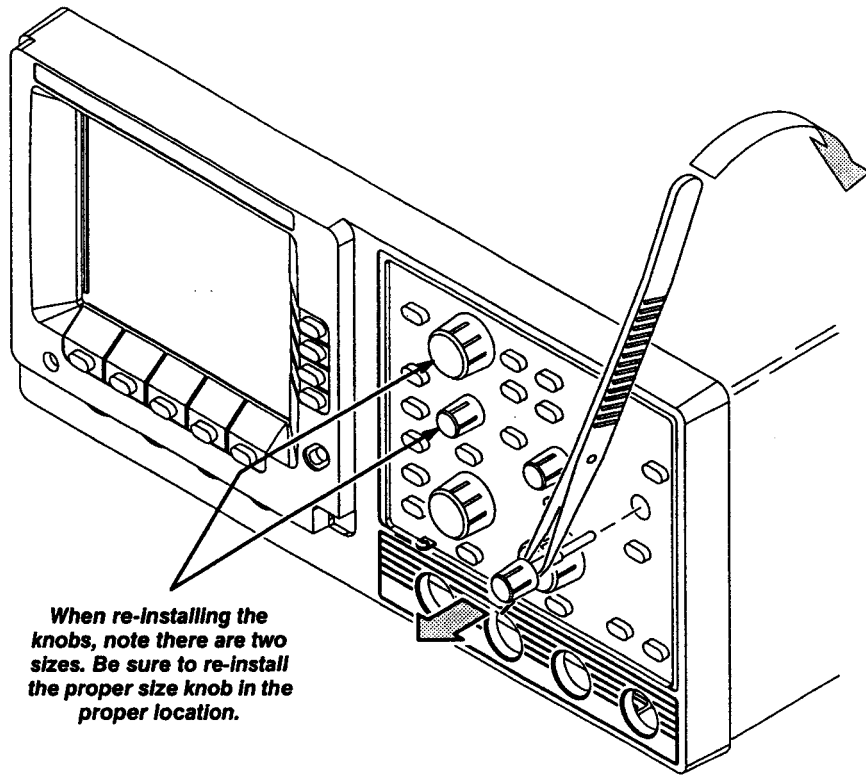


Figure 8-3: Knob and Shaft Removal

Feet, Rear Cover, and Cabinet

Before removing the rear cover or cabinet, install the optional front cover on the front panel of the oscilloscope (if available) and then position the oscilloscope as indicated in Figure 8-4.

Replacing the Front Feet — If you are replacing a front foot, use a pair of slip-jaw pliers to firmly grip the foot, then pull with a turning motion to remove. Do this step in reverse order to replace the foot.

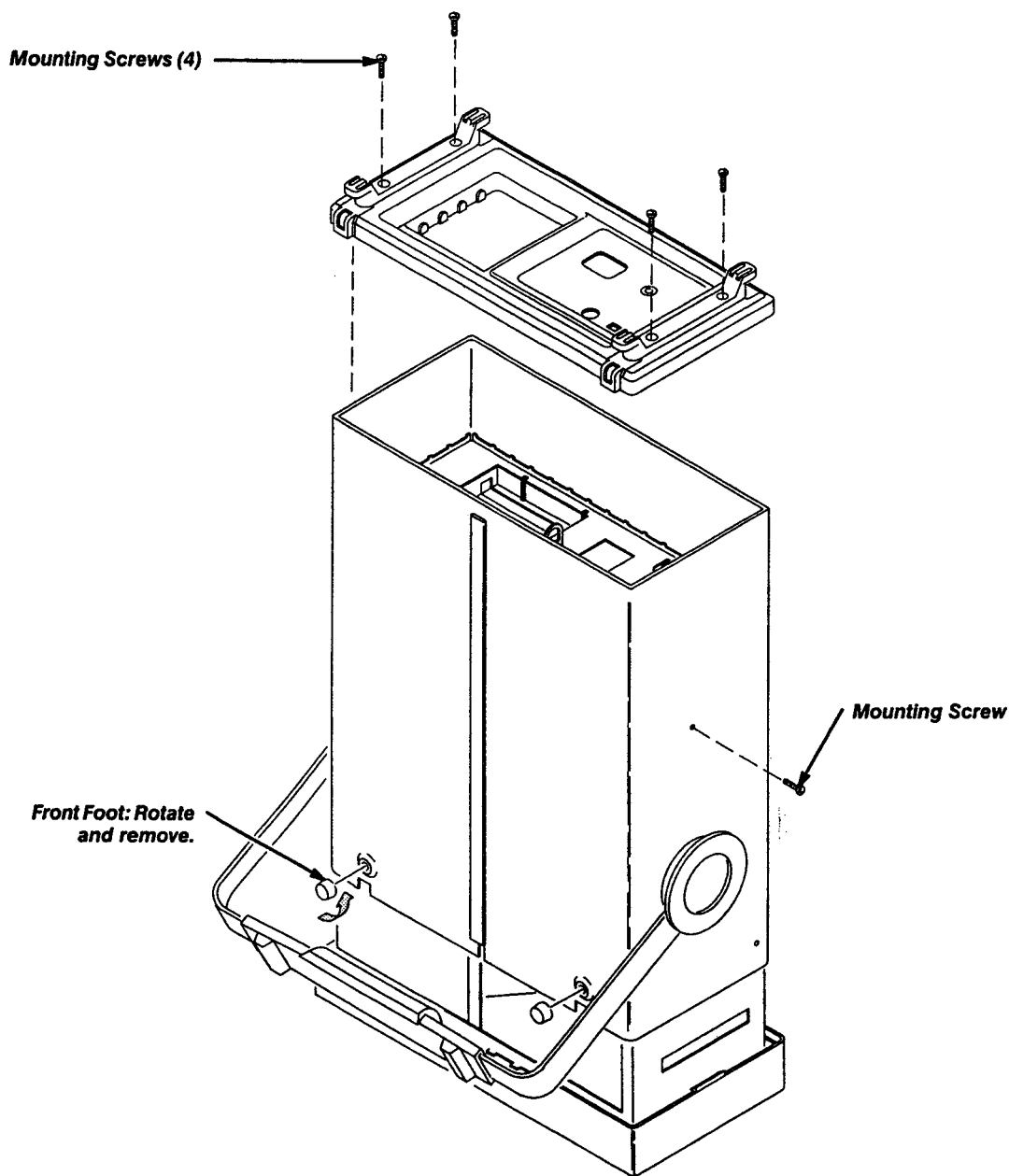


Figure 8-4: Rear Cover, Cabinet, and Feet Removal

Rear Cover — Use the following steps to remove and install the rear cover.

1. Position the oscilloscope as indicated in Figure 8-4.
2. Use the screwdriver to remove the four T-15 Torx screws that secure the rear cover to the oscilloscope.
3. Lift off the rear cover. Do these steps in reverse order to install the rear cover.

Cabinet — Use the following steps to remove and install the cabinet.

1. Remove the rear cover.
2. Remove the single T-15 Torx screw on the left side of the oscilloscope.
3. Grasp the two handle hubs and pull them outward as if to rotate the handle.
4. While holding the handle hubs out, lift the cabinet up and slide it off the oscilloscope. Take care not to bind or snag the cabinet on the internal cabling as you remove it.

Front-Panel Trim, Menu and Power Buttons

Use the following procedures to remove and install front-panel trim.

Prepare the oscilloscope by removing the rear cover and cabinet. Next, set the oscilloscope (bottom side down) on the work surface and face the front side toward you.

Removing the Front Trim — Use the following steps to remove the front trim.

1. Slide a flat-bladed spudger between the chassis and the plastic front trim, near one of the four flex locks. See Figure 8-5.
2. Gently pry the front trim up and slightly forward to disengage the flex lock. Do this until all four flex locks are disengaged.
3. Pull the front trim forward and off the instrument.

Menu Buttons — Use the following steps to remove and install the menu buttons.

1. Lay the front trim on a flat surface.
2. Gently remove menu button elastomer. Avoid touching the electrical contacts.
3. Remove the menu button(s).
4. Install menu buttons by placing a menu button in each menu button location.
5. Place the menu button elastomer over the menu buttons, ensuring that all standoffs protrude through the elastomer. Avoid touching the electrical contacts.

Power Button — Use the following steps to remove and install the power button.

1. With the front trim removed, grasp the power button and pull straight out from the chassis.

2. Install the power button by pushing the button onto the power button shaft until it locks into place.

Installing the Front Trim — Use the following steps to install the front trim.

1. If the menu buttons were removed, insert each button to its hole in the trim ring and install the menu button elastomer.
2. Align the front trim to the front of the instrument, without engaging any of the four flex locks.
3. Position the power button in line with the front-panel power button opening.
4. Slide the front trim onto the instrument, ensuring that all four flex locks engage.
5. If installing a new front trim, apply the appropriate front trim label.

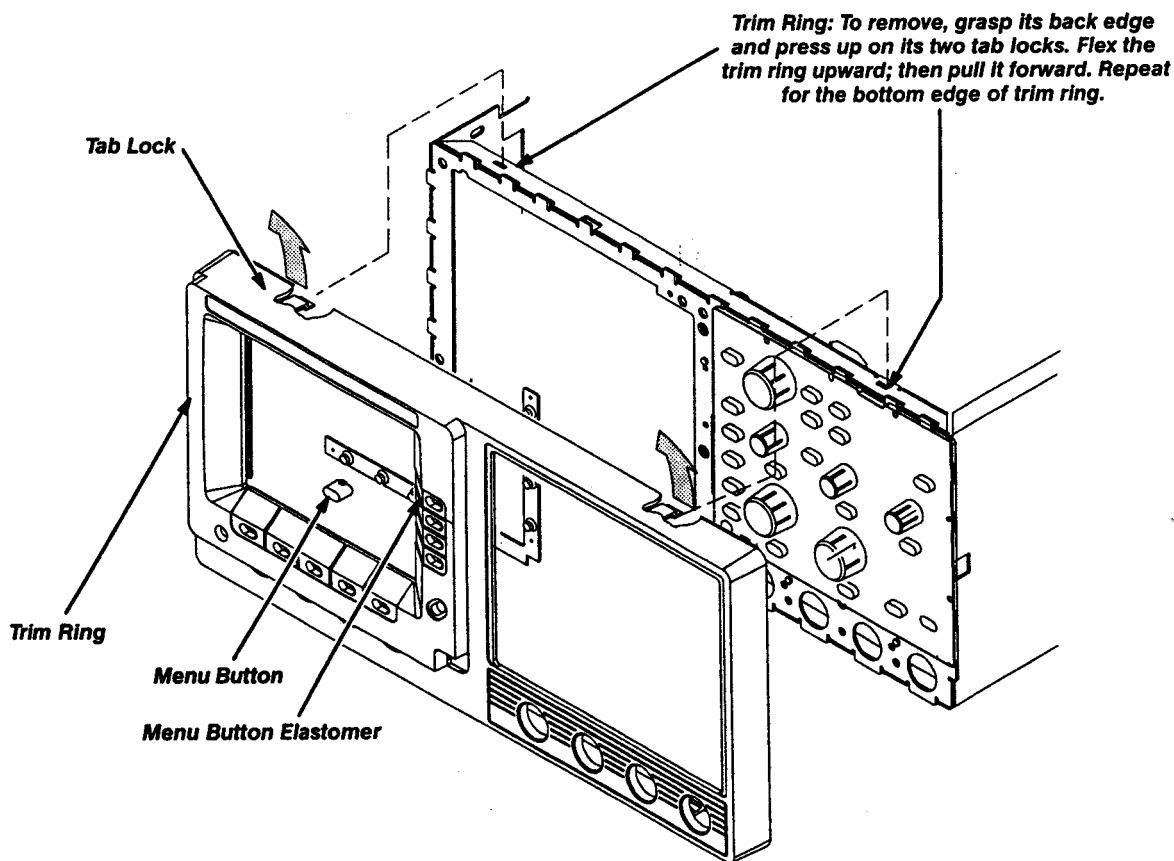


Figure 8-5: Trim Ring and Menu Buttons Removal

Installing the EMI Gaskets (TAS 485 Only) — The EMI gaskets are only used on TAS 485 oscilloscopes with serial numbers B010321 and above. Oscilloscopes with earlier serial numbers do not contain the gaskets. Use the following steps to install the gaskets.

1. If you are servicing the front EMI gaskets, discard the old ones.
2. Without installing the EMI gaskets, align the trim ring to the front of the chassis and push it on to seat. Be sure that both pairs of flex locks, one pair each at the inside top and bottom of the trim ring, snap over the edge of the chassis.
3. Lay the oscilloscope so its front cover is on the work surface.
4. Align an EMI gasket so it lies between any pair of adjacent flex locks along the groove between the cabinet and the trim ring.
5. Using a flat-bladed spudger, push the EMI gasket until it is firmly seated at the bottom of the groove (see Figure 8-6). It should not overlap either flex lock.
6. Repeat the process just described to install the remaining three gaskets.

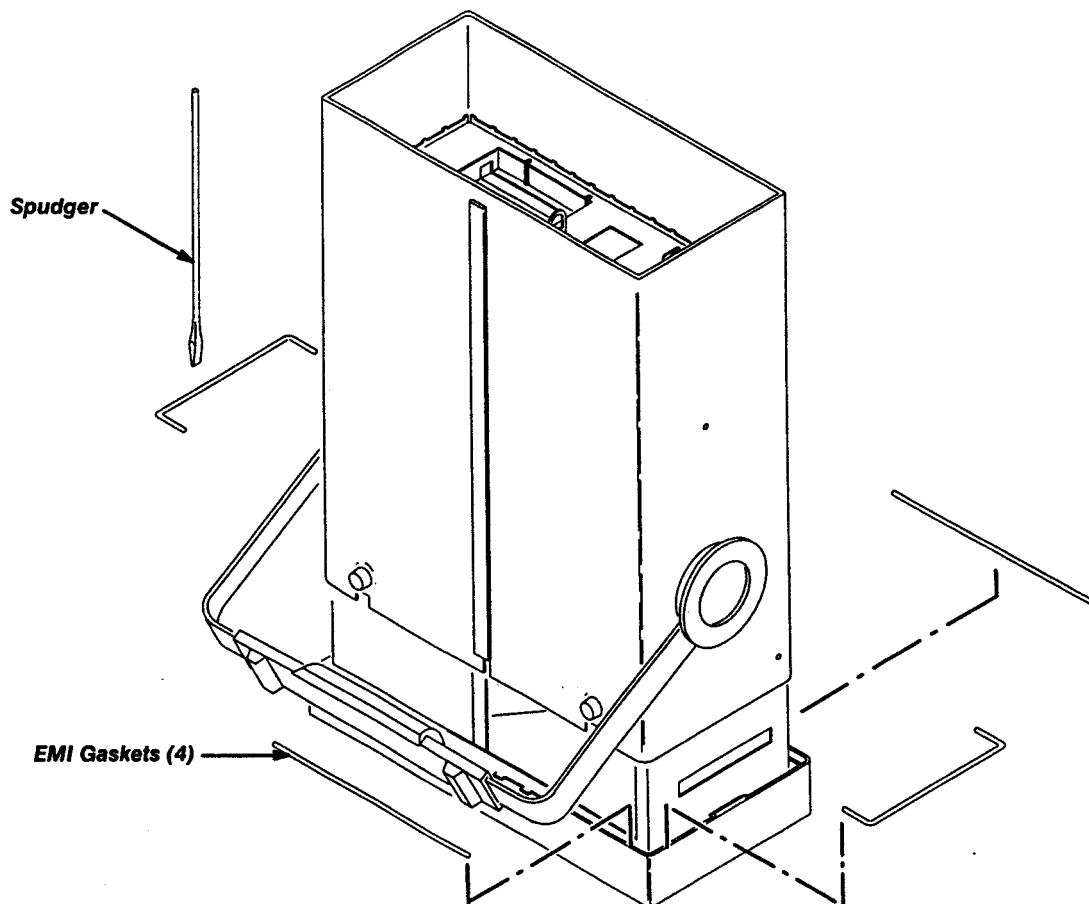


Figure 8-6: EMI Gasket Installation

CRT Implosion Shield — The steps that follow describe how to remove and install the CRT implosion shield. Removal and installation of the shield from the front of the instrument is possible only on the instruments with serial numbers listed in the following note.

NOTE

TAS 475 — SN: B010571 and Above

TAS 485 — SN: B010329 and Above

Additional procedures required — This procedure requires that the following procedures be performed first:

- Rear Cover Removal
 - Cabinet Removal
 - Front Trim Removal
1. From the front of the implosion shield, slip the spudger into the slot provided on the side of the CRT front bracket. See Figure 8-7.
 2. Carefully pry the implosion shield up and out of the CRT front bracket guides.
 3. Re-install the implosion shield by placing the left side of the shield into the CRT front bracket guides. If installing a new implosion shield, remove the clear protective covers.
 4. Snap the right side of the implosion shield into the CRT front bracket snaps.
 5. Install all previously removed components.

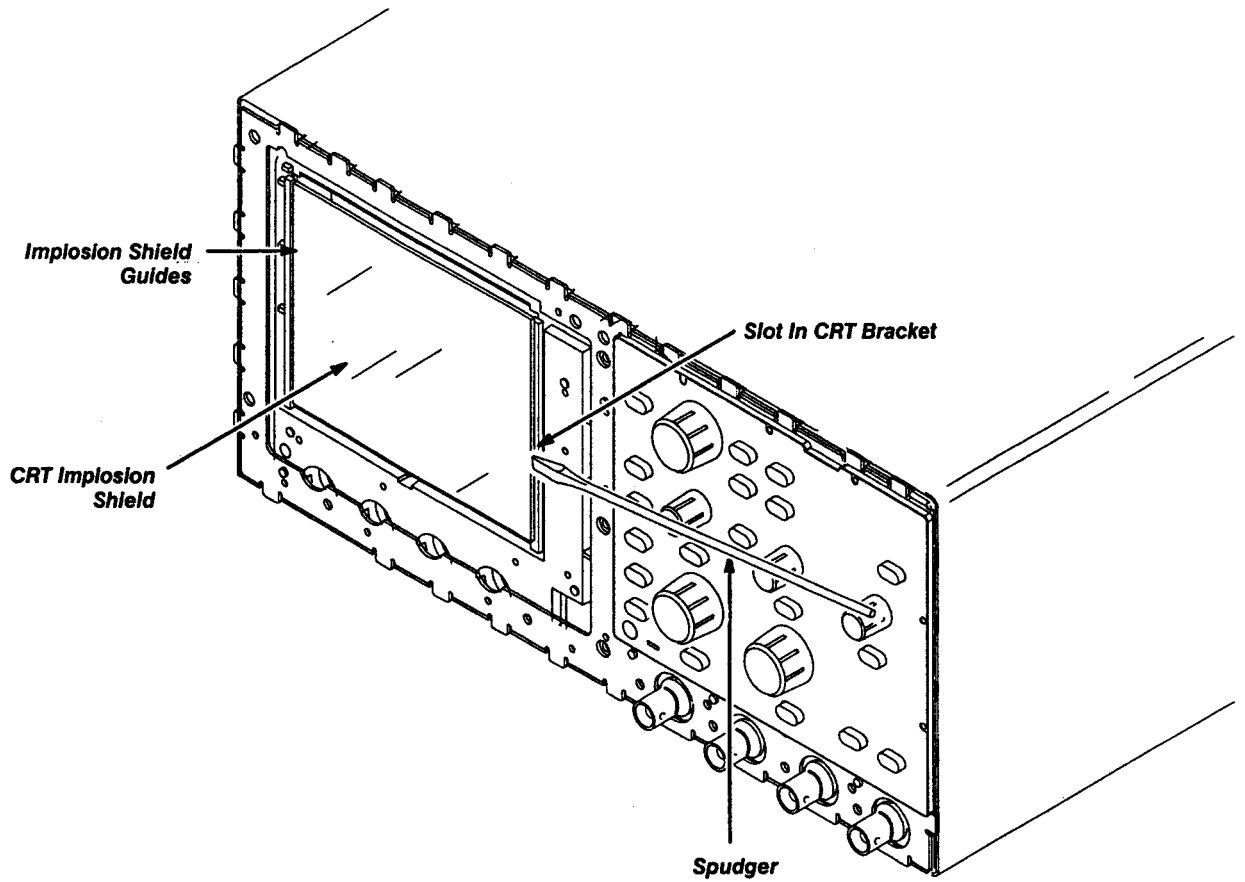


Figure 8-7: CRT Implosion Shield Removal

Parts List

Replaceable Parts List

This section contains a list of the replaceable cosmetic parts for the TAS 475 and TAS 485 Oscilloscopes. Use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts are available from or through your local Tektronix, Inc. service center or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest circuit improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- part number
- instrument type or model number
- instrument serial number
- instrument modification number, if applicable

If a part you order has been replaced with a different or improved part, your local Tektronix service center or representative will contact you concerning any change in the part number.

Change information, if any, is located at the rear of this manual.

Instrument Repair

If your TAS 475 and TAS 485 Oscilloscopes appears to have an electrical failure during or after the warranty period, contact your local Tektronix service center or representative or call 1-800-TEKWIDE, extension 6630.

A Service manual is also available for the TAS 475 and TAS 485 Analog Oscilloscopes, part number 070-8878-00. The service manual contains a complete electrical and mechanical parts list for the TAS 475 and TAS 485 Oscilloscopes.

Using the Replaceable Parts List

The tabular information in the Replaceable Parts List is arranged for quick retrieval. Understanding the structure and features of the list will help you find the all the information you need for ordering replacement parts.

Item Names

In the Replaceable Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, U.S. Federal Cataloging Handbook H6-1 can be used where possible.

Indentation System

This parts list is indented to show the relationship between items. The following example is of the indentation system used in the Description column:

1	2	3	4	5	Name & Description
					<i>Assembly and/or Component</i>
					<i>Attaching parts for Assembly and/or Component</i> <i>(END ATTACHING PARTS)</i>
					<i>Detail Part of Assembly and/or Component</i>
					<i>Attaching parts for Detail Part</i> <i>(END ATTACHING PARTS)</i>
					<i>Parts of Detail Part</i>
					<i>Attaching parts for Parts of Detail Part</i> <i>(END ATTACHING PARTS)</i>

Attaching parts always appear at the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. Attaching parts must be purchased separately, unless otherwise specified.

Abbreviations

Abbreviations conform to American National Standards Institute (ANSI) standard Y1.1

CROSS INDEX – MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
S3109	FELLER	72 VERONICA AVE UNIT 4	SUMMERSET NJ 08873
TK1163	POLYCAST INC	9898 SW TIGARD ST	TIGARD OR 97273
TK1908	PLASTIC MOLDED PRODUCTS	4336 SO ADAMS	TACOMA WA 98409
TK1935	ACCRA-FAB INC	11007 NE 37TH CIRCLE	VANCOUVER WA 98682
TK2280	ESCORT INSTRUMENTS CORP	2-FL NO 37 POA HSIN RD PO BOX 3-20 MUCHA	TAIPEI TAIWAN ROC 00080
TK2432	UNION ELECTRIC	15/F #1, FU-SHING N. ROAD	TAIPEI, TAIWAN ROC
OJR05	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER WA 98661-2999
0KB00	SCHRAMM PLASTIC FABRICATIORS	7885 SW HUNZIKER	TIGARD OR 97223
0KB01	STAUFFER SUPPLY	810 SE SHERMAN	PORTLAND OR 97214
34416	PARSONS MFG CORP	1055 OBRIAN DR	MENLO PARK CA 94025-1408
61857	SAN-0 INDUSTRIAL CORP	85 ORVILLE DR PO BOX 511	BOHEMIA LONG ISLAND NY 11716-2501
70903	COOPER BELDEN ELECTRONICS WIRE AND CABLE SUB OF COOPER INDUSTRIES INC		
75915	LITTELFUSE INC SUB TRACOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016-3049
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001

Replaceable Parts List

Fig. & Index No.	Tektronix Part No.	Serial No.		Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Dscont					
1-1	020-2036-00			1		KNOBS,BUTTONS AND SHAFTS	80009	020203600
-2	337-2926-03			1		SHLD,IMPLOSION:4.44 X 3.67 X 0.06,CLEAR	TK1159	ORDER BY DESC
-3	211-0730-00			1		SCR,ASSM WSHR:6-32 X 0.375,PNH,STL CD PL	0KB01	ORDER BY DESC
-4	390-1106-00			1		CABINET,OSC,W/HANDLE:ALUMINUM	TK1935	ORDER BY DESC
-5	211-0691-00			4		SCREW,MACHINE:6-32 X 0.625,PNH,STL CD PL	0KB01	ORDER BY DESC
-6	200-3975-01			1		COVER,REAR:W/FEET AND LABELS	80009	200897501
-7	348-0659-00			2		FOOT,CABINET:BLACK POLYURETHANE	0JR05	ORDER BY DESC
-8	260-2561-00			1		SWITCH,PB:BEZEL	80009	260256100
-9	378-0199-03			1		FILTER,LT,CRT:BLUE,3.415 X 4.105 X 0.030THK	0KB00	378019903
-10	101-0139-00			1		TRIM,DECORATIVE:	80009	101013500
-11	334-8424-00			1		MARKER,IDENT:MKD BEZEL (TAS 485)	80009	334820400
	334-8422-00			1		MARKER,IDENT:MKD BEZEL (TAS 475)	80009	334820400
	348-1258-00			4		SHLD,GASKET,ELE: 2 LAYER,0.094 X 0.188 X 8.750 (TAS 485)		

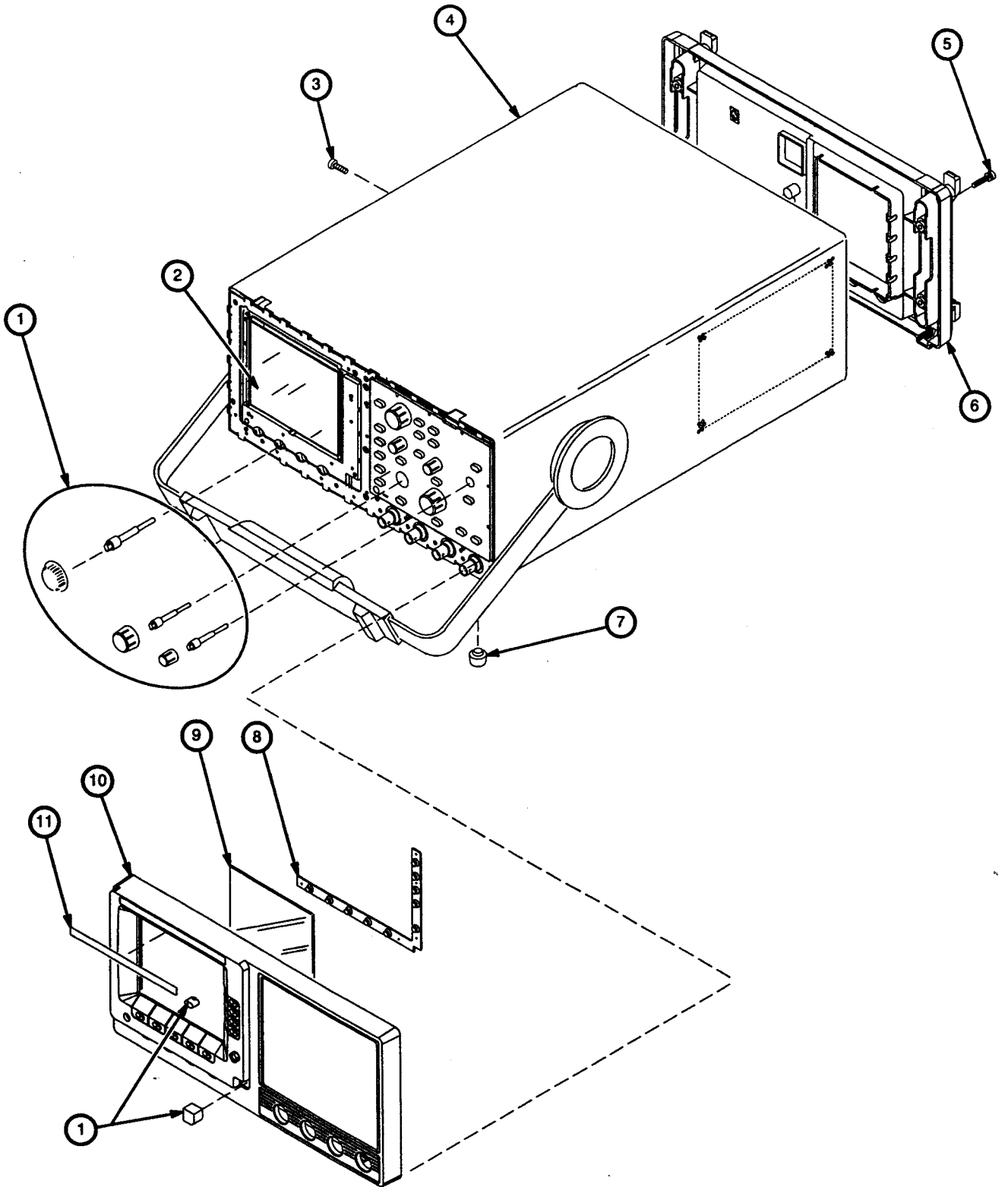


Figure 9-1: Replaceable Parts

Replaceable Parts List

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscnt	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
STANDARD ACCESSORIES						
9-2-1	161-0230-01		1	CABLE ASSY,PWR,:3,18 AWG,92 L,SVT,TAN (STANDARD)	TK2432	ORDER BY DESC
-2	161-0104-05		1	CABLE ASSY,PWR,:3,18 AWG,240V,98.0 L (OPTION A3-AUSTRALIAN)	S3109	SAA/3-OD3CCFC3X
-3	161-0104-06		1	CABLE ASSY,PWR,:3 X 0.75MM SQ,220V,98.0 L (OPTION A1-EUROPEAN)	S3109	VIIGSOPO-HO5VVF
-4	161-0104-07		1	CABLE ASSY,PWR,:3,1.0MM SQ,240 VOLT,2.5M L (OPTION A2-UNITED KINGDOM)	S3109	ORDER BY DESC
-5	161-0104-08		1	CABLE ASSY,PWR,:3,18 AWG,98 L,SVT,GREY/BLK (OPTION A4-NORTH AMERICAN)	70903	ORDER BY DESC
-6	161-0167-00		1	CABLE ASSY,PWR,:3.0 X 0.75,6A,240V,2.5M L (OPTION A5-SWITZERLAND)	S3109	ORDER BY DESC
-7	343-1213-00		1	CLAMP,PWR CORD:POLYIMIDE	TK1163	ORDER BY DESC
-8	159-0277-00		1	FUSE,CARTRIDGE:5 X 20MM,3A,250V,5 SEC	75915	235003
	070-8688-01		1	MANUAL,TECH:INSTR	80009	070868801
	070-8720-00		1	MANUAL,TECH:REFERENCE	80009	070872000
	070-8690-01		1	MANUAL,TECH:USER,XYZ OF OSCILLOSCOPES	80009	070869001
	P6109B		1	PROBE,PASSIVE:100MHZ,10X,W/READOUT (TAS 475)	80009	P6109B
	P6111B		1	PROBE,PASSIVE:200MHZ,10X,W/READOUT (TAS 485)	80009	P6111B
OPTIONAL ACCESSORIES						
	016-1154-00		1	HOOD ASSEMBLY:	80009	016115400
	016-1157-00		1	CASE,CARRYING:26 X 22 X 12,HARD TRANSFER	34416	ORDER BY DESC
	016-1158-00		1	CASE,CARRYING:SOFT PADDED,OPTIONS	80009	016115800
	016-1159-00		1	POUCH:POUCH & PLATE,GPS SIZE	80009	016115900
	016-1166-00		1	RACK MOUNT KIT:RACK MOUNT TDS400	80009	016116600
	070-8878-00		1	MANUAL,TECH:SERVICE,COMPONENT LEVEL	80009	070887800
-9	159-0311-00		1	FUSE,CARTRIDGE:METRIC,1.5A,250V,FAST (OPTIONS A1,A2,A3,A4,A5)	TK2280	62-25608-1U
	159-0190-00		1	FUSE,CARTRIDGE:5 X 20MM,3.15A,250V,50MS	61857	EQ-3.15A
-10	200-3232-00		1	COVER,FRONT:ABS	TK1908	ORDER BY DESC
	C9		1	CAMERA,SCOPE:	80009	C9
	K212		1	CART:PORTABLE INSTRUMENT	80009	K212

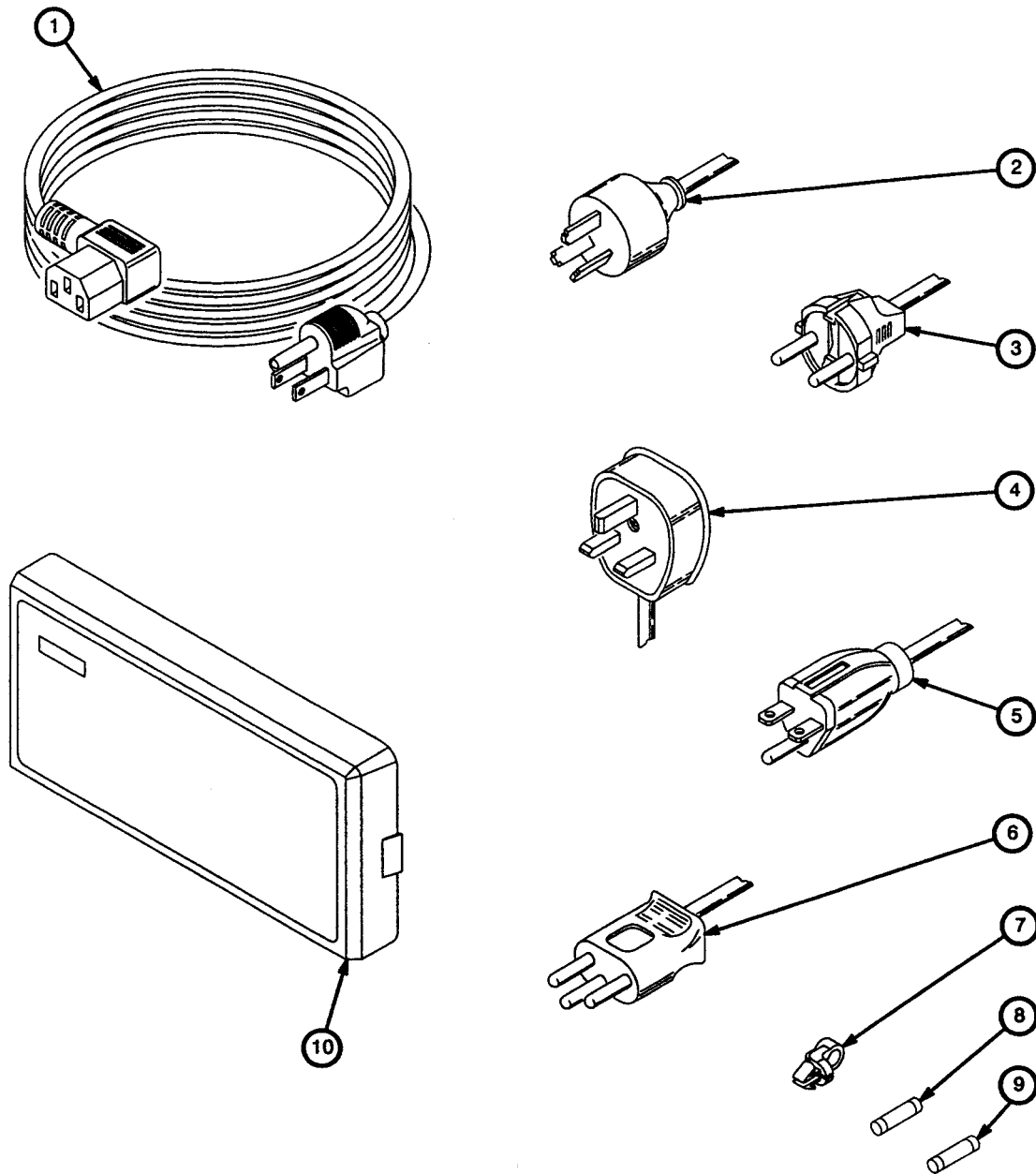


Figure 9-2: Accessories

Appendices

Appendix A: Detailed Menu Descriptions

This section contains detailed information of the TAS 475 and TAS 485 Oscilloscopes menu functions.

Vertical System Menus

The **VERTICAL MENU** button displays the menu items for channels 1 through 4 of vertical operating system. The menu displayed is dependent on the channel select buttons. Each menu and its choices are discussed here.

- **CPLG** — Selects the method to couple input signals to the attenuators of the selected input channel.
 - **DC** — DC coupling passes all components of the signal to the input channel. The D_C indicator appears to the right of the associated volts/div readout.
 - **AC** — AC coupling blocks the DC component of the input signal. The A_C indicator appears to the right of the associated volts/div readout.
 - **GND** — Disconnects the input signal and grounds the input of the associated vertical attenuator to provide a zero (ground) reference voltage display; it does not ground the front panel input connector. The \downarrow indicator appears to the right of the associated volts/div readout.
- **VAR** — When on, the **VOLTS/DIV** control operates in an uncalibrated or variable mode and the > symbol appears to the left of the readout.

Variable gain increases the vertical deflection of the selected channel by a factor of at least 2.5 times. Use the General Purpose Knob to change the gain by a factor of up to 2.5 times the current volts/div scale.

- **INV** — When on, the instrument inverts the channel input signal and the \downarrow indicator appears to the right of the channel indicator.
- **BW** — Provides a selection to enable the full bandwidth of the vertical and trigger systems or limit them.
 - **20 MHz** — Selecting **20 MHz** limits the bandwidth of the vertical deflection system and trigger system to 20 MHz. The B_W indicator appears in the readout when the bandwidth limit is in effect.
 - **Full** — Selecting **Full** enables the entire bandwidth of the oscilloscope.

ALT/CHOP, ADD — Pressing the **ALT/CHOP ADD** button displays the menu choices for display modes and math operations.

- **ADD1+2** — When on, the instrument displays a third signal that is the sum of the channel 1 and channel 2 input signals. The + indicator appears to the left of the channel 2 readout.
- **ADD3+4** — When on, the instrument displays a third signal that is the sum of the channel 3 and channel 4 input signals. The + indicator appears to the left of the channel 4 readout.
- **DISP** — The display selection allows you to choose how to display multiple channels.
 - **Alt** — When in alternate mode, the instrument displays the selected channels in sequence (alternating at the end of each sweep).
 - **Chop** — When in chop mode, the display chops between selected input channels at a rate of about 550 kHz.

Horizontal System Menus

The **HORIZONTAL MENU** button displays the following menu choices for the horizontal operating system.

- **MAIN** — Selects the main sweep horizontal deflection mode. The **SEC/DIV** control determines the sweep speed scale, which appears on the CRT readout. The main sweep can be displayed exclusively or with delay.
- **DELAY** — Selects the delayed sweep horizontal deflection mode. The **SEC/DIV** control determines the delayed sweep speed scale, which appears on the CRT readout. The delayed sweep can be displayed exclusively or with main.

In **Runs After** mode, the start of the delayed sweep (or the arming of the delayed trigger in any trigger mode) is delayed by the time you set with the General Purpose Knob. The delayed sec/div scale and the delay time position setting appear in the CRT readout. The > indicator appears in front of the delay time position readout if the delayed trigger mode is not **Runs After**.

- **XY** — Selects XY mode. The **CH 1** input signal produces the horizontal (X-axis) deflection. The **CH 2**, **CH 3**, **CH 4**, or added channels are sources for providing the vertical (Y-axis) deflection.

Use the channel 1 **POSITION** control to horizontally position an XY display. Use the channel 2, 3, or 4 **POSITION** control for vertical positioning.

- **VAR** — When on, the **SEC/DIV** control is uncalibrated and provides variable, uncalibrated sweep speeds to at least 2.5 times slower than the calibrated sec/div scales. Use the General Purpose Knob to change the variable sweep speeds.

The > indicator appears to the left of the sec/div readout to show that the horizontal scale is uncalibrated.

- **TRCSEP** — Trace separation assigns the General Purpose Knob to adjust the vertical separation between the main and delayed sweeps.

Trigger System Menus

The **TRIGGER MENU** button displays menu choices for the trigger operating system. This section discusses each menu and its choices. Menus for either the main or delayed sweeps are dependent on the selection of the **MAIN/DELAY SELECT** button.

Main Trigger Menu

- **MODE** — Selects the type of trigger used to initiate a sweep.
 - **Auto** — The main sweep will trigger when you set the trigger level within the peak-to-peak limits of an adequate trigger signal. The main sweep will free-run if the trigger is lost, such as if the signal amplitude is too low or the frequency is less than 10 Hz.
 - **Auto Level** — Automatically sets the trigger level to midtrace.

If the instrument loses the trigger, it will reset the auto-level range. The main sweep will free-run if the trigger is lost, such as if the signal amplitude is too low or the frequency is less than 10 Hz.
 - **Normal** — The main sweep will trigger when you set the trigger level within the peak-to-peak limits of an adequate trigger signal. The main sweep will not run if there is no adequate trigger signal.
 - **Single Sequence** — Single sequence sets the main sweep to complete one sweep when the instrument receives an adequate trigger. Once triggered, the **MAIN SWP TRIG'D** indicator lights and remains lit until the instrument completes all displays. Pressing the **RESET S SEQ** button arms the main sweep, lights the **READY** indicator, and the trigger circuit waits for the next trigger signal.

You can set the readout and cursors to turn on briefly at the start of the sequence (useful when using a camera), or remain on by changing the instrument configuration from the **UTILITY** menu (see page A-7).

- **Video Line** — The main sweep triggers at the beginning of each horizontal sync pulse (every line) of a composite video signal. The **SLOPE** polarity must match the **Video Sync Polarity** (see page A-7) to obtain video line triggering. Inverted video uses positive trigger slope. Normal video uses negative trigger slope.

- **Video Field** — The main sweep triggers at the beginning of each vertical sync pulse (every field) of a composite video signal. The **SLOPE** polarity must match the **Video Sync Polarity** (see page A-7) to obtain video field triggering.
 - **odd** — The main sweep triggers at the beginning of the vertical sync pulse of field one in a standard interlaced video signal.
 - **even** — The main sweep triggers at the beginning of the vertical sync pulse of field two in a standard interlaced video signal.
 - **both** — The main sweep triggers at the beginning of the vertical sync pulse of either field one or field two in a standard interlaced video signal.
- **SRC** — Selects the source of the trigger signal to initiate the main sweep.
 - **Priority Vert** — The instrument obtains the trigger signal from the highest priority active channel. See Table A-1 to determine the trigger source.

Table A-1: Selected Trigger Source When in Priority Vert

Channel Conditions						Selected Trigger Source
CH 1	CH 2	CH 3	CH 4	ADD1+2	ADD3+4	
On	†	†	†	†	†	Channel 1
Off	On	†	†	†	†	Channel 2
Off	Off	On	†	†	†	Channel 3
Off	Off	Off	On	†	†	Channel 4
Off	Off	Off	Off	On	†	ADD1+2
Off	Off	Off	Off	Off	On	ADD3+4

† indicates that the channel supplies no signal to the trigger system, whether or not the channel is displayed.

- **Ch1** — The signal applied to the **CH 1** input connector is the source of the trigger signal.
- **Ch2** — The signal applied to the **CH 2** input connector is the source of the trigger signal.
- **Ch3** — The signal applied to the **CH 3** input connector is the source of the trigger signal.
- **Ch4** — The signal applied to the **CH 4** input connector is the source of the trigger signal.
- **Add1+2** — The instrument obtains the trigger signal from the signal created when adding input channels 1 and 2 together.

- **Add3+4** — The instrument obtains the trigger signal from the signal created when adding input channels 3 and 4 together.
- **Line** — The instrument obtains the triggering signal from the AC power source.
- **CPLG** — Coupling selects the components of the trigger signal applied to the trigger circuitry.
 - **DC** — Couples DC and all frequency components of a triggering signal to the trigger circuitry.
 - **Noise Reject** — Noise reject couples all frequency components of the trigger signal to the trigger circuitry but increases the peak-to-peak signal amplitude required to trigger the sweep.
 - **HF Reject** — High frequency reject attenuates the frequency components of the trigger signal that are above 50 kHz, reducing high-frequency interference.
 - **AC** — Blocks the DC component of the trigger signal and attenuates trigger signal frequency components below 160 Hz.
 - **LF Reject** — Low frequency reject blocks the DC component of the trigger signal and attenuates the frequency components of the trigger signal that are below 50 kHz, reducing low-frequency interference.
- **SLOPE** — Selects the slope of the trigger source signal that triggers the sweep.
 - **Rising** — The rising edge (positive going) of the input signal triggers the sweep.
 - **Falling** — The falling edge (negative going) of the input signal triggers the sweep.
- **HOLDOFF** — When on, holdoff adds additional time between the end of the sweep and the arming of the trigger circuit. The holdoff time is adjustable from a preset minimum value to 10 times the minimum value. The General Purpose Knob adjusts the holdoff time.

Delayed Trigger Menu

- **MODE** — Selects the operating mode of the delayed trigger system.
 - **Runs After** — Starts the delayed sweep immediately after the delay time requirement is satisfied, selected by the General Purpose Knob.
 - **Trig After** — The delayed sweep triggers when the instrument receives an adequate trigger signal after the delay time condition has been met. When there is no trigger signal, there is no delayed sweep trace.

- **Video Line (from main trigger)** — Starts the delayed sweep at the beginning of a video signal line received after the delay time condition has been met.

Slope polarity defaults to the main trigger slope. The slope polarity must match the **Video Sync Polarity** (see page A-7) to obtain correct triggering on the horizontal sync pulse.
- **SRC** — Selects the source of the trigger signal to initiate the delayed sweep.
 - **Ch1** — The signal applied to the **CH 1** input connector is the source of the trigger signal.
 - **Ch2** — The signal applied to the **CH 2** input connector is the source of the trigger signal.
 - **Ch3** — The signal applied to the **CH 3** input connector is the source of the trigger signal.
 - **Ch4** — The signal applied to the **CH 4** input connector is the source of the trigger signal.
 - **Add1+2** — The instrument obtains the trigger signal from the signal created when adding input channels 1 and 2 together.
 - **Add3+4** — The instrument obtains the trigger signal from the signal created when adding input channels 3 and 4 together.
 - **Line** — The triggering signal is the AC power source.
- **CPLG** — Coupling selects the components of the trigger signal applied to the trigger circuitry.
 - **DC** — Couples DC and all frequency components of a triggering signal to the trigger circuitry.
 - **Noise Reject** — Noise reject couples all frequency components of the trigger signal to the trigger circuitry but increases the peak-to-peak signal amplitude required to trigger the sweep.
 - **HF Reject** — High frequency reject attenuates the high-frequency components of the trigger signal that are above 50 kHz, reducing high-frequency interference.
 - **AC** — Blocks the DC component of the trigger signal and attenuates trigger signal frequency components below 160 Hz.
 - **LF Reject** — Low frequency reject blocks the DC component of the trigger signal and attenuates the low-frequency components of the trigger signal that are below 50 kHz, reducing low-frequency interference.
- **SLOPE** — Selects the slope of the trigger source signal that triggers the sweep.
 - **Rising** — The sweep triggers on the rising (positive going) edge of the input signal.

- **Falling** — The sweep triggers on the falling (negative going) edge of the input signal.

Cursor Menus

The **CURSOR** button displays the cursors on the waveform. Use the General Purpose Knob to move the cursors. The **TOGGLE** button switches cursor control from active cursor to inactive.

- **Δ VOLTS** — Displays the delta voltage (difference) between the two horizontal cursors.
- **ABS V** — Displays the absolute voltage level of the horizontal cursor (referenced to ground).
- **Δ TIME** — Displays the delta time (measured in seconds) between the two vertical cursors.
- **1/ Δ T** — Displays the frequency (measured in Hertz) between the two vertical cursors.

Save and Recall Menus

The **SAVE/RECALL SETUP** button displays menus that allow you to store four complete front-panel setups for later recall. You can select save and recall functions by pressing the menu-item select buttons. Setup locations are underlined on the CRT if they contain a stored setup.

- **RECALL** — Pressing the **RECALL** menu button recalls the front-panel settings previously saved in one of the four memory locations.
 - **1 through 4** — These are the memory locations to retrieve a front-panel setting.
- **SAVE** — Pressing the **SAVE** menu button will save the front-panel setup to one of four memory locations.
 - **1 through 4** — These are the memory locations to save a front-panel setting.
- **ERASE** — Pressing the **ERASE** menu button will erase the memory of one of the four memory locations.
 - **1 through 4** — These are the memory locations that can be erased.

Utility Menus

The **UTILITY** button displays menus used to configure certain aspects of the oscilloscope operating system and perform calibration routines.

- **CONFIG** — Use the configuration menu to define operating conditions seldom changed once set.
 - **Intensity Delay = Main** — Both the main and the delayed sweeps have the same intensity level.

- **Intensity Delay > Main** — The intensity of the delayed sweep is greater than that of the main sweep.
- **Intensity Delay Maximum** — The intensity of the delayed sweep is set to its maximum level.
- **Video Sync Positive** — When using a video trigger mode, the trigger system triggers on the positive slope of the video signal (horizontal sync pulses on the top of the video signal).
- **Video Sync Negative** — When using a video trigger mode, the trigger system triggers on the negative slope of the video signal (horizontal sync pulses on the bottom of the video signal).
- **Video Sync = Main Trigger Slope** — Sets the slope of the trigger source for video signals to match the main trigger slope selection.
- **Dual Delay Disabled** — Provides one intensified delayed event.
- **Dual Delay Enabled** — Provides two intensified delayed events when time measurement cursors are on and both the main and delayed sweeps are on.
- **SSeq Readout Continuous** — The readout remains on when the trigger mode is set to single sequence.
- **SSeq Readout Flash** — The readout is flashed on at the end of the display sequence when the trigger mode is set to single sequence.
- **CAL** — This selection displays calibration routines.
 - **Horizontal Sweep Path** — Initiates the temperature compensation calibration procedure for the horizontal system.
 - **Vertical Signal Path** — Initiates the temperature compensation calibration procedure for the vertical system.
 - **Factory Vertical Cal** — Initiates the vertical calibration procedure.
- **ID** — Displays the software version on-screen.

Appendix B: Autoset Control Settings

Using the Autoset Feature

The **AUTOSET** feature of the TAS 475 and TAS 485 Oscilloscopes automatically sets most of the front panel controls. Table A-2 lists the instrument control settings obtained when using **AUTOSET**.

Table A-2: Control Setup Action During Autoset

Front Panel Control		AUTOSET Action
Horizontal	Magnification	X1.
	Position	Midrange.
	Main Sweep	On.
	Delay Sweep	Off.
	XY	Off.
	Main Sec/Div Scale ¹	At least one complete cycle of the signal is displayed (no slower than 20 ms/div).
	Variable	Off.
Trigger	Main Mode	Auto Level.
	Main Source	Priority Vert.
	Main Coupling	Noise Reject if the volts/div scale is set to 2 mV or 5 mV, otherwise DC.
	Main Level	Midway between the peaks of the signal.
	Holdoff	Off (min).
Vertical	Bandwidth	Full.
	Add1+2 and Add 3+4	Off.
	Display Mode	Chop if the main sec/div scale is 0.1 ms/div or slower; alternate if 50 μ s/div or faster.
	Invert	Off.
	Position (all channels displayed) ²	
	CH 1	The ground level is centered in the upper half of the display area.
	CH 2, CH 3, and CH 4	The ground level of each channel is positioned in the lower half of the display area, one division apart in successive order.

Table A-2: Control Setup Action During Autoset (Cont.)

Front Panel Control	AUTOSET Action
Position (not all channels displayed) ²	The ground level of the highest priority channel (channel 1 being the highest and channel 4 being the lowest) is centered in the upper half of the display area. Remaining channels are displayed in the lower half of the display area in successive order.
Volts/Div Scale (displayed channels)	The lowest value for which all waveform values are within approximately ± 2 divisions of ground.
Coupling (displayed channels)	DC, if coupling set to GND or DC; otherwise AC.
Variable Mode	Off.
Other	
Menu Selection	Menus are turned off.
Intensity	40% of maximum intensity if current intensity is less than 28% from the counter clockwise stop; otherwise as adjusted by user.

¹ Uncertain settings may occur when using AUTOSET on signals with periods of less than 20 ms (50Hz).

² Uncertain settings may occur when using AUTOSET on signals with large DC offsets relative to the pk-to-pk voltage when vertical coupling is set to DC.

Glossary

Glossary

AC coupling

A type of signal transmission that blocks the DC component of a signal but uses the dynamic (AC) component. Useful for observing an AC signal that is normally riding on a DC signal.

Accuracy

The closeness of the indicated value to the true value.

Active cursor

The cursor that moves when you turn the General Purpose Knob. It is represented in the display by a solid line.

Amplitude

The high waveform value less the low waveform value.

Area

Measurement of the waveform area taken over the entire waveform or the gated region. Expressed in volt-seconds. Area above ground is positive; area below ground is negative.

Attenuation

The degree the amplitude of a signal is reduced when it passes through an attenuating device such as a probe or attenuator. That is, the ratio of the input measure to the output measure. For example, a 10X probe will attenuate, or reduce, the input voltage of a signal by a factor of 10.

Automatic trigger mode

A trigger mode that causes the oscilloscope to automatically display a sweep if triggerable events are not detected within a specified time period.

Autoset

A function of the oscilloscope that automatically produces a stable waveform of usable size. Autoset sets up front-panel controls based on the characteristics of the active waveform.

Bandwidth

The highest frequency signal the oscilloscope can accurately display with no more than -3 dB ($\times .707$) attenuation of the original (reference) signal.

Channel

An input used for coupling signals to oscilloscope.

Coupling

The association of two or more circuits or systems in such a way that power or information can be transferred from one to the other. You can couple the input signal to the trigger and vertical systems several different ways.

Cursors

Paired markers that you can use to make measurements between two waveform locations. The oscilloscope displays the values (expressed in volts or time) of the position of the active cursor and the distance between the two cursors.

Cycle area

A measurement of waveform area taken over one cycle. Expressed in volt-seconds. Area above ground is positive; area below ground is negative.

Cycle RMS

The true root mean square voltage over one cycle.

DC coupling

A mode that passes both AC and DC signal components to the circuit. Available for both the trigger system and the vertical system.

Delay measurement

A measurement of the time between the middle reference crossings of two different waveforms.

Delay time

The time between the trigger event and the display of data.

Display system

The part of the oscilloscope that shows waveforms, measurements, menu items, status, and other parameters.

Edge Trigger

Triggering occurs when the oscilloscope detects the source passing through a specified voltage level in a specified direction (the trigger slope).

Fall time

A measurement of the time it takes for trailing edge of a pulse to fall from a high-ref value (typically 90%) to a low-ref value (typically 10%) of its amplitude.

Frequency

A timing measurement that is the reciprocal of the period. Measured in Hertz (Hz) where 1 Hz = 1 cycle per second.

General purpose knob

A front-panel knob used for multiple tasks such as cursor placement or changing the value of the assigned parameter.

Graticule

A grid on the display screen that creates the horizontal and vertical axes. You can use it to visually measure waveform parameters.

Ground (GND) coupling

Coupling option that disconnects the input signal from the vertical system.

Holdoff, trigger

A specified amount of time after a trigger signal that elapses before the trigger circuit will accept another trigger signal to help ensure a stable display.

Horizontal bar cursors

The two horizontal bars that you position to measure the voltage parameters of a waveform. The oscilloscope displays the value of the active (moveable) cursor with respect to ground and the voltage value between the bars.

Intensity

Display brightness.

Main menu

A group of related controls for a major oscilloscope function that the oscilloscope displays across the bottom of the screen.

Main menu buttons

Bezel buttons under the main menu display. They allow you to select items in the main menu.

Maximum

Amplitude (voltage) measurement of the maximum amplitude. Typically the most positive peak voltage.

Mean

Amplitude (voltage) measurement of the arithmetic mean over the entire waveform.

Minimum

Amplitude (voltage) measurement of the minimum amplitude. Typically the most negative peak voltage.

Negative duty cycle

A timing measurement representing the ratio of the negative pulse width to the signal period, expressed as a percentage.

Normal trigger mode

A mode on which the oscilloscope does not display a waveform unless a valid trigger event occurs.

Oscilloscope

An instrument for making a graph of two factors. These are typically voltage versus time.

Peak-to-Peak

Amplitude (voltage) measurement of the absolute difference between the maximum and minimum amplitude.

Period

A timing measurement of the time covered by one complete signal cycle. It is the reciprocal of frequency and is measured in seconds.

Phase

A timing measurement between two waveforms of the amount one leads or lags the other in time. Phase is expressed in degrees, where 360° comprise one complete cycle of one of the waveforms. Waveforms measured should be of the same frequency or one waveform should be a harmonic of the other.

Positive duty cycle

A timing measurement of the ratio of the positive pulse width to the signal period, expressed as a percentage.

Positive width

A timing measurement of the distance (time) between two amplitude points — rising-edge and falling-edge on a positive pulse.

Probe

An oscilloscope input device.

Probe compensation

Adjustment that improves low-frequency response of a probe.

Reference memory

Memory in a oscilloscope used to store settings. The data is saved even when the oscilloscope is turned off or unplugged.

Rise time

The time it takes for a leading edge of a pulse to rise from the minimum value (typically 10%) to the maximum value (typically 90%) of its amplitude.

RMS

Amplitude (voltage) measurement of the true root mean square voltage.

Selected waveform

The waveform on which all measurements are performed, and which is affected by vertical position and scale adjustments. The light next to one of the channel selector buttons indicates the current selected waveform.

Side menu

Menu that appears to the right of the display. These selections expand on main menu selections.

Side menu buttons

Bezel buttons to the right of the side menu display. They allow you to select items in the side menu.

Slope

The direction at a point on a waveform. You can calculate the direction by computing the sign of the ratio of change in the vertical quantity (Y) to the change in the horizontal quantity. The two values are rising and falling.

Sweep speed

See time base.

Time base

The parameters that let you define the timing of the sweep, expressed as seconds per division.

Toggle button

A button that changes which of two displayed cursors is active.

Trigger

An event that marks time zero in the waveform record. It results in acquisition and display of the waveform.

Trigger level

The vertical level the trigger signal must cross to generate a trigger.

Vertical bar cursors

The two vertical bars you position to measure the time parameter of a waveform record. The oscilloscope displays the value of the active (moveable) cursor with respect to trigger and the time value between the bars.

Waveform

The shape or form (visible representation) of a signal.

XY format

A display format that compares the voltage level of two waveforms. It is useful for studying phase relationships between two waveforms.

YT format

The conventional oscilloscope display format. It shows the voltage of a waveform (on the vertical axis) as it varies over time (on the horizontal axis).

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