

Service Manual



TLS 216 Logic Scope 070-8831-02

This document applies for firmware version 1.00 and above.

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.

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Printed in the U.S.A.

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TLS 216 WARRANTY

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Service Safety Summary

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

Do Not Service Alone

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

Disconnect Power

To avoid electric shock, disconnect the main power by means of the power cord or, if provided, the power switch.

Use Caution When Servicing the CRT

To avoid electric shock or injury, use extreme caution when handling the CRT. Only qualified personnel familiar with CRT servicing procedures and precautions should remove or install the CRT.

CRTs retain hazardous voltages for long periods of time after power is turned off. Before attempting any servicing, discharge the CRT by shorting the anode to chassis ground. When discharging the CRT, connect the discharge path to ground and then the anode. Rough handling may cause the CRT to implode. Do not nick or scratch the glass or subject it to undue pressure when removing or installing it. When handling the CRT, wear safety goggles and heavy gloves for protection.

Use Care When Servicing With Power On

Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

X-Radiation

To avoid x-radiation exposure, do not modify or otherwise alter the high-voltage circuitry or the CRT enclosure. X-ray emissions generated within this product have been sufficiently shielded.

Preface

This is the Service Manual for the TLS 216 Logic Scope. Before using this manual to service the logic scope, please read all topics in this preface. Also, read the introduction that follows this preface, as it describes the strategy (module replacement) used to service this product.

Manual Structure

This manual is divided into sections, such as *Specifications and Theory of Operation*. Further, it is divided into subsections, such as *Product Description* and *Removal and Installation Procedures*.

The following is a brief description of each manual section.

- **Specifications** — contains a product description of the logic scope and tables of the characteristics and descriptions that apply to it.
- **Operating Information** — includes installation and operating instructions at the level needed to safely power on and service this logic scope. Instructions for shipment of the logic scope are also found in this section.
- **Theory of Operation** — contains circuit descriptions that support general service and fault isolation.
- **Performance Verification** — contains a collection of procedures for confirming that this logic scope functions properly and meets warranted limits.
- **Adjustment Procedures** — contains a collection of procedures for adjusting this Logic Scope to meet warranted limits.
- **Maintenance** — contains information and procedures for doing preventive and corrective maintenance of this logic scope. Instructions for cleaning, for module removal and installation, and for fault isolation to a module are found here.
- **Options** — contains information on servicing any of the factory-installed options that may be present in your logic scope.
- **Electrical Parts List** — contains a statement referring you to *Replaceable Parts*, where both electrical and mechanical modules are listed. See below.
- **Diagrams** — contains a block diagram and an interconnection diagram useful for isolating failed modules.

- **Mechanical Parts List** — includes a table of all replaceable modules, their descriptions, and their Tektronix part numbers.

Conventions

This manual uses certain conventions which you should become familiar with before doing service.

Modules This manual refers to any replaceable component, assembly, or part of this logic scope generically as a module. In general, a module is an assembly, like a circuit board, rather than a component, like a resistor or an integrated circuit. Sometimes a single component is a module; for example, each chassis part of the logic scope is a module.

Safety Symbols and terms related to safety appear in the Safety Summary found at the beginning of this manual.

Symbols Besides the symbols related to safety, this manual uses the following symbols:

***STOP.** The STOP label appears with information that must be read in order to correctly do service and to avoid incorrectly using or applying service procedures.*



The clock icon labels procedure steps which require a pause to wait for the logic scope to complete some operation before you can continue.



Various icons such as the example icon at the left are used in procedures to help identify certain readouts and menu functions on screen.

Operating Instructions

Throughout this manual, you will find various procedures which contain steps of instructions for you to perform. To keep those instructions clear and consistent, this manual uses the following conventions:

- Names of front-panel controls and menu labels appear in boldface print.
- Names also appear in the same case (initial capitals, all uppercase, etc.) in the manual as is used on the logic scope front panel and menus. Front panel names are all upper case letters, for example, **GROUP MENU** and **GROUP 1**.
- Instruction steps are numbered. The number is omitted if there is only one step.

- When steps require that you make a sequence of selections using front-panel controls and menu buttons, an arrow (→) marks each transition between a front panel button and a menu, or between menus. Also, whether a name is a main menu or side menu item is clearly indicated: Press **HORIZONTAL MENU** → **Record Length** (main) → **500 points in 10 divs** (side) → **Trigger Position** (main) → **Set to 20%** (side).

Using the convention just described results in instructions that are graphically intuitive and simplifies procedures. For example, the instruction just given replaces these five steps:

1. Press the front-panel button **HORIZONTAL MENU**.
2. Press the main menu button **Record Length**.
3. Press the side menu button **500 points in 10 divs**.
4. Press the main menu button **Trigger Position**
5. Press the side menu button **Set to 20%**

Sometimes you may have to make a selection from a popup menu: Press **TRIGGER MENU** → **Type** (main) → **Edge** (pop-up). In this example, you repeatedly press the main menu button Type until Edge is highlighted in the pop-up menu.

Related Manuals

The following documents are related to the use or service of the logic scope.

The *TLS 216 User Manual* contains a tutorial to quickly show you how to operate the logic scope and an in depth discussion of how to more completely use its features. Applications are also discussed.

The *TLS 216 Programmer Manual* (Tektronix part number 070-8835-00) describes using a computer to control the logic scope through the GPIB interface.

The *TLS 216 Reference* (Tektronix part number 070-8833-00) gives you a quick overview of how to operate your logic scope.

Introduction

This introduction describes what you should do before attempting servicing of the TLS 216 Logic Scope, outlines the strategy for servicing that this manual supports, and lists service that you can obtain from Tektronix.

Before Servicing

This manual is for servicing the TLS 216 Logic Scope. To prevent injury to yourself or damage to the logic scope, do the following before you attempt service:

- Be sure you are a qualified service person;
- Read the Safety Summary and Preface found at the beginning of this manual;
- Read *Strategy for Servicing*, below, and *Installation* in Section 2.

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

When performing any procedure, be sure to read any introduction it may provide. These introductions provide information needed to do the service safely, correctly, and efficiently.

Strategy for Servicing

NOTE. *Throughout this manual, any field-replaceable component, assembly, or part of this logic scope is referred to generically as a module.*

This manual contains all the information needed for periodic maintenance of the logic scope. (Examples of such information are procedures for checking performance and for readjustment.) Further, it contains all information for corrective maintenance down to the module level. This means that the procedures, diagrams, and other troubleshooting aids help isolate failures to a specific module, rather than to components of that module. Once a failure is isolated, replace the module with a fresh unit obtained from the factory.

All modules are listed in Section 10, *Mechanical Parts List*. To isolate a failure to a module, use the fault isolation procedures found in Section 6, *Maintenance Information*. To remove and replace any failed module, follow the instructions in *Removal and Installation Procedures*, also found in Section 6.

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 logic scope. Tektronix technicians are apprised of the latest information on improvements to the product as well as the latest new options to the product.

Warranty Repair Service

Tektronix warrants this product for three years from date of purchase, excluding probes for which the warranty is one year. (The warranties appear following the title page and copyright page near the front of 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

The following services may be purchased to tailor repair and/or calibration of your TLS 216 Logic Scope to fit your requirements.

Option 9C. When you order your TLS 216 Logic Scope with Option 9C, it is shipped with a *Certificate of Calibration and Test Data Report*. This certificate provides traceability to the National Institute of Standards and Technology (NIST). It certifies procedures used to calibrate the logic scope comply with U. S. Military Standard 45662A.

At-Depot Service. Tektronix offers several standard-priced adjustment (calibration) and repair services:

- A single repair and/or adjustment.
- Calibrations using equipment and procedures that meet the traceability standards specific to the local area.
- Annual maintenance agreements that provide for either calibration and repair or calibration only of the logic scope.

Of these services, the annual maintenance agreement offers a particularly cost-effective approach to service for many owners of the TLS 216 Logic Scope. Such agreements can be purchased to span several years.

On-Site Service. The annual maintenance agreement can be purchased with on-site service, with repair and calibration done at your facility. This service reduces the time your logic scope is out of service when calibration or repair is required.

Self Service

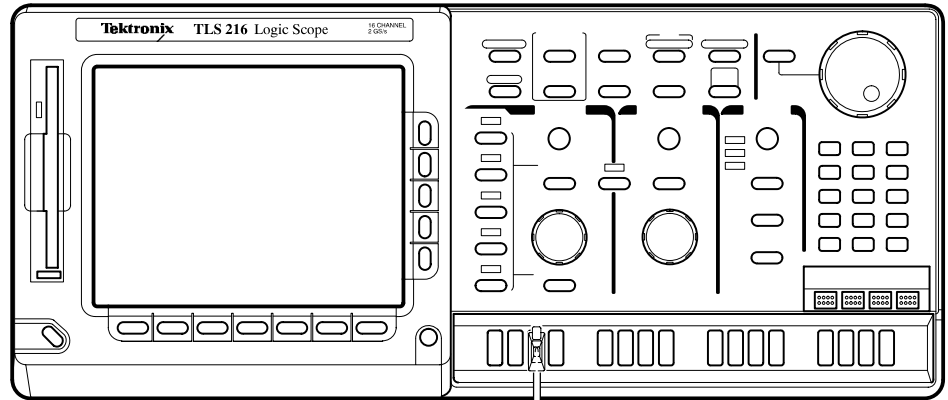
Tektronix supports repair to the module level by providing *Module Exchange* and *Module Repair and Return*.

Module Exchange. This service reduces down time for repair by allowing you to exchange most modules for remanufactured ones. Tektronix ships you an updated and tested exchange module from the Beaverton, Oregon service center, typically within 24 hours. Each module comes with a 90-day service warranty.

Module Repair and Return. This service returns to you within 10 days the same module that you shipped to Tektronix. The module shipped is repaired, tested, and returned to you from the Beaverton, Oregon service center. It is *not* updated to match current modules of the same type. Again, each module comes with a 90-day service warranty.

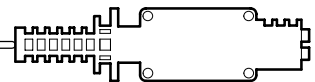
For More Information. Contact your local Tektronix service center or sales engineer for more information on any of the repair or adjustment services just described.

Product Description



The Tektronix TLS 216 Logic Scope is a superb tool for analyzing and debugging digital circuits. Its performance addresses the needs of digital designers and troubleshooters of such circuits with the following features:

- sixteen channels, equipped with sixteen 2.5 pF FET probes, for acquiring waveforms from digital circuits
- three display modes — displays analog waveforms, digital BusForms, and dual-threshold timing diagrams
- four threshold level presets based on four logic families, TTL, CMOS, +ECL, and -ECL, for deriving digital levels for BusForm™ and timing diagram displays
- five trigger types — Edge, Pulse, Pattern, State, and Sequence
- 500 MHz maximum bandwidth, a 2 Gigasamples/second maximum digitizing rate, eight-bit digitizers, and up to a 2,000-sample record length per channel
- full GPIB software programmability and hardcopy output using GPIB, RS-232, or Centronics ports
- complete measurement and documentation capability
- intuitive operation using graphic icons and the more familiar and traditional horizontal and vertical knobs
- on-line help at the touch of a button



Warranted Characteristics

This subsection lists the various *warranted characteristics* that describe the TLS 216, including both electrical and environmental characteristics.

Warranted characteristics are quantifiable performance limits that are warranted.

NOTE. In these tables, those warranted characteristics that are checked (either directly or indirectly) in the Performance Verification, found in Section 1, appear in **boldface type** under the column **Name**.

Performance Conditions

The electrical characteristics found in these tables of warranted characteristics apply when the TLS 216 has been adjusted at an ambient temperature between +20° C and +30° C, has had a warm-up period of at least 20 minutes, and is operating at an ambient temperature between +4° C and +50° C (unless otherwise noted), and has passed both the signal path compensation and probe calibration routines.

Table 1–1: Warranted Characteristics: Input System

Name	Description
Input Resistance with Coaxial Adapter	50 Ω , $\pm 1\%$.
Input Resistance with P6240 Probe	1 M Ω , $\pm 15\%$ at DC.
Input Dynamic Range with Coaxial Adapter	± 5 V (DC + Peak AC).
Input Dynamic Range with P6240 Probe	+15 V to –12 V (DC + Peak AC).
Maximum Input Voltage with Coaxial Adapter	± 5 V (DC + Peak AC).
Maximum Input Voltage with P6240 Probe	± 25 V (DC + Peak AC).
Maximum Input Voltage (Instrument Front Panel)	± 5 V (DC + Peak AC).

Table 1–2: Warranted Characteristics: Signal Acquisition System

Name	Description
DC Gain Accuracy with P6240 Probe	$\pm 1.5\%$ for time base settings of 50 mV/Div to 2 V/Div.
DC Gain Accuracy with Coaxial Adapter	$\pm 4.0\%$ for time base settings of 50 mV/Div to 2 V/Div.

Table 1–2: Warranted Characteristics: Signal Acquisition System (Cont.)

Name	Description								
DC Voltage Measurement Accuracy, Averaged, with Coaxial Adapter	For an average of ≥ 16 waveforms: $\pm(4.0\% \times \text{reading} - \text{Offset} + \text{Offset Accuracy} + (0.06 \text{ Div} \times \text{V/Div}))$ Delta Volts between any two averages of ≥ 16 waveforms acquired under the same setup and ambient conditions: $\pm(4.0\% \times \text{reading} + (0.1 \text{ Divs} \times \text{V/Div}) + 0.3 \text{ mV})$								
DC Voltage Measurement Accuracy, Averaged, with P6240 Probe	For an average of ≥ 16 waveforms: $\pm(1.5\% \times \text{reading} - \text{Offset} + \text{Offset Accuracy} + (0.06 \text{ Div} \times \text{V/Div}))$ Delta Volts between any two averages of ≥ 16 waveforms acquired under the same setup and ambient conditions: $\pm(1.5\% \times \text{reading} + (0.1 \text{ Divs} \times \text{V/Div}) + 0.3 \text{ mV})$								
DC Voltage Measurement Accuracy, Not Averaged, with Coaxial Adapter	Any sample: $\pm(4.0\% \times \text{reading} - \text{Offset} + \text{Offset Accuracy} + (0.13 \text{ Divs} \times \text{V/Div}) + 0.6 \text{ mV})$ Delta Volts between any two samples acquired under the same setup and ambient conditions: $\pm(4.0\% \times \text{reading} + (0.26 \text{ Divs} \times \text{V/Div}) + 1.2 \text{ mV})$								
DC Voltage Measurement Accuracy, Not Averaged, with P6240 Probe	Any sample: $\pm(1.5\% \times \text{reading} - \text{Offset} + \text{Offset Accuracy} + (0.13 \text{ Divs} \times \text{V/Div}) + 0.6 \text{ mV})$ Delta Volts between any two samples acquired under the same setup and ambient conditions: $\pm(1.5\% \times \text{reading} + (0.26 \text{ Divs} \times \text{V/Div}) + 1.2 \text{ mV})$								
Offset Accuracy	<table border="0"> <thead> <tr> <th data-bbox="799 1327 1068 1375"><u>V/Div Setting</u></th> <th data-bbox="1075 1327 1459 1375"><u>Offset Accuracy</u></th> </tr> </thead> <tbody> <tr> <td data-bbox="799 1383 1068 1417">50 mV/Div to 499 mV/Div</td> <td data-bbox="1075 1383 1459 1417">2% of offset $\pm .3 \text{ Divs} \times \text{V/Div}$</td> </tr> <tr> <td data-bbox="799 1425 1068 1465">500 mV/Div to 2 V/Div</td> <td data-bbox="1075 1425 1459 1465">2% of offset $\pm .2 \text{ Divs} \times \text{V/Div}$</td> </tr> </tbody> </table>	<u>V/Div Setting</u>	<u>Offset Accuracy</u>	50 mV/Div to 499 mV/Div	2% of offset $\pm .3 \text{ Divs} \times \text{V/Div}$	500 mV/Div to 2 V/Div	2% of offset $\pm .2 \text{ Divs} \times \text{V/Div}$		
<u>V/Div Setting</u>	<u>Offset Accuracy</u>								
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500 mV/Div to 2 V/Div	2% of offset $\pm .2 \text{ Divs} \times \text{V/Div}$								
Analog Bandwidth with P6240 Probe or Coaxial Adapter	Limits given for an ambient temperature range of 0° C to $+30^\circ \text{ C}$. Derate upper bandwidth frequencies by 5.0 MHz for each $^\circ \text{ C}$ above $+30^\circ \text{ C}$. <table border="0"> <thead> <tr> <th data-bbox="799 1579 1068 1627"><u>V/Div Setting</u></th> <th data-bbox="1075 1579 1459 1627"><u>Bandwidth</u></th> </tr> </thead> <tbody> <tr> <td data-bbox="799 1635 1068 1669">200 mV/Div to 2 V/Div</td> <td data-bbox="1075 1635 1459 1669">DC to 500 MHz</td> </tr> <tr> <td data-bbox="799 1677 1068 1711">100 mV/Div to 199 mV/Div</td> <td data-bbox="1075 1677 1459 1711">DC to 450 MHz</td> </tr> <tr> <td data-bbox="799 1719 1068 1768">50 mV/Div to 99.9 mV/Div</td> <td data-bbox="1075 1719 1459 1768">DC to 350 MHz</td> </tr> </tbody> </table>	<u>V/Div Setting</u>	<u>Bandwidth</u>	200 mV/Div to 2 V/Div	DC to 500 MHz	100 mV/Div to 199 mV/Div	DC to 450 MHz	50 mV/Div to 99.9 mV/Div	DC to 350 MHz
<u>V/Div Setting</u>	<u>Bandwidth</u>								
200 mV/Div to 2 V/Div	DC to 500 MHz								
100 mV/Div to 199 mV/Div	DC to 450 MHz								
50 mV/Div to 99.9 mV/Div	DC to 350 MHz								
Delay Between Channels with Coaxial Adapter	$\leq 200 \text{ ps}$ for any two channels with equal V/Div settings.								

Table 1–2: Warranted Characteristics: Signal Acquisition System (Cont.)

Name	Description
Delay Between Channels with P6240 Probe	≤ 500 ps for any two channels with equal V/Div settings.
Cross Talk (Channel Isolation)	≥ 100:1 at 100 MHz and ≥ 30:1 at the rated bandwidth for the sensitivity rating of the channel, for any two channels having equal V/Div settings.

Table 1–3: Warranted Characteristics: Time Base System

Name	Description						
Sample Rate and Delay Time Accuracy	± 100 ppm over any interval ≥ 1 ms.						
Seconds/Div Time Base Accuracy	± 100 ppm over any interval ≥ 1 ms.						
Delta Time Measurement Accuracy	<table border="1"> <thead> <tr> <th>Conditions</th> <th>Time Measurement Accuracy</th> </tr> </thead> <tbody> <tr> <td>Single shot sample mode, 20 MHz Bandwidth selected</td> <td>$\pm(1 \text{ WI}^1 + 100 \text{ ppm} \times \text{Reading} + 1.1 \text{ ns})$</td> </tr> <tr> <td>Repetitive, ≥ 8 averages, bandwidth selected</td> <td>$\pm(1 \text{ WI}^1 + 100 \text{ ppm} \times \text{Reading} + 180 \text{ ps})$</td> </tr> </tbody> </table>	Conditions	Time Measurement Accuracy	Single shot sample mode, 20 MHz Bandwidth selected	$\pm(1 \text{ WI}^1 + 100 \text{ ppm} \times \text{Reading} + 1.1 \text{ ns})$	Repetitive, ≥ 8 averages, bandwidth selected	$\pm(1 \text{ WI}^1 + 100 \text{ ppm} \times \text{Reading} + 180 \text{ ps})$
Conditions	Time Measurement Accuracy						
Single shot sample mode, 20 MHz Bandwidth selected	$\pm(1 \text{ WI}^1 + 100 \text{ ppm} \times \text{Reading} + 1.1 \text{ ns})$						
Repetitive, ≥ 8 averages, bandwidth selected	$\pm(1 \text{ WI}^1 + 100 \text{ ppm} \times \text{Reading} + 180 \text{ ps})$						

¹ The Waveform Interval (WI) is the time between the samples in the waveform record.

Table 1–4: Warranted Characteristics: Triggering System

Name	Description								
Edge Trigger Accuracy	Any channel: 0.50 Divs from DC to 50 MHz, increasing to 3.0 Divs at 500 MHz.								
Pulse-, Sequence-, or Pattern-Type Trigger Time Accuracy (Single Channel)	<table border="1"> <thead> <tr> <th>Width or Limit Setting</th> <th>Trigger Time Accuracy</th> </tr> </thead> <tbody> <tr> <td>2.4 ns to 35 ns</td> <td>$\pm(5\% \text{ of setting} + 0.5 \text{ ns})$</td> </tr> <tr> <td>35 ns to 1 μs</td> <td>$\pm(10\% \text{ of setting} + 0.5 \text{ ns})$</td> </tr> <tr> <td>1.02 μs to 1 s</td> <td>$\pm(.01\% \text{ of setting} + 50 \text{ ns})$</td> </tr> </tbody> </table>	Width or Limit Setting	Trigger Time Accuracy	2.4 ns to 35 ns	$\pm(5\% \text{ of setting} + 0.5 \text{ ns})$	35 ns to 1 μs	$\pm(10\% \text{ of setting} + 0.5 \text{ ns})$	1.02 μs to 1 s	$\pm(.01\% \text{ of setting} + 50 \text{ ns})$
Width or Limit Setting	Trigger Time Accuracy								
2.4 ns to 35 ns	$\pm(5\% \text{ of setting} + 0.5 \text{ ns})$								
35 ns to 1 μs	$\pm(10\% \text{ of setting} + 0.5 \text{ ns})$								
1.02 μs to 1 s	$\pm(.01\% \text{ of setting} + 50 \text{ ns})$								
Pulse-, Sequence-, or Pattern-Type Trigger Time Accuracy (Multiple Channels)	<table border="1"> <thead> <tr> <th>Width or Limit Setting</th> <th>Trigger Time Accuracy</th> </tr> </thead> <tbody> <tr> <td>2.4 ns to 35 ns</td> <td>$\pm(5\% \text{ of setting} + 2.5 \text{ ns})$</td> </tr> <tr> <td>35 ns to 1 μs</td> <td>$\pm(10\% \text{ of setting} + 2.5 \text{ ns})$</td> </tr> <tr> <td>1.02 μs to 1 s</td> <td>$\pm(.01\% \text{ of setting} + 50 \text{ ns})$</td> </tr> </tbody> </table>	Width or Limit Setting	Trigger Time Accuracy	2.4 ns to 35 ns	$\pm(5\% \text{ of setting} + 2.5 \text{ ns})$	35 ns to 1 μs	$\pm(10\% \text{ of setting} + 2.5 \text{ ns})$	1.02 μs to 1 s	$\pm(.01\% \text{ of setting} + 50 \text{ ns})$
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2.4 ns to 35 ns	$\pm(5\% \text{ of setting} + 2.5 \text{ ns})$								
35 ns to 1 μs	$\pm(10\% \text{ of setting} + 2.5 \text{ ns})$								
1.02 μs to 1 s	$\pm(.01\% \text{ of setting} + 50 \text{ ns})$								
Pulse-, Sequence-, or Pattern-Type Trigger Minimum Time Interval	500 ps.								
Edge-Type Trigger Minimum Pulse Width	800 ps.								
Pulse-Type Trigger Rearm Time	2.5 ns.								
Pulse-Type Trigger Minimum Pulse Width	2.0 ns.								
Pattern-Type Trigger Minimum Pattern Width	4.0 ns.								

Table 1–4: Warranted Characteristics: Triggering System (Cont.)

Name	Description
Pattern-Type Trigger Rearm Time	4.5 ns.
Sequence-Type Trigger Rearm Time	4.5 ns.
Sequence-Type Trigger Minimum Pulse Width	4.0 ns.
State-Type Trigger Setup and Hold Times	Setup: 4.0 ns; hold time: 4.0 ns.
Trigger Threshold Accuracy	$\pm 2\%$ of (threshold setting – offset setting) + 0.2 Divs + offset accuracy
Auxiliary Trigger Input Sensitivity	DC to 50 MHz input frequency with $V_{IN(HI)} = 2.0$ V and $V_{IN(LO)} = 0.8$ V.

Table 1–5: Warranted Characteristics: Output Ports and Power Distribution System

Name	Description
Main and Delayed Trigger Output Logic Levels	Logic-High ($V_{OUT(HI)}$): ≥ 2.5 V open circuit, ≥ 1.0 V into a 50Ω load to ground. Logic-Low ($V_{OUT(LO)}$): ≤ 0.7 V into a load of ≤ 4 mA; ≤ 0.25 V into a 50Ω load to ground.
Source Voltage	90 to 250 VAC _{RMS} , continuous range.
Source Frequency	47 Hz to 440 Hz.
Power Consumption	≤ 350 W.
Probe Compensator Output Voltage and Frequency	Output voltage: 0.5 V (base to top) $\pm 2\%$ into a $\geq 50 \Omega$ load; frequency: 1 kHz $\pm 5\%$.

Table 1–6: Warranted Characteristics: Environmental

Name	Description
Temperature (Operating and Nonoperating)	Operating: $+4^\circ$ C to $+50^\circ$ C. Nonoperating: -22° C to $+60^\circ$ C
Electrostatic Discharge Susceptibility	Up to 8 kV with no change to control settings, or impairment of normal operation; up to 15 kV with no damage that prevents recovery of normal operation by the user.

Table 1–6: Warranted Characteristics: Environmental (Cont.)

Name	Description
Emissions	The instrument meets or exceeds the EMC requirements of the following standards: Vfg. 243/1991 Amended per Vfg. 46/1992 FCC Code of Federal Regulations, 47 CFR, Part 15, Subpart B, Class A
Third Party Certification	UL: 1244, Ninth Edition CSA: C22.2 No. 231-M89

Typical Characteristics

This subsection contains tables that list the various *typical characteristics* that describe the TLS 216 Logic Scope.

Typical characteristics describe typical or average performance. Typical characteristics are not warranted.

Table 1–7: Typical Characteristics: Input System

Name	Description
Input Resistance (Instrument Front Panel)	75 Ω , $\pm 1\%$ at DC.
Probe Input Capacitance	2.5 pF maximum.

Table 1–8: Typical Characteristics: Signal Acquisition System

Name	Description																									
Effective Bits	For a 9-division (peak-to-peak) sine wave output: <table border="0"> <tr> <td><u>Output Frequency</u></td> <td><u>2 GS/s Sample Rate</u></td> </tr> <tr> <td>98 MHz</td> <td>5.5 bits</td> </tr> <tr> <td>245 MHz</td> <td>5.0 bits</td> </tr> <tr> <td>490 MHz</td> <td>4.5 bits</td> </tr> </table>	<u>Output Frequency</u>	<u>2 GS/s Sample Rate</u>	98 MHz	5.5 bits	245 MHz	5.0 bits	490 MHz	4.5 bits																	
<u>Output Frequency</u>	<u>2 GS/s Sample Rate</u>																									
98 MHz	5.5 bits																									
245 MHz	5.0 bits																									
490 MHz	4.5 bits																									
Input Current	$\leq 60 \mu\text{A}$ at an ambient temperature $\leq 30^\circ \text{C}$.																									
Step Response Rise Time	<table border="0"> <tr> <td><u>V/Div Setting</u></td> <td><u>Rise Time</u></td> </tr> <tr> <td>50 mV/Div to 99.9 mV/Div</td> <td>1.0 ns</td> </tr> <tr> <td>100 mV/Div to 199 mV/Div</td> <td>900 ps</td> </tr> <tr> <td>200 mV/Div to 2 V/Div</td> <td>800 ps</td> </tr> </table>	<u>V/Div Setting</u>	<u>Rise Time</u>	50 mV/Div to 99.9 mV/Div	1.0 ns	100 mV/Div to 199 mV/Div	900 ps	200 mV/Div to 2 V/Div	800 ps																	
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200 mV/Div to 2 V/Div	800 ps																									
Step Response Settling Time with Coaxial Adapter	<table border="0"> <tr> <td><u>V/Div Setting</u></td> <td><u>\pmStep Response</u></td> <td colspan="3"><u>Settling Error at</u></td> </tr> <tr> <td></td> <td></td> <td><u>20 ns</u></td> <td><u>100 ns</u></td> <td><u>20 ms</u></td> </tr> <tr> <td>50 mV/Div to 99.9 mV/Div</td> <td>$\leq 5.0 \text{ V}$</td> <td>$\leq 0.5\%$</td> <td>$\leq 0.2\%$</td> <td>$\leq 0.1\%$</td> </tr> <tr> <td>100 mV/Div to 199 mV/Div</td> <td>$\leq 5.0 \text{ V}$</td> <td>$\leq 1.0\%$</td> <td>$\leq 0.5\%$</td> <td>$\leq 0.2\%$</td> </tr> <tr> <td>200 mV/Div to 2 V/Div</td> <td>$\leq 5.0 \text{ V}$</td> <td>$\leq 1.0\%$</td> <td>$\leq 0.5\%$</td> <td>$\leq 0.2\%$</td> </tr> </table>	<u>V/Div Setting</u>	<u>\pmStep Response</u>	<u>Settling Error at</u>					<u>20 ns</u>	<u>100 ns</u>	<u>20 ms</u>	50 mV/Div to 99.9 mV/Div	$\leq 5.0 \text{ V}$	$\leq 0.5\%$	$\leq 0.2\%$	$\leq 0.1\%$	100 mV/Div to 199 mV/Div	$\leq 5.0 \text{ V}$	$\leq 1.0\%$	$\leq 0.5\%$	$\leq 0.2\%$	200 mV/Div to 2 V/Div	$\leq 5.0 \text{ V}$	$\leq 1.0\%$	$\leq 0.5\%$	$\leq 0.2\%$
<u>V/Div Setting</u>	<u>\pmStep Response</u>	<u>Settling Error at</u>																								
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200 mV/Div to 2 V/Div	$\leq 5.0 \text{ V}$	$\leq 1.0\%$	$\leq 0.5\%$	$\leq 0.2\%$																						

Table 1–9: Typical Characteristics: Triggering System

Name	Description
Trigger Position Accuracy (All Types)	<u>Acquisition Mode</u> <u>Accuracy</u>
	Sample or Average $\pm(1 WI^1 + 1.5 \text{ ns})$
	Envelope $\pm(2 WI^1 + 1.5 \text{ ns})$
Edge-Type Trigger Jitter	0.5 ns peak-to-peak for 100 records.
Pulse-, Pattern-, State-, or Sequence-Type Trigger Sensitivity	1.0 Div from DC to 200 MHz, with a minimum slew rate of 25 Divs/ μs at the trigger level threshold.
Pulse-, Pattern-, or Sequence-Type Trigger Time Range and Resolution	Range: 2.4 ns to 1 s.
	<u>Time Range</u> <u>Time Resolution</u>
	2.4 ns to 10 ns 0.2 ns
	10.5 ns to 20 ns 0.5 ns
	21 ns to 50 ns 1 ns
	52 ns to 100 ns 2 ns
	104 ns to 200 ns 4 ns
	210 ns to 500 ns 10 ns
520 ns to 1 s 20 ns	
Trigger Holdoff Range	0.5 ns to 10 s.
“Set Trigger Level to 50%” Minimum Operable Frequency	50 Hz.
Delayed Trigger Time Range	16.5 ns to 250 ns at 10 μs or faster; 15.152 ns to 250 s at 25 μs or slower.
Delayed Trigger Events Range	2 to 10 million events.
Auxiliary Trigger Input Logic Levels	$V_{IN(HI)} = 2.0 \text{ V}$ and $V_{IN(LO)} = 0.8 \text{ V}$.
Auxiliary Trigger Input Characteristics	Input is TTL compatible.

¹ The Waveform Interval (WI) is the time between the samples in the waveform record.

Table 1–10: Typical Characteristics: Display and Data Handling Systems

Name	Description
Video Display Resolution	640 pixels horizontally by 480 pixels vertically in a display area of 12.8 cm (5.04 in.) horizontally by 9.6 cm (3.78 in.) vertically.
Nonvolatile Memory Capacity	Reference waveforms (4), stored setups (10), and calibration constants are retained in nonvolatile memory.
Nonvolatile Memory Retention Time	≥ 5 years.
Floppy Disk Drive	3.5" floppy disk, 1.44 Mbyte, DOS 4.0 format for storing waveforms, hard copies, and instrument setups.

Table 1–11: Typical Characteristics: Operating Environment

Name	Description
Humidity (Operating and Nonoperating)	Nonoperating: to 90% relative humidity from –22° C to +40° C to 50% relative humidity from –22° C to +50° C Operating: to 80% relative humidity from +4° C to +29° C to 20% relative humidity from +4° C to +50° C
Altitude (Operating and Nonoperating)	Operating: to 4570 m (15,000 ft.). Nonoperating: to 12190 m (40,000 ft.).
Random Vibration (Operating and Nonoperating)	Operating: 0.31 g _{RMS} from 5 to 500 Hz, 10 minutes each axis Nonoperating: 3.04 g _{RMS} from 5 to 500 Hz, 10 minutes each axis.

Nominal Traits

This subsection contains a collection of tables that list the various *nominal traits* that describe the TLS 216, including both electrical and mechanical traits.

Nominal traits are described using simple statements of fact such as “16, all identical” for the trait “Input Channels, Number of,” rather than in terms of limits that are performance requirements.

Table 1–12: Nominal Traits: Input System

Name	Description
Input Probe Type	Tektronix P6240 only.
Input Coaxial Adapter Type	Tektronix part number 013–0282–00.
Probe Input Coupling	DC.
Input Probe Connector Type	Amp Inc. Amplimite coax Mix, Amp part number 750019–1. Mates with Amp part number 750020–1.

Table 1–13: Nominal Traits: Signal Acquisition System

Name	Description
Input Channels, Number of	16, all identical; identified as Ch1, Ch2,... Ch16.
Input Coupling	DC only.
Samplers, Number of	16, all identical; one per channel.
Digitized Bits, Number of	8 bits.
V/Div Gain Sensitivity Settings	50 mV/Div to 2 V/Div in a 1–2–5 sequence.
V/Div Fine Gain Range and Resolution	Range: adjustable between the V/Div step gain setting and the next lower step gain setting. Resolution: 1% of the lower step gain setting.
Offset Voltage Range and Resolution	Range: +15 V to –12 V. Resolution: 5 mV.
Position Range	±5 divisions.
Position Accuracy	0.1 divisions.
Analog Bandwidth Selections	20 MHz and FULL (500 MHz) bandwidth.

Table 1-14: Nominal Traits: Time Base System

Name	Description
Seconds/Division Range	0.5 ns/div to 5 s/div.
Seconds/Division Step Settings	0.5 ns/Div to 5 s/div in a 1–2.5–5 sequence.
Sample-Rate Range, Real-Time ¹	10 Samples/s to 2 GS/s on 16 channels simultaneously.
Sample-Rate Range, Interpolated ¹	5 GSamples/s to 100 GSamples/s.
Record Length Selection	500 samples, 1000 samples, 2000 samples.

¹ The range of real-time rates, expressed in samples/second, at which a digitizer samples signals at its inputs and stores the samples in memory to produce a record of time-sequential samples.

Table 1-15: Nominal Traits: Triggering System

Name	Description
Trigger Threshold Range and Resolution (Any Trigger Source)	Range: ± 10 Divs; Resolution: 0.02 Divs.
Line Trigger Level	0 V. Triggers at all 0 volt crossings regardless of whether positive going or negative going.

Table 1-16: Nominal Traits: Display System

Name	Description
Contrast Ratio	> 100:1.
Waveform Display Graticule	Single Graticule: 401 \times 501 pixels, 8 \times 10 divisions, where divisions are 1 cm by 1 cm
Waveform Display Color Scale	16 colors in infinite persistence and variable persistence display styles.

Table 1-17: Nominal Traits: GPIB Interface and Output Ports

Name	Description
Video Output, VGA	DB-15 rear panel video connector, noninterlaced; levels comply with ANSI Standard R5343A.
GPIB Interface	GPIB interface complies with IEEE Std 488-1987.
RS-232 Interface	RS-232 interface complies with EIA/TIA 574.
Centronics Interface	Centronics interface complies with Centronics interface standard C332-44 Feb 1977, REV A.

Table 1–18: Nominal Traits: Fuse Rating

Name	Description
Fuse Rating	<p>Either of two fuses may be used.</p> <p>0.25" × 1.25" (UL 198.6, 3AG): 6 A FAST, 250 V.</p> <p>5 mm × 20 mm (IEC 127): 5A (T), 250 V.</p>

Table 1–19: Nominal Traits: Mechanical

Name	Description
Weight	<p>12.3 kg (29 lbs) with front cover.</p> <p>24.7 kg (54 lbs), when packaged for shipment.</p>
Dimensions	<p>Height: 193 mm (7.6 in) with the feet installed.</p> <p>Width: 445 mm (17.5 in), with handle.</p> <p>Depth: 434 mm (17.1 in), with front cover installed.</p>
Cooling Method	Forced-air circulation with no air filter.
Finish Type	Tektronix Blue vinyl-clad material on an aluminum cabinet.
Construction Material	Chassis parts constructed of aluminum alloy; front panel constructed of plastic laminate; circuit boards constructed of glass laminate. Cabinet is aluminum and is clad in Tek Blue vinyl material.
Weight of Rackmounted Instrument and Rackmount Conversion Kit	<p>2.3 kg (5 lbs) for the rackmount conversion kit only; 3.6 kg (8 lbs) when packaged for shipment.</p> <p>12.3 kg (29 lbs) plus weight of rackmount parts for the rack-mounted instrument (Option 1R).</p> <p>20.5 kg (54 lbs) when the rackmounted instrument is packaged for domestic shipment.</p>
Dimensions of Rackmount Instrument	<p>Height: 178 mm (7 in).</p> <p>Width: 483 mm (19 in).</p> <p>Depth: 559 mm (22 in).</p>

Installation

This section contains the information needed to operate the TLS 216 Logic Scope when servicing it. The following topics are included:

- *Installation* details how to put the logic scope into service. It covers power requirements, power connection, and operating environment. It also details considerations for applying, interrupting, and removing power and provides instructions for repackaging the logic scope for shipment.
- *General Operating Instructions* describe how to turn on the logic scope and how to make basic operational settings from the front panel. It also covers operation of the on-board Help and Status features.
- *Operating Instructions for Waveform Groups* briefly describe basic principles for creating waveform groups and how to control them. (The logic scope displays a waveform only as part of a waveform group.)

Supplying Operating Power



CAUTION. Read all information and heed all cautions in this section before connecting the logic scope to a power source.



CAUTION. AC POWER SOURCE AND CONNECTION. The logic scope operates from a single-phase power source. It has a three-wire power cord and two-pole, three-terminal grounding type plug. The voltage to ground (earth) from either pole of the power source must not exceed the maximum rated operating voltage, 250 volts.

Before making connection to the power source, be sure the logic scope has a suitable two-pole, three-terminal grounding-type plug.

GROUNDING. This logic scope is safety Class 1 equipment (IEC designation). All accessible conductive parts are directly connected through the grounding conductor of the power cord to the grounded (earthing) contact of the power plug.



CAUTION. *The power input plug must be inserted only in a mating receptacle with a grounding contact where earth ground has been verified by a qualified service person. Do not defeat the grounding connection. Any interruption of the grounding connection can create an electric shock hazard.*

For electric shock protection, the grounding connection must be made before making connection to the input or output terminals of the logic scope.

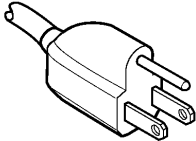
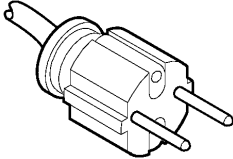
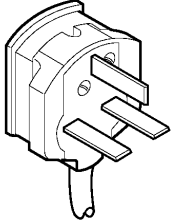
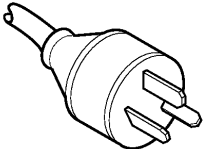
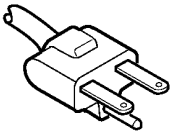
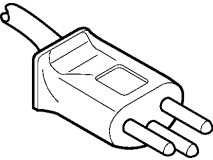
Power Cord Information

A power cord with appropriate plug configuration is supplied with each logic scope. Table 2–1 gives the color-coding of the conductors in the power cord. If you require a power cord other than the one supplied, refer to Table 2–2, *Power Cord Identification*.

Table 2–1: Power-Cord Conductor Identification

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Light Blue	White
Grounded (Earthing)	Green/Yellow	Green

Table 2-2: Power Cord Identification

Plug Configuration	Normal Usage	Option Number
	North America 115 V	Standard
	Europe 230 V	A1
	United Kingdom 230 V	A2
	Australia 230 V	A3
	North America 230 V	A4
	Switzerland 230 V	A5

Operating Voltage

This logic scope operates with any line voltage from 90–250 VAC_{RMS} with any line frequency from 47–63 Hz. There are two fuses, either of which may be used throughout the line voltage and frequency ranges. (The two fuses are not totally interchangeable as each requires a different fuse cap.)

Memory Backup Power

Memory modules with on-board batteries allow the logic scope to retain some types of data upon loss of the AC power source. The stored adjustment constants, saved front-panel settings, current front-panel settings (logic scope status), and waveforms saved in memory are retained.

The on-board batteries of the memory modules have a shelf life of about five years. Partial or total loss of stored settings upon power on may indicate that the memory modules need to be replaced.

Operating Environment

The following environmental requirements are provided to ensure proper operation and long logic scope life.

Operating Temperature

The logic scope can be operated where the ambient air temperature is between 4° C and +50° C and can be stored in ambient temperatures from -22° C to +60° C. After storage at temperatures outside the operating limits, allow the chassis to stabilize at a safe operating temperature before applying power.

Ventilation Requirements

The logic scope is cooled by air drawn in and exhausted through its cabinet side panels by an internal fan. To ensure proper cooling of the logic scope, allow at least two inches clearance on both sides and 3/4 inch on the bottom of the logic scope. (The feet on the bottom of the logic scope provide the required clearance when set on flat surfaces.) The top of the logic scope does not require ventilation clearance.



CAUTION. *If air flow is restricted, the internal power supply of the logic scope may temporarily shut down.*

Applying and Interrupting Power

Consider the following information when you power on or power off the logic scope, or when power is interrupted due to an external power failure.

Power On

Upon power on, the logic scope runs its power-on self check. If it passes, the logic scope displays a “passed” status message and a prompt to press CLEAR MENU to continue. If it fails, the logic scope displays a diagnostic log that identifies the area(s) that failed and a prompt to press CLEAR MENU to

continue. See Section 6, *Maintenance*, for information on diagnostics and fault isolation.

Power Off



CAUTION. *DO NOT power off the logic scope when either running a signal path compensation or when doing any of the adjustments described in Section 5, Adjustment Procedures. To do so might result in the loss of internally stored adjustment constants.*

In general, do not power off the logic scope when doing operations that affect the data types listed in Table 2–3. Wait for the logic scope to finish the operation when doing adjustments, saving waveforms, or saving setups.

Improper power off or unexpected loss of power to the logic scope can result in the following corruptions of non-volatile RAM (NVRAM). The following table describes the messages displayed when power is restored after an abnormal power off.

Table 2–3: Effects of Corrupted Data

Corrupted Data Type	Results
<i>Adjustment Constants:</i>	
Signal Path Compensation	A signal path compensation is required.
Voltage Reference	A voltage reference adjustment is required (Section 5).
Frequency Response	A frequency response adjustment is required (Section 5).
<i>Error Log</i>	Errors logged are lost.
<i>Reference Waveforms</i>	Waveform Lost.
<i>Saved Setups</i>	Setup Lost.

Repackaging Instructions

Use a corrugated cardboard shipping carton having a test strength of at least 275 pounds and with an inside dimension at least six inches greater than the logic scope dimensions.

If the logic scope is being shipped to a Tektronix Service Center, enclose the following information: the owner's address, name and phone number of a contact person, type and serial number of the logic scope, reason for returning, and a complete description of the service required.

Seal the shipping carton with an industrial stapler or strapping tape.

Mark the address of the Tektronix Service Center and also your own return address on the shipping carton in two prominent locations.

General Operating Instructions

This section describes how to turn on the TLS 216 Logic Scope and how to make basic operational settings from the front panel. It also covers operation of the onboard Help and Status features.

Before doing service, read these general operating instructions for servicing the logic scope. They prepare you to follow the operating instructions contained in the service procedures of this manual, such as the front-panel setup instructions required to do the *Performance Verification* in Section 4 or the *Adjustments* in Section 5.

NOTE. *These instructions are at the level appropriate for servicing the logic scope. The complete operator instructions are found in the TLS 216 User Manual.*

NOTE. *Unlike a conventional digitizing oscilloscope, the logic scope displays the waveform it acquires as groups instead of as individual waveforms. For instructions on using groups, see Operating Instructions for Waveform Groups on page 2–15.*

Screen Layout

See Figure 2–1 to become familiar with the basic layout of the logic scope display and the components within that display.

Basic Procedures

Read the following procedures to learn how to power on the logic scope and how to use its front panel controls and menus to set logic scope functions.

How to Power On

Push the principal power switch found on the rear panel of the logic scope to the on (1) position, then push the **ON/STBY** (standby) switch to toggle the Logic Scope into operation.



CAUTION. The principal power switch at the rear panel is the true power disconnect switch. When connected to a power source and when the principal power switch is on, the internal power supplies and much of the other circuitry of the logic scope are energized **REGARDLESS** of the setting of the **ON/STBY** switch. The **ON/STBY** (standby) switch simply toggles operation on and off.

How to Use Help

To enter help mode, push the **HELP** front-panel button. Front-panel knobs and buttons now display information about their function when turned or pushed. Push **HELP** again to exit help mode.

To get help information on a menu item, display the menu desired (if you are in help mode, exit help first). Push **HELP**. Now the menu buttons display information about their function when pushed.

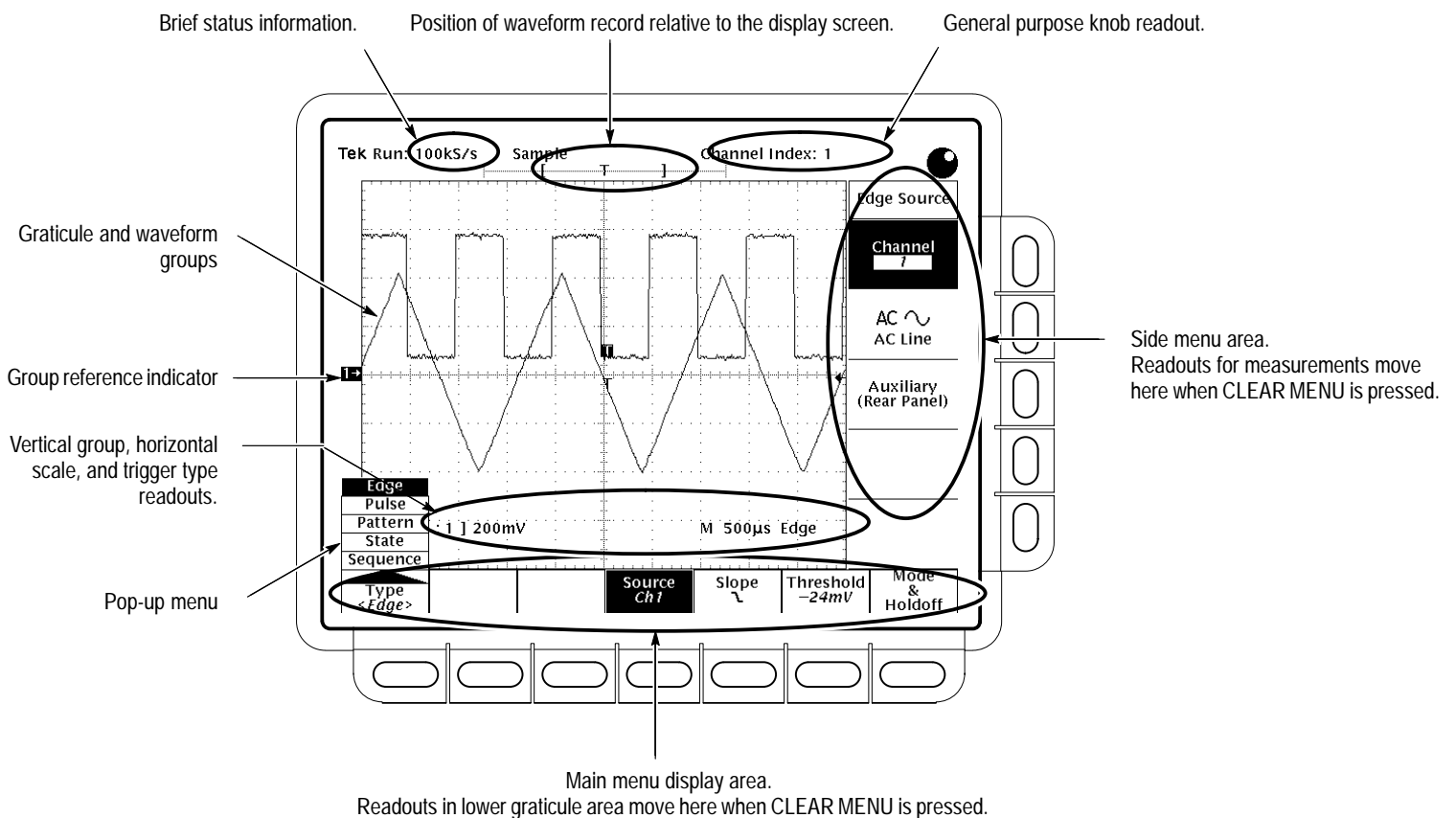


Figure 2-1: Map of Display Functions

How to Display Logic Scope Status

Push the **SHIFT**, and then the **STATUS** front-panel buttons to display the status menu. You will find menu selections that display messages that reflect the state of the acquisition system, the eight waveform groups, and the trigger system.

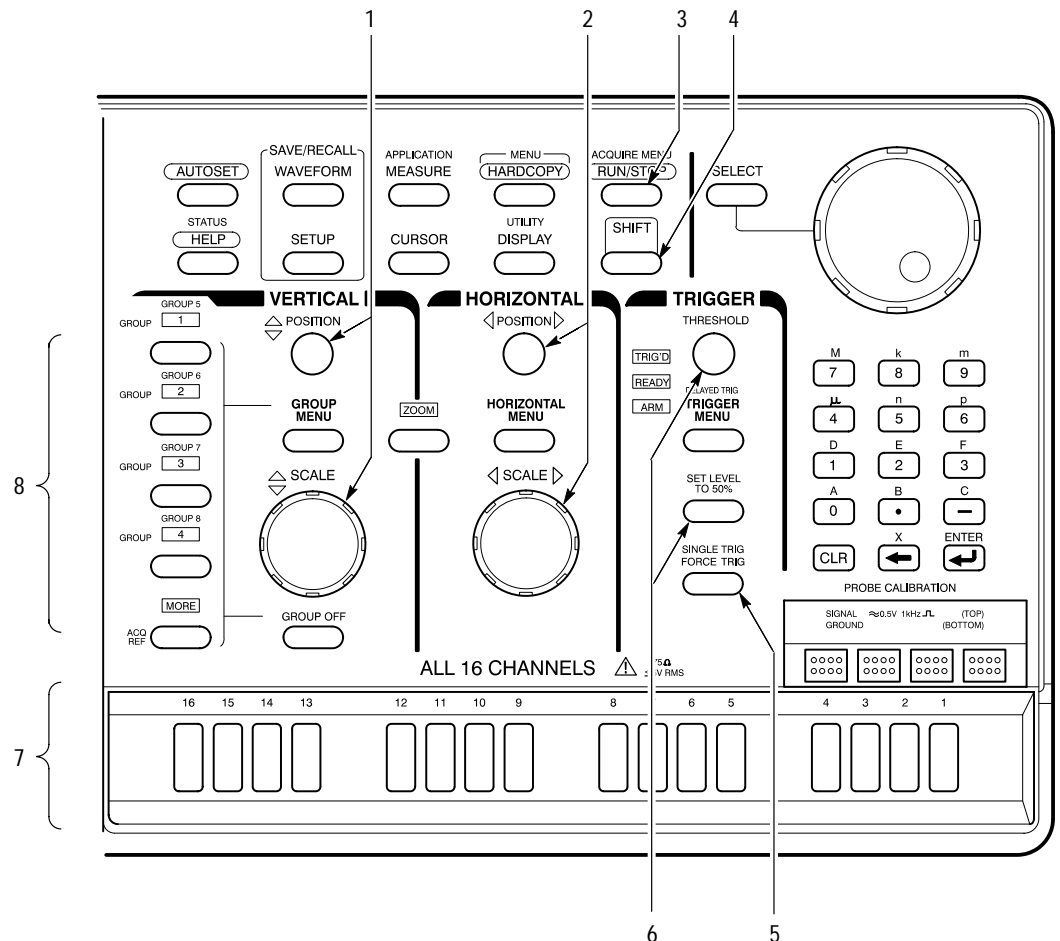
How to Reset the Logic Scope

Before beginning maintenance, you might want to set the controls of the logic scope to their factory defaults. To do so, press the **SETUP** front-panel button, press **Recall Factory Setup** in the main menu, and then press **OK Confirm Factory Init** in the side menu.

How to Set Functions from the Front Panel

The following functions can be set using the front-panel knobs without accessing menus: vertical scale and position, horizontal scale and position, trigger level (Edge and Pulse type trigger only), and run/stop waveform acquisition. To adjust these functions, reset the logic scope as described above, and then do the following steps:

1. Input the waveform source(s) to the input channels (7). (Numbers in parentheses call out front-panel controls in the illustrations accompanying these instructions.) The channels must be defined to be part of a logic scope waveform group (see *How to Create a Waveform Group* on page 2–20).



2. Select the group containing the waveform source(s) using the group buttons (8).
3. Locate the front-panel control and adjust the function to be set:
 - To adjust vertical position and scale of the selected group, rotate the vertical position and scale knobs (1). (The logic scope must be in Analog display mode to vertically size waveforms on screen; see *To Select a Group Mode* on page 2–23.)
 - To adjust horizontal position and scale of the selected group, rotate the horizontal position and scale knobs (2).
 - To stop the logic scope from actively acquiring waveforms, press the button RUN/STOP (3). Press RUN/STOP again to toggle to actively acquiring.
 - To adjust trigger level (edge and pulse trigger type settings only), rotate the THRESHOLD knob (6) or press the SET LEVEL TO 50% button (6). Level adjustment occurs on the trigger source selected in the trigger menu.
 - To force a triggering of an acquisition, press FORCE TRIGGER (5).

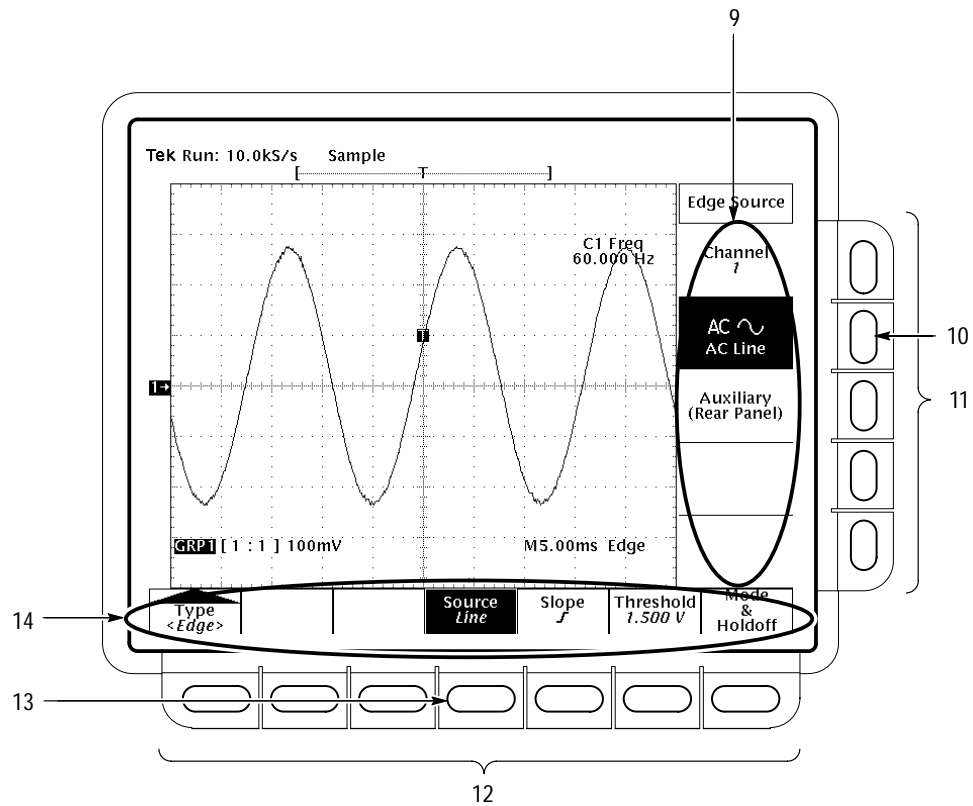
How to Set Functions from Menus

All other functions must be set using menus. To set such functions, do the following steps:

1. Press the button corresponding to the function to be set. (Push **SHIFT** (4) before pressing the button if the function to be set is highlighted in blue on the front panel.)
2. Push the front-panel button that corresponds to the menu containing the function. A main menu (14) for selecting among related functions appears. Example: Push **TRIGGER MENU**.

Note the two labels: the top label is a function to choose from; the bottom label tells you the current setting for that function. **Type** is currently set to *Edge*.

3. Select a function from the main menu using the main-menu buttons (12). A side menu for selecting among that the available settings for that function appears. Example: Push **Source** (13).
4. Select the setting for the function from the side menu (9) using the side-menu buttons (11). Example: Push **AC** (10).



How to Set Complex Functions

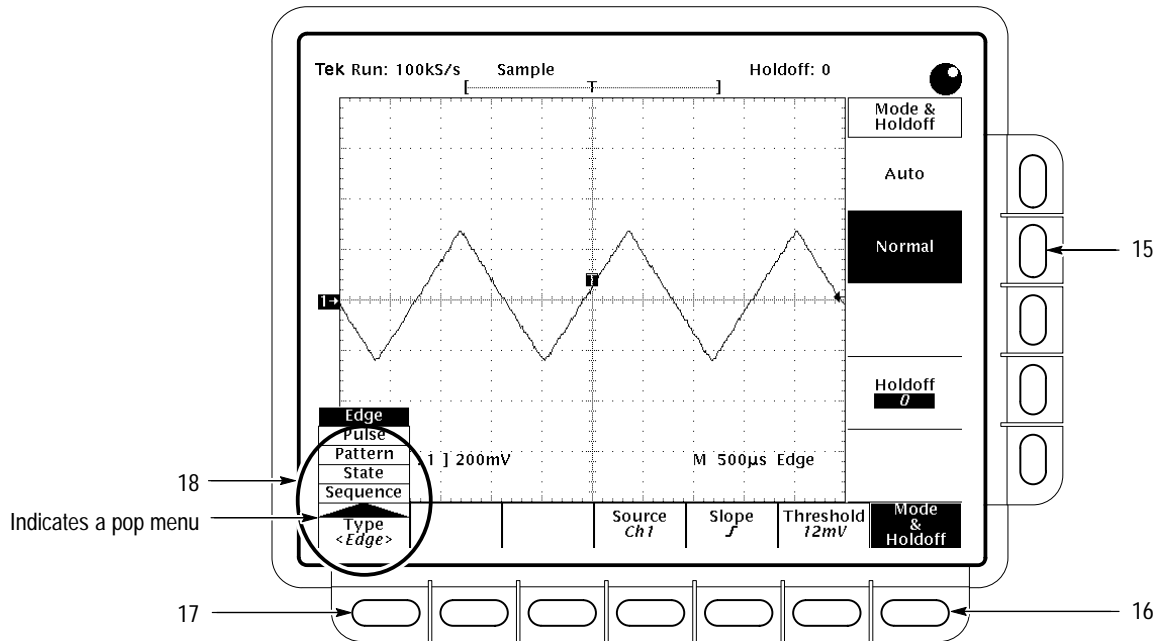
A few functions require more than just two levels (main and side) of menus to completely specify their settings. In such cases, either the main menu “pops up” a menu to supply additional choices or the side menu displays a field that can be varied to set parameters.

To set a function that uses a pop-up menu, do the following steps:

1. Push a main-menu button to pop up a menu (18) of subfunctions. Note the upward pointing arrow or triangle in the main menu button. This triangle indicates that a pop-up menu appears when the main button is pushed. Example: Push **Type** (17).

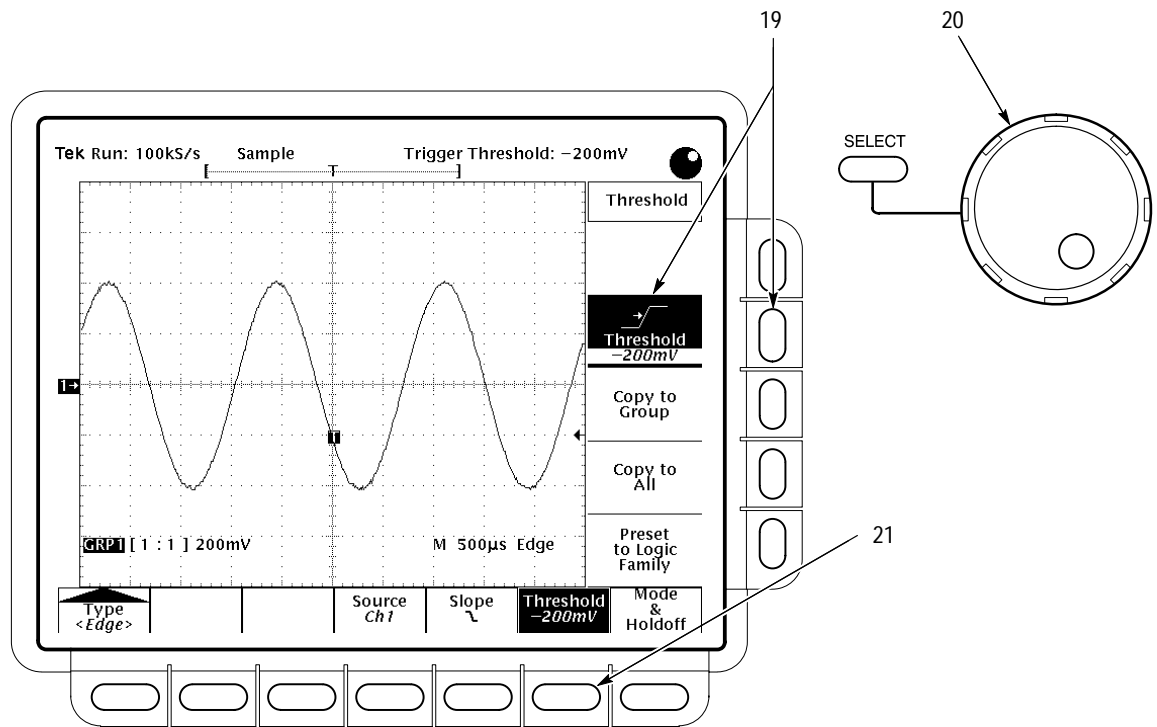
Note the pop-up menu for **Type** is set to **Edge**. All the main-menu buttons to the right of the pop-up menu are labeled with subfunctions of **Edge**.

2. Pushing the button that popped up the menu (17) toggles through the pop-up menu choices. Example: Repeatedly push **Type** to toggle through the pop-up menu. Notice the other main-menu button labels change accordingly.
3. Complete the setting of the desired mode by selecting from the main menu and the side menu that results. Example: Push **Mode & Holdoff** (16), and then push **Normal** (15).



To adjust a function setting appearing in a side menu field, do the following steps: (The examples of possible menu selections in the substeps that follow assume you've pushed TRIGGER MENU and set Type to *Edge*.)

1. Push a main menu button that displays a side menu with a menu item(s) that contains a field (readout) that can be varied. Example: Push **Threshold** (21).
2. Push the side-menu button labeled with the menu item containing the field to select it for setting. Example: Push **Threshold** (19).
3. Use the general purpose knob (20) to adjust the field to the trigger level to the setting desired. Example: Turn the knob to **-200 mV**. Alternately, you could set the level using the keypad. Example: Enter **-200**, press **SHIFT**, then press **m** to set the threshold to **-200 mV**.



More About the General Purpose Knob — The general purpose knob is used to control many logic scope functions, such as cursor positioning, display intensities, delay time, gated measurements, number of events, trigger position, holdoff, offset, and variable persistence.

In all cases, the menus are used to select the function to which the general purpose knob is assigned. The following attributes apply to this knob:

- Depending on the function it is assigned to control, the general purpose knob may vary numerical readouts, position objects (cursors) on screen, or select between icon-label settings that show up in side-menu labels.
- The general purpose knob has a readout area at the upper right corner of the screen. (See Figure 2–1 on page 2–8.) This readout always reflects the name and value of the function that the general purpose knob is currently controlling.
- Whenever the general purpose knob assignment is changed, a knob icon appears immediately to the right of the general purpose knob readout to notify you of the assignment change. The icon is removed as soon as you use the general purpose knob to change the value of the function it is assigned to.
- Whenever the menu is removed, the general purpose knob is not assigned and doesn't control any function. (An exception is the cursor function. If cursors are turned on, removing the menu leaves the knob assigned to

control the cursors until reassigned by selecting another menu and function that uses the knob.)

- When the **SHIFT** button is lit, the general purpose knob becomes a coarse adjustment. When the **SHIFT** button is not lit, the general purpose knob becomes a fine adjustment.
- The general purpose knob also has a **SELECT** button. This button is used to toggle the knob between the control of either of the two cursors displayed when H-bar or V-bar cursors are turned on in the cursor menu.

Display and Utility Menus — Using the techniques described for using menus, you can access and change functions in the display menu and utilities menu. In the Display menu, you can set the following functions:

- Color: waveforms, readouts, graticule.
- Intensity: waveforms, readouts, graticule, etc.
- Style of waveform display(s): vectors or dots, intensified or non-intensified samples, and infinite or variable persistence.
- Graticule format: type.
- Waveform interpolation filter and readout options.

From the Utility menu, you can configure the GPIB port (talk/listen, address, etc.) and access internal routines for self diagnostics and self compensation. Instructions for setting up communication over the GPIB are found in Section 5, *Adjustment Procedures*.

Operating Instructions for Waveform Groups

The TLS 216 Logic Scope receives input signals through its channels, but only displays those signals if the channels receiving them are assigned to waveform groups. This section briefly describes basic principles for creating waveform groups and how to control them.

NOTE. These instructions are at the level appropriate for servicing the logic scope. The complete operator instructions are found in the TLS 216 User Manual.

NOTE. These instructions do not cover the basic principles of operating the front-panel interface. For those instructions, see General Operating Instructions on page 2–7.

Vertical Readout

To determine the composition (first and last channel) of any group displayed, check the *Vertical Readout* at the bottom of the display. (See Figure 2–2.)

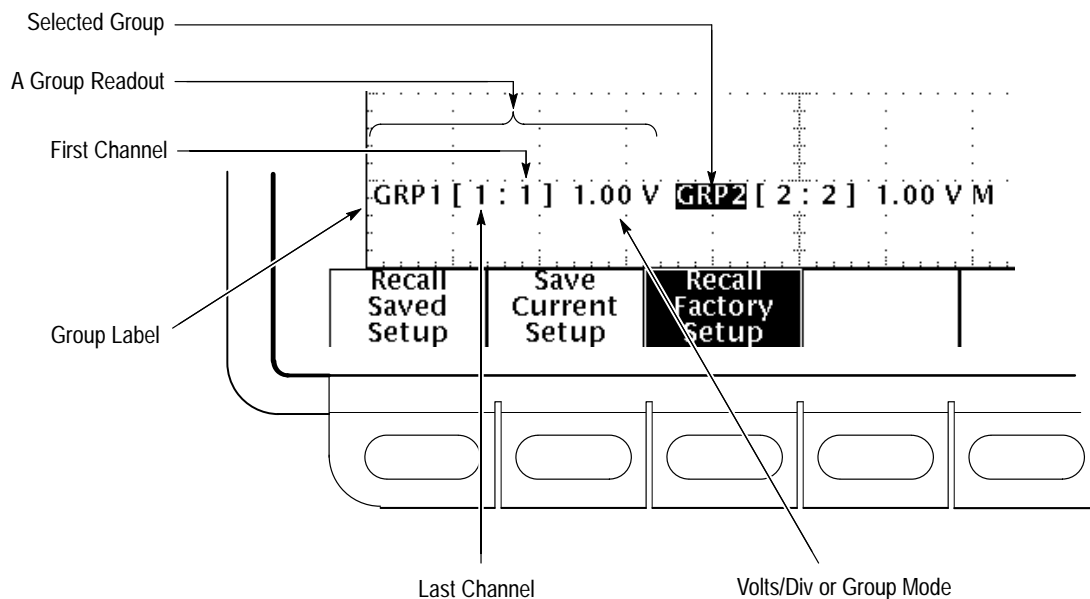


Figure 2–2: Vertical Readout Displaying Two Group Readouts

The Vertical Readout includes group readouts. Each group readout lists each group by number and indicates its last and first channel. In addition, the Vertical Readout:

- displays only groups that are defined.
- displays the label of the selected group in reverse video. (See Figure 2–2.)
- displays OFF in the group readout for any group that is turned off in its Display Mode menu.
- displays the volts/division setting next to the group label of groups that are set to Analog mode with *all* channels in the group displayed. If set to Analog mode with only the *selected* channel displayed, the word *Select* replaces the volts/division readout. (See *Choosing a Group Display Mode*, which begins on page 2–22 for information about group modes.)
- displays the display mode, Bus or Timing, next to the group label of groups set to BusForm or Timing Diagram modes.
- displays the contents of the group by listing the last and the first channel it contains.
- displays only one of the two “pages” of live (as opposed to reference) groups at a time: Group 1 through Group 4 or Group 5 through Group 8, whichever page contains the currently selected group.
- displays the reference group currently selected in the Group More menu. (If MORE is lighted, the live group readouts are removed from the Vertical Readout.)

How to Adjust the Vertical Setup

To effectively use the vertical controls, consider how they operate with regard to the group display mode (group display modes are described on page 2–22):

- The vertical position, bandwidth, and offset controls operate directly on the *selected* group regardless of its display mode: Analog, BusForm, or Timing Diagram.
- The Vertical SCALE knob adjusts the vertical size of a group displayed in Analog mode on screen.
- Although the Vertical SCALE knob adjusts the scale used by the acquisition hardware regardless of the group display mode, it does not alter the vertical size on screen of a group displayed in either BusForm or Timing Diagram mode. You set the vertical size directly in divisions of difference between the logic HIGH and LOW values that these two modes display.

To Scale and Position Waveform Groups

To adjust the vertical scale and position of the selected waveform group, use the following procedure:

1. To vertically scale the selected waveform group, turn the Vertical **SCALE** knob. Changing the vertical scale changes the volts per division setting to vertically expand or contract all waveforms in the group. (This knob controls the vertical size of the selected group only if its group display mode is Analog. See page 2–24 for sizing groups set to other modes.)
2. To vertically position the selected group, turn the Vertical **POSITION** knob. This knob controls only the selected group and operates independently of the display mode.

NOTE. The instructions in the remainder of this section make use of the convention for procedure steps described in the preface to this manual (see Conventions on page xiv).

To Set Up from the Vertical Controls Menu

To access the Vertical Controls menu, press **GROUP MENU** → **Vertical Controls** (main). (See Figure 2–3.)

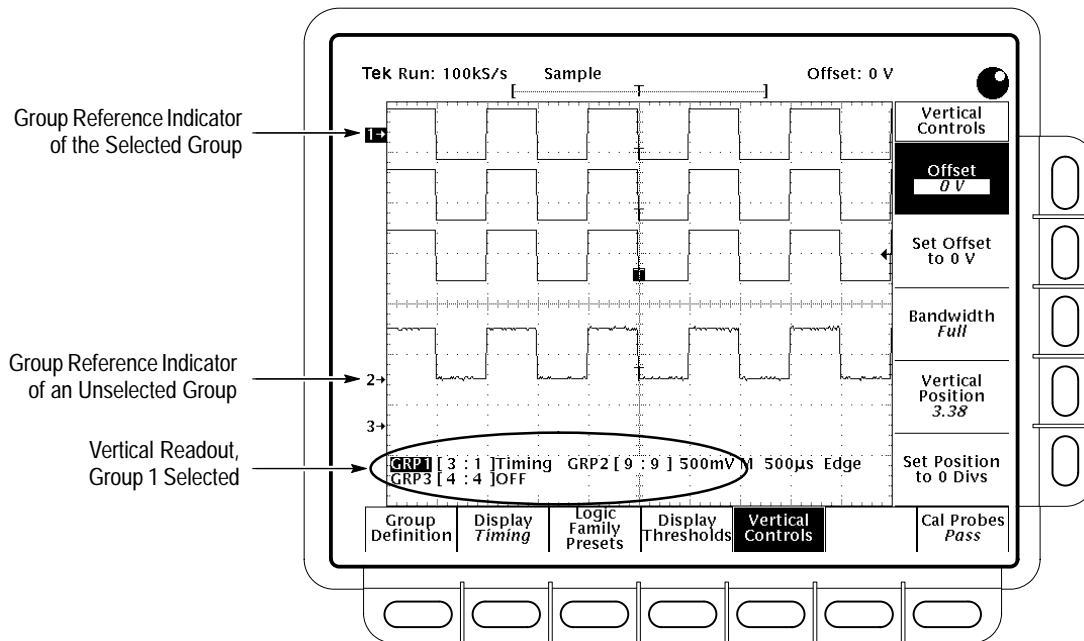


Figure 2–3: The Vertical Readout and Vertical Controls Menu

Use this menu to set vertical offset and bandwidth (full or limited) of the selected group. You can also change the vertical position to a specific number of divisions from center screen from this menu instead of using the Vertical POSITION knob.

How to Select Groups and Channels

The logic scope applies the control changes you make, such as vertical bandwidth, offset, position, and scale, to the *selected group*. To make these changes to a group, or to define a group (choose the channels the group contains, its display mode, and so on), you must first select it.

To Select a Group

To select a live waveform group (one that can acquire waveforms as opposed to a reference waveform group that can only store and display them) do the following steps.

1. Press any of group selection buttons **GROUP 1** through **GROUP 4** on the right side of the display to select any one of groups 1 – 4.
2. Press **SHIFT** and repeat step 1 to select any one of groups 5 – 8. Note that the labels GROUP 5 through GROUP 8 are shifted functions of the GROUP 1 through GROUP 4 buttons.

When selecting groups, note the following operating characteristics:

- The logic scope highlights the selected group. It also displays its group reference indicator (left of the graticule) and its group readout label in reverse video. (See Figure 2–3.)
- The logic scope creates the group automatically if you select a group not yet defined. It creates it using the first channel not allocated to another group. It displays it using Analog display mode.
- The logic scope displays all groups except those undefined (deleted) or those which have their display mode set to Off. (See page 2–19 to learn how to remove and return a group from the display.)
- The logic scope ignores attempts to select undefined groups when the defined groups have used up all 16 channels.
- The logic scope lights the LED above the button you press. The LED lights regardless of whether you select a shifted group (5 – 8) or one that is not shifted (1 – 4). Therefore, if you are not sure which group is selected, look at the group readout. It always indicates the selected group.
- The logic scope does not depend on the selected group to determine its trigger source. You define the trigger source independently in the Main Trigger menu or Delayed Trigger menu.

To select a reference waveform group (as opposed to a live waveform group), do the following steps.

1. Press the **MORE** group selection button. The More Group menu will appear.
2. Press **Reference Group** (main). Select from **Ref1** (side) through **Ref4** (side).

***NOTE.** If references are empty (appear shaded in the Select Ref menu), you cannot display them. If a reference group is turned off in its Display Mode menu, selecting it switches its display mode to Analog, so it is automatically displayed.*

To Select a Channel

The logic scope also applies a limited number of control changes based on the *selected channel* in the selected group. For example, Autoset, which automatically adjusts control settings based on the signals at its input channels, uses the selected channel to determine the logic scope control setup. Also Measure, the automatic measure feature, takes most automatic measurements on the selected channel.

To designate one channel as the selected channel within the selected group, perform the following steps.

1. Select a live or reference group as previously described.
2. Press **Group Definition** (main) → **Selected Channel** (side). Use the general purpose knob or key pad to designate the selected channel in the group.

To Remove a Group from the Display

To remove a group from display, do the following steps.

1. Press the group selection button (**GROUP 1** through **GROUP 8**) to select the group you want to remove from the display.
2. Press the **GROUP OFF** button to remove the currently selected group.

To display a group that is turned off, turn it on in the group mode menu:

Press **GROUP MENU** → **Group Definition** (main) → **Analog, Bus, or Timing Diagram** (side).

***NOTE.** Turning a group off does not make its channels available for including in other groups. Turning off a group that includes a channel providing a trigger source does not turn that channel off as a trigger source. Turning off a group does remove any automated measurements of channels in that group.*

How to Create a Waveform Group

The logic scope operates on channels and the waveforms they acquire only as individual groups. To perform even basic operations on any waveform, such as displaying, vertically positioning, and vertically scaling it, you must first know how to include it in a group.

To more fully understand what a group is, consider its characteristics.

Groups contain one or up to sixteen channels. You must assign a channel to a group for it to be displayed. See Figure 2–4.

Groups use only contiguous channels. For example, a group can contain channels 5 through 10, but not channels 5 through 8 plus 10.

Groups cannot share channels. For example if Group 1 contains channel 10, no other group can include channel 10.

Groups are the objects you display, vertically scale, and vertically position. You can adjust a single channel like a group if you make it the only channel in a group and adjust that group.

Groups can be displayed in any of three display modes: Analog, BusForm, or Timing Diagram.

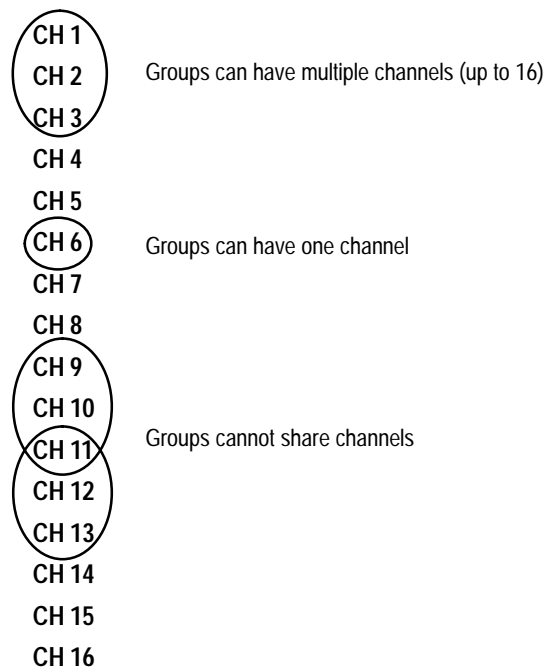


Figure 2–4: Groups — Valid and Invalid

To Define a Group

To define a waveform group, you select the group, specify the channels it contains, and designate one of the channels as the selected channel. To do so, perform the following steps.

1. Press any of group selection buttons **GROUP 1** through **GROUP 4** on the right side of the display. Or press **SHIFT**, and then press any of group selection buttons **GROUP 5** through **GROUP 8**. (The **MORE** selection button allows you to select internally stored *Ref* groups of saved waveforms for display.)
2. Press **Group Definition** (main) → **First Channel** (side). Use the key pad to select the first channel in the group.
3. Press **Last Channel** (side). Use the key pad to select the last channel in the group.
4. Press **Selected Channel** (side). Use the key pad to designate the selected channel in the group.

Several operating characteristics can be observed when you perform the steps just listed:

- Selecting a group not yet defined creates the group using a single channel. The logic scope uses the lowest numbered channel not yet assigned to a group.
- When defining a first channel or last channel, the logic scope ignores the input of any channels belonging to another group.
- Attempting to increase the first channel to a higher numbered channel than that set for last channel sets both the first and last channels to the higher numbered channel. This operation results in a single channel group.
- Attempting to decrease the last channel to a lower numbered channel than that set for first channel sets both the first and last channels to the lower numbered channel. This operation results in a single channel group.

You can also increment the first, last, and selected channels by repeatedly pressing their menu button in the side menu after selection.

To Delete a Group

To delete a group, do the following steps:

1. Press the group selection button (**GROUP 1** through **GROUP 8**) to select the group you want to delete.
2. Press **Group Definition** (main) → **Delete Group** (side). The logic scope takes the following actions:
 - Removes the group and its vertical readout from the display.
 - Removes any automated measurements on channels in the group.

- Releases all channels in the group so that they are available for including in existing groups or new groups you create.

NOTE. Channels selected as trigger sources in the trigger menu continue to be the trigger source regardless of whether it belongs to a group that is displayed, turned off, or deleted (belongs to no group at all).

How to Choose the Group Display Mode

The logic scope displays the waveform groups you define in your choice of three display modes: *Analog*, *BusForm*, and *Timing Diagram*.

Analog displays each waveform in the group as the analog of its input signal. All waveforms in the group have superimposed ground references. (See Figure 2–5.) The logic scope scales Analog groups vertically on screen when you use the Vertical SCALE knob. Also, the group reference indicator for the group (left side of screen) points to the ground reference level for the group in Analog mode if vertical offset is set to zero.

Analog mode is the only group display mode that can be switched between a display of all the channels in a group and display of a single channel in a group.

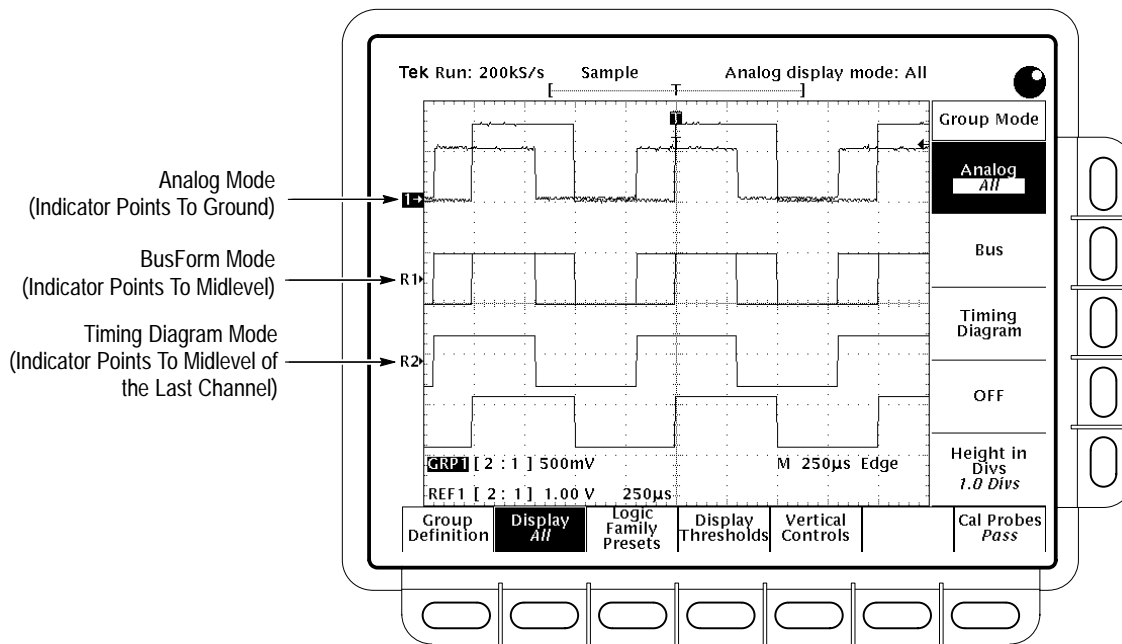


Figure 2–5: Display Modes

BusForm displays each waveform in the group as one or more of three digital logic levels defined as HIGH, LOW, or indefinite (between HIGH and LOW). The level of each waveform displayed depends on how the instantaneous level of its input signal compares with two threshold levels that you define.

As with Analog mode, all waveforms in the group have superimposed ground references. (The group reference indicator points to the midlevel for the group instead of the ground level.) However, in BusForm mode the logic scope does not display waveform height in volts/division but as a number of divisions that you specify between the HIGH and LOW levels (group height).

Timing Diagram displays each waveform in the group as one or more of three digital logic levels like BusForm. However, unlike BusForm, the logic scope vertically offsets the ground reference of each waveform, so that the waveforms are separated vertically on screen. (The group reference indicator points to the midlevel of the last channel (highest numbered) included in the group.)

OFF removes the display of all waveforms in the group. Only the waveforms are turned off; the group reference indicator, trigger position, and trigger bar indicators remain on screen. You can select, position, and scale a group regardless of whether it is on or off.

To Select a Group Mode

To select a group display mode, do the following steps:

1. Press any of group selection buttons **GROUP 1** through **GROUP 4** on the right side of the display. Or press **SHIFT**, and then press any of group selection buttons **GROUP 5** through **GROUP 8**. (The MORE button allows you to select internally stored Ref waveform groups for display and manipulation.)

The selected group is indicated by the lighted LED above each button.

2. Press **GROUP MENU** → **Display** (main) → **Analog, Bus, Timing Diagram**, or **OFF** (side). (See Figure 2–5.)

To Display Only the Selected Channel

For groups displayed in Analog mode, you can remove the display of all but the *selected* channel. To toggle between a display of all the channels in a group and a display of only the selected channel, do the following steps:

1. Press **GROUP MENU** → **Display** (main) → **Analog** (side).
2. Press **Analog** (side) again to toggle between the **All** and **Select** settings.

Note that the logic scope replaces the volt/division setting with the word *Select* when you toggle to that setting.

To Define Group Thresholds and Height

If displaying waveform groups in BusForm or Timing Diagram display mode, you must set the display thresholds and group height. To set these parameters for the currently selected group, do the following steps:

1. Press **GROUP MENU** → **Display Thresholds** (main).
2. Press **Vhigh, min** and use the general purpose knob or keypad to set the voltage level the waveform group must exceed to be displayed as a HIGH.
3. Press **Vlow, max** and use the general purpose knob or keypad to set the voltage level the waveform group must *not* exceed to be displayed as a LOW.
4. Press **Display Thresholds** (main) → **Height in Divs** (side) and use the keypad to set the height of all waveforms in the currently selected group.

NOTE. *Although the Vertical Scale knob does not size BusForm and Timing Diagram mode groups on screen, you should set it to a level that displays your digital waveforms properly. For example, if your waveforms are clipped in Analog mode, they will be clipped in BusForm and Timing Diagram modes as well (“Clipping” appears on screen). Adjust the Vertical Scale knob until clipping stops.*

To Remove a Group from the Display

To remove the display of a group, do the following step:

Select the group and press the **GROUP OFF** button. (Alternately, you could set the display mode to Off in the Display Mode menu.)

Removing the display of a group also removes from the display any automated measurements being made on any waveforms in that group.

To Find More Information

For the complete operator instructions for the logic scope, see the *TLS 216 User Manual*.

For general operating instructions on operating front-panel controls and menus, see *General Operating Instructions* on page 2–7 of this section.

For a general description of the logic scope, see *Product Description* in Section 1 of this manual.

For general instructions for operating the internal diagnostic routines of the logic scope, see on *General Operating Instructions* page 2–7.

Circuit Description

This section describes the electrical operation of the TLS 216 Logic Scope using the major circuit blocks or modules.

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 TLS 216 Logic Scope contains many 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, and 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. The specific voltages that constitute a high or low state vary among the electronic devices.

Active-low signals are indicated by a tilde prefixed to the signal name (~RESET). Signal names are considered to be either active-high, active-low, or to have both active-high and active-low states.

Module Overview

This module overview describes the basic operation of each functional circuit block as shown in Figure 9-2.

General

The Tektronix TLS 216 Logic Scope is a 16-channel instrument. Each channel provides a calibrated vertical scale factor. All of the 16 channels can be simultaneously acquired at the maximum digitizing rate of 2 GSamples/sec.

Input Signal Path

A signal enters the logic scope through a probe attached to a logic scope input connector on the A10 Acquisition board.

Acquisition System — The acquisition system provides 50Ω inputs and, under control of the processor system, attenuation of input signals. It attenuates/amplifies the input signals, samples them, converts them to digital signals, and

controls the acquisition process under direction of the processor system. The acquisition system includes the trigger, acquisition timing, and acquisition mode generation and control circuitry.

D1 Bus — The acquisition system passes the digital values representing the acquired waveform through the A14 D1 Bus to the A11 DRAM Processor/Display board. This happens after a waveform acquisition is complete if the digital signal processor in the processor system requests the waveform.

Processor System — The processor system contains a 68020 microprocessor that controls the entire instrument. It includes the firmware. It also includes a GPIB interface. You can reprogram the firmware from a remote controller using the GPIB and an external software package.

The processor also includes a digital signal processor. This signal processor processes each waveform as directed by the system processor. Waveforms and any text to be displayed are passed on to the display system. The A11 DRAM Processor/Display board contains both the processor and display systems.

Display System — Text and waveforms are processed by different parts of the display circuitry. The display system sends the text and waveform information to the tube assembly as a video signal. The display system also generates and sends vertical (VSYNC) and horizontal (HSYNC) sync signals to the tube assembly. A VGA-compatible video output is at the rear of the TLS 216.

Voltage Controlled Oscillator (VCO)

Master clocks for the acquisition system are generated by the circuitry on the A10 Acquisition board. The circuitry makes up a phased locked loop. The master clock is divided down by the A10 Acquisition circuitry under control of the processor system.

Tube Assembly

All information (waveforms, text, graticules, and pictographs) is displayed by the A30/31/32 Display system. The A30 Display Driver board generates the high voltages necessary to drive the display tube. It also contains the video amplifier, horizontal oscillator, and the vertical and horizontal yoke driver circuitry.

Front Panel

The processor system sends instructions to and receives information from the Front Panel Processor on the A12 Front Panel board. The Front Panel Processor reads the front-panel switches and potentiometers. Any changes in their settings are reported to the processor system. The Front Panel Processor also turns the LEDs on and off and generates the bell signal.

Front-panel menu switches are also read by the Front Panel Processor. The processor sends any changes in menu selections to the processor system. The

ON/STBY switch is one of the menu switches. However, it is not read by the Front Panel Processor, but passes through the A12 Front Panel board and the A11 DRAM Processor/Display board to the low voltage power supply.

The front panel also generates the probe compensation signals **SIGNAL** and **GND**.

Rear Panel The **GPIB** connector provides access to stored waveforms, and allows external control of the logic scope.

You can output hardcopies to the GPIB, RS-232 and Centronics ports.

Low Voltage Power Supply The low voltage power supply is a switching power converter with active power factor control. It supplies power to all of the circuitry in the logic scope.

The principal **POWER** switch, located on the rear panel, controls all power to the logic scope including the Low Voltage Power Supply. The **ON/STBY** switch, located on the front panel, also controls all of the power to the logic scope except for part of the circuitry in the Low Voltage Power Supply.

The power supply sends a power fail (~PF) warning to the processor system if the power is going down.

Fan The fan provides forced air cooling for the logic scope. It connects to +25 V from the Low Voltage Power Supply by way of the A11 DRAM Processor/Display module.

Introduction

The entire performance verification procedure includes both the *Brief Procedures* and the *Performance Tests*, found later in this section. You may not need to perform all of these procedures, depending on what you want to accomplish.

- To rapidly confirm that the logic scope functions and was adjusted properly, just do the procedures under *Self Tests*, which begin on page 4–5.

Advantages: These procedures are short, require no external signal sources, and perform extensive functional and accuracy testing to provide high confidence that the logic scope will perform properly. You can use them as a quick check before making a series of important measurements.

Time Required: Approximately 55 minutes.

- To further check functionality, first do the *Self Tests* just mentioned; then do the procedures under *Functional Tests* that begin on page 4–7.

Advantages: These procedures require minimal additional time to perform, require no additional equipment other than the standard-accessory probes and a floppy disk, and more completely test the internal hardware of the logic scope. You can use them to quickly verify that the primary features of the logic scope are operational.

Time Required: Approximately 45 minutes.

- If you desire a more extensive confirmation of performance, do the *Performance Tests*, beginning on page 4–15, after doing the *Functional* and *Self Tests* just referenced.

Advantages: These procedures add direct and indirect checking of warranted specifications. They require more time to perform and suitable test equipment. (See *Equipment Required* beginning on page 4–15.)

Time Required: Approximately 11 hours, 35 minutes.

Option 1S

If you ordered this product as an Option 1S, you must obtain a complete set (16) of probes to do a complete performance verification. (Option 1S substitutes Coax Adapters for the probes normally shipped.) Alternately, you may choose to adapt the procedures as follows:

1. Perform the procedure *Self Tests* on page 4–5, skipping the test *Verify Probe Function and Calibration* on page 4–6.

2. Skip all of the procedure *Functional Tests* except for the test *Verify the File System* on page 4–13.
3. If you desire a more extensive confirmation of performance, do the procedure *Performance Tests*. When doing the Performance Tests, you must also skip the test *Check Outputs — Probe Compensator on page 4–51*, since that check requires a probe.

Operating Information

If you are not familiar with operating this logic scope, read the TLS 216 Reference or the TLS 216 User Manual. These manuals contain instructions that will acquaint you with the use of the front-panel controls and the menu system.

Conventions

Throughout these procedures the following conventions apply.

- Each test procedure uses the following general format.
 - Title of Test
 - Equipment Required
 - Time Required
 - Prerequisites
 - Procedure
- Each procedure consists of as many steps and substeps as required to do the test. Steps and substeps are sequenced as follows:
 1. First Step
 - a. First Substep
 - b. Second Substep
 2. Second Step
- Refer to Figure 4–1: “Main menu” refers to the menu that labels the seven menu buttons under the display; “side menu” refers to the menu that labels the five menu buttons to the right of the display. “Pop-up menu” refers to a menu that pops up when a main-menu button is pressed.

- Instructions for making a menu selection will follow this format: **FRONT PANEL BUTTON → Pop-Up (if necessary) → Main Menu Button → Side Menu Button.** For example, “Press **TRIGGER MENU → Type: Edge (pop-up) → Source (main) → AC (side).**”

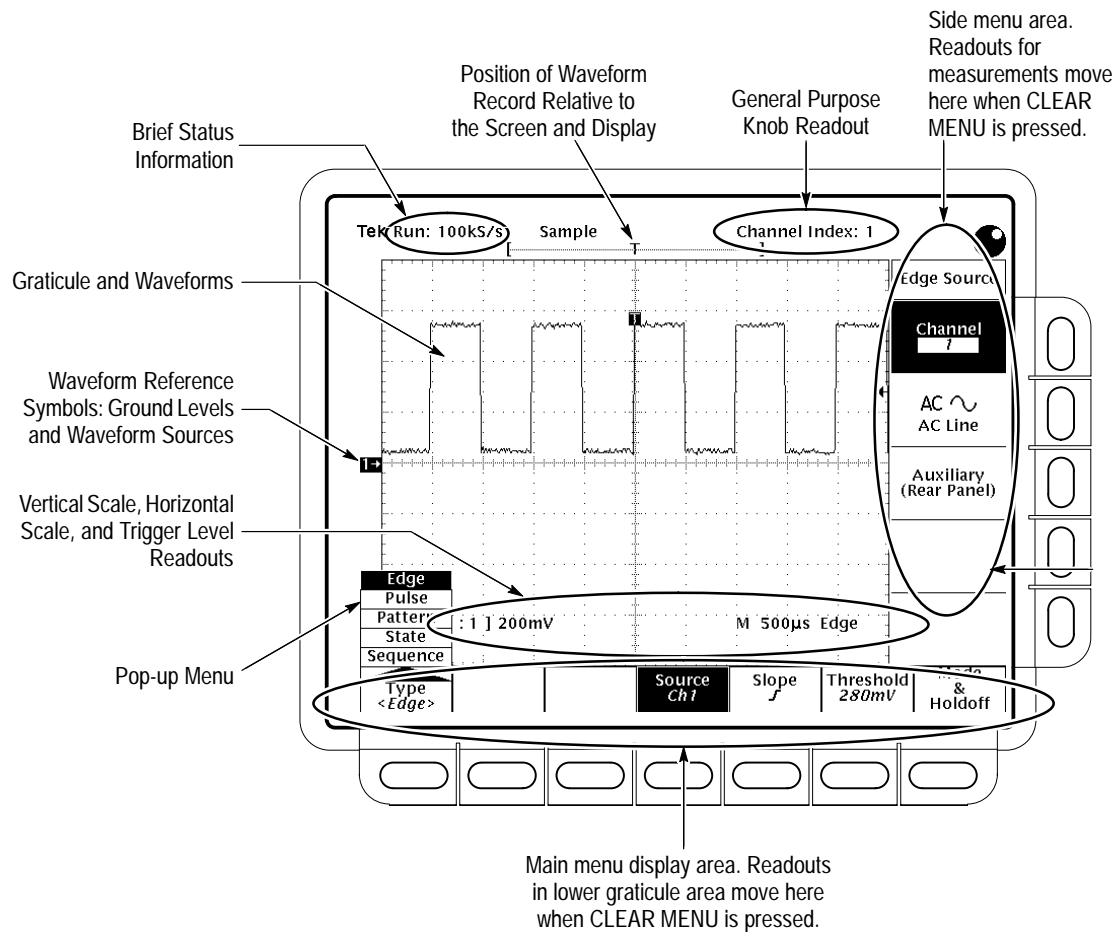


Figure 4-1: Map of Display Functions

Brief Procedures

The *Self Tests* use internal routines to confirm basic functionality and proper adjustment. The standard-accessory probes are the only equipment required.

The *Functional Tests* use the probe-calibration output at the front panel as a test-signal source to further verify that the logic scope functions properly. The standard accessory probes and a floppy disk are the only equipment required.

Self Tests

These procedures use internal routines to verify that the logic scope functions and was adjusted properly.

Verify Internal Adjustment, Self Calibration, and Diagnostics

Equipment Required: None.

Time Required: Approximately 40 minutes after warm-up period.

Prerequisites: Power on the logic scope and allow a 20 minute warm-up before doing this procedure.

Procedure:

1. *Verify that internal diagnostics pass:*
 - a. Press **SHIFT**; then press **UTILITY** → **System: Diag/Err** (pop-up) → **Area: All** (pop-up).
 - b. Disconnect all input signals and probes from all sixteen channels.
 - c. Press **Execute** (main) → **OK Confirm Run Test** (side).
 - d. Wait. The internal diagnostics do an exhaustive verification of proper logic scope function. This verification will take up to two minutes. At some time during the wait, a “clock” icon (shown at left) may appear on screen. When the logic scope finishes the verification, the resulting status will appear on the screen.
 - e. Verify that no failures occur.
 - f. Press **SHIFT**; then press **UTILITY** → **System: Cal** (pop-up).
 - g. Verify that the word *Pass* appears in the main menu under the **Voltage Reference, Frequency Response, and Pulse Trigger** menu labels (See Figure 4–2.)



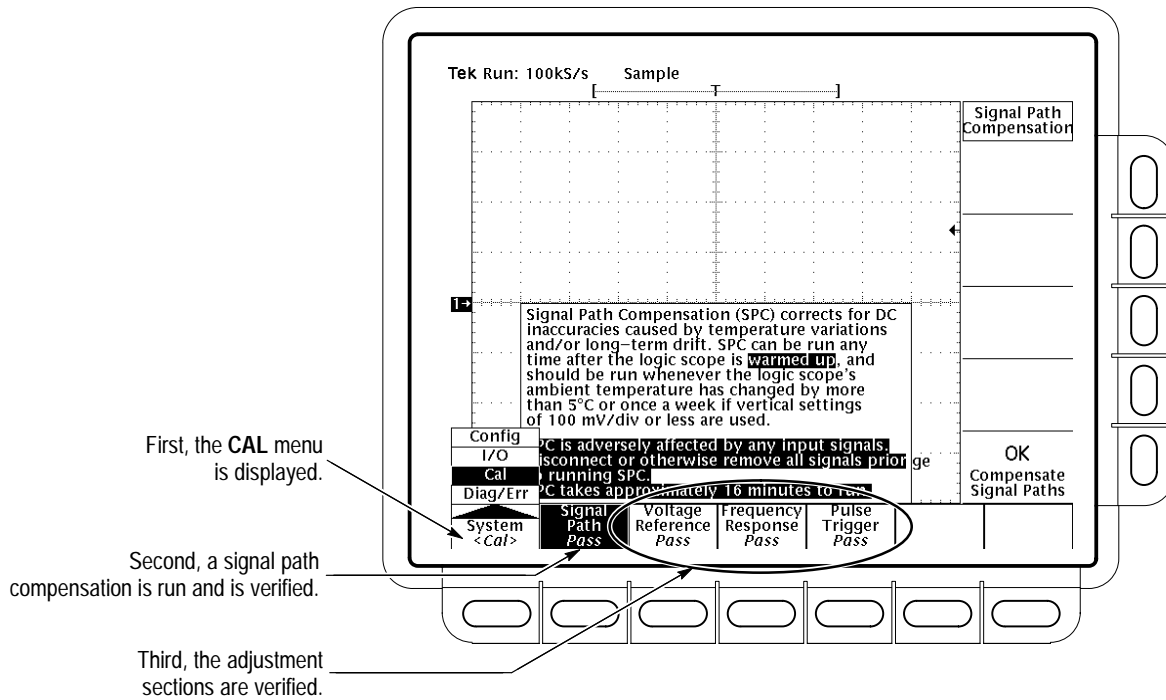


Figure 4-2: Verifying Adjustments and Signal-Path Compensation



- h. Press **Signal Path** (main) → **OK Compensate Signal Paths** (side).
- i. Wait. Signal-path compensation runs in about 16 minutes. While it progresses, a “clock” icon (shown at left) is displayed on screen.
- j. Verify that the word **Pass** appears under **Signal Path** in the main menu. (See Figure 4-2.)

2. *Return to regular service:* Press **CLEAR MENU** to exit the system menus.

Verify Probe Function and Calibration

Equipment Required: Sixteen P6240 probes.

Time Required: Approximately 15 minutes.

STOP. If your logic scope was ordered configured as Option 1S, it was shipped without the 16 probes included with the standard configured logic scope. You must have the probes to do the following steps and may wish to skip verification of probe function. Read the information under Option 1S on page 4-1 before continuing.

Procedure:

1. *Connect the probes and preset the instrument controls:*
 - a. Connect 16 P6240 probes to the logic scope (one to each channel).
 - b. Connect each probe tip to a **PROBE CALIBRATION** output terminal (order is not important); ensure correct orientation of each probe (ground pins on the bottom).
 - c. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **Ok Confirm Factory Init** (side).
2. *Run the probe calibration routine on all probes:*
 - a. Press **GROUP MENU** → **Group Definition** (main) → **Last Channel** (side). Use the numeric keypad to set the last channel to 16.
 - b. Press the main menu button **Cal Probes**; then press the side menu button **OK Compensate Probes**.
 - c. Wait. Calibration of all 16 probes will take about 4 minutes.
 - d. Verify that no failures occur. If a failure occurs, consult the error log [**SHIFT – UTILITY** → **System: Diag/Err** (pop-up) → **Error Log** (main)] to pinpoint the faulty probe.
3. *Return to regular service:* Press **CLEAR MENU** to exit the system menus and disconnect the probes.

Functional Tests

The purpose of these procedures is to confirm that the logic scope functions properly. The only equipment required is two standard-accessory probes and a 3.5", 720 K or 1.44 Mbyte floppy disk.

STOP. *These procedures verify functions; that is, they verify that the logic scope features operate. They DO NOT verify that they operate within limits.*

Therefore, when the procedure calls 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,” etc., do NOT interpret the quantities given as limits. To check operation within limits, proceed to the Performance Tests, which begin on page 4–15.

DO NOT make changes to the front-panel settings that are not called out in the procedures. Each verification procedure will require you to set the logic scope to certain default settings before verifying functions. If you make changes to these

settings other than those called out in the procedure you may obtain invalid results. In this case, just redo the procedure from step 1.

STOP. *If your logic scope was ordered configured as Option 1S, it was shipped without the 16 probes included with the standard configured logic scope. You must have the probes to do the following steps and may wish skip all the function tests except the last. Read the information under Option 1S on page 4-1 before continuing.*

Verify All Input Channels

Equipment Required: Two P6240 probes.

Time Required: Approximately 30 minutes.

Prerequisites: None.

Procedure:

1. *Install the test hookup and preset the logic scope controls:*

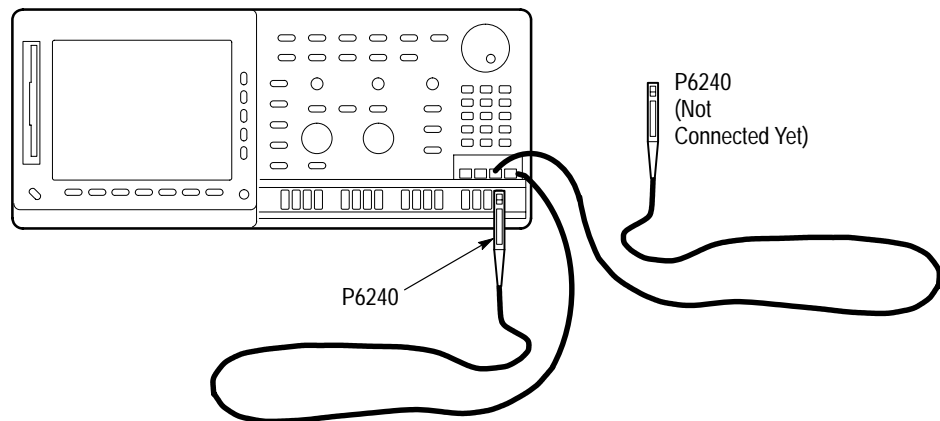


Figure 4-3: Test Hookup for Functional Tests

- a. Install one probe on channel 1. Connect the probe tip to a **PROBE CALIBRATION** signal output on the front panel. Connect the probe tip of a second probe to a **PROBE CALIBRATION** signal output, but *do not install it yet.*
- b. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **Ok** **Confirm Factory Init** (side).

- c. Press **GROUP MENU** → **Cal Probes** (main) → **OK Initialize Probes** (side).
 - d. Set the vertical **SCALE** to 500 mV.
 - e. Press **SET LEVEL TO 50%**.
 - f. Press **GROUP MENU** → **Group Definition** (main) → **Last Channel** (side). Use the numeric keypad to set the last channel to 16.
2. *Verify that all input channels operate:* Do the following substeps — test channel 1 first and then proceed to the other channels.
 - a. Confirm that the following statements are true for the selected channel.
 - A square-wave probe-calibration signal about one division in amplitude is on screen. (See Figure 4–4.)

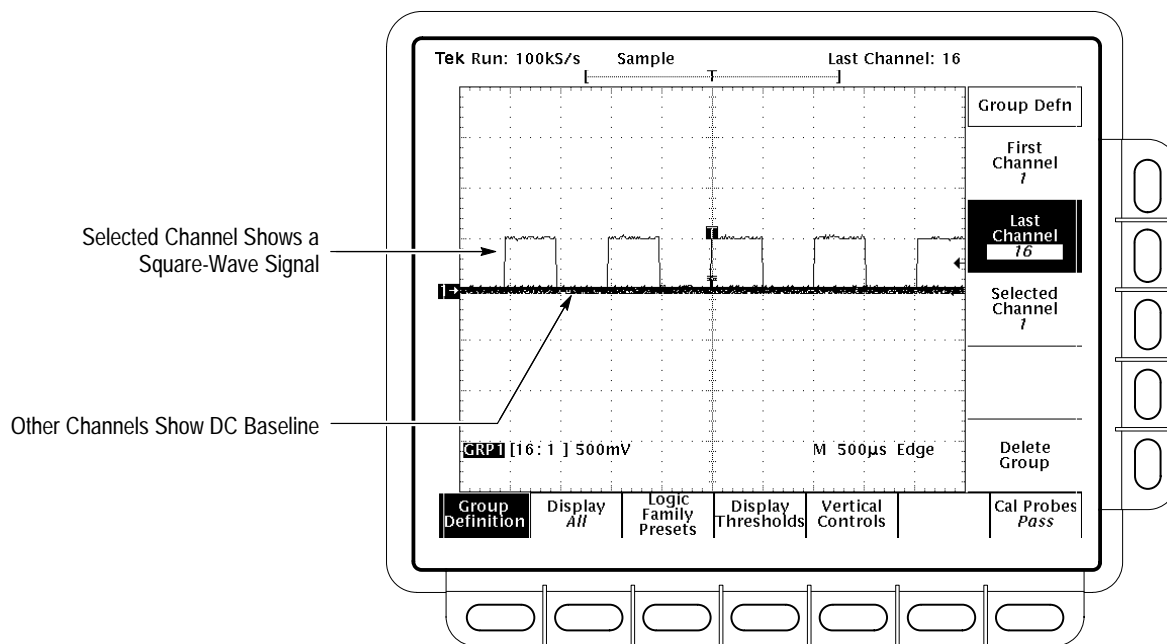


Figure 4–4: Square Wave Calibration and DC Baseline Signals

- The vertical **POSITION** knob moves all signals up and down the screen when rotated.
- Turning the vertical **SCALE** knob counterclockwise decreases the amplitude of the waveform on screen (this may untrigger the signal), turning the knob clockwise increases the amplitude, and returning the knob to 500 mV returns the amplitude to about one division.

- b. Press **SHIFT**; then press **ACQUIRE MENU**. Use the side menu to select, in turn, each of the three acquisition modes and confirm that the following statements are true. Refer to the icons at the left of each statement as you confirm those statements.



- **Sample** mode displays an actively acquiring waveform on screen. (Note that there is noise present on the peaks of the square wave.)



- **Envelope** mode displays an actively acquiring waveform on screen with the noise displayed.



- **Average** mode displays an actively acquiring waveform on screen with the noise reduced. Now return the instrument to **Sample** mode.

- c. Install the second probe (mentioned in step 1a) on the next channel in numeric sequence. *Leave the first probe installed on channel 1.*
- d. Press **GROUP MENU** → **Group Definition** (main) → **Selected Channel** (side). Press the side menu button **Selected Channel** again if necessary to increment the selected channel to the next channel to be tested.
- e. Press **SET LEVEL TO 50%** as necessary to trigger the signal.
- f. Repeat substeps a through d until you have verified all sixteen input channels.
3. *Remove the test hookup:* Disconnect the probes from the channel inputs and the probe calibration terminals.

Verify the Time Base

Equipment Required: One P6240 probe.

Time Required: Approximately 5 minutes.

Prerequisites: None.

Procedure:

1. *Install the test hookup and preset the logic scope controls:*
 - a. Install the probe on channel 1. Connect the probe tip to the **PROBE CALIBRATION** signal on the front panel. (See Figure 4–3 on page 4–8.)
 - b. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **Ok Confirm Factory Init** (side).
 - c. Press **SET LEVEL TO 50%**.
 - d. Set the vertical **SCALE** to 500 mV.

- e. Set the horizontal **SCALE** to 250 μ s.
 - f. Press **CLEAR MENU** to remove the menus from the screen.
2. *Verify that the time base operates:* Confirm the following statements.
 - a. One period of the square-wave probe-calibration signal is about four horizontal divisions on screen.
 - b. Rotating the horizontal **SCALE** knob clockwise expands the waveform on screen (more horizontal divisions per waveform period), counter-clockwise rotation contracts it, and returning the horizontal scale to 250 μ s returns the period to about four divisions.
 - c. The horizontal **POSITION** knob positions the signal left and right on screen when rotated.
 3. *Remove the test hookup:* Disconnect the probe from the channel input and the probe-calibration terminals.

Verify the Main and Delayed Trigger Systems

Equipment Required: One P6240 probe.

Time Required: Approximately 5 minutes.

Prerequisites: None.

Procedure:

1. *Install the test hookup and preset the logic scope controls:*
 - a. Install the probe on channel **1**. Connect the probe tip to the **PROBE CALIBRATION** signal on the front panel. (See Figure 4–3 on page 4–8.)
 - b. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **Ok Confirm Factory Init** (side).
 - c. Press **SET LEVEL TO 50%**.
 - d. Set the vertical **SCALE** to 200 mV.
 - e. Set the horizontal **SCALE** for the **M** (main) time base to 250 μ s.
 - f. Press **TRIGGER MENU** → **Mode & Holdoff** (main) → **Normal** (side).
2. *Verify that the main trigger system operates:* Confirm that the following statements are true.
 - a. The trigger **Threshold** readout in the main menu changes with the trigger **THRESHOLD** knob.

- b. The trigger **THRESHOLD** knob can trigger and untrigger the square-wave signal as you rotate it. (Leave the signal *untriggered*.)
 - c. Pressing **SET LEVEL TO 50%** triggers the signal that you just left untriggered. (Leave the signal triggered.)
3. *Verify that the delayed trigger system operates:*
- a. Press **HORIZONTAL MENU** → **Time Base** (main) → **Delayed Triggerable** (side).
 - b. Press the side-menu button **Delayed Only**.
 - c. Set the horizontal **SCALE** for the **D** (delayed) time base to 250 μ s.
 - d. Press **SHIFT**; then press **DELAYED TRIG** → **Threshold** (main) → **Threshold** (side).
 - e. Confirm that the following statements are true:
 - The trigger **Threshold** readouts in the main and side menus change as you turn the general purpose knob.
 - The general purpose knob can trigger and untrigger the square-wave signal as you rotate it. (Leave the signal *untriggered*.)
 - Pressing **SET LEVEL TO 50%** triggers the signal that you just left untriggered. (Leave the signal triggered.)
 - f. Press the main-menu button **Delay by Time**.
 - g. Use the keypad to enter a delay time of 1 second.
 - h. Verify that the trigger **READY** indicator on the front panel flashes about once every second as the waveform is updated on screen.
4. *Verify main and delayed triggering for the logic triggers:*
- a. Press **HORIZONTAL MENU** → **Time Base** (main) → **Main Only** (side).
 - b. Press **TRIGGER MENU** → **Type: Pattern** (pop-up).
 - c. Verify that the screen shows a triggered square-wave signal.
 - d. Press **HORIZONTAL MENU** → **Time Base** (main) → **Delayed Only** (side).
 - e. Verify that the trigger **READY** indicator on the front panel flashes about once every second as the waveform is updated on screen.
5. *Remove the test hookup:* Disconnect the standard-accessory probe from the channel input and the probe calibration terminals.

Verify the File System

Equipment Required: One 720 K or 1.44 Mbyte, 3.5" DOS compatible disk (formatted).

Time Required: Approximately 5 minutes.

Prerequisites: None.

Procedure:

1. *Preset the logic scope controls:*
 - a. Insert the disk in the disk drive to the left of the monitor.
 - b. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **Ok Confirm Factory Init** (side).
 - c. Set the horizontal **SCALE** to 250 μ s (one click clockwise). Notice the horizontal readout now displays 250 μ s at the bottom of the screen.
2. *Verify the file system works:*
 - a. Press save/recall **SETUP** → **Save Current Setup** (main) → **To File** (side).
 - b. Turn the general purpose knob to select the file to save. Choose **TEK?????.SET**. With this choice, you will save a file starting with **TEK**, then containing 5-numbers, and a **.SET** extension. For example, the first time you run this on a blank, formatted disk or on the Example Programs Disk, the logic scope will assign the name **TEK00000.SET** to your file. If you ran the procedure again, the logic scope would increment the name and call the file **TEK00001.SET**.
 - c. Press the side-menu button **Save To Selected File**.
 - d. Set the horizontal **SCALE** to 500 μ s, and then use the vertical **POSITION** knob to place the channel 1 baseline trace two divisions above center screen.
 - e. Press **Recall Saved Setup** (main) → **From File** (side).
 - f. Turn the general purpose knob to select the file to recall. For example, if you followed the instructions above and used a blank disk, you had the logic scope assign the name **TEK00000.SET** to your file.
 - g. Press the side-menu button **Recall From Selected File**.
 - h. Verify that the logic scope retrieved the saved setup from the disk. Do this by noting that the horizontal **SCALE** again reads 250 μ s and the channel 1 baseline waveform is again vertically positioned near center screens as when you saved the setup.
3. *Remove the test hookup:* Remove the disk from the disk drive.

Performance Tests

This section contains a collection of procedures for checking that the TLS 216 performs as warranted.

The procedures appear in four logical groupings: *Signal Acquisition System Checks*, *Time Base System Checks*, *Triggering System Checks*, and *Output Signal Checks*. They check (either directly or indirectly) all the characteristics that are designated as checked in the *Specifications*. (The characteristics that are checked appear in **boldface** type under *Warranted Characteristics* beginning on page 1–3.)

Prerequisites

The tests in this subsection comprise an extensive, valid confirmation of performance and functionality given the following prerequisites:

- The cabinet must be installed on the logic scope.
- You must have performed and passed the procedures under *Self Tests*, found on page 4–5, and those under *Functional Tests*, found on page 4–7.
- You must have performed *Preparation: Clear Probe Calibrations*, found on page 4–24.
- The logic scope must have been last adjusted at an ambient temperature between +20° C and +30° C, must have been operating for a warm-up period of at least 20 minutes, and must be operating at an ambient temperature between 4° C and +50° C. (The warm-up requirement is usually met by completing the *Self Tests* and *Functional Tests*.)

Read *General Instructions* and *Conventions* that start on page 4–1 before performing these procedures.

Equipment Required

These procedures use external, traceable signal sources to directly check warranted characteristics. Table 4–1 shows the required equipment list.

Table 4–1: Test Equipment

Item Number and Description	Minimum Requirements	Example	Purpose
1. Attenuator, 10X (three required)	Ratio: 10X; impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011–0059–02	Signal Attenuation
2. Attenuator, 2X	Ratio: 2X; impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011–0069–02	Signal Attenuation

Table 4-1: Test Equipment (Cont.)

Item Number and Description	Minimum Requirements	Example	Purpose
3. Terminator, 50 Ω	Impedance 50 Ω ; connectors: female BNC input, male BNC output	Tektronix part number 011-0049-01	Signal Termination for Channel Delay Test
4. Cable, Precision 50 Ω Coaxial (three required)	50 Ω , 36 in, male to male BNC connectors	Tektronix part number 012-0482-00	Signal Interconnection
5. Connector, Dual-Banana (two required)	Female BNC to dual banana	Tektronix part number 103-0090-00	Various Accuracy Tests
6. Connector, BNC "T"	Male BNC to dual female BNC	Tektronix part number 103-0030-00	Checking Trigger Sensitivity
7. Coupler, Dual-Input	Female BNC to dual male BNC	Tektronix part number 067-0525-02	Checking Delay Between Channels
8. Generator, Calibration	Variable amplitude to ± 104 V; accuracy to 0.1%	Data Precision 8200	Checking DC Offset, Gain, and Measurement Accuracy
9. Generator, Leveled Sine Wave, Medium-Frequency	200 kHz to 250 MHz; Variable amplitude from 5 mV to 4 V _{p-p} into 50 Ω	Tektronix SG 503 Leveled Sine Wave Generator	Checking Trigger Sensitivity at low frequencies
10. Generator, Leveled Sine Wave, High-Frequency	250 MHz to 500 MHz; Variable amplitude from 500 mV to 4 V _{p-p} into 50 Ω ; 6 MHz reference	Tektronix SG 504 Leveled Sine Wave Generator with a TM 500 Series Power Module with SG 504 Output Head	Checking Analog Bandwidth and Trigger Sensitivity at high frequencies
11. Generator, Time Mark	Variable marker frequency from 10 ms to 10 ns; accuracy within 2 ppm	Tektronix TG 501A Time Mark Generator	Checking Sample-Rate and Delay-time Accuracy
12. P6240 Probes, which are a Standard Accessory to this product ¹	P6240 probes	Tektronix part number P6240	Signal Interconnection
13. Adapter, Coaxial (two required)	Logic Scope channel input to female SMA adapter	Tektronix part number 013-0282-00	Signal Interconnection
14. Adapter, SMA to BNC (two required)	Male SMA to female BNC	Tektronix part number 015-0554-00	Signal Interconnection

¹ If your logic scope was ordered configured as Option 1S, it was shipped without the 16 probes included with the standard configured logic scope. Read the information under Option 1S on page 4-1 before continuing.

Test Record Photocopy the next 7 pages and use them to record the performance test results for your instrument.

TLS 216 Test Record

Instrument Serial Number: _____
 Temperature: _____
 Date of Calibration: _____

Certificate Number: _____
 RH %: _____
 Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
Offset Accuracy (Zero Setting)				
CH1 Offset	-60 mV	_____	_____	+60 mV
CH2 Offset	-60 mV	_____	_____	+60 mV
CH3 Offset	-60 mV	_____	_____	+60 mV
CH4 Offset	-60 mV	_____	_____	+60 mV
CH5 Offset	-60 mV	_____	_____	+60 mV
CH6 Offset	-60 mV	_____	_____	+60 mV
CH7 Offset	-60 mV	_____	_____	+60 mV
CH8 Offset	-60 mV	_____	_____	+60 mV
CH9 Offset	-60 mV	_____	_____	+60 mV
CH10 Offset	-60 mV	_____	_____	+60 mV
CH11 Offset	-60 mV	_____	_____	+60 mV
CH12 Offset	-60 mV	_____	_____	+60 mV
CH13 Offset	-60 mV	_____	_____	+60 mV
CH14 Offset	-60 mV	_____	_____	+60 mV
CH15 Offset	-60 mV	_____	_____	+60 mV
CH16 Offset	-60 mV	_____	_____	+60 mV

DC Gain				
CH1	Δ: Reading	+480 mV	_____	+520 mV
CH2	Δ: Reading	+480 mV	_____	+520 mV
CH3	Δ: Reading	+480 mV	_____	+520 mV
CH4	Δ: Reading	+480 mV	_____	+520 mV
CH5	Δ: Reading	+480 mV	_____	+520 mV
CH6	Δ: Reading	+480 mV	_____	+520 mV
CH7	Δ: Reading	+480 mV	_____	+520 mV
CH8	Δ: Reading	+480 mV	_____	+520 mV
CH9	Δ: Reading	+480 mV	_____	+520 mV
CH10	Δ: Reading	+480 mV	_____	+520 mV
CH11	Δ: Reading	+480 mV	_____	+520 mV
CH12	Δ: Reading	+480 mV	_____	+520 mV
CH13	Δ: Reading	+480 mV	_____	+520 mV
CH14	Δ: Reading	+480 mV	_____	+520 mV

TLS 216 Test Record (Cont.)

Instrument Serial Number: _____
 Temperature: _____
 Date of Calibration: _____

Certificate Number: _____
 RH %: _____
 Technician: _____

Performance Test		Minimum	Incoming	Outgoing	Maximum
DC Gain					
CH15	Δ : Reading	+480 mV	_____	_____	+520 mV
CH16	Δ : Reading	+480 mV	_____	_____	+520 mV
DC Accuracy					
CH1	+2.7 V Offset -2.7 V Offset	+2.898 V -2.898 V	_____ _____	_____ _____	+3.102 V -3.102 V
CH2	+2.7 V Offset -2.7 V Offset	+2.898 V -2.898 V	_____ _____	_____ _____	+3.102 V -3.102 V
CH3	+2.7 V Offset -2.7 V Offset	+2.898 V -2.898 V	_____ _____	_____ _____	+3.102 V -3.102 V
CH4	+2.7 V Offset -2.7 V Offset	+2.898 V -2.898 V	_____ _____	_____ _____	+3.102 V -3.102 V
CH5	+2.7 V Offset -2.7 V Offset	+2.898 V -2.898 V	_____ _____	_____ _____	+3.102 V -3.102 V
CH6	+2.7 V Offset -2.7 V Offset	+2.898 V -2.898 V	_____ _____	_____ _____	+3.102 V -3.102 V
CH7	+2.7 V Offset -2.7 V Offset	+2.898 V -2.898 V	_____ _____	_____ _____	+3.102 V -3.102 V
CH8	+2.7 V Offset -2.7 V Offset	+2.898 V -2.898 V	_____ _____	_____ _____	+3.102 V -3.102 V
CH9	+2.7 V Offset -2.7 V Offset	+2.898 V -2.898 V	_____ _____	_____ _____	+3.102 V -3.102 V
CH10	+2.7 V Offset -2.7 V Offset	+2.898 V -2.898 V	_____ _____	_____ _____	+3.102 V -3.102 V
CH11	+2.7 V Offset -2.7 V Offset	+2.898 V -2.898 V	_____ _____	_____ _____	+3.102 V -3.102 V
CH12	+2.7 V Offset -2.7 V Offset	+2.898 V -2.898 V	_____ _____	_____ _____	+3.102 V -3.102 V
CH13	+2.7 V Offset -2.7 V Offset	+2.898 V -2.898 V	_____ _____	_____ _____	+3.102 V -3.102 V
CH14	+2.7 V Offset -2.7 V Offset	+2.898 V -2.898 V	_____ _____	_____ _____	+3.102 V -3.102 V
CH15	+2.7 V Offset -2.7 V Offset	+2.898 V -2.898 V	_____ _____	_____ _____	+3.102 V -3.102 V
CH16	+2.7 V Offset -2.7 V Offset	+2.898 V -2.898 V	_____ _____	_____ _____	+3.102 V -3.102 V

TLS 216 Test Record (Cont.)

 Instrument Serial Number: _____
 Temperature: _____
 Date of Calibration: _____

 Certificate Number: _____
 RH %: _____
 Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
Analog Bandwidth				
CH1 Pk-Pk Reading	848 mV	_____	_____	N/A
CH2 Pk-Pk Reading	848 mV	_____	_____	N/A
CH3 Pk-Pk Reading	848 mV	_____	_____	N/A
CH4 Pk-Pk Reading	848 mV	_____	_____	N/A
CH5 Pk-Pk Reading	848 mV	_____	_____	N/A
CH6 Pk-Pk Reading	848 mV	_____	_____	N/A
CH7 Pk-Pk Reading	848 mV	_____	_____	N/A
CH8 Pk-Pk Reading	848 mV	_____	_____	N/A
CH9 Pk-Pk Reading	848 mV	_____	_____	N/A
CH10 Pk-Pk Reading	848 mV	_____	_____	N/A
CH11 Pk-Pk Reading	848 mV	_____	_____	N/A
CH12 Pk-Pk Reading	848 mV	_____	_____	N/A
CH13 Pk-Pk Reading	848 mV	_____	_____	N/A
CH14 Pk-Pk Reading	848 mV	_____	_____	N/A
CH15 Pk-Pk Reading	848 mV	_____	_____	N/A
CH16 Pk-Pk Reading	848 mV	_____	_____	N/A
Delay Between Channels				
CH1 and CH2	N/A	_____	_____	200 ps
CH1 and CH3	N/A	_____	_____	200 ps
CH1 and CH4	N/A	_____	_____	200 ps
CH1 and CH5	N/A	_____	_____	200 ps
CH1 and CH6	N/A	_____	_____	200 ps
CH1 and CH7	N/A	_____	_____	200 ps
CH1 and CH8	N/A	_____	_____	200 ps
CH1 and CH9	N/A	_____	_____	200 ps
CH1 and CH10	N/A	_____	_____	200 ps
CH1 and CH11	N/A	_____	_____	200 ps
CH1 and CH12	N/A	_____	_____	200 ps
CH1 and CH13	N/A	_____	_____	200 ps
CH1 and CH14	N/A	_____	_____	200 ps

Performance Tests

TLS 216 Test Record (Cont.)

Instrument Serial Number: _____	Certificate Number: _____
Temperature: _____	RH %: _____
Date of Calibration: _____	Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
Delay Between Channels				
CH1 and CH15	N/A	_____	_____	200 ps
CH1 and CH16	N/A	_____	_____	200 ps

Long Term Sample Rate				
CH1	-4.0 Div	_____	_____	+4.0 Div
CH5	-4.0 Div	_____	_____	+4.0 Div
CH9	-4.0 Div	_____	_____	+4.0 Div
CH13	-4.0 Div	_____	_____	+4.0 Div

Delta Time				
C1 Per Reading	19.760 ns	_____	_____	20.240 ns
C5 Per Reading	19.760 ns	_____	_____	20.240 ns
C9 Per Reading	19.760 ns	_____	_____	20.240 ns
C13 Per Reading	19.760 ns	_____	_____	20.240 ns

Logic Triggering				
Pulse-Glitch (Main) Generator Readings At:				
10 ns	56.2 MHz	_____	_____	N/A
250 ns	2.27 MHz	_____	_____	N/A
2.5 µs	244 kHz	_____	_____	N/A
Pulse-Width (Main) Generator Readings At:				
10 ns	56.2 MHz	_____	_____	N/A
250 ns	2.27 MHz	_____	_____	N/A
2.5 µs	244 kHz	_____	_____	N/A
Pulse-Glitch (Delayed) Generator Readings At:				
10 ns	56.2 MHz	_____	_____	N/A
250 ns	2.27 MHz	_____	_____	N/A
2.5 µs	244 kHz	_____	_____	N/A
Pulse-Width (Delayed) Generator Readings At:				
10 ns	56.2 MHz	_____	_____	N/A
250 ns	2.27 MHz	_____	_____	N/A
2.5 µs	244 kHz	_____	_____	N/A

TLS 216 Test Record (Cont.)

Instrument Serial Number: _____	Certificate Number: _____
Temperature: _____	RH %: _____
Date of Calibration: _____	Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
Logic Triggering				
Sequence (Main) Generator Readings	2.27 MHz	_____	_____	N/A
Sequence (Delayed) Generator Readings	2.27 MHz	_____	_____	N/A
Trigger Threshold				
Threshold Readings				
Positive Slope	2.54 V	_____	_____	3.46 V
Negative Slope	2.54 V	_____	_____	3.46 V
Edge Trigger				
CH1 (50 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH2 (50 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH3 (50 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH4 (50 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH5 (50 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH6 (50 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH7 (50 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH8 (50 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH9 (50 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A

TLS 216 Test Record (Cont.)

Instrument Serial Number: _____
 Temperature: _____
 Date of Calibration: _____

Certificate Number: _____
 RH %: _____
 Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
Edge Trigger				
CH10 (50 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH11 (50 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH12 (50 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH13 (50 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH14 (50 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH15 (50 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH16 (50 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
AUX Trigger Input				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH1 (500 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH2 (500 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH3 (500 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH4 (500 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH5 (500 MHz)				
Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A

TLS 216 Test Record (Cont.)

Instrument Serial Number: _____ Certificate Number: _____
 Temperature: _____ RH %: _____
 Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
Edge Trigger				
CH6 (500 MHz) Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH7 (500 MHz) Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH8 (500 MHz) Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH9 (500 MHz) Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH10 (500 MHz) Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH11 (500 MHz) Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH12 (500 MHz) Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH13 (500 MHz) Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH14 (500 MHz) Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH15 (500 MHz) Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
CH16 (500 MHz) Positive Slope	Stable Trigger	_____	_____	N/A
Negative Slope	Stable Trigger	_____	_____	N/A
Output Signal Checks				
Probe Calibrator Output Voltage	490 mV	_____	_____	510 mV
Frequency	950 Hz	_____	_____	1050 Hz
Main Trigger Output	High ≥ 1.0 V	_____	_____	Low ≤ 0.25 V
Delayed Trigger Output	High ≥ 1.0 V	_____	_____	Low ≤ 0.25 V

Preparation: Clear Probe Calibrations

Before performing any of the performance checks that follow, you must initialize all channels to remove any previously stored probe calibrations. To do so, perform the following procedure.

Equipment Required: None.

Time Required: Approximately 5 minutes.

Procedure:

1. *Create a 16-channel group:*
 - a. Disconnect any input signals and probes from the front panel.
 - b. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **OK Confirm Factory Init** (side).
 - c. Press **GROUP MENU** → **Group Definition** (main) → **Last Channel** (side). Use the numeric keypad to set the last channel to 16.
2. *Run the probe initialization routine on all probes:* Press the main menu button **Cal Probes**; then press the side menu button **OK Initialize Probes**.

NOTE. Ignore the message that appears on screen that instructs you to connect probes; installation of probes is only required when compensation of probes is to be performed.

3. *Return to regular service:* Press **CLEAR MENU** to exit the system menus.

Signal Acquisition System Checks

These procedures check (either directly or indirectly) those characteristics that relate to the signal-acquisition system and are listed as checked under *Warranted Characteristics* in the *Specifications* section.

Check Accuracy of Offset (Zero Setting)

Equipment Required: None.

Time Required: Approximately 20 minutes.

Prerequisites: The logic scope must meet the prerequisites listed on page 4–15.

1. *Preset the instrument controls:*
 - a. Disconnect any input signals from all channels.
 - b. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **OK Confirm Factory Init** (side).
 - c. Set the horizontal **SCALE** to 1 ms.
 - d. Press **SHIFT**; then press **ACQUIRE MENU** → **Mode** (main) → **Average 16** (side).
 - e. Press **DISPLAY** → **Graticule** (main) → **Frame** (side).
 - f. Press **CURSOR** → **Function** (main) → **H Bars** (side).
 - g. Press **CLEAR MENU**.
2. *Confirm input channels are within limits for offset accuracy at zero offset:*
Do the following substeps — test channel **1** first and then proceed to the rest of the channels.
 - a. Set the vertical **SCALE** setting to 200 mV.
 - b. Rotate the general purpose knob to superimpose the active cursor over the baseline DC test level. (Ignore the other cursor.)
 - c. Read the measurement results at the absolute (@:) cursor readout (see Figure 4–5).

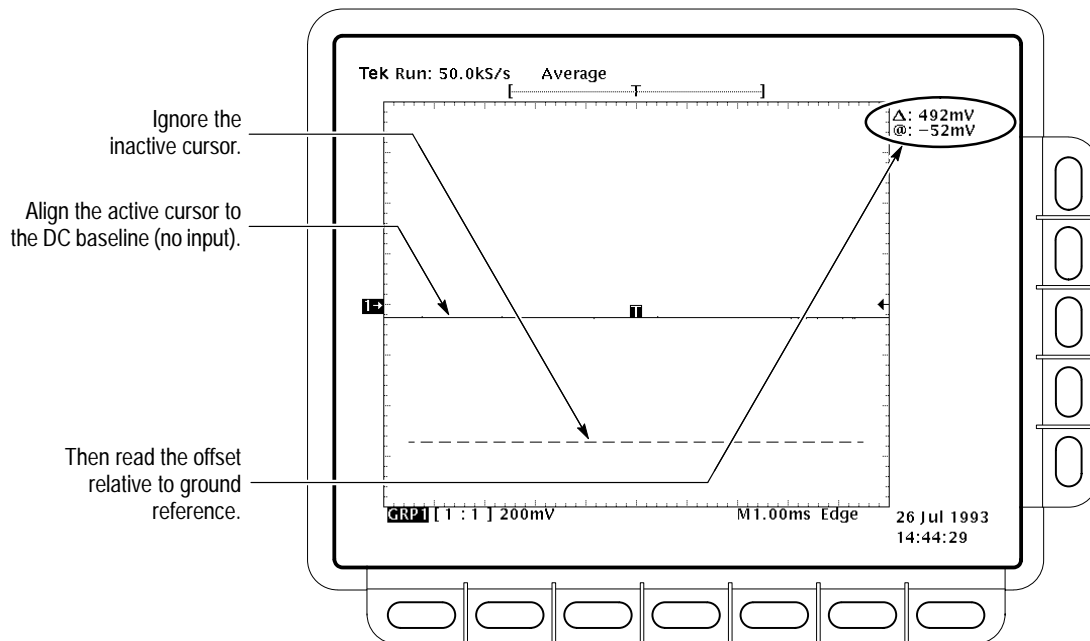


Figure 4-5: Measurement of DC Offset Accuracy at Zero Setting

- d. Check that the readout indicates an offset between +60 mV and –60 mV.
- e. Press **GROUP MENU** → **Group Definition** (main) → **First Channel** (side). Press the side menu button **First Channel** again if necessary to increment to the next channel to be tested.
- f. Press **CURSOR**; press **CLEAR MENU**.
- g. Repeat substeps b through f for all 16 channels. (Substeps e and f will not be necessary for channel 16.)

Check DC Gain and Voltage Measurement Accuracy

Equipment Required: Two dual-banana connectors (Item 5), one BNC T connector (Item 6), one DC calibration generator (Item 8), two precision coaxial cables (Item 4), one coaxial adapter (Item 13), and one SMA to BNC adapter (Item 14).

Time Required: Approximately 3 hours.

Prerequisites: The logic scope must meet the prerequisites listed on page 4–15.

Procedure:

1. *Install the test hookup and preset the instrument controls:*
 - a. Set the output of the DC calibration generator to 0 V.

- b. Connect the output of the DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector. See Figure 4–6.
- c. Connect the Sense output of the generator through a second dual-banana connector followed by a 50 Ω precision coaxial cable to the other side of the BNC T connector. Now connect the BNC T connector to channel 1 through the SMA to BNC adapter and a coaxial adapter. See Figure 4–6.

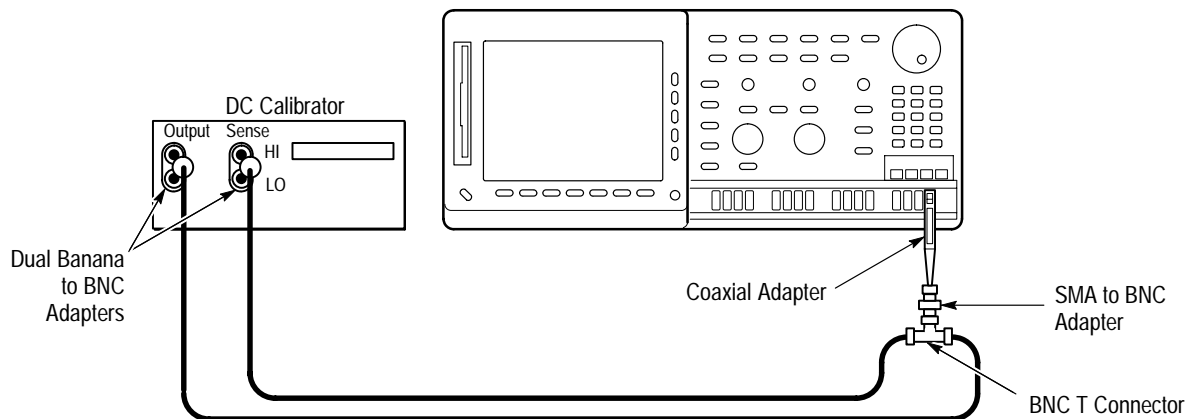


Figure 4–6: Test Hookup for DC Gain and Accuracy Tests

- d. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **OK Confirm Factory Init** (side).
 - e. Set the vertical **SCALE** to 100 mV.
 - f. Press **SHIFT**; then press **ACQUIRE MENU** → **Mode** (main) → **Average 16** (side).
 - g. Press **DISPLAY** → **Graticule** (main) → **Frame** (side).
 - h. Press **CURSOR** → **Function** (main) → **H Bars** (side).
2. *Confirm input channels are within limits for DC gain accuracy:* Do the following substeps — test channel 1 first, then proceed on to the other channels.
 - a. Press **GROUP MENU** → **Vertical Controls** (main) → **Offset** (side). Use the keypad to set offset to 250 mV. (Press **250**, then press **SHIFT m**, and then press **ENTER**.)
 - b. Set the generator output to 0 V.
 - c. Press **CLEAR MENU**. Use the general purpose knob to precisely align the active cursor to the DC baseline level on screen.

- d. Set the generator output to 500 mV.
- e. Press **SELECT**. Use the general purpose knob to precisely align the alternate cursor to the 500 mV DC test level on screen.
- f. Read the measurement results from the delta (Δ :) readout, not the absolute (@:) readout. (See Figure 4–7.) Check that the Δ : readout on screen is between 480 mV and 520 mV

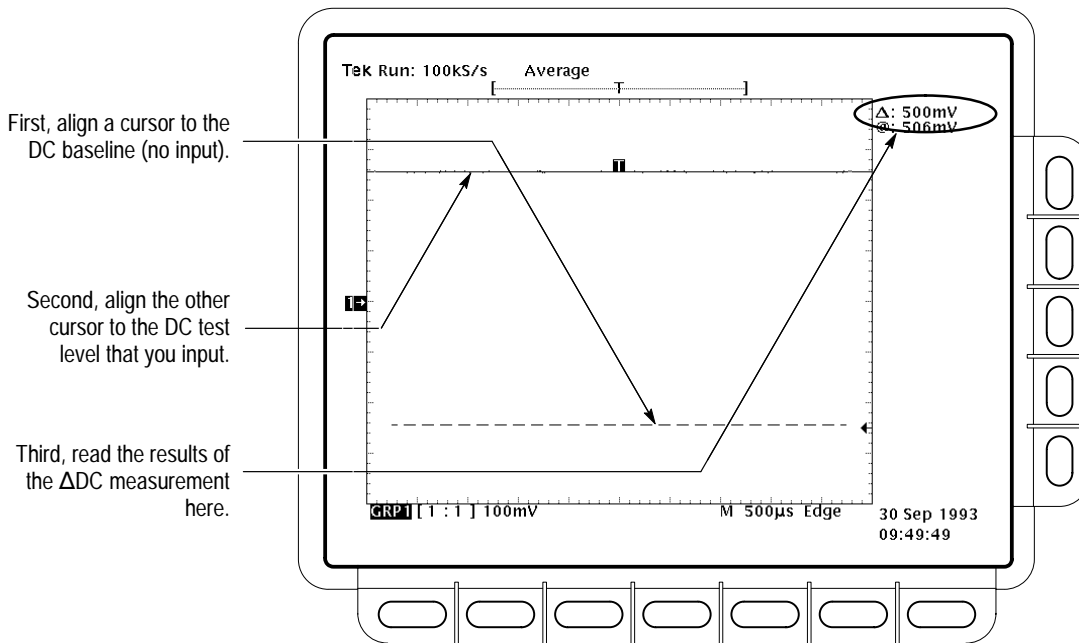


Figure 4–7: Measurement of DC Gain Accuracy

- g. Press **GROUP MENU** → **Group Definition** (main) → **First Channel** (side). Press the side menu button **First Channel** again if necessary to increment to the next channel to be tested.
 - h. Set the generator output to 0 V.
 - i. Move the test hookup to the channel you select.
 - j. Repeat substeps c through i for all 16 channels. (Substeps g through i will not be necessary for channel 16.)
3. *Reestablish the initial test setup:*
- a. Set the generator output to 0 V.
 - b. Move the test hookup back to channel 1.

- c. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **OK Confirm Factory Init** (side).
 - d. Press **SHIFT**; then press **ACQUIRE MENU** → **Mode** (main) → **Average 16** (side).
 - e. Press **DISPLAY** → **Graticule** (main) → **Frame** (side).
4. *Confirm input channels are within limits for DC accuracy:* Do the following substeps — test channel **1** first, then proceed on to the other channels.
- a. Set the vertical **SCALE** to 100 mV.
 - b. Press **GROUP MENU** → **Vertical Controls** (main) → **Offset** (side). Use the keypad to set vertical offset to +2.7 V. The baseline level will move off screen.
 - c. Set the generator to +3 V. The DC test level should appear on screen. (If it doesn't return, the DC accuracy check has failed for the current channel.)
 - d. Press **MEASURE** → **Select Measrmt for Ch x** (main).
 - e. Press the side-menu button **more** until the menu label **Mean** appears in the side menu (its icon is shown at the left). Press the side-menu button **Mean**.
 - f. Press **CLEAR MENU**. Read the measurement results at the **Mean** measurement readout. See Figure 4–8.



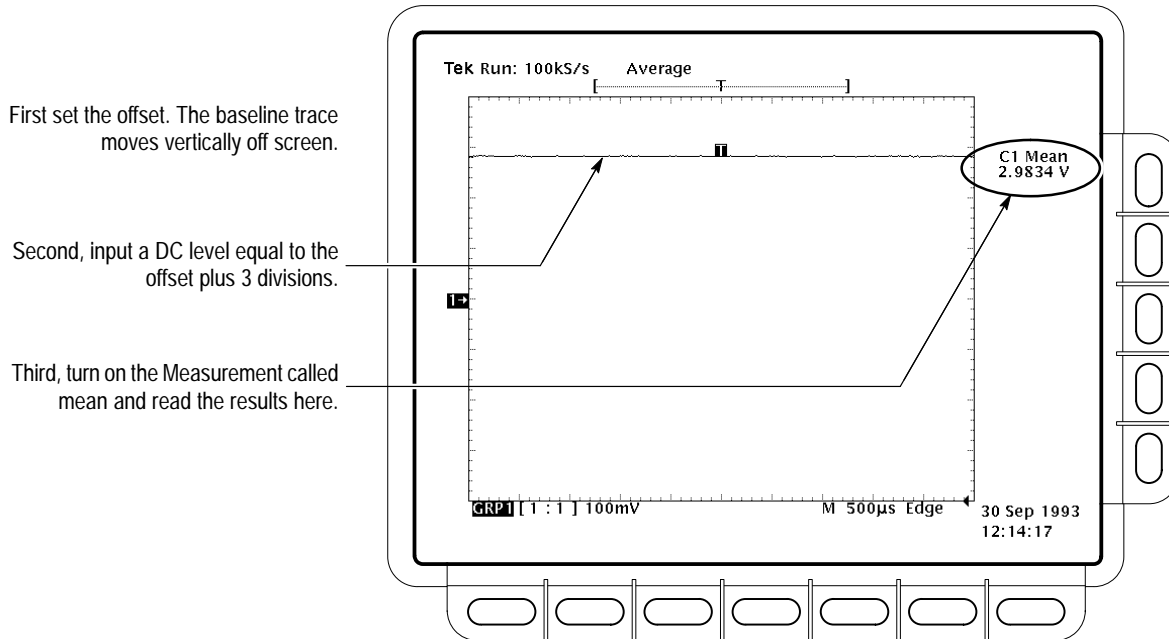


Figure 4-8: Measurement of DC Accuracy

- g. Check that the **Mean** measurement readout is within the limits listed in Table 4-2.

Table 4-2: DC Accuracy

Scale Setting	Offset Setting	Generator Setting	Accuracy Limits
100 mV	+2.7 V	+3 V	+2.898 V to +3.102 V
	-2.7 V	-3 V	-2.898 V to -3.102 V

- h. Press **GROUP MENU** → **Group Definition** (main) → **First Channel** (side). Press the side menu button **First Channel** again if necessary to increment to the next channel to be tested.
- i. Move the test hookup to the selected channel.
- j. Repeat substeps d through i for all 16 channels. (Substeps h and i will not be necessary for channel 16.)
- k. Repeat substeps b and c, reversing the polarity of the offset and generator settings as is listed in Table 4-2.
- l. Move the test hookup back to channel 1.

- m. Press **GROUP MENU** → **Group Definition** (main) → **Last Channel** (side). Use the numeric keypad to set the last channel to **1**.
 - n. Repeat substeps d through i for all 16 channels. (Substeps h and i will not be necessary for channel **16**.)
5. *Disconnect the hookup:*
- a. Set the generator output to 0 V.
 - b. Disconnect the test hookup at the input connector of channel 16.

Check Analog Bandwidth

Equipment Required: One high-frequency leveled sine wave generator and its leveling head (Item 10), one coaxial adapter (Item 13), one SMA to BNC adapter (Item 14).

Time Required: Approximately 1 hour and 25 minutes.

Prerequisites: The logic scope must meet the prerequisites listed on page 4–15.

Procedure:

1. *Install the test hookup and preset the instrument controls:*
 - a. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **OK Confirm Factory Init** (side).
 - b. Set the horizontal **SCALE** to 50 ns.
 - c. Press **MEASURE** → **High-Low Setup** (main) → **Min-Max** (side).
 - d. Connect, through its leveling head, an SMA to BNC adapter, and a coaxial adapter, the sine wave output of a high-frequency leveled sine wave generator to channel **1**. Set the output of the generator to a reference frequency of 6 MHz. See Figure 4–9.

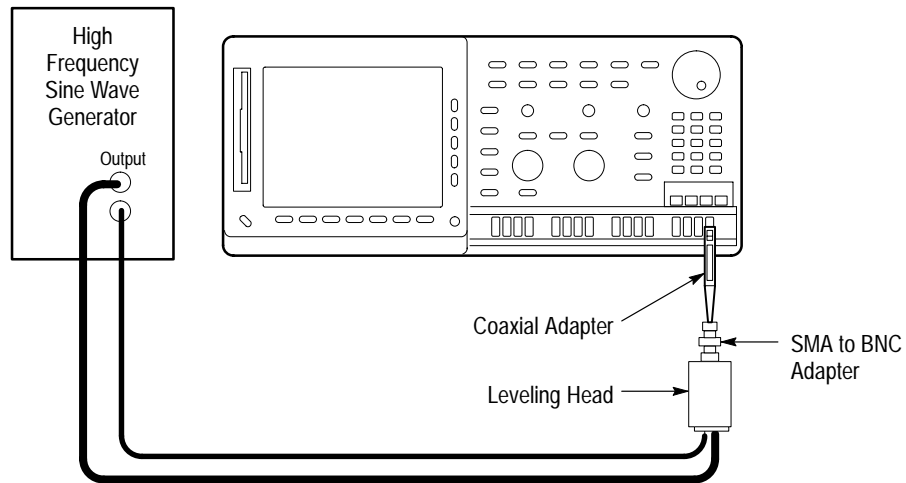


Figure 4-9: Test Hookup for Analog Bandwidth Test

2. *Confirm the input channels are within limits for analog bandwidth:* Do the following substeps — test channel **1** first, then proceed on to the other channels.
 - a. Set the vertical **SCALE** to 200 mV.
 - b. Press **TRIGGER MENU** → **Source** (main) → **Channel** (side). Use the keypad to specify the selected channel as the trigger source.
 - c. Press **MEASURE** → **Select Measrmnt for Ch x** (main).
 - d. Press the side-menu button **more** until the menu label **Pk-Pk** appears in the side menu (its icon is shown at the left). Press the side-menu button **Pk-Pk**.
 - e. Repeatedly press the side-menu button **more** until **Frequency** appears in the side menu (its icon is shown at the left). Press the side-menu button **Frequency**.
 - f. Press **CLEAR MENU**.
 - g. Set the generator output so the **C1 Pk-Pk** readout equals 1.2 V. Press **SET LEVEL TO 50%** as necessary to trigger a stable display and ensure an accurate setting.
 - h. Set the frequency of the generator, as shown on screen, to approximately 500 MHz.
 - i. Set the horizontal **SCALE** to 1 ns. If necessary, adjust the generator until the output frequency is 500 MHz. Press **SHIFT**; then press **ACQUIRE MENU** → **Mode** (main) → **Average 16** (side).



- j. Read the results at the **C1 Pk-Pk** readout, which will automatically measure the amplitude of the test signal. See Figure 4-10.

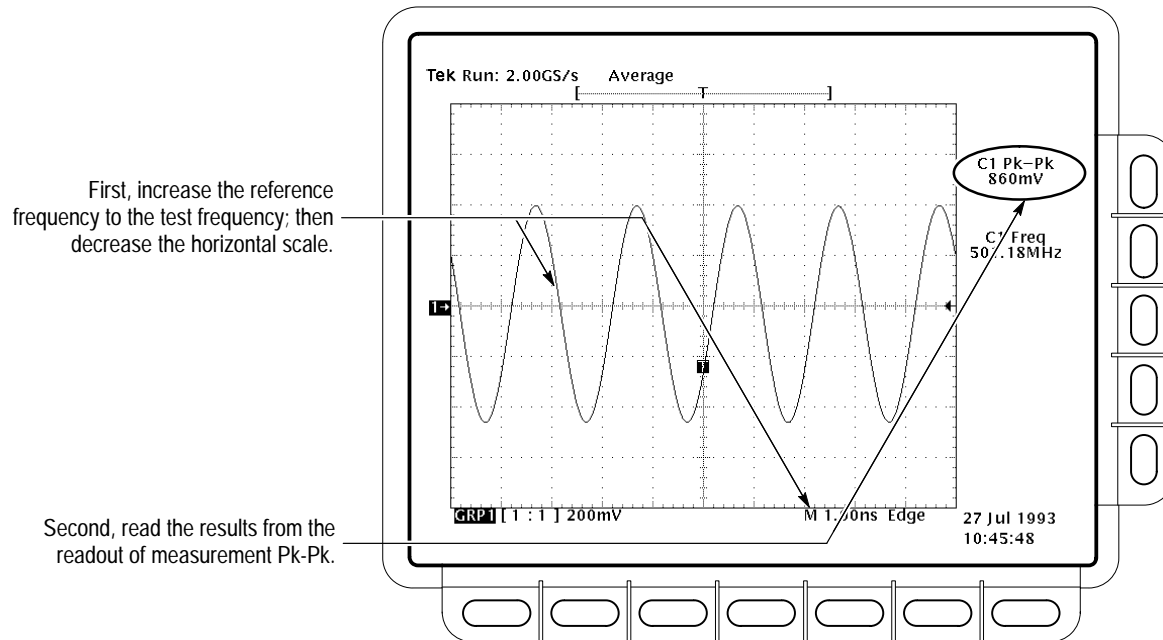


Figure 4-10: Measurement of Analog Bandwidth

- k. Press the side menu button **Sample**. Check that the **Pk-Pk** readout on screen is ≥ 848 mV.
- l. Set the horizontal **SCALE** back to the 50 ns.
- m. Press **GROUP MENU** → **Group Definition** (main) → **First Channel** (side). Press the side menu button **First Channel** again if necessary to increment to the next channel to be tested.
- n. Set the generator output to a reference frequency of 6 MHz.
- o. Move the test hookup to the selected channel.
- p. Repeat substeps b through o for all 16 channels. (Substeps l through o will not be necessary for channel **16**.)
3. *Disconnect the hookup*: Disconnect the test hookup at the input connector of channel **16**.

Check Delay Between Channels

Equipment Required: One medium-frequency leveled sine wave generator (Item 9), one precision coaxial cable (Item 4), one 50 Ω terminator (Item 3), one dual-input coupler (Item 7), two coaxial adapters (Item 13), and two SMA to BNC adapters (Item 14).

Time Required: Approximately 1 hour.

Prerequisites: The logic scope must meet the prerequisites listed on page 4–15.

STOP. DO NOT use the vertical position knob to reposition any channel while doing this check. To do so invalidates the test.

Procedure:

1. *Install the test hookup and preset the instrument controls:*
 - a. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **OK Confirm Factory Init** (side).
 - b. Set the horizontal **SCALE** to 500 ps.
 - c. Press **SHIFT**; then press **ACQUIRE MENU** → **Mode** (main) → **Average 16** (side).
 - d. Press **GROUP 2**.
 - e. Connect, through a 50 Ω precision coaxial cable followed by a 50 Ω termination, the output of a medium-frequency sine wave generator to a dual-input coupler. See Figure 4–11.
 - f. Connect the coupler to channels **1** and **2** through two coaxial adapters and two SMA to BNC adapters. See Figure 4–11.
2. *Confirm all channels are within limits for channel delay:*
 - a. Set the generator frequency to 250 MHz and the amplitude for about two divisions in channel **1**.
 - b. Locate the point on the rising edge of the left-most waveform where it crosses the center horizontal graticule line. This is the *time reference point* for this waveform. Note the corresponding *time reference point* for the right-most waveform. See Figure 4–12.
 - c. Press **CURSOR** → **Function** (main) → **V Bars** (side).
 - d. Press **CLEAR MENU**.

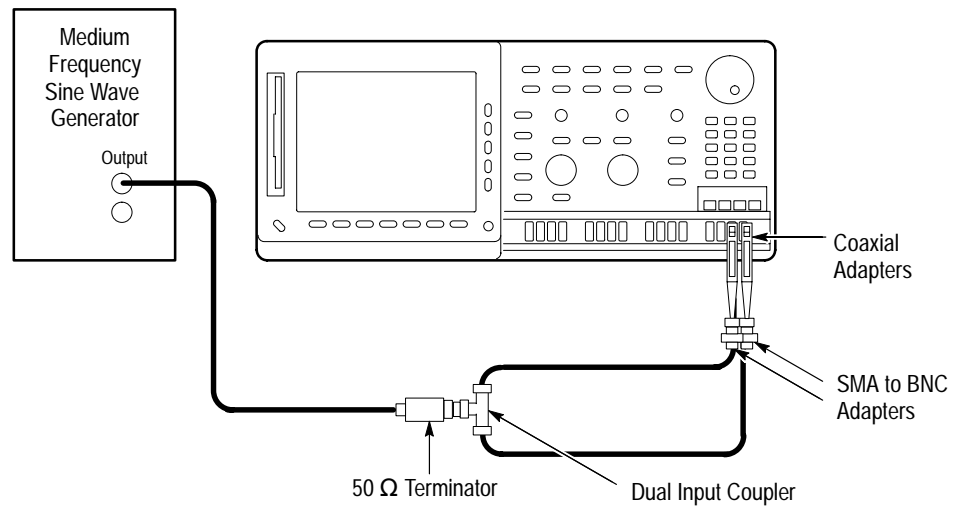


Figure 4-11: Test Hookup for Channel Delay Test

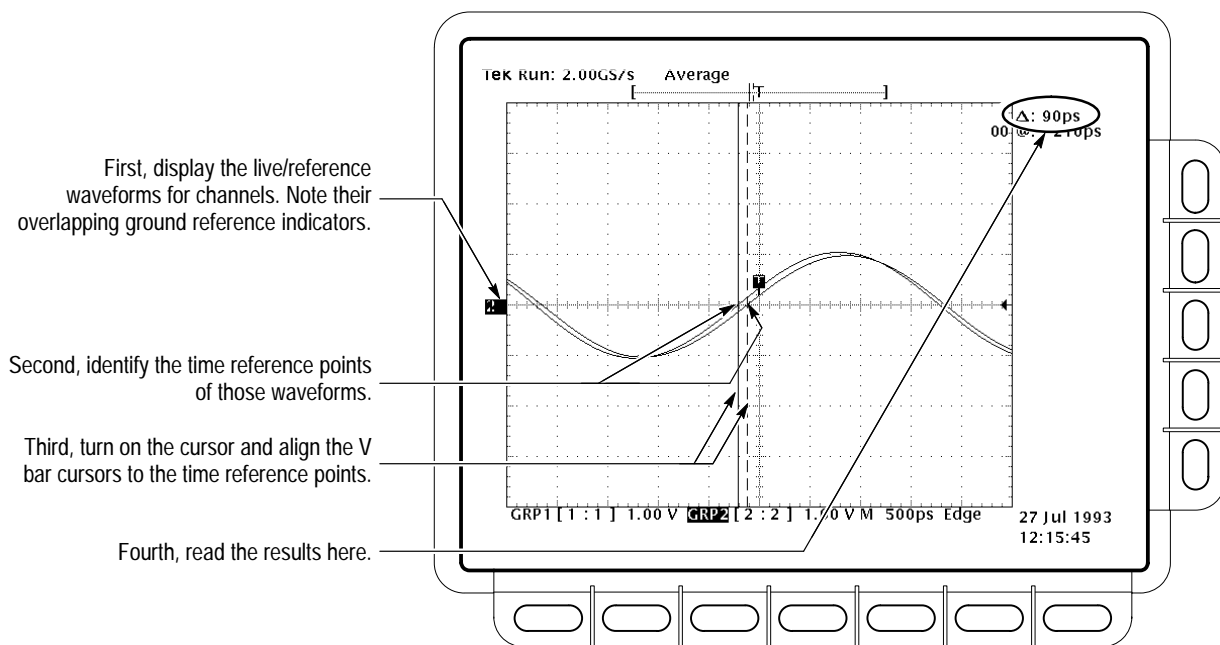


Figure 4-12: Measurement of Channel Delay

- e. Rotate the General Purpose knob to align one cursor to the *time reference point* of the left-most waveform edge and the other cursor to the *time reference point* of the right-most waveform edge. (Press **SELECT** to switch between the two cursors.) See Figure 4-12.

- f. Read the measurement results at the **Δ**: cursor readout, not the **@**: readout on screen.
 - g. Check that the cursor readout on screen is ≤ 200 ps.
 - h. Leaving one half of the test hookup installed on channel **1**, move the other half to the next channel in sequence (for example, from channel **2** to channel **3**).
 - i. Press **GROUP MENU** → **Group Definition** (main) → **First Channel** (side) to increment First Channel to next channel to be checked. Press the side menu button **First Channel** again if necessary to increment the first channel.
 - j. Repeat substeps c through i until you have checked all 16 channels (substeps h and i will not be necessary for channel **16**).
3. *Disconnect the hookup*: Disconnect the hookup at the input connectors of channels **1** and **16**.

Time Base System Check

This procedure checks (either directly or indirectly) those characteristics that relate to the Main and Delayed time base system and are listed as checked under *Warranted Characteristics* in the *Specifications* section.

Check Accuracy for Long-Term Sample Rate, Delay Time, and Delta Time Measurements

Equipment Required: One time-mark generator (Item 11), one 50 Ω precision coaxial cable (Item 4), one coaxial adapter (Item 13), and one SMA to BNC adapter (Item 14).

Time Required: Approximately 40 minutes.

Prerequisites: The logic scope must meet the prerequisites listed on page 4–15.

Procedure:

1. *Install the test hookup and preset the instrument controls:*
 - a. Connect, through a 50 Ω precision coaxial cable, a coaxial adapter, and an SMA to BNC adapter, the time-mark output of a time-mark generator to channel **1**. Set the output of the generator for 10 ms markers. See Figure 4–13.

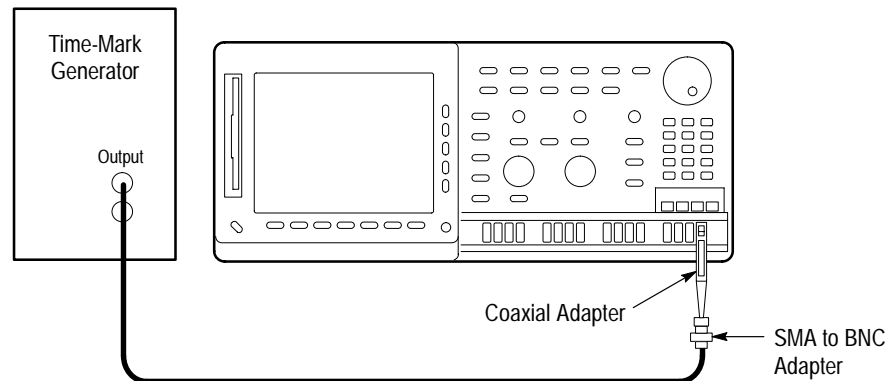


Figure 4-13: Test Hookup for Time Base System Check

- b. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **OK Confirm Factory Init** (side).
 - c. Set the vertical **SCALE** to 500 mV.
 - d. Press **SET LEVEL TO 50%**.
 - e. Use the vertical **POSITION** knob to center the test signal on screen.
 - f. Press **TRIGGER MENU** → **Mode & Holdoff** (main) → **Normal** (side).
 - g. Press **HORIZONTAL MENU** → **Record Length** (main) → **1000 Points in 20divs** (main).
 - h. Press the main-menu button **Trigger Position**. Press the side-menu button **Set to 20%**.
 - i. Press **SHIFT**; then press **ACQUIRE MENU**. Press the main-menu button **Mode**; then press the side-menu button **Average 16**.
 - j. Press **MEASURE** → **High-Low Setup** (main) → **Min-Max** (side).
2. *Confirm Main and Delayed time bases are within limits for accuracies:*
 - a. Set the horizontal **SCALE** of the Main time base to 1 ms. Press **SET LEVEL TO 50%** as necessary to trigger the signal.
 - b. Adjust the horizontal **POSITION** so the trigger **T** is aligned to the center vertical graticule line.
 - c. Press **HORIZONTAL MENU** → **Time Base** (main) → **Delayed Only** (side) → **Delayed Runs After Main** (side).
 - d. Set the horizontal **SCALE** of the **D** (delayed) time base to 250 ns.

- e. Use the keypad to set delayed time to 10 ms. (Press **10**, then **SHIFT**, then **m** followed by **ENTER**.) Press **SET LEVEL TO 50%** as necessary to trigger the signal.
- f. Check that the rising edge of the marker crosses the center horizontal graticule line at a point within ± 4.0 divisions of center graticule (see Figure 4–14).

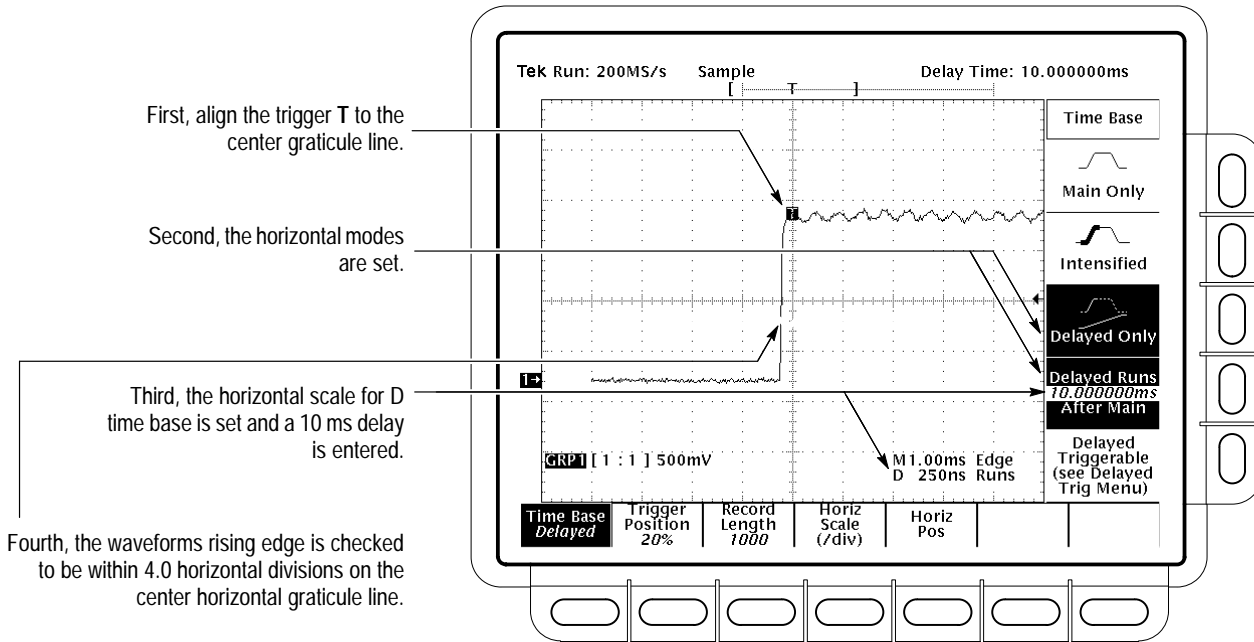


Figure 4–14: Measurement of Accuracy — Long-Term and Delay Time

- g. Press the side-menu button **Main Only**. Set the horizontal **SCALE** to 2.5 ns.
- h. Set the output of the generator for 20 ns markers.
- i. Press **SET LEVEL TO 50%**.
- j. Press **MEASURE** → **Select Measrmnt for Ch x**. Press the side-menu button **–more–**, until **Period** appears in the side menu. Press **Period**.
- k. Press **CLEAR MENU**.
- l. Check that the readout for **C1 Per** is within 19.760 ns to 20.240 ns.
- m. Move the test hookup to the first channel in the next bank (**5, 9, or 13**).

- n. Press **GROUP MENU** → **Group Definition** (main). Press the side menu button **First Channel** four times. (The channel with the test hookup connected should become the first channel.)
 - o. Press **TRIGGER MENU** → **Source** (main) → **Channel** (side). Use the numeric keypad to set the trigger source to the selected channel.
 - p. Set the generator output back to 10 ms markers.
 - q. Press **HORIZONTAL MENU**.
 - r. Repeat substeps a through q until you have checked channels **1, 5, 9,** and **13.** (Substeps m through q will be unnecessary for channel **13.**)
3. *Disconnect the hookup:* Disconnect the test hookup at the input connector of channel **13.**

Trigger System Checks

These procedures check (either directly or indirectly) those characteristics that relate to the Main and Delayed trigger systems and are listed as checked under *Warranted Characteristics* in the *Specifications* section.

Check Accuracy for Logic Triggering

Equipment Required: One medium-frequency leveled sine wave generator (Item 9), one 10X attenuator (Item 1), one precision coaxial cable (Item 4), one coaxial adapter (Item 13), and one SMA to BNC adapter (Item 14).

Time Required: Approximately 1 hour and 35 minutes.

Prerequisites: See page 4–15.

Procedure:

1. *Install the test hookup and preset the instrument controls:*
 - a. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **OK Confirm Factory Init** (side).
 - b. Set the horizontal **SCALE** to 10 ns.
 - c. Set the vertical **SCALE** to 100 mV.
 - d. Connect the output of a medium-frequency leveled sine wave generator to channel **1** through a 50 Ω precision coaxial cable, a 10X attenuator, an SMA to BNC adapter, and a coaxial adapter. See Figure 4–15.

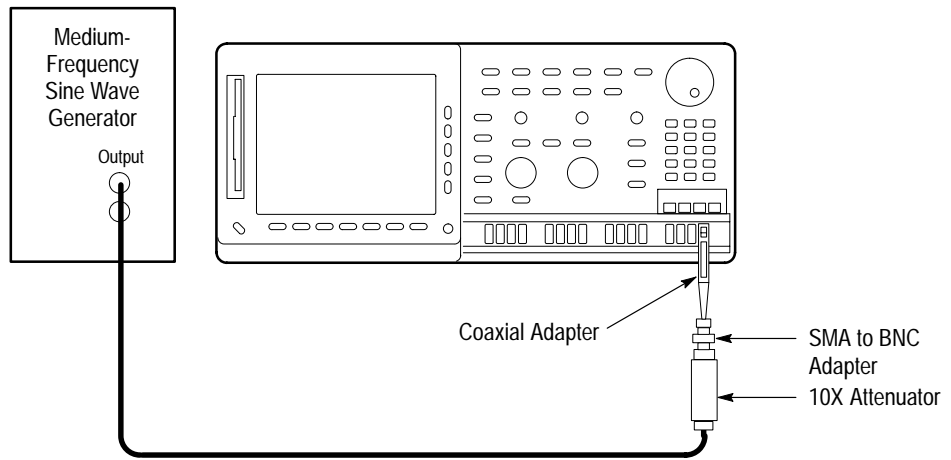


Figure 4-15: Test Hookup for Logic Trigger Check

- e. Press **MEASURE** → **Select Measurement for Ch x** (main).
 - f. Repeatedly press the side-menu button **–more–** until **Frequency** appears in the side menu. Press **Frequency**.
 - g. Press **High-Low Setup** (main) → **Min-Max** (side).
2. *Confirm the trigger system is within time-accuracy limits for main, nonsequence logic triggering:*
- a. Set the output of the sine wave generator for a 84.7 MHz, four-division sine wave on screen. Press **SET LEVEL TO 50%**.
 - b. Press **TRIGGER MENU** → **Mode & Holdoff** (main) → **Normal** (side).
 - c. Press **Type: Pulse** (pop-up) → **Trig When** (main).
 - d. Press the side menu button **Width**. See Table 4-3. Use the numeric keypad to enter the width dictated by the current time base setting. (Use the number in the “Upper Limit or Width Setting” column).

Table 4-3: Settings For Logic Trigger Accuracy Checks

Time Base Setting	Upper Limit or Width Setting	Initial Generator Setting	Low Frequency Limit
10 ns	8 ns	84.7 MHz	56.2 MHz
250 ns	200 ns	3.13 MHz	2.27 MHz
2.5 μs	2 μs	263 kHz	244 kHz

- e. Slowly decrease the output frequency until the **TRIG'D** LED on the front panel turns off. The **READY** LED should be lit.
 - f. Check that the **C1 Freq** readout is greater than the “Low Frequency Limit” listed in Table 4–3.
 - g. Set the generator output frequency to the next “Initial Generator Setting” listed in Table 4–3. Set the time base accordingly.
 - h. Repeat substeps d through g until you have checked all the time base settings listed in Table 4–3.
 - i. Set the generator output frequency back to 84.7 MHz; set the horizontal **SCALE** to 10 ns.
 - j. Press the main menu button **Class**. Press it again to select pulse-width triggering.
 - k. Press the side-menu button **Upper Limit**. Use the numeric keypad to enter the upper limit dictated by the current time base setting. (See Table 4–3).
 - l. Slowly decrease the output frequency until the signal becomes untriggered (the **TRIG'D** LED turns off).
 - m. Check that the **C1 Freq** readout is greater than the “Low Frequency Limit” listed in Table 4–3.
 - n. Set the generator output frequency to the next “Initial Generator Setting” listed in Table 4–3. Set the time base accordingly.
 - o. Repeat substeps k through n until you have checked all the time base settings listed in Table 4–3.
 - p. Press the side menu button **Upper Limit**; use the numeric keypad to set the upper limit to 3 μ s. Press **Class: Glitch** (pop-up) \rightarrow **Width** (side); use the numeric keypad to set the width to 3 μ s.
3. *Confirm the trigger system is within time-accuracy limits for delayed, nonsequence logic triggering:*
 - a. Set the output of the sine wave generator to 84.7 MHz.
 - b. Press **HORIZONTAL MENU** \rightarrow **Time Base** (main) \rightarrow **Delayed Only** (side); press the side menu button **Delayed Triggerable**.
 - c. Set the horizontal **SCALE** of the delayed time base to 10 ns
 - d. Press **SHIFT – DELAYED TRIG**.

- e. Repeat steps 2c through 2o. When performing step 2e, ignore the front-panel LEDs. Instead decrease the output frequency until the word **D TRIG?** appears at the top center of the screen.
4. *Confirm the trigger system is within time-accuracy limits for main and delayed sequence triggering:*
 - a. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **OK Confirm Factory Init** (side).
 - b. Press **TRIGGER MENU** → **Mode & Holdoff** (main) → **Normal** (side).
 - c. Press **MEASURE** → **Select Measurement for Ch x** (main).
 - d. Repeatedly press the side-menu button **–more–** until **Frequency** appears in the side menu. Press **Frequency**.
 - e. Set the output of the sine wave generator to 3.13 MHz; set the horizontal **SCALE** to 250 ns.
 - f. Set the vertical **SCALE** to 100 mV.
 - g. Press **TRIGGER MENU** → **Type: Sequence** (pop-up).
 - h. Press the main menu button **Define End Pattern**, then press the side menu button **Ch Index**. Use the numeric keypad to set the channel index to 2.
 - i. Press the side menu button **Set to Don't Care**; then press the side menu button **Set to Low**.
 - j. Press the main menu button **Sequence Trig When**; then press the side menu button **Time**. Use the numeric keypad to set the time to 200 ns.
 - k. Press the side menu button **< Time**.
 - l. Slowly decrease the generator output frequency until the signal becomes untriggered (the **TRIG'D** LED turns off).
 - m. Check that the **C1 Freq** readout is greater than 2.27 MHz.
 - n. Press the side menu button **Time**; set the time to 1 μ s. Press **HORIZONTAL MENU** → **Time Base** (main) → **Delayed Only** (side); press the side menu button **Delayed Triggerable**.
 - o. Press **SHIFT – DELAYED TRIG**.
 - p. Repeat substeps e through m for the delayed trigger.
 5. *Disconnect the hookup:* Disconnect the cable from the generator output at the input connector of channel **1**.

Check Accuracy, Trigger Threshold

Equipment Required: One DC calibration generator (Item 8), one BNC T connector (Item 6), two precision coaxial cables (Item 4), one coaxial adapter (Item 13), one SMA to BNC adapter (Item 14), and two dual banana connectors (Item 5).

Time Required: Approximately 5 minutes.

Prerequisites: The logic scope must meet the prerequisites listed on page 4–15. It must also pass the *Signal Acquisition System Checks* beginning on page 4–25.

Procedure:

1. *Install the test hookup and preset the instrument controls:*
 - a. Set the output of the DC calibration generator to 0 volts.
 - b. Connect the output of the DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector. (See Figure 4–16)

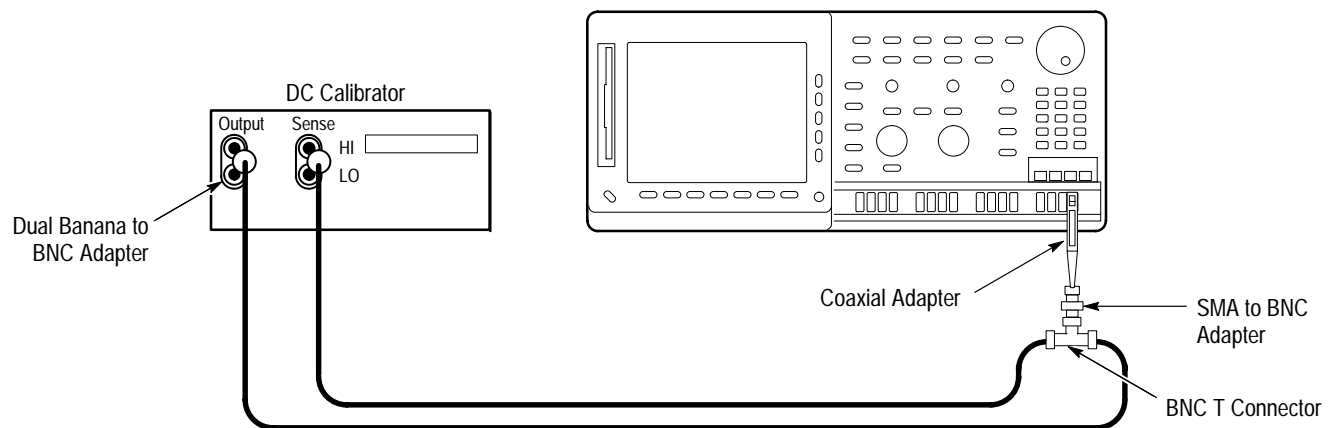


Figure 4–16: Test Hookup for Trigger Threshold Check

- c. Connect the Sense output of the generator, through a second dual-banana connector followed by a 50 Ω precision coaxial cable, to the other side of the BNC T connector.
- d. Connect the BNC T connector to channel **1** through a coaxial adapter and an SMA to BNC adapter.
- e. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **OK Confirm Factory Init** (side).

2. *Confirm Main trigger system is within limits for trigger threshold accuracy:*
 - a. Press **GROUP MENU** → **Vertical Controls** (main) → **Vertical Position** (side). Use the keypad to set vertical position to -3 divisions. The baseline level will move down three divisions.
 - b. Press the side menu button **Offset**. Use the keypad to set vertical offset to +3 volts. The baseline level will move off screen.
 - c. Set the standard output of the DC calibration generator to +3 volts. The DC test level will appear on screen.
 - d. Press **SET LEVEL TO 50%**.
 - e. Press **TRIGGER MENU**.
 - f. Check that the **Threshold** readout in the main menu is between 2.54 V and 3.46 V. See Figure 4-17.

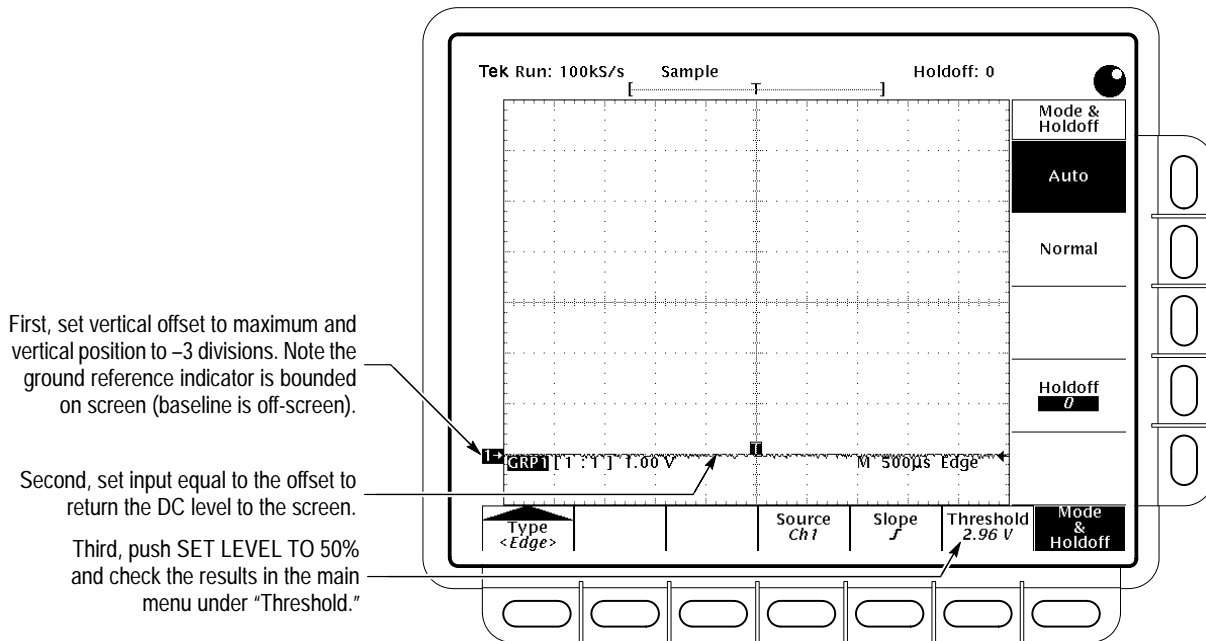


Figure 4-17: Measurement of Trigger-Level Accuracy



- g. Press the main-menu button **Slope**; then press the side-menu button for negative slope. (See icon at left.)
 - h. Press **SET LEVEL TO 50%**.
 - i. Check that the **Threshold** readout in the main menu is between 2.54 V to 3.46 V.
3. *Disconnect the hookup:*
 - a. Set the output of the DC calibration generator to 0 volts.
 - b. Disconnect the cable from the generator output at the input connector of channel 1.

Sensitivity, Edge Trigger

Equipment Required: One medium-frequency leveled sine wave generator (Item 9), one high-frequency leveled sine wave generator (Item 10), two precision 50 Ω coaxial cables (Item 4), one 10X attenuator (Item 1), one BNC T connector (Item 6), one 2X attenuator (Item 2), one coaxial adapter (Item 13), and one SMA to BNC adapter (Item 14).

Time Required: Approximately 3 hours and 15 minutes.

Prerequisites: The logic scope must meet the prerequisites listed on page 4-15. It must also pass the *Signal Acquisition System Checks* beginning on page 4-25.

Procedure:

1. *Install the test hookup and preset the instrument controls:*
 - a. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **OK Confirm Factory Init** (side).
 - b. Set the horizontal **SCALE** for the **M** (main) time base to 25 ns.
 - c. Set the vertical **SCALE** to 200 mV.
 - d. Press **TRIGGER MENU** → **Mode & Holdoff** (main) → **Normal** (side).
 - e. Press **SHIFT**; then press **ACQUIRE MENU** → **Mode** (main) → **Average 16** (side).
 - f. Press **MEASURE** → **High-Low Setup** (main) → **Min-Max** (side).
 - g. Connect the signal output of a medium-frequency sine wave generator to channel 1 through a 50 Ω coaxial cable, a coaxial adapter, and an SMA to BNC adapter. See Figure 4–18.

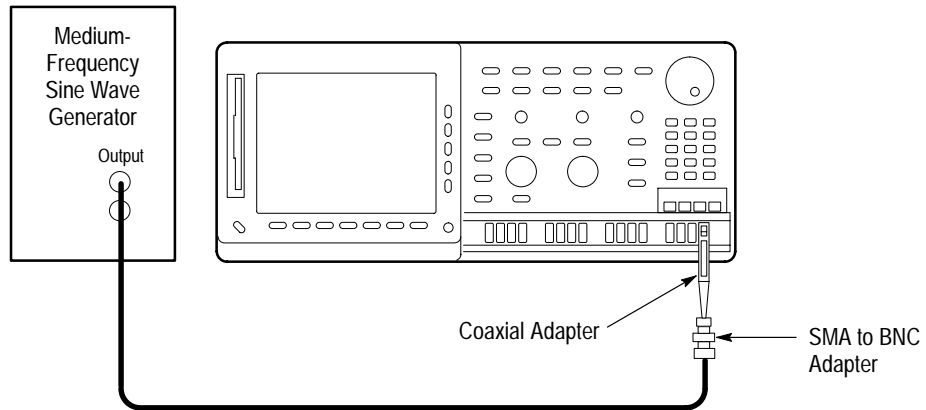


Figure 4-18: Test Hookup for Main Edge Trigger Sensitivity Checks

2. *Confirm Main trigger system is within sensitivity limits (50 MHz):*
 - a. Set the generator frequency to 50 MHz.
 - b. Press **MEASURE** → **Select Measrmnt for Ch x**.
 - c. Press the side-menu button **–more–** until **Amplitude** appears in the side menu (its icon is shown at the left). Press the side-menu button **Amplitude**.
 - d. Press **SET LEVEL TO 50%**.



- e. Press **CLEAR MENU**.
- f. Adjust the generator output until the **C1 Amplitude** readout indicates the amplitude is 1.000 V. (Readout may fluctuate around 1.000 V.)
- g. Disconnect the precision 50 Ω coaxial cable from the SMA to BNC adapter and reconnect it through a 10X attenuator.
- h. Press **TRIGGER MENU** → **Slope** (main).
- i. Press **SET LEVEL TO 50%**. Check that the instrument obtains a stable trigger for the test waveform on both the positive and negative slopes. See Figure 4–19. (Use the side menu to switch between trigger slopes; use the **THRESHOLD** knob to stabilize the trigger if required.)
- j. Disconnect the test hookup, remove the 10X attenuator, and reconnect it to the next channel in numeric sequence.
- k. Press **GROUP MENU** → **Group Definition** (main) → **First Channel** (side). Press the side menu button **First Channel** again if necessary to increment the first (and selected) channel.
- l. Press **TRIGGER MENU** → **Source** (main) → **Channel** (side). Use the numeric keypad to enter the next channel in sequence.
- m. Repeat substeps b through l for all sixteen channels. (Substeps j through l will be unnecessary for channel **16**.)
- n. Leave the Main trigger system triggered on the positive slope of the waveform before continuing to the next step.

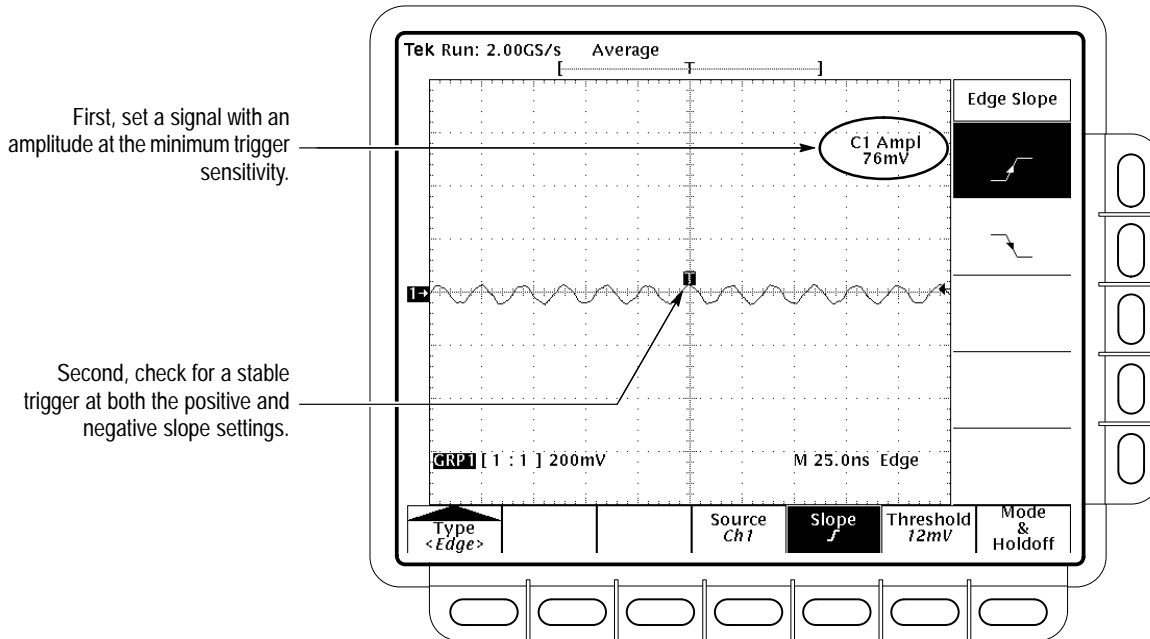


Figure 4-19: Measurement of Trigger Sensitivity

3. *Confirm the AUX Trigger input:*

- a. Remove the 10X attenuator from the hookup. Connect a BNC-T connector to the **AUX TRIGGER** input on the rear panel. Connect one side of the T connector to the generator through a 50 Ω coaxial cable; connect the other side of the T connector to channel 1 through a 50 Ω coaxial cable, an SMA to BNC adapter, and a coaxial adapter. See Figure 4-20.

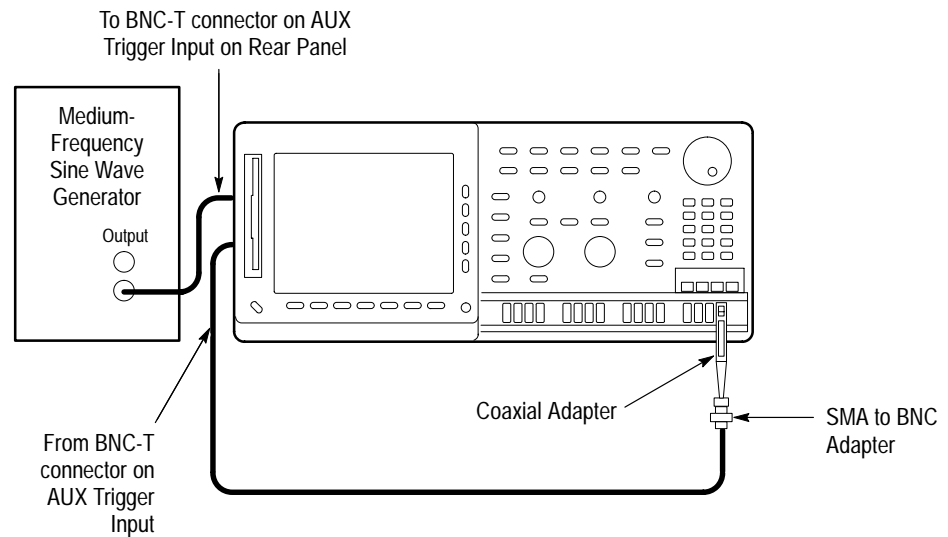


Figure 4–20: Test Hookup for AUX TRIGGER Input Sensitivity Check

- b. Press **GROUP MENU** → **Group Definition** (main) → **First Channel** (side). Use the numeric keypad to set the first channel to **1**.
- c. Press **GROUP MENU** → **Group Definition** (main) → **Last Channel** (side). Use the numeric keypad to set the last channel to **1**.
- d. Set the vertical **SCALE** to 1 V.
- e. Press **TRIGGER MENU** → **Source** (main) → **Channel** (side). Use the numeric keypad to set the channel index to **1**. Press **SET LEVEL TO 50%**.
- f. Press **MEASURE** → **Select Measrmnt for Ch x** (main).
- g. Press the side-menu button **–more–** until **Amplitude** appears in the side menu (its icon is shown at the left). Press the side-menu button **Amplitude**.
- h. Set the generator frequency to 25 MHz; adjust the generator output until the **C1 Amplitude** readout indicates the amplitude is 4 V. (Readout may fluctuate around 4 V.)
- i. Press **TRIGGER MENU** → **Source** (main) → **Auxiliary** (side).
- j. Press **SET LEVEL TO 50%**. Check that the instrument obtains a stable trigger for the test waveform on both the positive and negative slopes. Press the main-menu button **Slope**; then use the side menu to switch between trigger slopes. Use the general purpose knob to stabilize the trigger if required.



- k. Leave the Main trigger system triggered on the positive slope of the waveform.
 - l. Press the main-menu button **Source**; then press the side-menu button **CH 1**.
4. *Confirm that the Main trigger system is within sensitivity limits (500 MHz):*
- a. Disconnect the hookup. Connect, through its leveling head, a coaxial adapter, and an SMA to BNC adapter, the signal output of a high-frequency leveled sine wave generator to channel **1**.
 - b. Set the horizontal **SCALE** to 500 ps for the **M** (Main) time base.
 - c. Set the vertical **SCALE** to 200 mV.
 - d. Set the generator frequency to 500 MHz; press **SET LEVEL TO 50%**.
 - e. Set the test signal amplitude for about six divisions on screen. Now fine adjust the generator output until the **C1 Amplitude** readout indicates the amplitude is 1.2 V. (Readout may fluctuate around 1.2 V.)
 - f. Disconnect the high frequency sine wave generator from the SMA to BNC adapter and reconnect it through a 2X attenuator.
 - g. Press **TRIGGER MENU** → **Slope** (main).
 - h. Check that the instrument obtains a stable trigger for the test waveform on both the positive and negative slopes. (Use the side menu to switch between trigger slopes; use the **THRESHOLD** knob to stabilize the trigger if required.)
 - i. Disconnect the test hookup and move it to the next channel in numeric sequence.
 - j. Press **GROUP MENU** → **Group Definition** (main) → **First Channel** (side). Press the side menu button **First Channel** again if necessary to increment to the next channel to be tested.
 - k. Press **TRIGGER MENU** → **Source** (main) → **Channel** (side). Use the numeric keypad to enter the next channel in sequence.
 - l. Press **MEASURE** → **Select Measrmt for Ch x**.
 - m. Press the side-menu button **–more–** until **Amplitude** appears in the side menu (its icon is shown at the left). Press the side-menu button **Amplitude**.
 - n. Repeat substeps g through m for all sixteen channels. (Substeps i through m will be unnecessary for channel **16**.)
5. Disconnect the test hookup at the channel **16** input.



Output Signal Checks

These procedures check those characteristics of the output signals that are listed as checked under *Warranted Characteristics* in the *Specifications* section.

Check Outputs — Probe Compensator

Equipment Required: One P6240 probe.

Time Required: Approximately 5 minutes.

Prerequisites: The logic scope must meet the prerequisites listed on page 4–15. It must also pass the *Signal Acquisition System Checks* beginning on page 4–25.

STOP. *If your logic scope was ordered configured as Option 1S, it was shipped without the 16 probes included with the standard configured logic scope. You must have one probe to check the probe compensator output and may wish skip this test. Read the information under Option 1S on page 4–1 before continuing.*

Procedure:

1. Install the test hookup and preset the logic scope controls:
 - a. Install one probe on channel 1. Connect the probe tip to a **PROBE CALIBRATION** signal output on the front panel. (See Figure 4–21.)

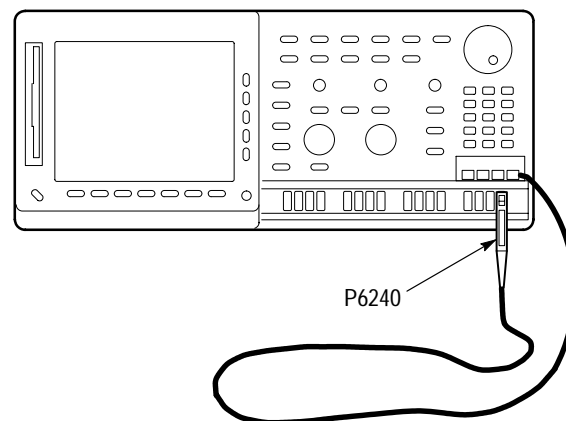


Figure 4–21: Test Hookup for Probe Compensator Check

- b. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **Ok Confirm Factory Init** (side).
- c. Set the vertical **SCALE** to 200 mV.

- d. Press **SHIFT**; then press **ACQUIRE MENU** → **Mode** (main) → **Average** (side). Use the keypad to set the number of averages to 64.
2. *Confirm Probe Compensator output voltage is within limits:*
 - a. Press **MEASURE** → **Select Measurement for Ch x** (main).
 - b. Repeatedly press the side-menu button **–more–** until **Pk–Pk** appears in the side menu. Press **Pk–Pk**.
 - c. Repeatedly press the side-menu button **–more–** until **Frequency** appears in the side menu. Press **Frequency**. (See Figure 4–22.)

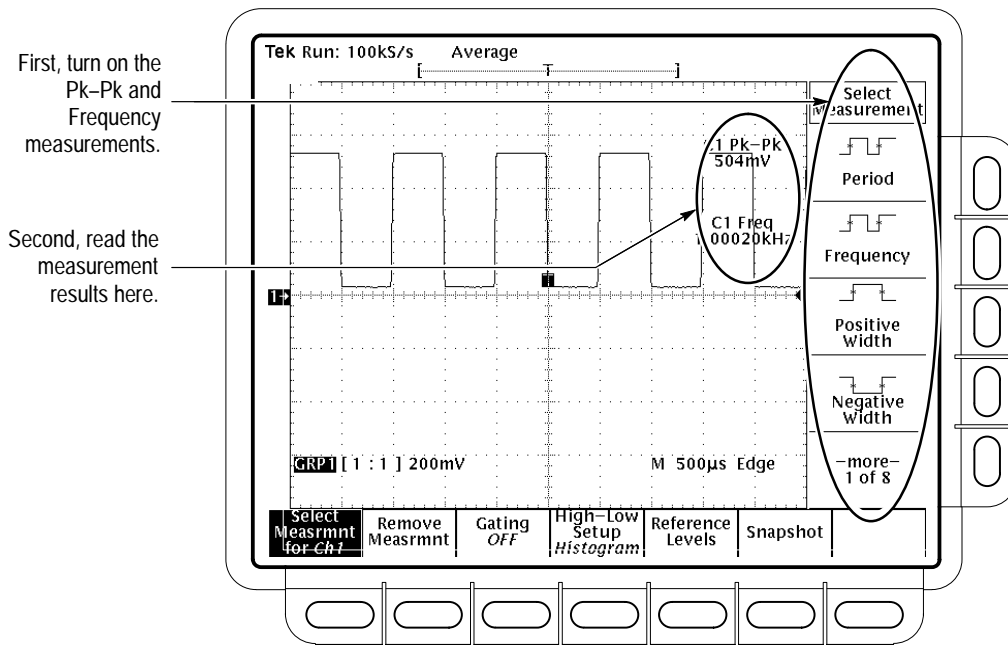


Figure 4–22: Measurement of Probe Compensator Limits

- d. Check that the **C1 Pk–Pk** readout is between 490 and 510 mV.
 - e. Check that the **C1 Freq** readout is between 950 and 1050 Hz.
3. Disconnect the probe from the channel **1** input.

Check Outputs — Main and Delayed Trigger

Equipment Required: One precision coaxial cable (Item 4), one coaxial adapter (Item 13), one SMA to BNC adapter (Item 14).

Time Required: Approximately 10 minutes.

Prerequisites: The logic scope must meet the prerequisites listed on page 4–15. It must also pass the *Signal Acquisition System Checks* beginning on page 4–25.

Procedure:

1. *Install the test hookup and preset the instrument controls:*
 - a. Connect the **MAIN TRIGGER OUTPUT** at the rear panel to channel 1 through a 50 Ω precision cable, a coaxial adapter, and an SMA to BNC adapter (see Figure 4–23).

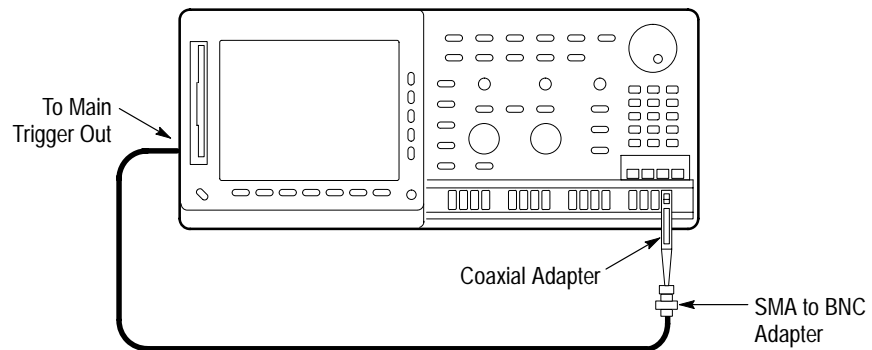
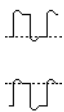


Figure 4–23: Test Hookup for Main Trigger Output Check

- b. Press save/recall **SETUP** → **Recall Factory Setup** (main) → **OK Confirm Factory Init** (side).
 - c. Set the horizontal **SCALE** to 250 μ s.
 - d. Press **SHIFT**; then press **ACQUIRE MENU** → **Mode** (main) → **Average** (side). Use the keypad to set the number of averages to 64.
2. *Confirm Main and Delayed Trigger outputs are within limits for logic levels:*
 - a. Use the vertical **POSITION** knob to center the display on screen.
 - b. Press **MEASURE** → **Select Measurement for Ch 1** (main).
 - c. Repeatedly press the side-menu button **–more–** until **High** and **Low** appear in the side menu (their icons are shown at the left). Press both side-menu buttons **High** and **Low**. (See Figure 4–24.)



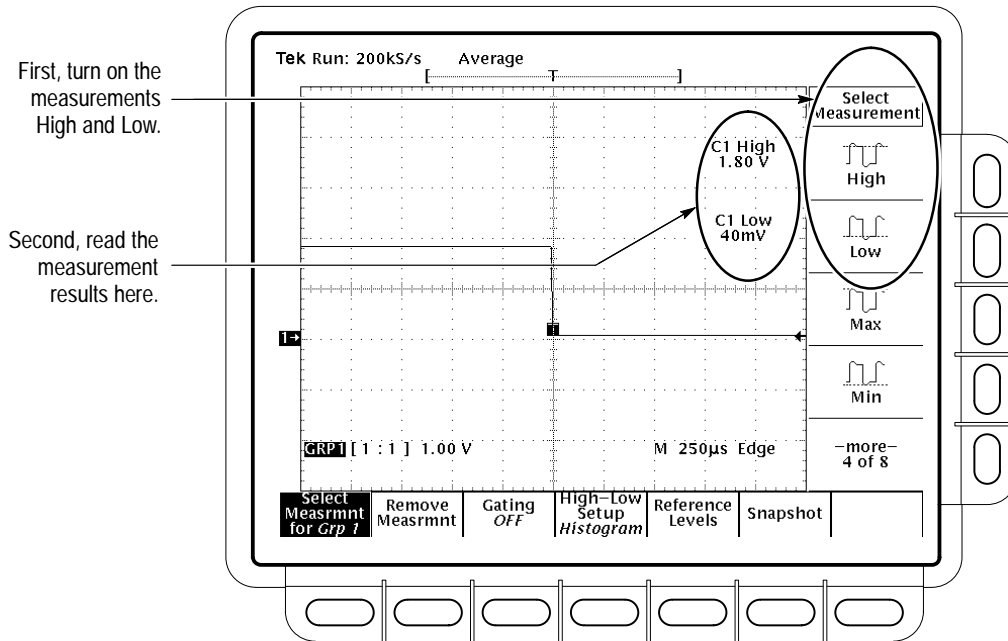


Figure 4-24: Measurement of Main Trigger Output Limits

- d. Check that the **C1 High** readout is ≥ 1.0 V and that the **C1 Low** readout is ≤ 0.25 V.
 - e. Move the precision 50 Ω cable from the **MAIN TRIGGER OUTPUT** BNC to the **DELAYED TRIGGER OUTPUT** BNC.
 - f. Check that the **C1 High** readout is ≥ 1.0 volt and that the **C1 Low** readout ≤ 0.25 volts.
3. Disconnect the cables from the channel 1 input and the rear panel output.

Adjustment Procedures

This section contains information needed to adjust your TLS 216 Logic Scope.

Description. The *Adjustment Procedures* are divided into six subsections:

- General information about adjusting the TLS 216 Logic Scope.
- A list of equipment required to perform the adjustments.
- The written procedures for installing and using the *TLS 216 Adjustment Software*.
- The *TLS 216 Adjustment Software* included with this manual. The material found in the subsections listed above should be read before using the adjustment software.
- A written procedure for manually adjusting the display assembly.

Purpose. This procedure is used to return the logic scope to conformance with its *Warranted Characteristics* as listed in Section 1, *Specification*. It can also be used to optimize the performance of the logic scope.

Adjustment Interval. As a general rule, these adjustments should be done every 2000 hours of operation or once a year if the logic scope is used infrequently.

Requirements for Performance

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

Personnel	This procedure is only to be performed by trained service technicians.
Warm-Up Period	This logic scope requires a 20 minute warm-up time in a 20° C to 30° C environment before it is adjusted. Adjustments done before the operating temperature has stabilized may cause errors in performance.
Access	Except when adjusting the display assembly, the cabinet is not removed. Instead, you enable the internal adjustment constants of the logic scope to be written. Two small holes in the chassis allow service personnel to insert a tool and push a switch to enable or disable the writing of new adjustment constants to non-volatile RAM.

The procedure that follows will tell you how and when to enable and disable the writing of adjustment constants. Be sure to disable the switch when you have finished adjusting the logic scope.

System The following computer and peripherals are required to adjust this logic scope.

Computer. An IBM® PC™ or a strict compatible is required. The system must also be equipped as follows:

- Eight MHz clock speed or faster.
- DOS 3.2 or higher.
- 640K Resident RAM with 580 K Available RAM.
- A hard drive.
- A high-density floppy drive: 3.5 inch (1.44 M) or 5.25 inch (1.2 M).
- A GPIB board — National Instruments® GPIB-PCII, GPIB-PCIIA or GPIB-PCII/IIA. (A PC-GPIB Package that includes the PCII/IIA is available — Tektronix part number S3FG210).
- Suitable keyboard and monitor.

Optional Peripherals Installation of a math coprocessor in your system is strongly recommended to decrease the time required to adjust the logic scope.

Test Equipment The equipment list, starting on page 5–4, lists all test equipment required to adjust this logic scope.

Usage

The following topics cover what is required of you when adjusting the logic scope and what is done by the software. Also, the performance of individual adjustments is discussed.

Performing the Adjustments When using the adjustment software, you will not be required to manually adjust any circuits. As you run the calibration tests, the software adjusts the circuits using external standards you provide in response to prompts on the computer screen. Your role, then, is to provide those test signals and to prompt the computer to continue.

Complete Adjustment A complete adjustment is the performance of all adjustments on the *TLS 216 Adjustment Software* in sequence.

Throughout this section, “complete adjustment” is used as just defined.

Individual Adjustments The adjustment software contains three classes of adjustments as shown in Table 5–1. Each class contains one or more individual calibration tests (CATS) and an internal compensation routine (SPC). The *TLS 216 Adjustment Software* provides you with instructions for running each of the tests.

All these software-based adjustments are made internally by the adjustment software, and all adjustments can be done without removal of the logic scope cabinet.

Signal Path Compensation (SPC). This internal routine is not an adjustment. It is a temperature compensation routine that compensates for the current operating temperature to optimize logic scope performance.

Table 5–1: Calibration Tests

Class of Adjustment	CATS Tests
Voltage Reference	CVR_CAL SPC
Frequency Response	SPC HF CAL
Pulse Trigger	SPC TRIG_POS_CAL

Partial Adjustment The adjustment software will allow you to make individual adjustments. However, usually all adjustments are made unless you are adjusting circuits in the course of troubleshooting the logic scope. Read the information under *Complete Adjustment*, *Adjustment After Repair*, and *Adjustment Dependencies* before doing an individual adjustment.

Adjustment After Repair After the removal and replacement of a module due to electrical failure, you must either do a complete adjustment or no adjustment is required, depending on the module replaced. See Table 5–2.

Table 5-2: Adjustments Required for Module Replaced

Module Replaced	Adjustment Required
Acquisition Board	Complete Adjustment
Front Panel Assembly	None Required
Low Voltage Power Supply	Complete Adjustment
Processor Board	Complete Adjustment ¹
Display Assembly	Display Adjustment Only

¹ If a firmware upgrade is done, a complete adjustment is required.

Adjustment Dependencies

Some adjustments depend on successful prior completion of other adjustments. For example, all the CATS tests associated with the Voltage Reference Adjustment class must be passed before any other adjustments can be successfully completed. The following table lists the adjustments and their dependencies.

Table 5-3: Adjustments and Dependencies

Class of Adjustment	Prior Completion Requirements
Voltage Reference Adjustment	None
Frequency Response Adjustment	Voltage Reference (SPC and all tests)
Pulse Trigger Adjustment	Voltage Reference (SPC and all tests)
Display Adjustment	None

Equipment Required

The test equipment required to adjust the TLS 216 Logic Scope is listed here.

Table 5-4: Test Equipment, Fixtures, and Supplies

Item Number and Description	Minimum Requirements	Example	Purpose
1. Adjustment Tool	Less than 1/8 inch diameter and over 2 inches long	Tektronix part number 003-0675-00	Software-based Adjustments (used as a probe) and Manual Adjustments
2. Attenuator, 10X (Two required)	Ratio: 10X; impedance 50 Ω ; connectors: female BNC input, male BNC output	Tektronix part number 011-0059-02	Software-based Adjustments

Table 5-4: Test Equipment, Fixtures, and Supplies (Cont.)

Item Number and Description	Minimum Requirements	Example	Purpose
3. Attenuator, 2X	Ratio: 2X; impedance 50 Ω ; connectors: female BNC input, male BNC output	Tektronix part number 011-0069-02	Software-based Adjustments
4. Cable GPIB	IEEE Std 488.1-1987/ IEEE Std 488.2-1987	Tektronix part number 002-0991-01	Software-based Adjustments
5. Coupler, Dual-Input		Tektronix part number 067-0525-02	Software-based Adjustments
6. Cable, Precision Coaxial	50 Ω , 36 in, male to male BNC connectors	Tektronix part number 012-0482-00	Software-based Adjustments
7. Connector, Dual-Banana	Female BNC to dual banana	Tektronix part number 103-0090-00	Software-based Adjustments
8. Generator, Calibration	High Amplitude pulse with variable amplitude of at least 60 V.	Tektronix PG 506A ¹ Calibration Generator	Probe Adjustment
9. Generator, DC Calibration	Variable amplitude to ± 104 V; accuracy to 0.1%	Data Precision 8200	Software-based Adjustments
10. Generator, Leveled Sine Wave, Medium-Frequency	200 kHz to 250 MHz; Variable amplitude from 5 mV to 4 V _{p-p} into 50 Ω ; flatness ≤ 3 %; harmonic content: 2 nd harmonic down -30 dB from fundamental; all others down -40 dB	Tektronix SG 503 ¹ or SG5030 Leveled Sine Wave Generator	Software-based Adjustments
11. Generator, Leveled Sine Wave, High-Frequency	250 MHz to 500 MHz; Variable amplitude from 0.5 V to 4 V _{p-p} into 50 Ω ; 6 MHz reference; harmonic content: 2 nd harmonic down -25 dB from fundamental; all others down -40 dB	Tektronix SG 504 ¹ Leveled Sine Wave Generator with its leveling head or a Tektronix SG 5030 ¹ Programmable Leveled Sine Wave Generator with its leveling head	Software-based Adjustments
12. Magnifier, 6X	Standard Tool		Brightness and Focus Adjustment
13. Photometer	0.1 to 200 Footlamberts	Tektronix J16 Photometer with J6503 Luminance Probe	Contrast Adjustment
14. Fixture, Cal Adapter	Zero Loss; P6240 to BNC	Tektronix part number 067-0232-xx	Software-based Adjustments

¹ Requires a TM 500 or TM5000 Series Power Module Mainframe.

Adjustment Instructions

The following instructions will guide you through installing the software on your system, setting up the logic scope for adjustment, and starting the adjustment of the logic scope by the software.

Hardware Installation

1. *Install the proper GPIB card (see System on page 5–2):* Use the manual accompanying your GPIB card to install and configure that card.
2. *Configure the GPIB card:*
 - a. This software is designed to be compatible with cards configured for PCII and PCIIA operation. The following table lists the default card settings.
 - b. If these settings conflict with your hardware setup, see your GPIB card manual for alternate settings.
 - c. If you have more than one GPIB card installed, this adjustment software assumes the first card (referenced 0). See your GPIB card manual for information on how to determine which card is your “0” card.

Table 5–5: GPIB Board Configuration¹

Board Settings	GPIB-PCII	GPIB-PCIIA
Base I/O Address (hex)	2B8	2E1
Interrupt Line	7	7
DMA Channel	1	1

¹ Systems using the combination card (GPIB-PCII/IIA) can be configured as either a GPIB-PCII or a GPIB-PCIIA.

Software Installation

STOP. ALWAYS use this installation procedure when installing this software on a new computer. This installation program uses parameters you supply (see step 2, substep a) to create a custom start-up file on your hard disk directory. After installation, you will be instructed to run this start-up batch file whenever you do software-based adjustments, so it can configure your computer properly before it runs the adjustment program. Do not simply copy the software files from one computer to another, since the start-up batch file you copy may not match the computer you copy it to.

1. *Create a working disk:* Using the proper DOS commands, copy the *TLS 216 Adjustment Software* disk to a working disk.
2. *Install the software to hard disk:*
 - a. Install your working disk in a floppy drive and type *install*. You will be asked to specify the hard disk on which to install the adjustment software. You will also be prompted to specify several GPIB-card configuration parameters.
 - b. The adjustment software will be installed in a directory called *TLS216.ADJ* on your hard drive. Be sure to read the files *readme* and *release.nts* in that directory before you continue.
3. *Store your installation disk:* Remove your installation disk and store in a secure place.

Software-Based Adjustments

Equipment Required: All items that are listed for “Software-based Adjustments” under “Purpose” in Table 5–4 starting on page 5–4.

1. *Hook up the logic scope:*
 - a. Connect the GPIB cable (Item 4) to the GPIB port at the computer rear panel. (When multiple GPIB cards are installed, connect to the GPIB0 card.)
 - b. Connect the GPIB cable (Item 4) to the GPIB port at the logic scope rear panel.
 - c. Power on the logic scope.
2. *Set up the logic scope:*
 - a. Press **SHIFT**; then press **UTILITY**.
 - b. Repeatedly press the main-menu button **System** until **I/O** is highlighted in the pop-up menu.
 - c. Press the side-menu button **TALK/LISTEN**.
 - d. Use the keypad to set any address between 0 and 29.
3. *Enable the adjustment constants to be written:*
 - a. Locate the two small access holes on the right side of the logic scope cabinet near the front.
 - b. Insert the adjustment tool (Item 1) in the hole nearest the front of the logic scope about $\frac{1}{2}$ inch to engage the rocker switch.
 - c. Push to rock the switch to its unprotected (enabled) position.

4. *Let the logic scope warm up:* Allow a 20 minute warm-up period before you begin step 5.

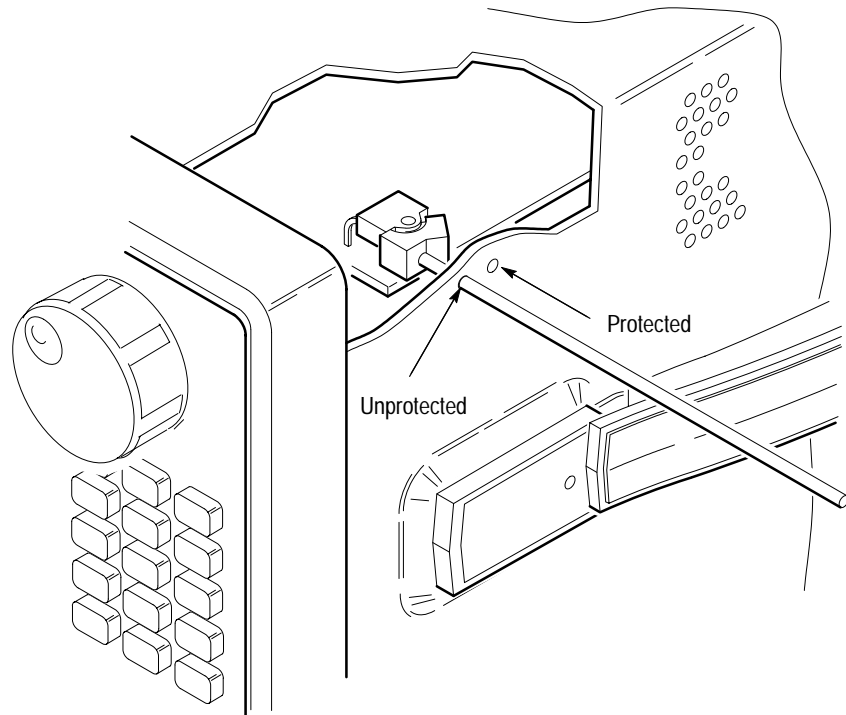


Figure 5-1: Accessing the Protection Switch

5. *Start the adjustment software:*
 - a. Change drives to your hard drive.
 - b. Change directories to TLS 216.ADJ.
 - c. Type ADJ216.
 - d. Follow the instructions as prompted on your computer screen.
6. *When adjustment has been completed:*



CAUTION. Be sure to disable the NVRAM Protection switch as instructed below to protect the adjustment constants against alteration.

- a. Locate the two small access holes on the right side of the logic scope cabinet near the front. (See Figure 5-1.)

- b. Insert the adjustment tool (Item 1) in the hole nearest the *rear* of the logic scope about 1/2 inch to engage the rocker switch.
- c. Push to rock the switch to its protected (disabled) position.

Display Assembly Adjustment

STOP. *It is not necessary to do this procedure to perform a complete adjustment. Only use this procedure to adjust the display assembly if it has been repaired or if brightness and contrast have become unsatisfactory.*

Rotation, Brightness, and Contrast Adjustment

Equipment Required: One 6X magnifier (Item 12) and one J16 Photometer with a J6503 Luminance Probe (Item 11).

Procedure:

1. *Access the inside of the logic scope: See Removal and Installation Procedures in Section 6 to remove the cabinet.*
2. *Adjust the display rotation*
 - a. *Display the Composite test pattern:*
 - Leave the logic scope powered off.
 - Set the DIP switch, located near the front of the A11 DRAM Processor/Display, as follows:

Switch No.	1	2	3	4	5	6	7	8
Open						X	X	
Closed	X	X	X	X	X			X

- Power on the logic scope.
- Press **SHIFT**; then press **UTILITY**.
- Repeatedly press the main-menu button **System** until **Diag/Err** is highlighted in the pop-up menu.
- Repeatedly press the main-menu button **Area** until **Display** is highlighted in the pop-up menu.
- Repeatedly press the side-menu button **–more–** until **Composite** appears in the side menu. Push **Composite**.

- Press the main-menu button **EXECUTE**; then press the side-menu button **Ok Confirm Run Test**.
 - b. *Make the adjustment:* Adjust R401 (TRACE ROTATION) to minimize the display's tilt. Use the frame around the display as a reference. R401 is the second adjustment from the fan.
3. *Adjust the display brightness:*
- Locate R403 (BRIGHTNESS). It is one of the adjustments on the left side of the instrument located just ahead of the fan. It is the fourth adjustment from the fan.
 - Observe the luminance patches using a 6X magnifier.
 - Adjust R403 (BRIGHTNESS) until the background raster lines in the 5% luminance patch (see Figure 5–2) just disappear, while the lines in the 10% luminance patch are just visible, when both are viewed through the magnifier.

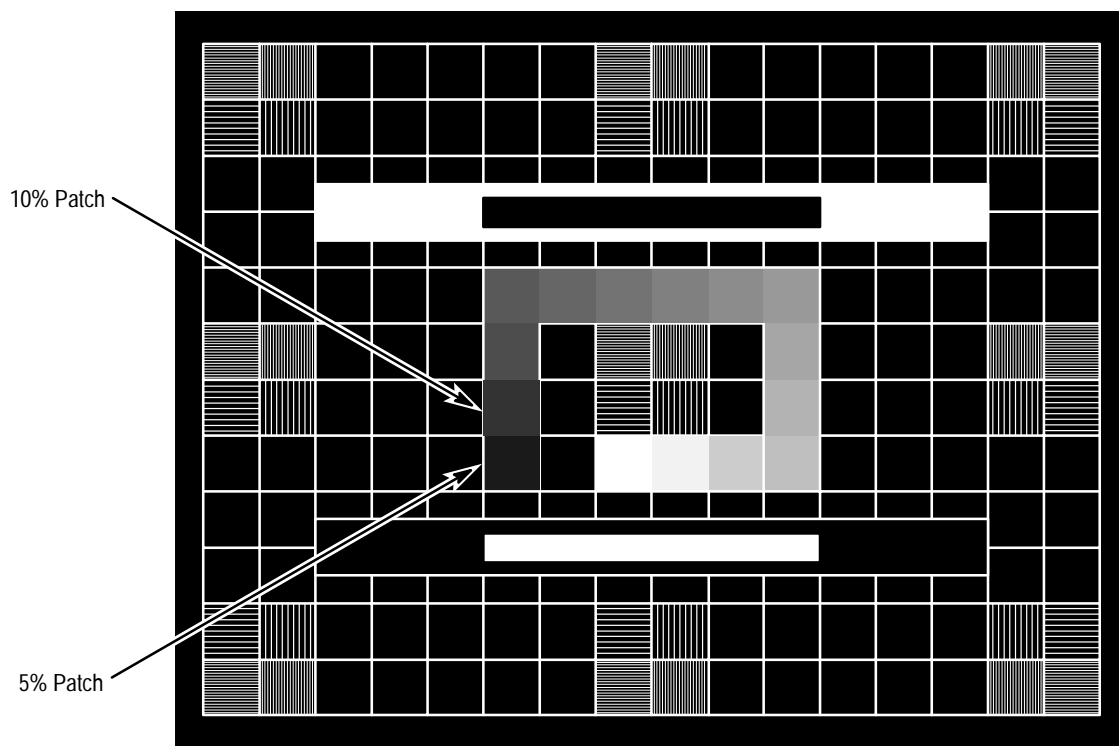


Figure 5–2: Five and Ten Percent Luminance Patches

4. *Adjust the display contrast:*

a. *Display the White Field test pattern:*

- Press the center main-menu button to display the main-menu.
- Press the main-menu button **Tests**.
- Repeatedly press the side-menu button **–more–** until **White Field** appears in the side menu. Push **White Field**.
- Press the main-menu button **EXECUTE**; then press the side-menu button **Ok Confirm Run Test**.

b. *Make the contrast adjustment:*

- Locate R404. It is one of the adjustments on the left side of the instrument located just ahead of the fan. It is the fifth adjustment from the fan.
- Monitor the luminance at center screen using a J16 photometer and a luminance probe.
- Adjust R404 (CONTRAST) for a reading of 40 foot lamberts.

NOTE. *The adjustments for contrast and brightness interact with each other.*

5. *Restore the logic scope to normal operation:*

a. Restore the dip switch to the settings that follow:

Switch No.	1	2	3	4	5	6	7	8
Open								
Closed	X	X	X	X	X	X	X	X

b. Power off the logic scope.

c. See *Removal and Installation Procedures* in Section 6 to reinstall the cabinet and other modules removed in step 1.

Maintenance Information

This section contains the information needed to do periodic and corrective maintenance on the TLS 216 Logic Scope. The following topics are included.

Maintenance Information provides this introduction plus general information on preventing damage to internal modules when doing maintenance.

Inspection and Cleaning provides information and procedures for inspecting the logic scope and cleaning its external and internal modules.

Removal and Installation Procedures provide instructions for the removal of defective modules and replacement of new or repaired modules. Also included is a procedure for disassembly of the logic scope for cleaning.

Troubleshooting provides information for isolating failed modules. Included are instructions for operating the internal diagnostic routines of the logic scope and troubleshooting trees. Most of the trees make use of these internal diagnostic routines to speed fault isolation to a module.

Procedures Not In This Section

The following sections contain information/procedures related to maintenance.

Operating Information, beginning on page 2–1, covers instructions useful when operating the logic scope in order to troubleshoot it. It also details the service strategy and lists options for obtaining maintenance service and for replacing failed modules.

Theory of Operation, beginning on page 3–1, contains a circuit description at the module, or block, level.

Performance Verification, beginning on page 4–1, contains procedures that may be useful in isolating problems to modules by testing logic scope performance.

Adjustment Procedures, beginning on page 5–1, addresses after repair adjustment and the interval between periodic adjustments. It contains a procedure for adjusting the internal circuits of the logic scope.

Diagrams, beginning on page 9–1, contains a block diagram using individual modules as blocks and an interconnection diagram showing connections between the modules.

Replaceable Parts List, beginning on page 10–1, lists all field replaceable modules by part number.

Preventing ESD



CAUTION. Static discharge can damage any semiconductor component in this logic scope.

Precautions

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

1. Minimize handling of static-sensitive modules.
2. Transport and store static-sensitive modules in their static protected containers or on a metal rail. Label any package that contains static-sensitive modules.
3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules. Do service of static-sensitive modules only at a static-free work station.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.
5. Handle circuit boards by the edges when possible.
6. Do not slide the modules over any surface.
7. Avoid handling modules in areas that have a floor or work-surface covering capable of generating a static charge.

Susceptibility to ESD

Table 6–1 lists the relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

Table 6–1: Relative Susceptibility to Static-Discharge Damage

Semiconductor Classes	Relative Susceptibility Levels ¹
MOS or CMOS microcircuits or discrete circuits, or linear microcircuits with MOS inputs (most sensitive)	1
Schottky signal diodes	3
Schottky TTL	4
High-frequency bipolar transistors	5
JFET	6
Linear microcircuits	7

Table 6-1: Relative Susceptibility to Static-Discharge Damage (Cont.)

Semiconductor Classes	Relative Susceptibility Levels ¹
Low-power Schottky TTL	8
TTL (least sensitive)	9

¹ Voltage equivalent for levels (voltage discharged from a 100 pF capacitor through resistance of 100 Ω):

1 = 100 to 500 V	5 = 400 to 600 V
2 = 200 to 500 V	6 = 600 to 800 V
3 = 250 V	7 = 400 to 1000 V (est.)
4 = 500 V	8 = 900 V
	9 = 1200 V

Inspection and Cleaning

This section describes how to inspect for dirt and damage on, and how to clean the exterior and interior of the TLS 216 Logic Scope. Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, may prevent logic scope malfunction and enhance its reliability.

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

How often to do maintenance depends on the severity of the environment in which the logic scope is used. A proper time to perform preventive maintenance is just before logic scope adjustment.

General Care

The cabinet helps keep dust out of the logic scope and should normally be in place when operating the logic scope. The logic scope front cover protects the front panel and display from dust and damage. Install it when storing or transporting the logic scope.

Inspection and Cleaning Procedures

Inspect and clean the logic scope 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 a failure, especially under high-humidity conditions.



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

Inspection — Exterior

Inspect the outside of the logic scope for damage, wear, and missing parts, using Table 6–2 as a guide. Any logic scope that appears to have been dropped or otherwise abused should be checked thoroughly to verify correct operation and performance. Immediately repair defects that could cause personal injury or lead to further damage to the logic scope.

Table 6–2: 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, flip stand, cabinet feet.	Correct operation.	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



Clean the outside of the logic scope as needed, using the following procedure.

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

1. Remove loose dust on the outside of the logic scope 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.
3. Clean the light filter protecting the monitor screen with a lint-free cloth dampened with either isopropyl alcohol or, preferably, a gentle, general purpose detergent-and-water solution.

Inspection — Interior

To access the inside of the logic scope for inspection and cleaning, refer to the *Removal and Installation Procedures* in this section.

Inspect the internal portions of the logic scope for damage and wear, using Table 6–3 as a guide. Defects found should be repaired immediately.

If any electrical module is replaced, check Table 5–2 in Section 5 to see if it is necessary to adjust the logic scope.

Table 6–3: Internal Inspection Check List

Item	Inspect For	Repair Action
Circuit boards	Loose, broken, or corroded solder connections. Burned circuit boards. Burned, broken, or cracked circuit-run plating.	Remove failed module and replace with a fresh module.
Resistors	Burned, cracked, broken, blistered condition.	Remove failed module and replace with a fresh module.

Table 6-3: Internal Inspection Check List (Cont.)

Item	Inspect For	Repair Action
Solder connections	Cold solder or rosin joints.	Resolder joint and clean with isopropyl alcohol.
Capacitors	Damaged or leaking cases. Corroded solder on leads or terminals.	Remove damaged module and replace with a fresh module from the factory.
Semiconductors	Loosely inserted in sockets. Distorted pins.	Firmly seat loose semiconductors. Remove devices that have distorted pins. Carefully straighten pins (as required to fit the socket), using long-nose pliers, and reinsert firmly. Ensure that straightening action does not crack pins, causing them to break off.
Wiring and cables	Loose plugs or connectors. Burned, broken, or frayed wiring.	Firmly seat connectors. Repair or replace modules with defective wires or cables.
Chassis	Dents, deformations, and damaged hardware.	Straighten, repair, or replace defective hardware.

Cleaning Procedure — Interior

Clean the inside of the logic scope as needed using the following procedure.

NOTE. 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 warm deionized water. (A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards.)



CAUTION. To prevent damage from electrical arcing, ensure that circuit boards and components are dry before applying power to the logic scope.

3. If steps 1 and 2 do not remove all the dust or dirt, the logic scope 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 and wait 60 seconds for the majority of the alcohol to evaporate.
6. Use hot (120° F to 140° F) 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 (125° F to 150° F) circulating air.

Lubrication There is no periodic lubrication required for this logic scope.

Removal and Installation Procedures

This section contains procedures for removal and installation of all mechanical and electrical modules. Any electrical or mechanical module, assembly, or part listed in Section 10 of this manual is a module.

Preparation — Please Read



WARNING. Before doing this or any other procedure in this manual, read the *Safety Summary* found at the beginning of this manual. Also, to prevent possible injury to service personnel or damage to the logic scope components, read *Before Servicing* in the introduction, *Supplying Operating Power* in Section 2, and *Preventing ESD* in this section.

This section contains the following technical information:

- This preparatory information that you need to properly do the procedures that follow.
- List of tools required to remove all modules.
- Three module locator diagrams for finding the External Modules (see Figure 6–1), Outer-Chassis Modules (see Figure 6–2), and Inner-Chassis Modules (see Figure 6–3) in this logic scope.
- Procedures for removal and reinstallation of the electrical and mechanical modules.
- A disassembly procedure for removal of all the major modules from the logic scope at one time and for reassembly of those modules into the logic scope. Such a complete disassembly is normally only done in order to completely clean the logic scope. (Instructions for doing the actual cleaning are found under *Inspection and Cleaning* at the beginning of this section.)



WARNING. Before doing any procedure in this section, disconnect the power cord from the line voltage source. Failure to do so could cause serious injury or death.

List of Modules Section 10 lists all modules.

General Instructions *READ THE GENERAL INSTRUCTIONS THAT FOLLOW BEFORE REMOVING A MODULE.*

First read over the *Summary of Procedures* that follows to understand how the procedures are grouped. Then read *Equipment Required* for a list of the tools needed to remove and install modules in this logic scope.

If you are disassembling this logic scope for cleaning, go to the procedure *Disassembly for Cleaning* (page 6–54).

If you are removing a module for service, begin by doing the procedure *Access Procedure* (page 6–14). By following the instructions in that procedure, you remove the module to be serviced while removing the minimum number of additional modules.

Summary of Procedures The procedures are described in the order in which they appear in this section. In addition, you can look up any procedure for removal and reinstallation of any module in the *Table of Contents* of this manual.

- The *Access Procedure* on page 6–14 first directs you to the procedure(s) (if any) that are required to access the module to be serviced, and then it directs you to the procedure to remove that module.
- *Procedures for External Modules*, beginning on page 6–15, are procedures for removing modules the removal of which do not require internal access to the logic scope.
- *Procedures for Outer-Chassis Modules*, beginning on page 6–29, are procedures for removing modules the removal of which require access internal to the instrument but external to the chassis.
- *Procedures for Inner-Chassis Modules*, beginning on page 6–46, are procedures for removing modules the removal of which require access internal to the logic scope *and* internal to the chassis.
- *Disassembly for Cleaning*, beginning on page 6–54, is a procedure, based on the removal procedures just described, that removes all modules for cleaning. Instructions for cleaning are found in *Inspection and Cleaning*, which begins this section.

NOTE. *Read the cleaning procedure before disassembling the logic scope for cleaning.*

Equipment Required

Most modules in this logic scope can be removed with a screwdriver handle mounted with a size T-15, Torx® screwdriver tip. *Use this tool whenever a procedure step instructs you to remove or install a screw unless a different size screwdriver is specified in that step.* All equipment required to remove and reinstall each module is listed in the first step of its procedure.

Table 6-4: Tools Required for Module Removal

Item No.	Name	Description	Tektronix Part Number
1	Screwdriver handle	Accepts Torx®-driver bits	003-0301-00
2	T-15 Torx tip	Torx®-driver bit for T-15 size screw heads	003-0966-00
3	T-20 Torx tip	Torx®-driver bit for T-20 size screw heads	003-0866-00
4	T-20 Torx tip	Special Tool: Narrow Torx®-driver bit for T-20 size screw heads (Fan removal only)	003-1457-01
5	Flat-bladed screwdriver	Standard tool; screwdriver for removing standard-headed screws	
6	Needle-Nose Pliers	Standard tool	
7	Nutdriver, ¼ inch	Standard tool	
8	Retaining Ring Pliers	Standard tool; 1-1/8 inch minimum throw	
9	Angle-Tip Tweezers	Standard tool	
10	Pliers	Standard tool	

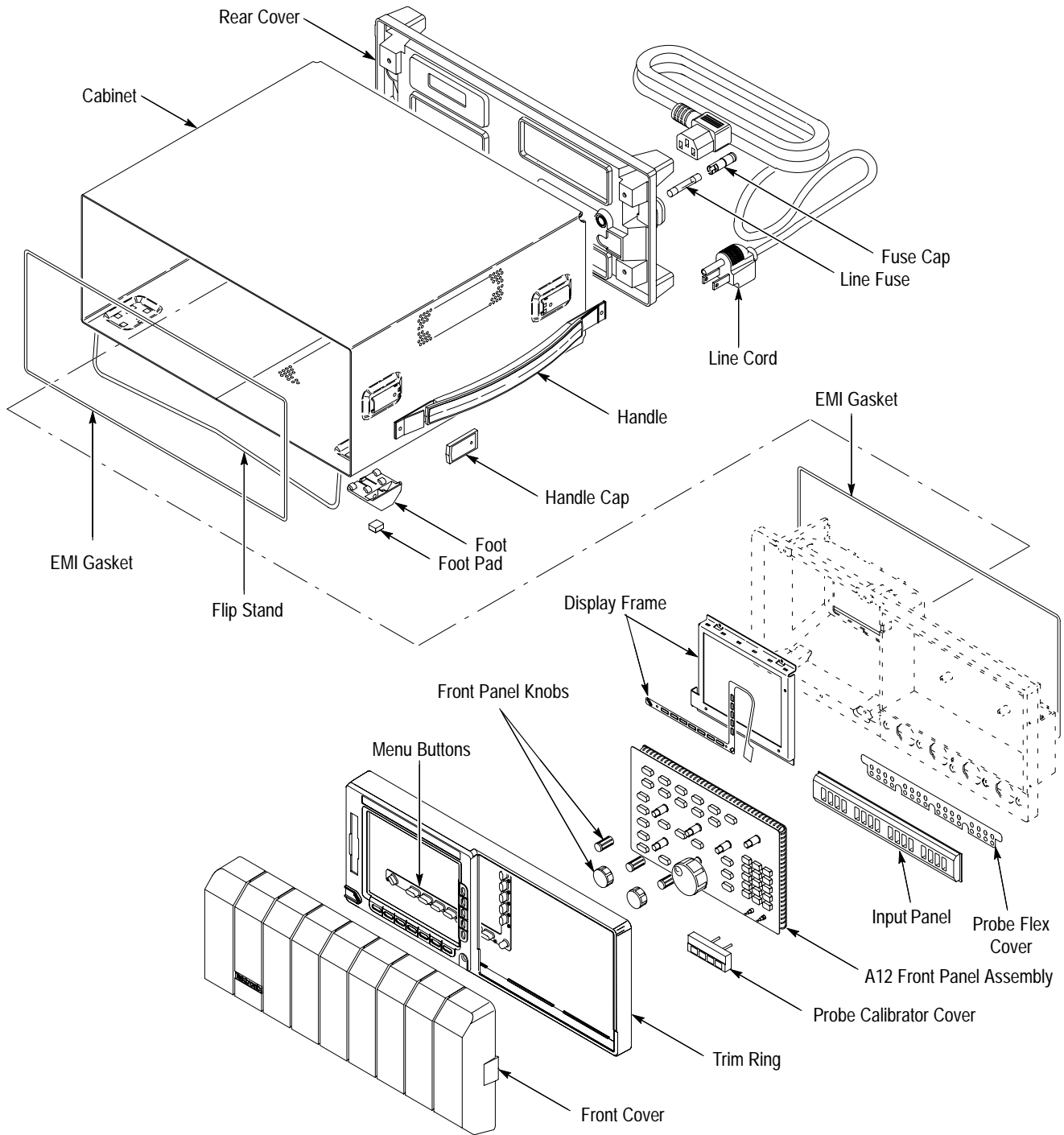


Figure 6-1: External Modules

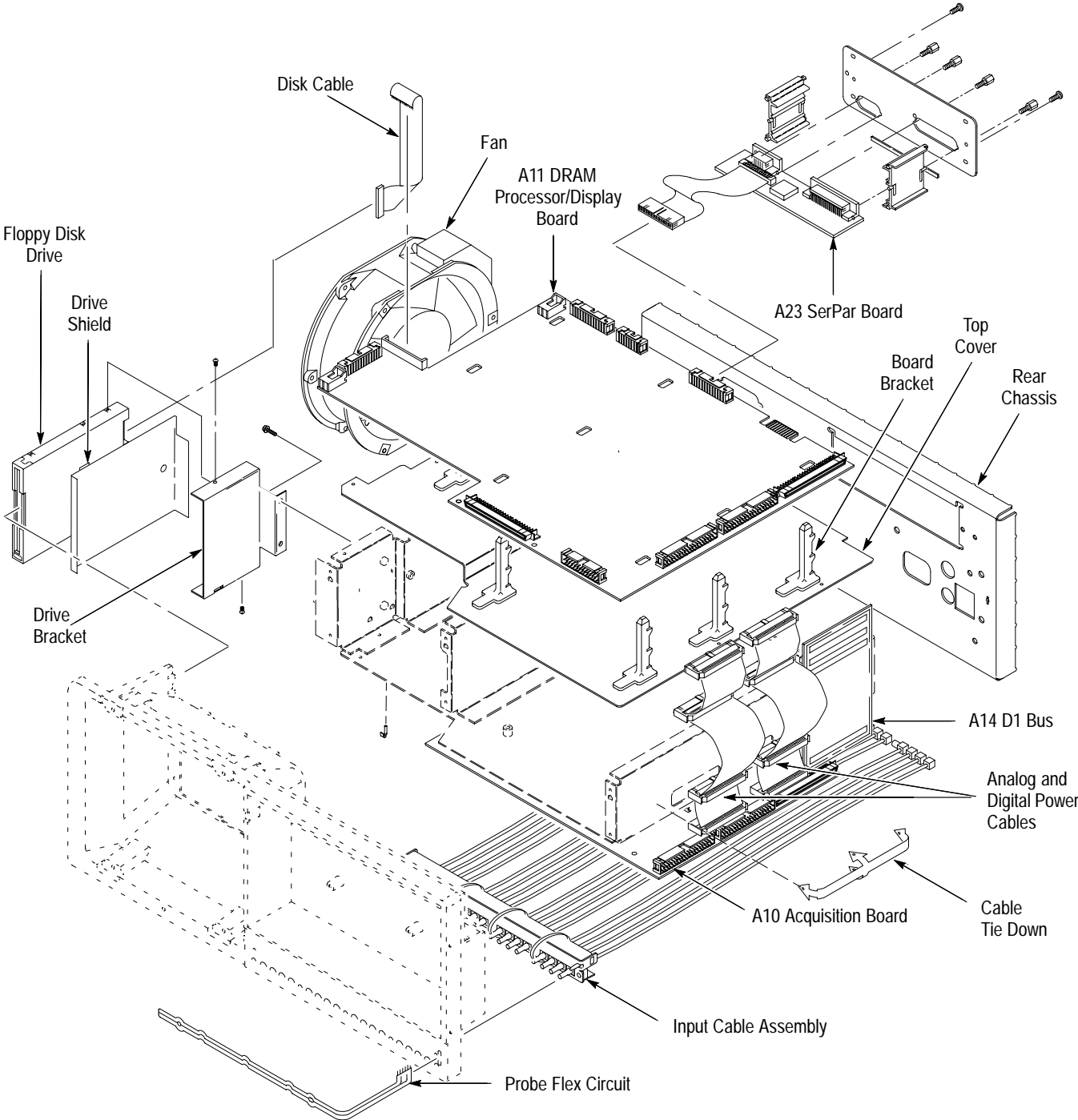


Figure 6-2: Outer-Chassis Modules

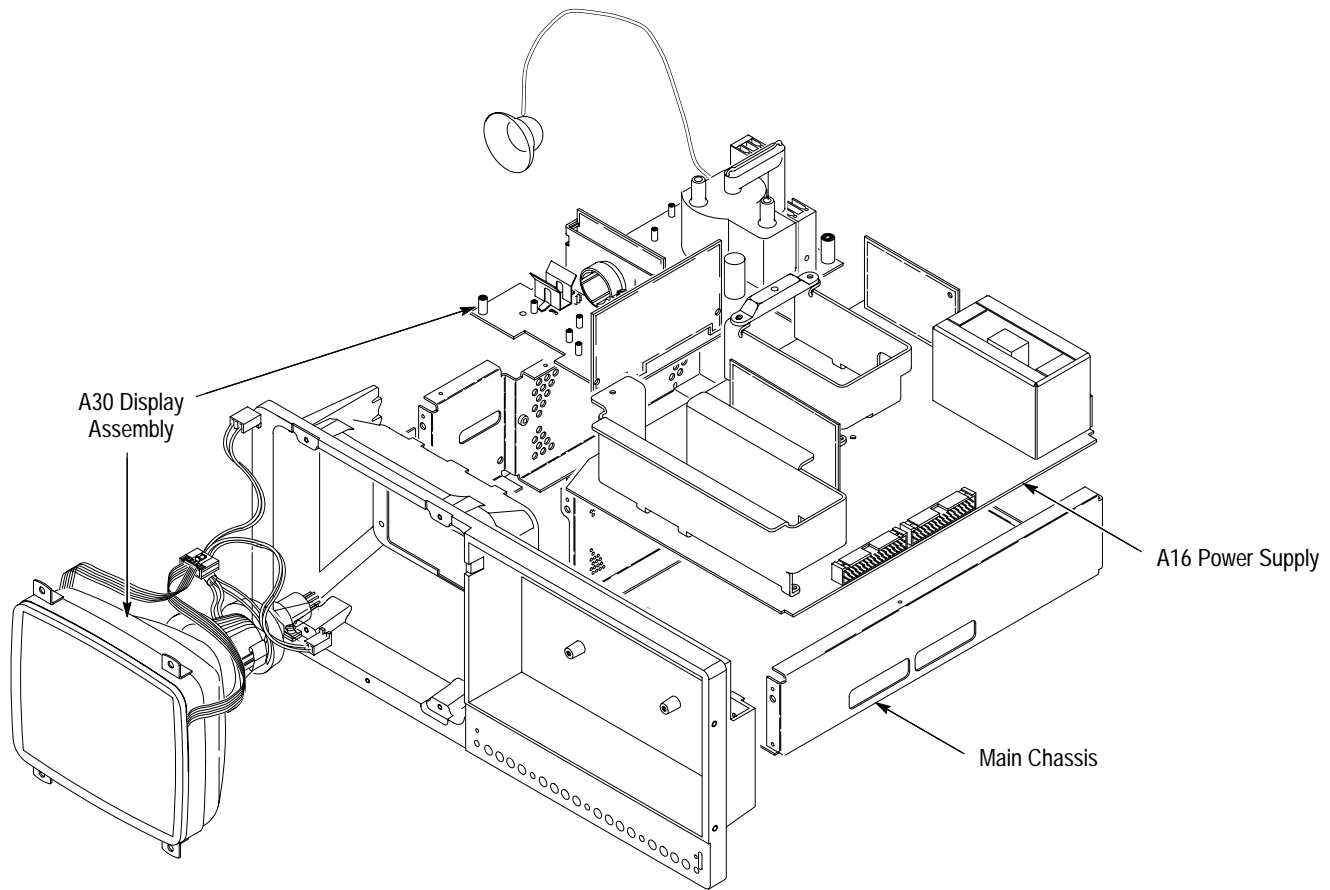


Figure 6-3: Inner-Chassis Modules

Access Procedure

Begin with this procedure when you have identified a module to be removed for service and have read *General Instructions* found earlier in this section.

1. *Locate module to be removed:*
 - a. Find the module to be removed in the module locator diagrams, Figures 6-1 through 6-3.
 - b. Once the module is found, note from the title of the figure whether the module is an external, outer-chassis mounted, or inner-chassis mounted part.
2. *If the module is externally mounted, no internal access is required; remove the module:* Find and do the procedure whose title matches the name of the module to be removed under *Procedures for External Modules* (page 6-15).

3. *If the module is an outer- or inner-chassis module, access the inside of the instrument:*
 - a. First do the procedure *Line Fuse and Line Cord*; then do the procedure *Rear Cover and Cabinet*. Both are found under *Procedures for External Modules* immediately following this procedure.
 - b. After completing those procedures, return to this procedure and continue with step 4.
4. *If the module is an outer-chassis module, remove it:*
 - a. If removing the display-frame assembly, first do the procedure *Front Cover, Trim Ring, Menu Buttons, and Input Panel*, found under *Procedures for External Modules* (page 6–15).
 - b. Find and do the procedure whose title matches the name of the module to be removed under *Procedures for Outer-Chassis Modules*, on page 6–29.
5. *If the module is an inner-chassis module, access the inner-chassis:*
 - a. If removing the display tube, display-driver board, or the front subpanel, first do the procedure *Front Cover, Trim Ring, Menu Buttons, and Input Panel*, found under *Procedures for External Modules*. Also remove the display-frame assembly found under *Procedures for External Modules*, on page 6–15.
 - b. Also, if removing the front subpanel, do *A12 Front-Panel Assembly* also found under *Procedures for External Modules*.
 - c. Do, in the order listed, the three procedures *A14 D1 Bus and Analog-Power and Digital-Power Cables*, *A11 Processor/Display Board* and *Top Cover* found under *Procedures for Outer-Chassis Modules*, page 6–29.
 - d. Find and do the procedure whose title matches the name of the module to be removed under *Procedures for Inner-Chassis Modules*, page 6–46.
6. *Reinstall all modules removed:* Read the instructions found at the end of the procedure that removes the module to be serviced — they will guide you in reinstalling all modules removed.

Procedures for External Modules

Do the *Access Procedure* (page 6–14) before doing any procedure in this collection. The procedures found here, listed in order presented, follow.

- *Front-Panel Knobs*
- *Line Fuse and Line Cord*

- *EMI Gaskets*
- *Rear Cover and Cabinet*
- *Front Cover, Trim Ring, Menu Buttons, and Input Panel*
- *A12 Front-Panel Assembly*
- *Display Frame*
- *Cabinet Modules*

Front-Panel Knobs

1. *Assemble equipment and locate modules to be removed:* Have an angled-tip tweezers (Item 9) handy. Find the knob(s) to be removed on the front panel.
2. *Orient the logic scope:* Set the logic scope so its bottom is down on the work surface and its front is facing you.
3. *Remove the knob(s):* Grasp any knob you wish to remove and pull it straight out from the front panel slightly to create some clearance between the base of the knob and the front panel. Insert the tweezers between the knob and front panel and use them to remove the knob.
4. *Reinstallation:* To reinstall, align knob to shaft and push it in until it snaps.

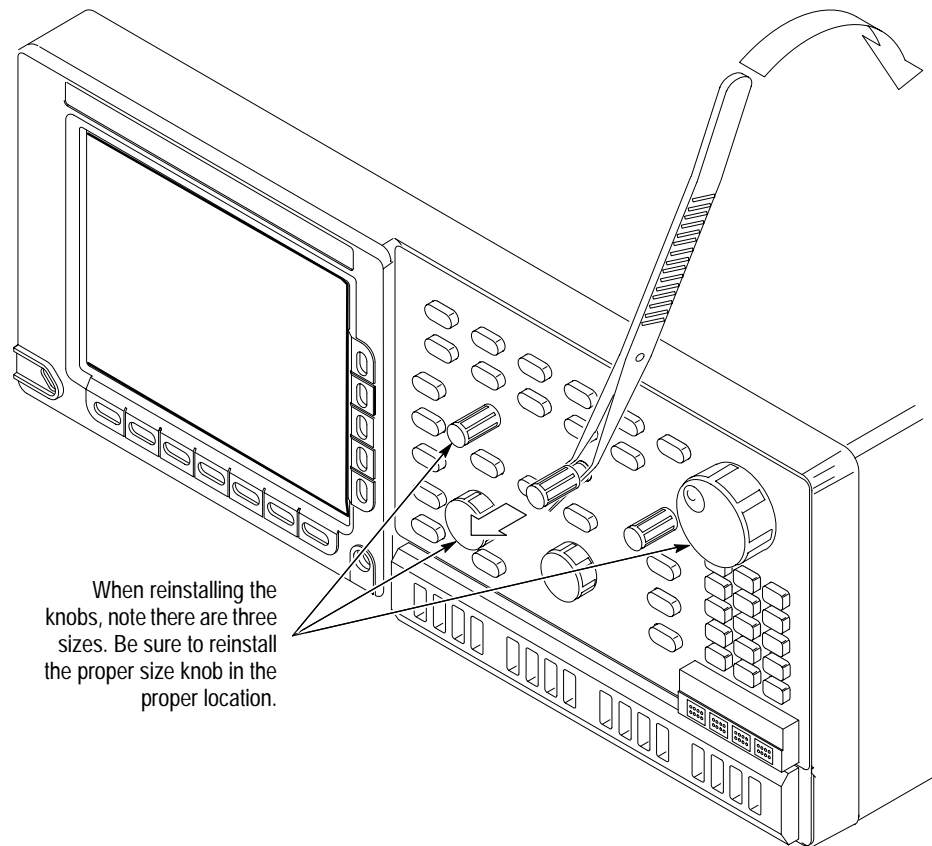


Figure 6-4: Knob Removal

Line Fuse and Line Cord

1. *Assemble equipment and locate modules to be removed:* Have a flat-bladed screwdriver (Item 5) handy. Locate the line fuse and line cord in the locator diagram *External Modules*, Figure 6-1.
2. *Orient the logic scope:* Set the logic scope so its bottom is down on the work surface and its rear is facing you. If you are servicing the line fuse, do the next step; if you are servicing the line cord, skip to step 4.

3. *Remove line fuse:* Find the fuse cap on the rear panel. (See Figure 6–5.) Now, remove the fuse cap by turning it counter-clockwise using a flat-bladed screwdriver, and remove the line fuse. Reverse procedure to reinstall.
4. *Remove line cord:* Find the line cord on the rear cover. (See Figure 6–5.) Now, remove the line-cord retaining clamp by first unplugging the line cord from its receptacle. Next, grasp both the line cord and the retaining clamp and rotate it 90 degrees counter-clockwise. Pull the line cord and clamp away to complete the removal. Reverse procedure to reinstall.
5. *Reinstallation:* Do in reverse steps 3 and 4 to reinstall the line cord and then the line fuse.

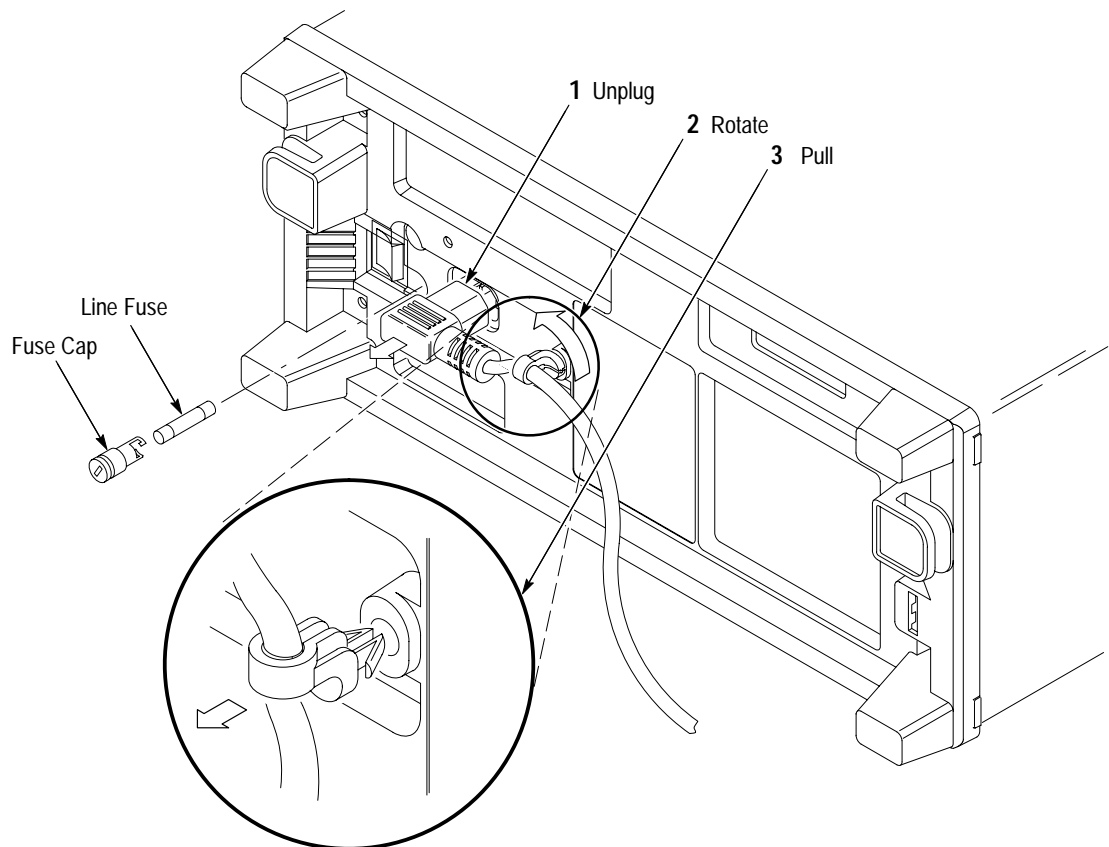


Figure 6–5: Line Fuse and Line Cord Removal

EMI Gaskets See *Rear Cover and Cabinet* procedure that follows.

Rear Cover and Cabinet

1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size T-20 Torx® tip (Items 1 and 4).
 - b. Make sure the logic scope's front cover is installed; if it's not, install it by snapping its edges over the trim ring.
 - c. Locate the rear cover and cabinet in the locator diagram *External Modules*, Figure 6-1.
2. *Orient the logic scope:* Set the logic scope so its face is down with its front cover on the work surface and its bottom facing you.
3. *Disconnect the line cord:* Unplug the line cord from its receptacle at the rear cover.
4. *Remove rear cover:* Remove the four screws securing the rear cover to the logic scope. Lift off the rear cover.
5. *Remove the cabinet:*
 - a. At the rear of the cabinet, grasp its left and right edges.
 - b. Pull upward to slide the cabinet off the logic scope. Take care not to bind or snag the cabinet on the logic scope's internal cabling as you remove it.

STOP. DO NOT do steps 6 through 8 to remove the EMI gasket(s) unless they must be replaced due to damage. If you are not replacing those gaskets, skip to step 9.

When reinstalling EMI gaskets and/or the logic scope cabinet, carefully follow the instructions given. Unless they are performed properly, the logic scope may not meet its emissions requirements (EMI).

6. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a pair of needle-nose pliers (Item 6).
 - b. Locate the modules to be removed in the locator diagram *External Modules*, Figure 6-1.
7. *Remove the EMI gaskets:*
 - a. Look for the point where the ends of the gasket touch in the channel at the rear edge of the cabinet.

- b.** Use a pair of needle-nose pliers to pry up one of the ends.
 - c.** Grasp the EMI gasket, and gently pull it out of its channel.
 - d.** Repeat substeps a through c to remove the gasket from its channel on the front casting.
- 8.** *Reinstallation of EMI gaskets:* Press each EMI gasket back into its groove at the rear edge of the cabinet or front casting. Make sure the ends of the gasket touch, but do not overlap, when installing. (Cut off excess length if required to prevent overlap.)
- 9.** *Reinstallation of cabinet and rear cover:*
 - a.** Do in reverse order steps 3 and 4 to reinstall the cabinet.
 - b.** Take care not to bind or snag the cabinet on internal cabling; redress cables as necessary.
 - c.** When sliding the cabinet on, be sure that the front edge of the cabinet aligns with the groove containing the EMI shield on the front casting.
 - d.** Be sure that the ridge around the rear chassis slides into the groove containing a second EMI cable on the rear of the cabinet.
 - e.** When reinstalling the four screws at the rear panel, tighten them to 16 foot-lbs torque.
 - f.** See the procedure *Line Fuse and Line Cord* to reinstall the line cord, which completes the logic scope reassembly.

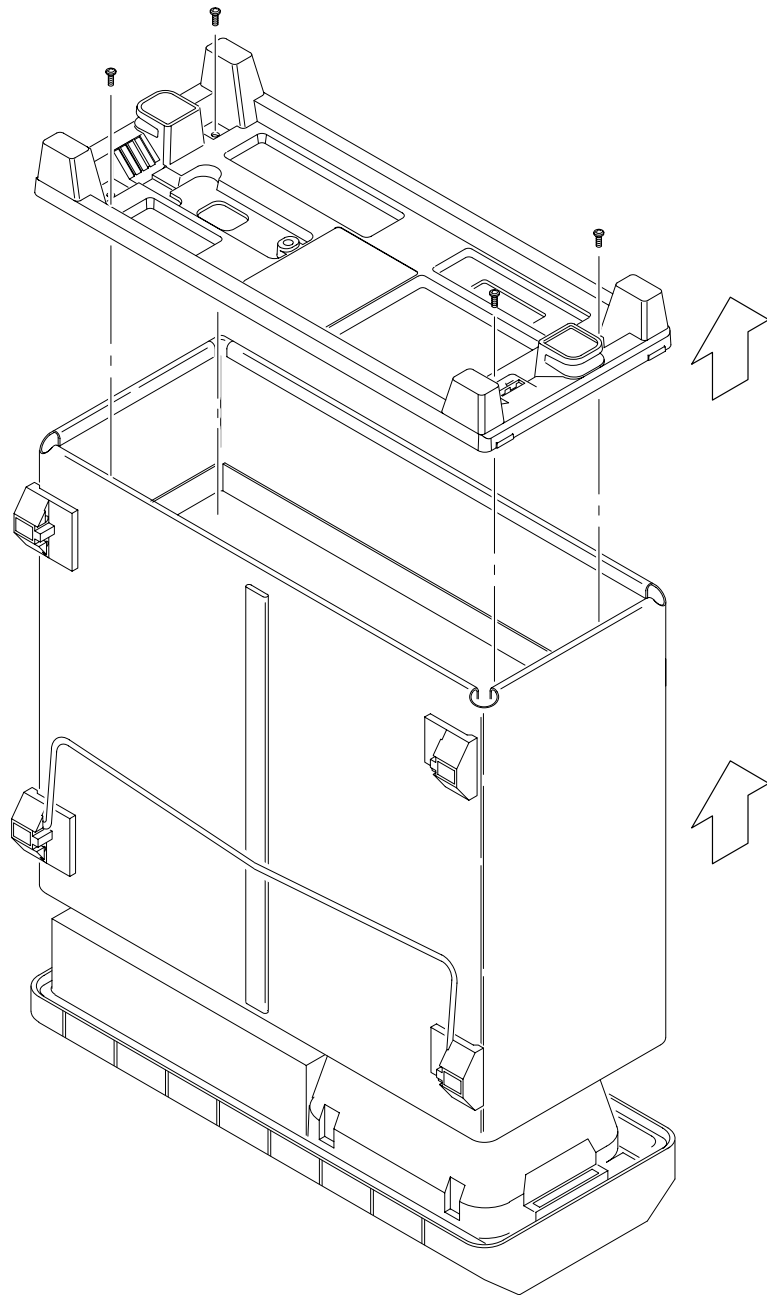


Figure 6-6: Rear Cover and Cabinet Removal

**Front Cover, Trim Ring,
Menu Buttons, and Input
Panel**

1. *Assemble equipment and locate modules to be removed:* No tools are needed. Locate the modules to be removed in the locator diagram *External Modules*, Figure 6-1.

2. *Orient the logic scope:* Set the logic scope so its rear is down on the work surface and its bottom is facing you.
3. *Remove the front cover:* Grasp the front cover by its left and right edges and snap it off of the front subpanel. (When reinstalling, align and snap back on.)

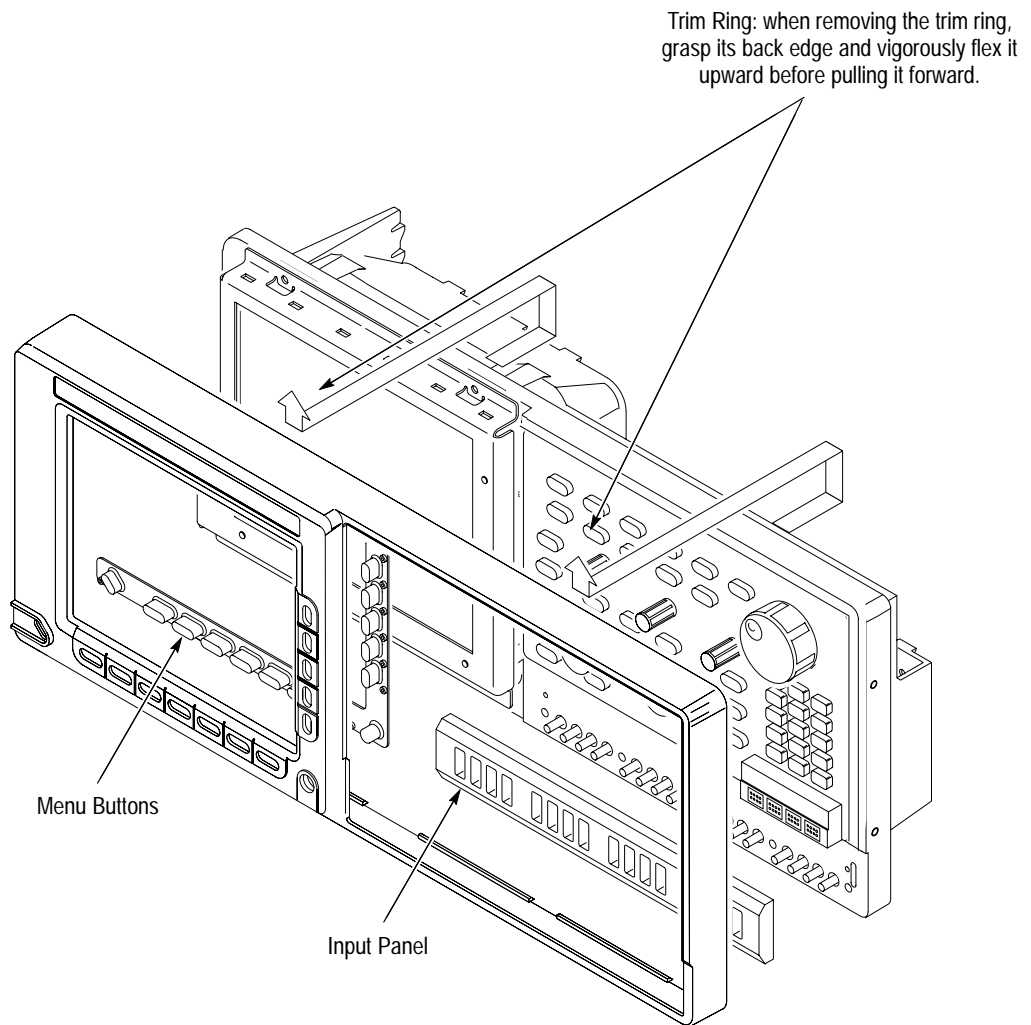


Figure 6-7: Front Cover, Trim Ring, Menu Buttons, and Input Panel Removal (Front Cover not Shown)

STOP. DO NOT touch the carbon contact points on the menu buttons installed in the trim ring. Also, do not touch the contacts on the flex circuit exposed when you remove the trim ring.

4. *Remove the trim ring:* Grasp the trim ring by its top edge and pry it up and lift it forward to snap it off of the front subpanel. If servicing the menu buttons, lift them out of the trim ring. (When reinstalling, reinsert the menu buttons, align the trim ring to the front subpanel and press it back on.)

STOP. DO NOT touch the contacts on the flex circuit exposed when you remove the input panel in the step that follows.

5. *Remove the input panel:* Gently pry, using your fingers, the snap-off/snap-on input panel away from the front subpanel to remove it. (When reinstalling, use your hands to press it back on.)
6. *Reinstallation:* Do in reverse steps 3–5 to reinstall the input panel, menu buttons, trim ring, and the front cover, following the reinstallation instructions found in each step.

A12 Front-Panel Assembly and Probe Calibrator

NOTE. *This procedure includes removal and reinstallation instructions for the front panel and front panel buttons. Unless either of those modules are being serviced, do not do step 5, “Further disassembly of front-panel assembly.”*

1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2).
 - b. Locate the modules to be removed in the locator diagram *External Modules*, Figure 6–1.
 - c. Do the procedure *Front Cover, Trim Ring, Menu Buttons, and Input Panel*, steps 1–5, immediately preceding this procedure.
2. *Orient the logic scope:* Set the logic scope so its bottom is down on the work surface and its front is facing you.
3. *Remove the front-panel assembly:*
 - a. Lift the front-panel assembly out of the front subpanel until you can reach the interconnect cable connecting it to the processor/display board.
 - b. Disconnect that cable at J2 of the processor/display board. Disconnect the flex-board connector at P3 of the front-panel assembly. (The flex board is part of the display-frame assembly.)
 - c. Finally, lift the front-panel assembly out of the front subpanel to complete the removal.

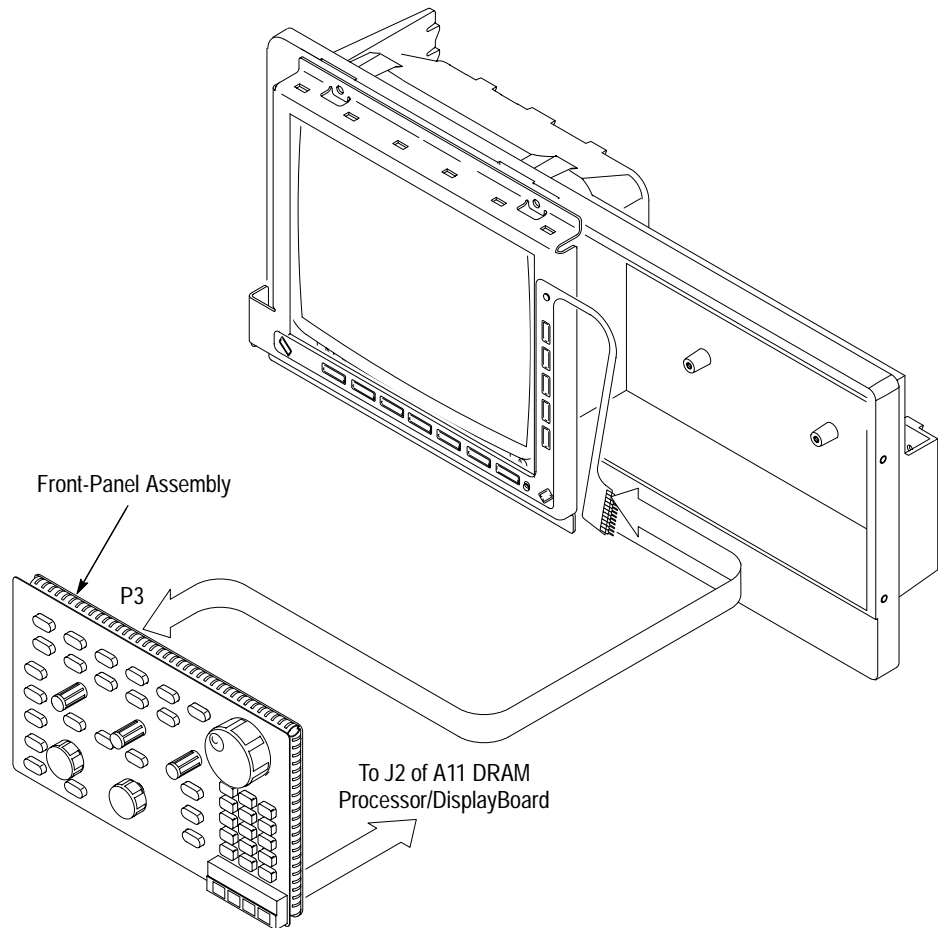


Figure 6-8: A12 Front-Panel Assembly Removal

4. *Remove the probe calibrator:* If the probe calibrator is to be serviced, remove the two nuts securing it to the front panel assembly. See Figure 6-9.
5. *Further disassembly of front-panel assembly:* If the front panel or the front-panel buttons are to be serviced, do the following substeps:
 - a. Remove the front-panel control knobs from the front-panel assembly using the method described in *Front-Panel Knobs* on page 6-16.
 - b. Remove the eight screws mounting the front-panel board to the front panel.
 - c. Now hand disassemble the front-panel assembly components using Figure 6-9 as a guide. Reverse procedure to reassemble, using the same Figure 6-9 as a guide.

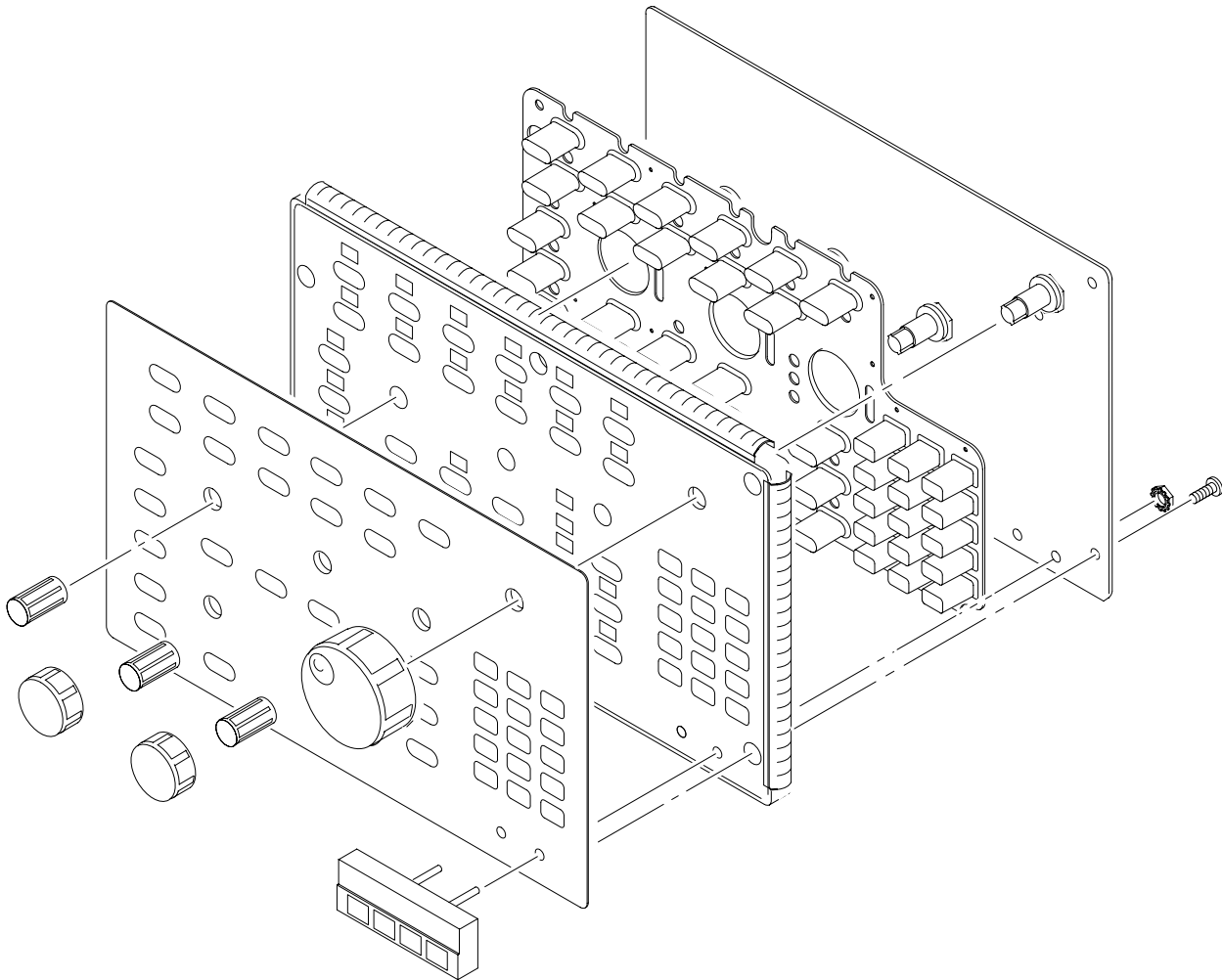


Figure 6–9: Disassembly of Front-Panel Assembly

6. Reinstallation:

- a. If the front-panel assembly was further disassembled in step 5, then reverse substeps 5a–5c to reassemble, using Figure 6–9 as a guide.
- b. If the probe calibrator was removed, reinstall it using Figure 6–9 as a guide. Be sure to align the calibrator cover flush to the front panel before installing the two nuts removed in step 4.
- c. Then do step 3, reversing the procedure outlined in each substep. Last, reinstall the trim ring and, if desired, the front cover, referring to the procedure *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6–21).

Display-Frame Assembly

1. *Assemble equipment and locate modules to be removed:* Have handy a screwdriver with a size T-15 Torx® (Items 1 and 2). Locate the modules to be removed in the locator diagram *External Modules*, Figure 6-1, page 6-12.
2. *Orient the logic scope:* Set the logic scope so its bottom is down on the work surface and its front is facing you.
3. *Remove the display-frame assembly:*
 - a. Do the procedure *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6-21) to remove the front cover and trim ring.
 - b. Lift the front-panel assembly out of the front subpanel until you can reach J2 on the front-panel assembly. Disconnect the flex cable coming from the display-frame assembly at J39 of the front-panel assembly.
 - c. Remove the three screws securing the display-frame assembly to the front subpanel and remove that assembly.
4. *Reinstallation:*
 - a. Do, in reverse order, substeps 3b-3c, reversing each step to reinstall the display-frame assembly. Then see the procedure *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6-21) to complete reassembly of the logic scope.

Cabinet Modules

1. *Assemble equipment and locate modules to be removed:* Have handy a pair of needle-nose pliers (Item 6). Locate the modules to be removed in the locator diagram *External Modules* (see Figure 6-1).
2. *Orient the logic scope:* Set the logic scope so the left side is down on the work surface and its handle is facing upwards.
3. *Remove the handle:*
 - a. Insert the tips of a pair of needle-nose pliers (Item 6) into the hole of either handle cap. Push and hold to depress the handle release (see Figure 6-10).
 - b. While holding the handle release depressed, pull the handle out of the slot in the handle cap. Repeat procedure to remove the handle from the other handle cap (see Figure 6-10).
 - c. Reverse procedure to reinstall.

4. *Remove the handle caps:*
 - a. Insert the retaining ring pliers (Item 8) into the opening created in the handle cap when you removed the handle.
 - b. While using the pliers to expand the handle cap outward, grasp it and snap it off.
 - c. Repeat procedure to remove the remaining cap as needed; push the cap(s) back on to reinstall.
5. *Remove the flip stand:* Grasp the flip stand by both sides near where it joins each flip stand foot. Now compress the flip stand until the flip stand ends clear the flip stand feet to complete the removal (see Figure 6–10).
6. *Remove the flip stand foot (or feet):*
 - a. Do *Rear Cover and Cabinet* procedure (page 6–19) to gain access to the inside of the cabinet.
 - b. Working from inside the cabinet, push the two retainers to release the flip stand foot you wish to remove and lift it away from the outside of the cabinet (see Figure 6–10).
 - c. Repeat procedure to remove as many of the remaining feet as needed; insert the two retainers back in their slots in the cabinet and snap into place any flip stand foot removed.
7. *Reinstallation:* If any flip stand feet were removed, reinstall as directed in step 6c; then see *Rear Cover and Cabinet* procedure (page 6–19) to reinstall the rear cover and cabinet. Do in reverse order steps 3 and 5, reversing each step, to reinstall the flip stand, then the handle caps (if removed), then the handle.

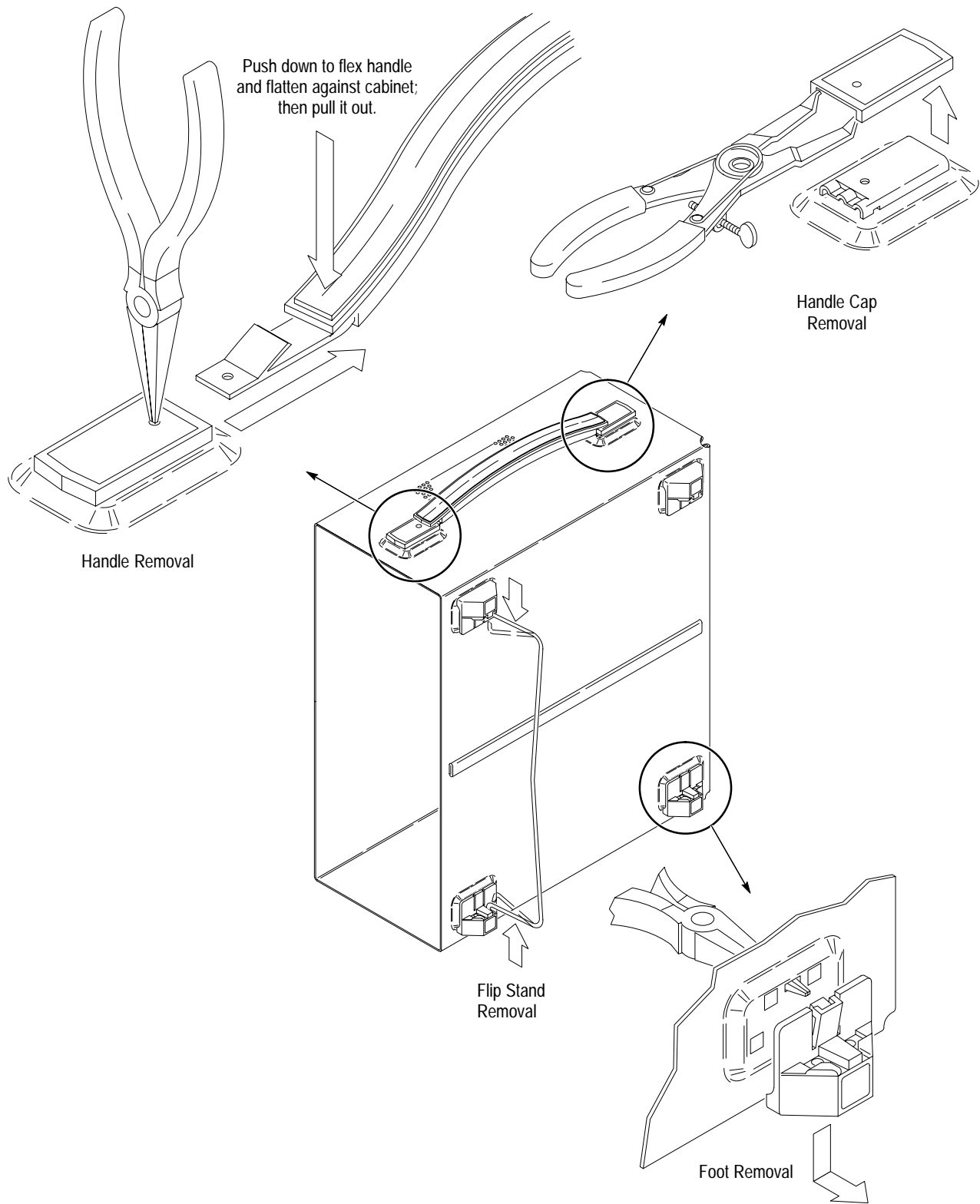


Figure 6-10: Cabinet Modules Removal

Procedures for Outer-Chassis Modules

Do the *Access Procedure* (page 6–14) before doing any procedure in this collection. The procedures found here, listed in order presented, follow.

- *Input Cable Assembly*
- *Probe Flex Circuit Replacement*
- *Fan*
- *A14 D1 Bus and Analog-Power and Digital-Power Cables*
- *A23 SerPar Board*
- *A11 Processor/Display Board*
- *Top Cover and Board Brackets*
- *Rear-Panel Cables*
- *A10 Acquisition Board*
- *Floppy Disk Drive*
- *Rear Chassis*

Input Cable Assembly

1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2).
 - b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6–2, page 6–13.
2. *Orient the logic scope:* Set the logic scope so its top is down on the work surface and its front is facing you.
3. *Remove the Input Cable Assembly:*
 - a. Unplug each of the 16 interconnect cables that connect to each of the 16 channel inputs from its jack on the Acquisition board. See Figure 6–11.
 - b. Now, remove the five screws you exposed when you removed the input panel (removed during the access procedure).
 - c. Complete the removal by lifting the *Input Cable Assembly* out of the front subpanel. Reverse the procedure to reinstall. Be careful to plug each cable into its correct jack — Figure 6–11 shows the correct orientation.

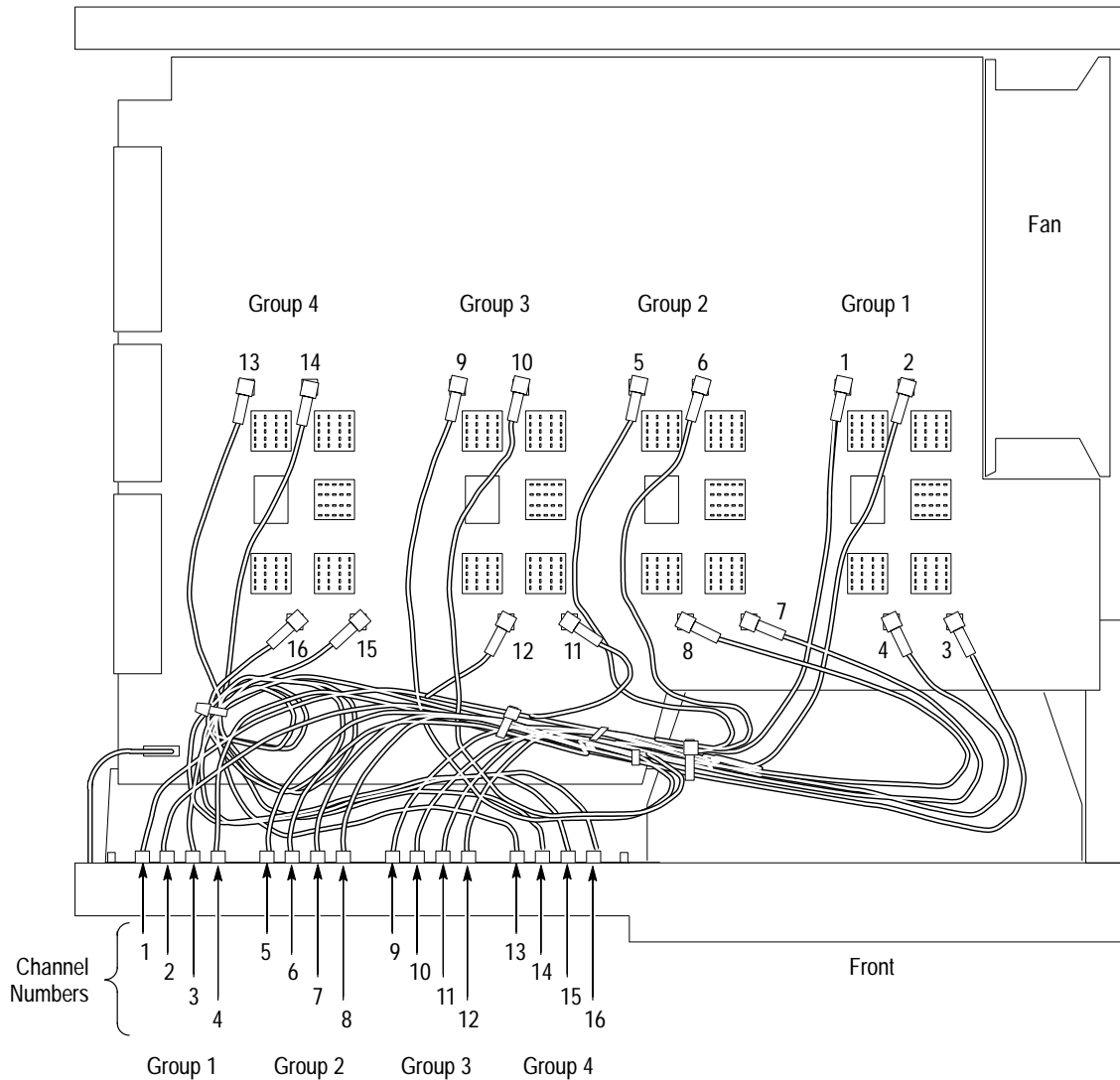


Figure 6–11: Input Cable Assembly Routing

4. *Reinstallation:* Do the following substeps to reinstall the input cable assembly:
 - a. If replacing the input cable assembly with a new unit from the factory, cut the three cable ties as shown in Figure 6–12. Do *not* cut any of the cable ties that gather the cables into bundles.
 - b. Do in reverse order substeps 3a–3c, reversing the removal instructions in each substep to reinstall the assembly. Be sure to connect each numbered channel to the jack labeled with the same number (see Figure 6–11).

- c. Then see the following procedures, in the order listed, to complete reassembly of the logic scope.
 - *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6–16)
 - *Rear Cover and Cabinet* (page 6–19)

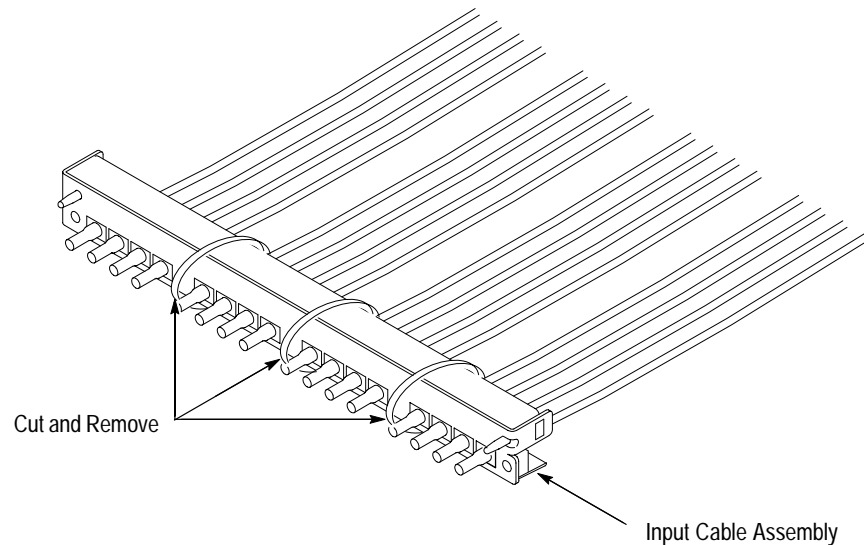


Figure 6–12: Cable Tie Removal for New Installations

Probe Flex Circuit Replacement

STOP. Do not perform the following procedure unless you are replacing a failed or damaged probe flex circuit with a fresh unit from the factory. (Removal of the circuit is likely to destroy it.) If such is not the case, skip this procedure.

1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2).
 - b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6–2, page 6–13.
2. *Orient the logic scope:* Set the logic scope so its top is down on the work surface and its front is facing you.
3. *Partially remove the Input Cable Assembly:*
 - a. Working from the front, remove the five screws mounting the input cable assembly to the front subpanel. (The heads of these screws were exposed

when you removed the input panel, which was removed during the access procedure.)

- b.** Lift the *Input Cable Assembly* out of the front subpanel (do not unplug the assembly from the A10 Acquisition Board) and route it out of the way. Reverse the procedure to reinstall.
- 4.** *Remove the probe flex circuit to be replaced:*
 - a.** Unplug it from J103 on the A10 Acquisition Board
 - b.** Pull the probe flex circuit away from the front subpanel. (It is held on by its sticky backing.)
 - c.** Route the non-connector end of the flex circuit from the front through the front subpanel to complete removal.
- 5.** *Clean the front subpanel:*
 - a.** Use a lint free cloth dampened in isopropyl alcohol to thoroughly clean from the surface area on the front subpanel upon which the probe flex circuit mounts. Remove as much adhesive as possible. (A small amount of adhesive from the flex circuit you removed will be left on the front of the chassis. This is normal.)
 - b.** Using a second lint free cloth dampened with deionized water, wipe the mounting surface of the front subpanel. Let dry.
- 6.** *Reinstall the Input Cable Assembly:* Do in reverse order substeps 3a and 3b.

STOP. DO NOT touch the contacts on the probe flex circuit with your bare fingers. You should wear clean cloth gloves that are free of lint when installing the probe flex circuit on the front chassis.

- 7.** *Install the new probe flex circuit:*
 - a.** Route the non-connector end of the probe flex circuit from the rear of the subpanel through to the front.
 - b.** Plug in the connector end to J103 on the A10 Acquisition Board.
 - c.** Peel the adhesive backing to expose the adhesive back of the probe flex circuit.
 - d.** Carefully align the two holes in flex circuit to the corresponding pins that protrude through the front subpanel (from the input cable assembly).
 - e.** Maintain alignment while pressing along the entire front surface of the flex circuit to ensure adhesion to the front subpanel.

- Clean the surface of the probe flex circuit just installed using isopropyl alcohol and a clean, lint-free cloth.
8. *Reassemble the logic scope:* See the following procedures, in the order listed, to complete reassembly of the logic scope.
- *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6–21)
 - *Rear Cover and Cabinet* (page 6–19)

Fan

1. *Assemble equipment and locate module to be removed:* Have handy a screwdriver with a size T-20 Torx® tip (Items 1 and 4). Locate the fan in the locator diagram *Outer-Chassis Modules*, Figure 6–2, page 6–13.
2. *Orient the logic scope:* Set the logic scope so its bottom is down on the work surface and its left side is facing you.
3. *Disconnect the fan from processor/display board:* Unplug the fan’s power cable from J20.
4. *Remove the fan:* Remove the two screws securing the fan to the main chassis and lift the fan away from the chassis.
5. *Reinstallation:* Do in reverse order steps 3 and 4, reversing the removal instructions in each step to reinstall the assembly. See the procedure *Rear Cover and Cabinet* (page 6–19) to complete reassembly of the logic scope.

A14 D1 Bus and Analog-Power and Digital-Power Cables

1. *Assemble equipment and locate modules to be removed:* Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2). Find the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6–2, on page 6–13.
2. *Orient the logic scope:* Set the logic scope so its left side is down on the work surface and its front is facing you.
3. *Remove the D1 bus:* Grasp the D1 bus and pull it up from the logic scope to unplug it from its two plug-in connectors. (J28 is the connector on the processor/display board; J100 is on the acquisition board.) Reverse these removal instructions to reinstall. See Figure 6–13.

4. *Remove the analog-power and digital-power interconnect cables:*
 - a. Unplug the analog-power cable at J26 on the display processor board, at J5 on the low-voltage power supply, and at J700 on the acquisition board.
 - b. Unplug the digital-power cable at J27 on the display processor board, at J6 on the low-voltage power supply, and at J101 on the acquisition board.

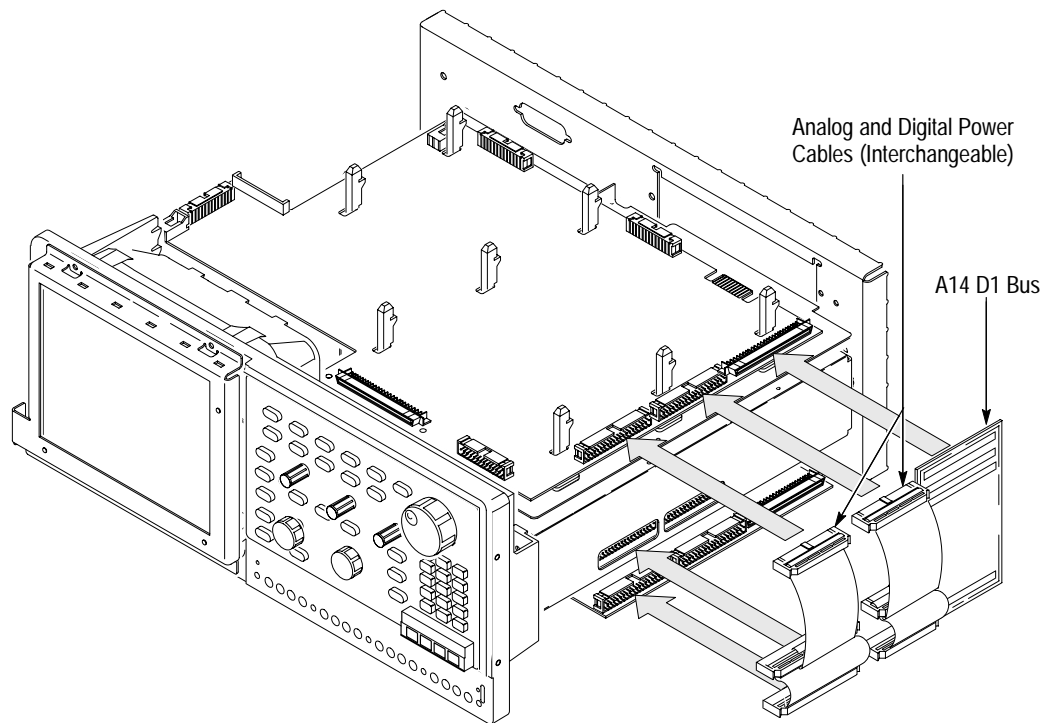


Figure 6-13: A14 D1 Bus and Analog-Power and Digital-Power Cables Removal

5. *Reinstallation:*
 - a. Do in reverse order steps 3 and 4, reversing the procedure outlined in each step to reinstall the assembly.
 - b. When installing the D1 bus be sure to orient it so the single connector at the bottom of the bus plugs into the acquisition board.
 - c. See the following procedures, in the order listed, to complete reassembly of the logic scope.
 - *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6-21)
 - *Rear Cover and Cabinet* (page 6-19)

A23 SerPar Assembly

1. *Assemble equipment and locate module to be removed:*
 - Have handy a screwdriver with a size T-20 Torx® tip (Items 1 and 4) and one $\frac{3}{16}$ inch nutdriver.
 - Locate the *A23 SerPar Board* in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.
2. *Remove circuit board assembly:*
 - a. Using a screwdriver with size T-20 Torx® tip, remove the two screws (number 4 in Figure 6-14) securing the rear plate of the circuit board assembly.

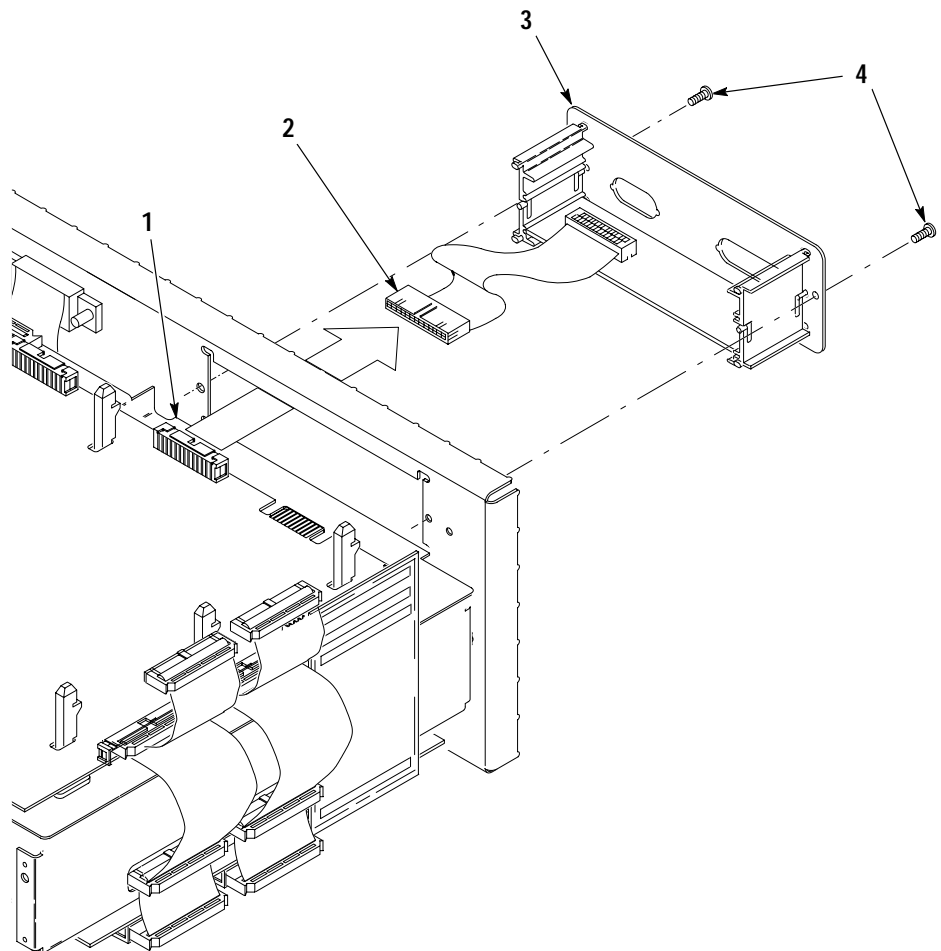


Figure 6-14: Circuit Board Assembly Removal

- b. Disconnect the cable connector (number 2) from the processor-display circuit board connector (number 1).
 - c. Pull out the A23 SerPar Board assembly (number 3) from the rear of the logic scope.
3. *Remove circuit board from assembly:*
- a. Using a 3/16-inch nutdriver, remove the four lock connectors (number 3 in Figure 6–15) securing the circuit board to the rear plate.
 - b. Separate the circuit board with attached cable (number 1), from the rear plate with attached brackets (number 2).

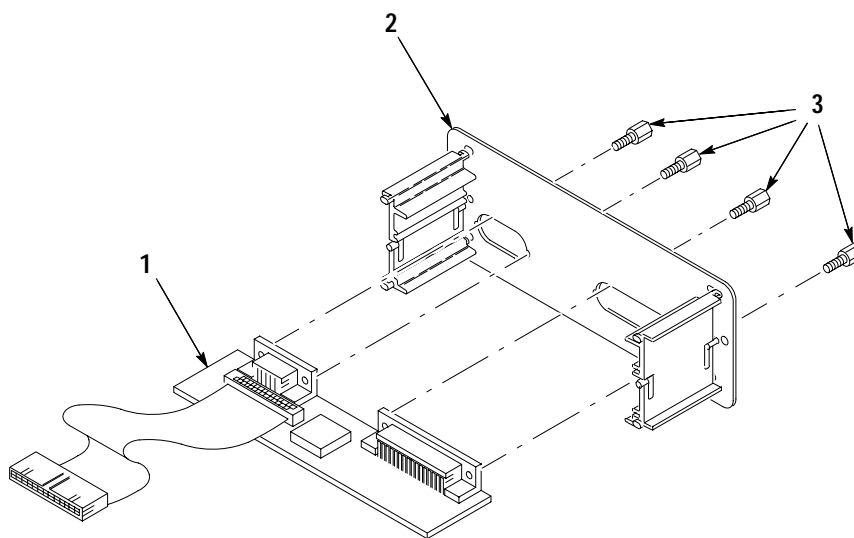


Figure 6–15: Remove Circuit Board From Assembly

4. *Reinstallation::*
- a. Do in reverse order substeps 3a and 3b of this procedure.
 - b. Reinstall the A23 SerPar Board assembly in the logic scope. Do in reverse substeps 2a through 2c of this procedure.
 - c. See the following procedures, in the order listed, to complete reassembly of the logic scope:
 - *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6–21).
 - *Rear Cover and Cabinet* (page 6–19).

- d. To ensure the A23 SerPar Board is working correctly, perform the power-up short diagnostics procedure described on page 6–57.

A11 Processor/Display Board

1. *Assemble equipment and locate modules to be removed*
 - a. Have handy a screwdriver with a size T-20 Torx® tip (Items 1 and 4).
 - b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6–2, page 6–13.
 - c. Do the procedure *A14 D1 Bus and Analog-Power and Digital-Power Cables* on page 6–33 to remove those interconnect cables.
2. *Orient the logic scope*: Set the logic scope so its bottom is down on the work surface and its rear is facing you.
3. *Disconnect the fan from processor/display board*: Unplug the fan’s power cable from J20.
4. *Remove the processor/display board*: Use Figure 6–16 as a guide while doing the following substeps:
 - a. Working from the rear panel, remove the two screws mounting the support bracket in the rear panel. Then lift it out from the rear panel.
 - b. Unplug the interconnect cable from the GPIB connector on the rear cover at J35 of the processor/display board. Disconnect the bus cable at J5. Unplug J62 video signal connector, J51 Monitor VGA connector, J37 RS232/Centronics connector, and J38 floppy drive connector.
 - c. Grasp the board by its right and left sides and pull it towards the rear of the logic scope. This will disconnect the processor/display board from the eight board mounts securing the board above the top cover.
 - d. Lift the board up away from the logic scope chassis to complete the removal.
5. *Reinstallation*:
 - a. Do, in reverse order, steps 3 through 4 reversing the removal instructions of each step to reinstall the processor/display board.
 - b. See the procedures *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6–33), *A23 SerPar Board* (page 6–35) and *Rear Cover and Cabinet* (page 6–19) to complete reassembly of the logic scope.

First, unplug the cables at J38 and J35.

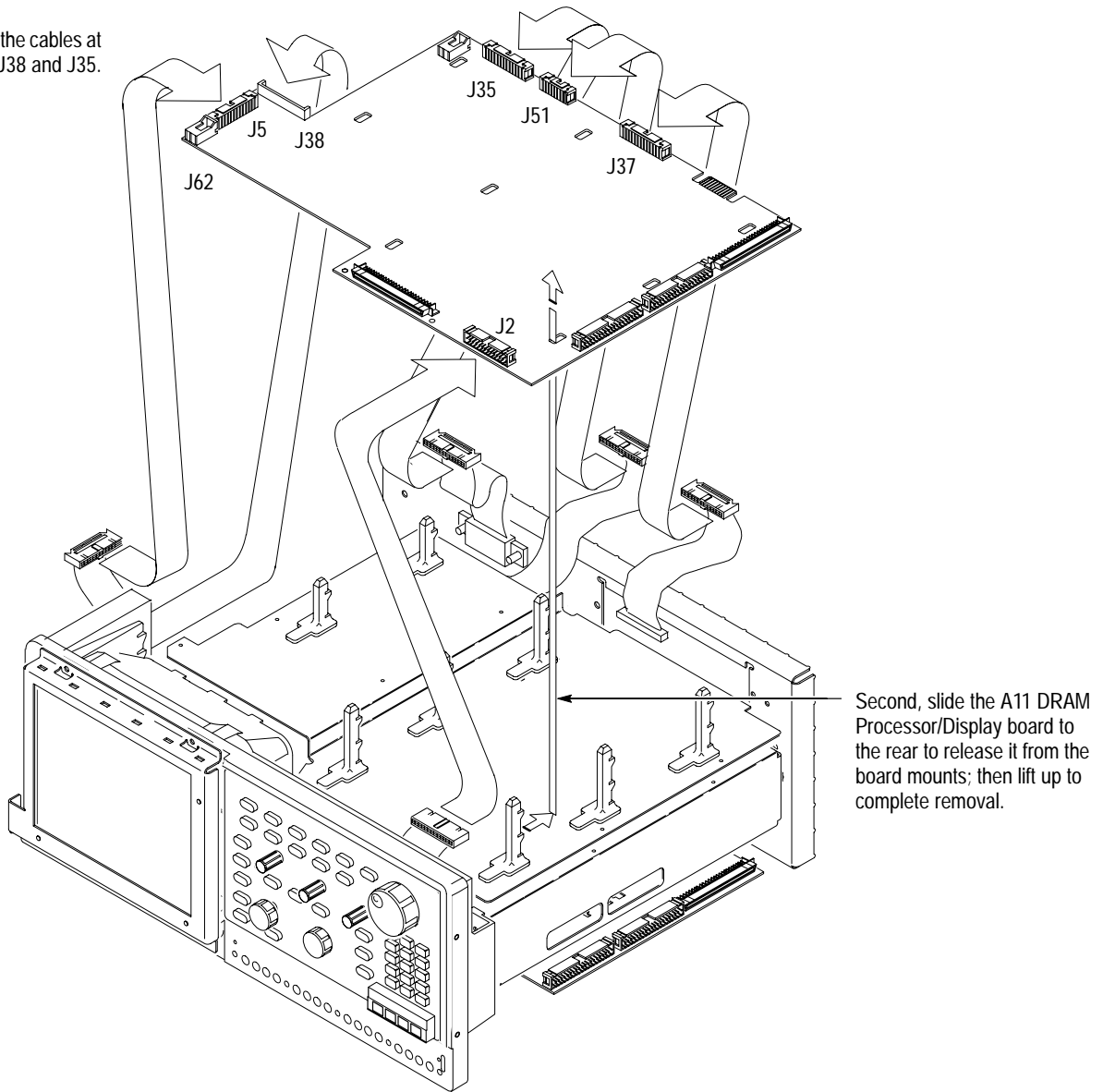


Figure 6-16: A11 Processor/Display Removal

Top Cover and Board Brackets

1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2) and, if removing any *board mount*, a flat-bladed screwdriver (Item 5).
 - b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6–2, page 6–13.
 - c. Do the procedures *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6–33) and *A11 Processor/Display Board* (page 6–37) to remove those modules.
2. *Orient the logic scope:* Set the logic scope so its bottom is down on the work surface and its front is facing you.
3. *Remove the top cover:* Remove the 12 screws securing the top cover to the main chassis, then slide it back until its front edge clears the retainers in the front subpanel. Lift the top cover away to complete removal.
4. *Remove the board mount(s):* From the top side of the top cover, use the flat-bladed screwdriver to pry up the retainer lug until it clears the slot in the front cover. While holding the lug clear of the slot, push the mount towards the rear until it releases. See Figure 6–17. (When reinstalling, be sure to align the lug properly and be sure it snaps into its slot.)

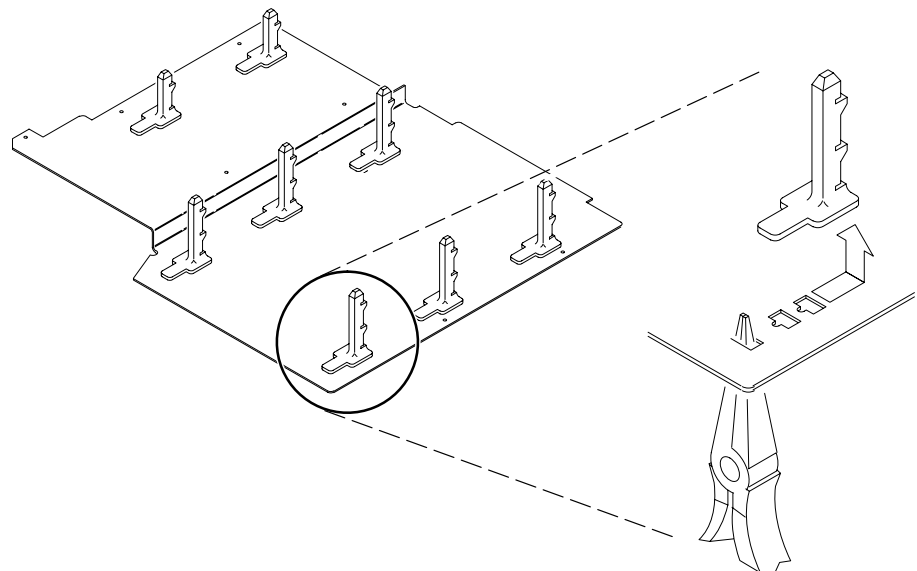


Figure 6–17: Board Bracket Removal

5. Reinstallation:

- a.** Do in reverse order steps 3 and 4, reversing the procedure outlined in each step to reinstall the assembly. Then see the following procedures, in the order listed, to complete reassembly of the logic scope.
 - *A11 Processor/Display Board* (page 6–37)
 - *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6–33)
 - *A23 SerPar Board* (page 6–35)
 - *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6–21)
 - *Rear Cover and Cabinet* (page 6–19)

Rear-Panel Cables

- 1.** *Assemble equipment and locate modules to be removed:* Have handy a pair of needle nose pliers (Item 6) and a 1/4 inch nut driver (Item 7).
- 2.** *If removing the GPIB cable, do the following substeps:*
 - a.** Unplug the GPIB cable from its jack (J35) of the processor/display board.
 - b.** Working from the rear panel and using the 1/4 inch nut driver, unscrew the two hex-headed mounting posts that secure the cable to the rear chassis.
 - c.** Working from inside the logic scope, lift the cable out of the rear chassis.
- 3.** *If removing any cable connected to the rear panel BNC connectors, do the following:*
 - a.** Do the procedure *A10 Acquisition Board*, on page 6–41.
 - b.** Using a pair of needle nose pliers, reach between the main chassis and the rear chassis and unplug the cable to be removed.
 - c.** Lift it away from the logic scope to remove it.
- 4.** *Reinstallation:* Reverse substeps in steps 2 and 3 to reinstall any cables removed. The routing of each rear cable removed in step 2 is shown in Figure 6–18 on page 6–42. See the procedure *A10 Acquisition Board* to reinstall the acquisition board if it was removed.

A10 Acquisition Board

1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2).
 - b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.
 - c. Do the procedure *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-33) to remove the D1 bus and the interconnect cables.
 - d. Do the procedure *Input Cable Assembly* (page 6-29) to disconnect the 16 input cables from the acquisition board. Do not remove the input cable assembly from the front subpanel.
2. *Orient the logic scope:* Set the logic scope so its top is down on the work surface and its front is facing you.
3. *Remove the Acquisition Board:* Use Figure 6-18 as a guide.
 - a. Disconnect the cables from AUX TRIGGER INPUT (at J600), MAIN TRIGGER OUT (at J300), DELAYED TRIGGER OUT (at J301).
 - b. Remove the two screws used to secure the noise reduction shield to the rear chassis.
 - c. Remove the eight screws that mount the acquisition board to the main chassis and lift the board away from the main chassis to complete removal.
4. *Reinstallation:* Do, in reverse order, substeps 3a-3c reversing each step to reinstall the *acquisition board*. Then see the following procedures, in the order listed, to complete reassembly of the logic scope:
 - *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-33).
 - *Input Cable Assembly* (page 6-29).
 - *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6-21).
 - *Rear Cover and Cabinet* (page 6-19).

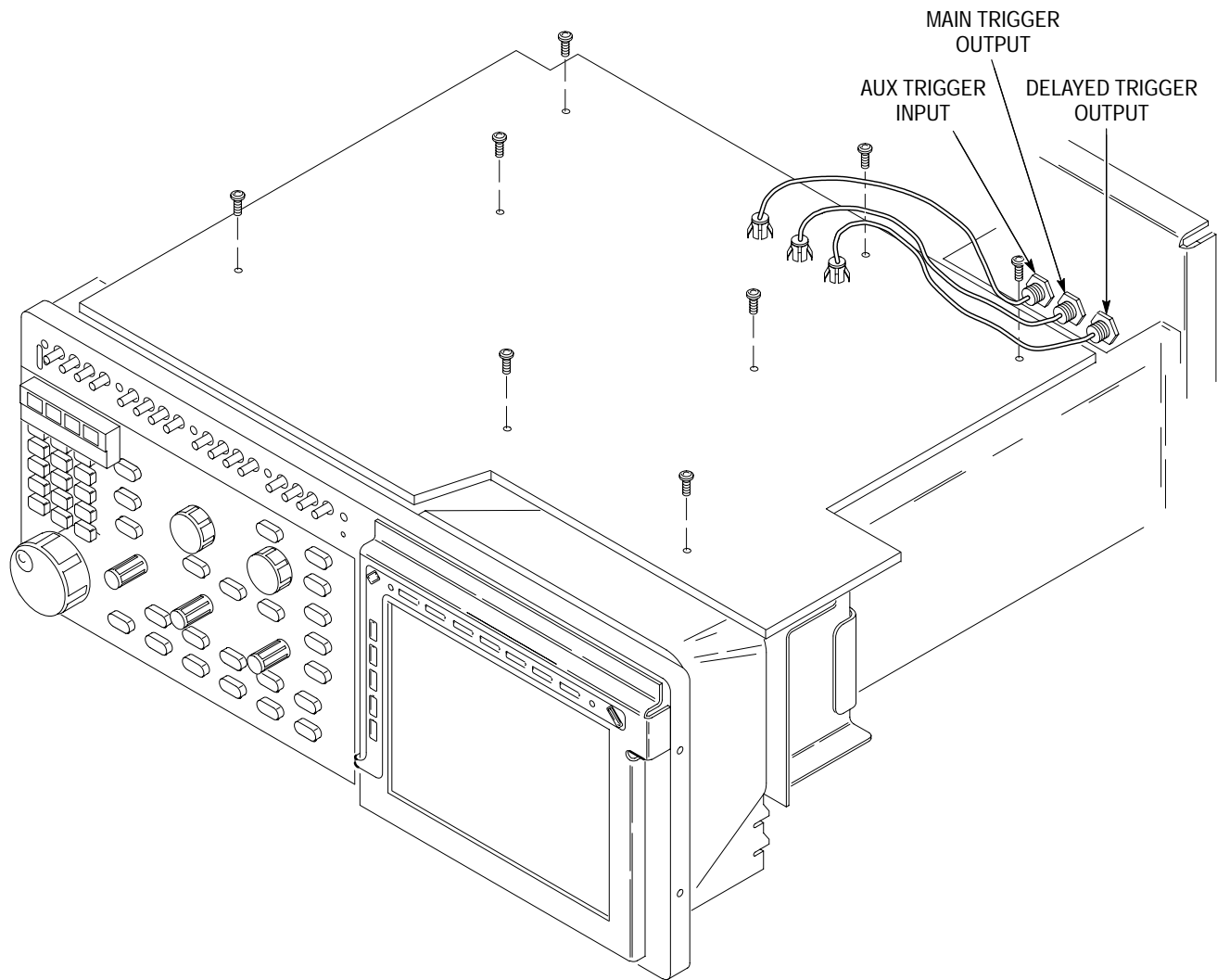


Figure 6-18: A10 Acquisition Board Removal

Floppy Disk Drive

1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2) and a screwdriver with a small Phillips head.
 - b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.
2. *Orient the logic scope:* Set the logic scope so its top is down on the work surface and its front is facing you.

- 3.** *Remove the Floppy Disk:* Use Figure 6–19 as a guide.
 - a.** Unplug the J38 disk cable connector (ribbon interconnect cable) that connects the disk drive to the A11 Processor/Display board.
 - b.** You can either remove the disk drive by itself or the drive with its disk bracket. To remove the drive and the disk bracket skip to step c. To remove the drive by itself, unscrew the 2 retaining Phillips screws on the sides of the disk. Then pull out the disk.
 - c.** To remove the disk drive and the disk bracket together, remove the two T15 torque screws holding the bracket to the chassis. Then remove the disk and the brackets as a unit.

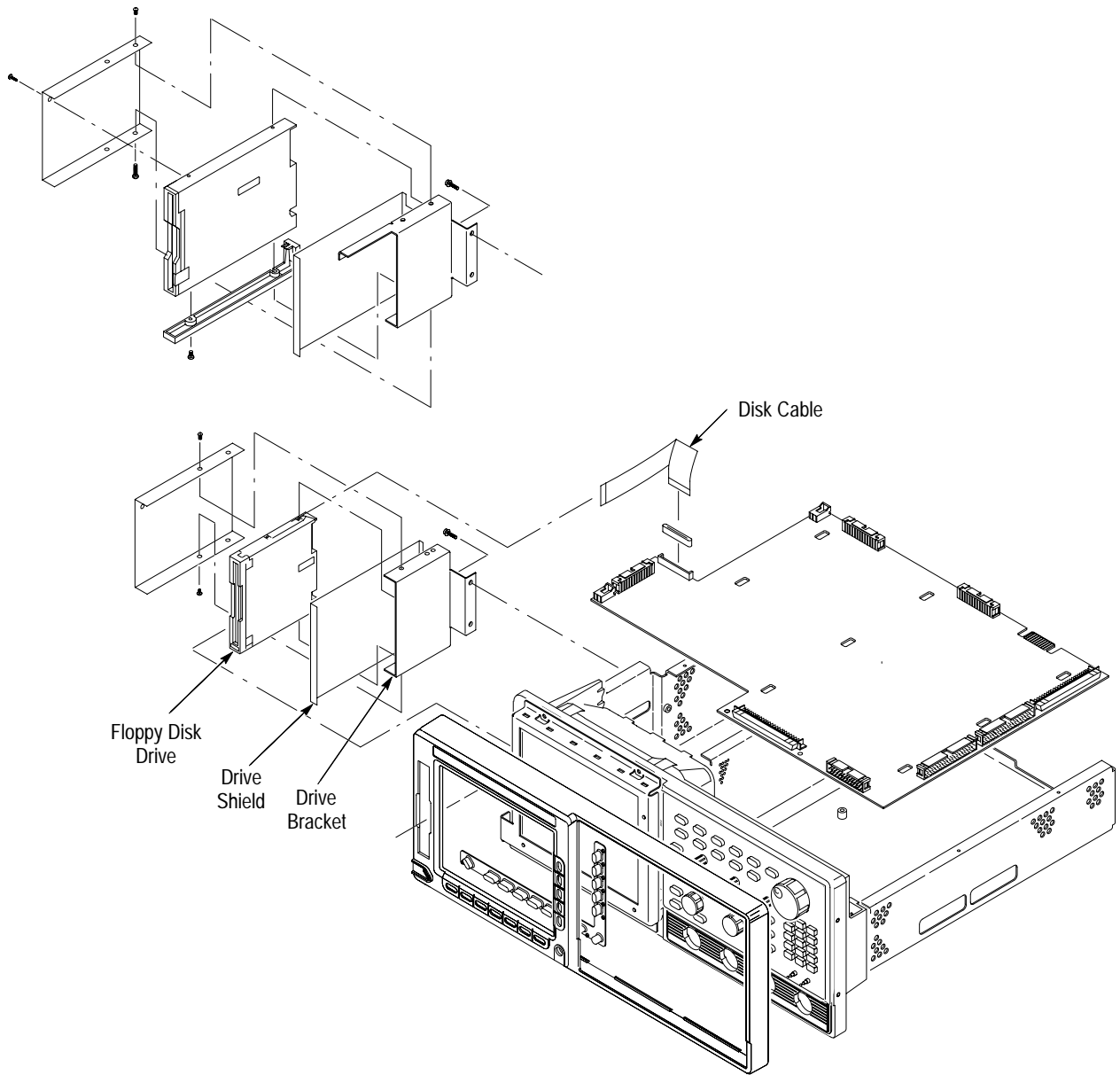


Figure 6-19: Floppy Disk Removal

4. *Reinstallation:* Do, in reverse order, substeps 3c then 3a or 3b then 3a to reinstall the *floppy disk*. Then see the following procedures, in the order listed, to complete reassembly of the logic scope:
 - *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6-21).
 - *Rear Cover and Cabinet* (page 6-19).

Rear Chassis

1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2) and a T-20 Torx® tip (Item 4).
 - b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.
 - c. Install the front cover if it is not already installed.
2. *Orient the logic scope:* Set the logic scope so its bottom is down on the work surface and its rear is facing you.
3. *Remove the rear chassis:* Use Figure 6-20 as a guide when doing the following substeps:
 - a. Unplug the GPIB interconnect cable at J32 of the processor/display board.
 - b. Remove the 6 screws securing the rear chassis to the main chassis and the two screws securing it to the low-voltage power-supply shield.
 - c. Lift the rear chassis up slightly to access the cables connected to it. Disconnect those cables from AUX TRIGGER INPUT (at J600), MAIN TRIGGER OUT (at J300), DELAYED TRIGGER OUT (at J301), all found on the acquisition board.
4. *Reinstallation:* Do, in reverse order, substeps 3a-3c, reversing each step to reinstall the rear chassis. Then see the following procedures, in the order listed, to complete reassembly of the logic scope.
 - *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-33)
 - *Rear Cover and Cabinet* (page 6-19)

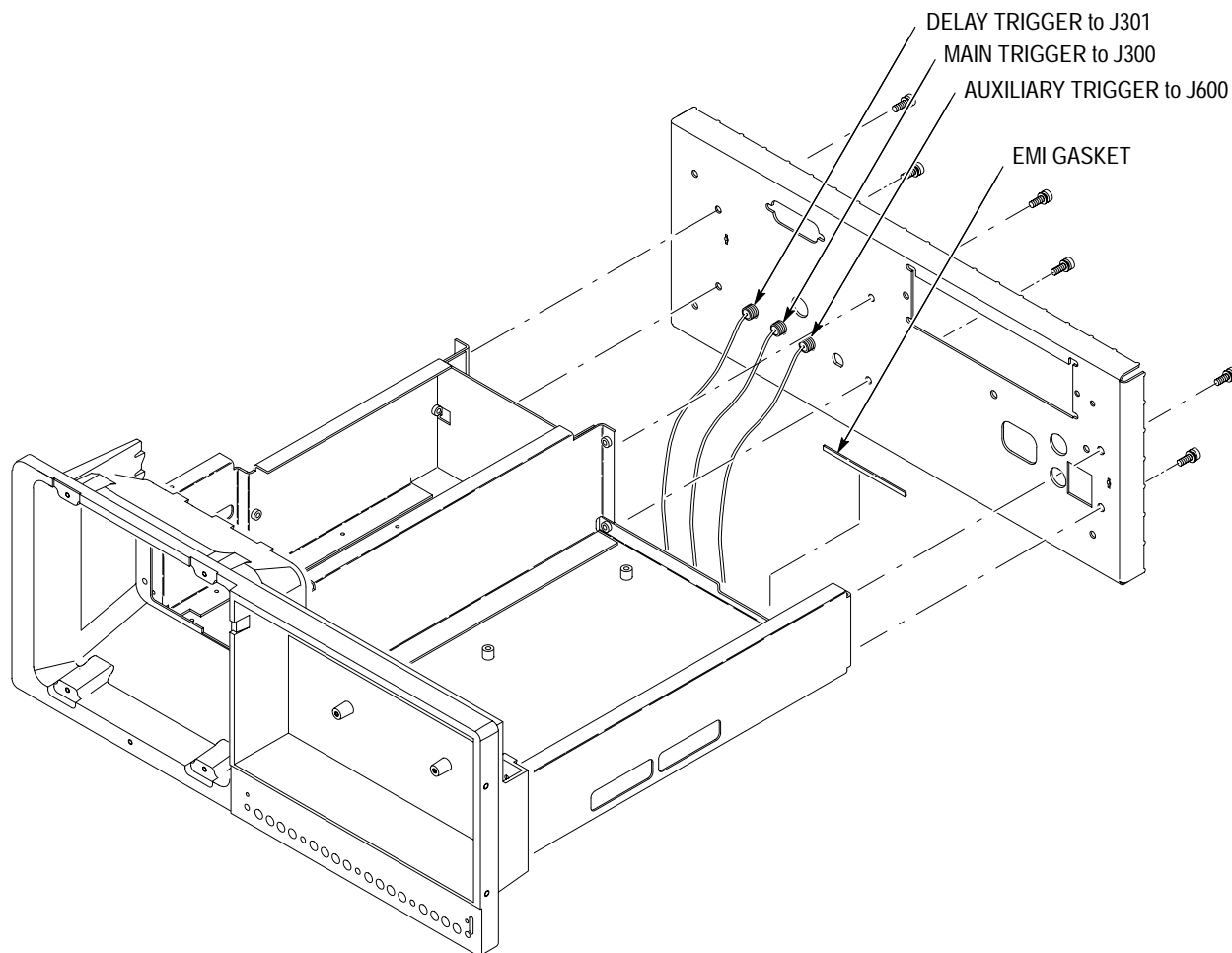


Figure 6–20: Rear Chassis Removal

Procedures for Inner-Chassis Modules

You should have completed the *Access Procedure* (page 6–14) before doing any of the procedures for the Inner-Chassis modules. The procedures are presented in the following order:

- *A16 Low Voltage Power Supply*
- *A30 Display Assembly and Supply Fuse*
- *Front Subpanel*
- *Main Chassis*

A16 Low Voltage Power Supply

1. *Assemble equipment and locate modules to be removed:* Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2). Locate the modules to be removed in the locator diagram *Inner-Chassis Modules*, Figure 6-2, page 6-13.
2. *Orient the logic scope:* Set the logic scope so its bottom is down on the work surface and its rear is facing you.
3. *Remove the low-voltage power supply:*



CAUTION. *If any RTV Silicon is removed from the logic scope, it must be replaced in order to maintain the warranted characteristics for random vibration.*

- a. Working from the rear of the logic scope, remove the two screws securing the low-voltage power supply to the rear chassis. See Figure 6-21.
 - b. Now, working from the top of the logic scope, remove the seven screws, indicated in Figure 6-21, that mount the supply to the main chassis.
 - c. Grasp the supply at the points indicated in the same figure and lift the board up out of the logic scope to complete removal.
4. *Reinstallation:* Do, in reverse order, substeps 3a through 3c reversing each step to reinstall the low-voltage power supply. Then see the following procedures to complete the reassembly:
 - *Top Cover and Board Brackets* (page 6-39)
 - *All Processor/Display Board* (page 6-37)
 - *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-33)
 - *Rear Cover and Cabinet* (page 6-19)

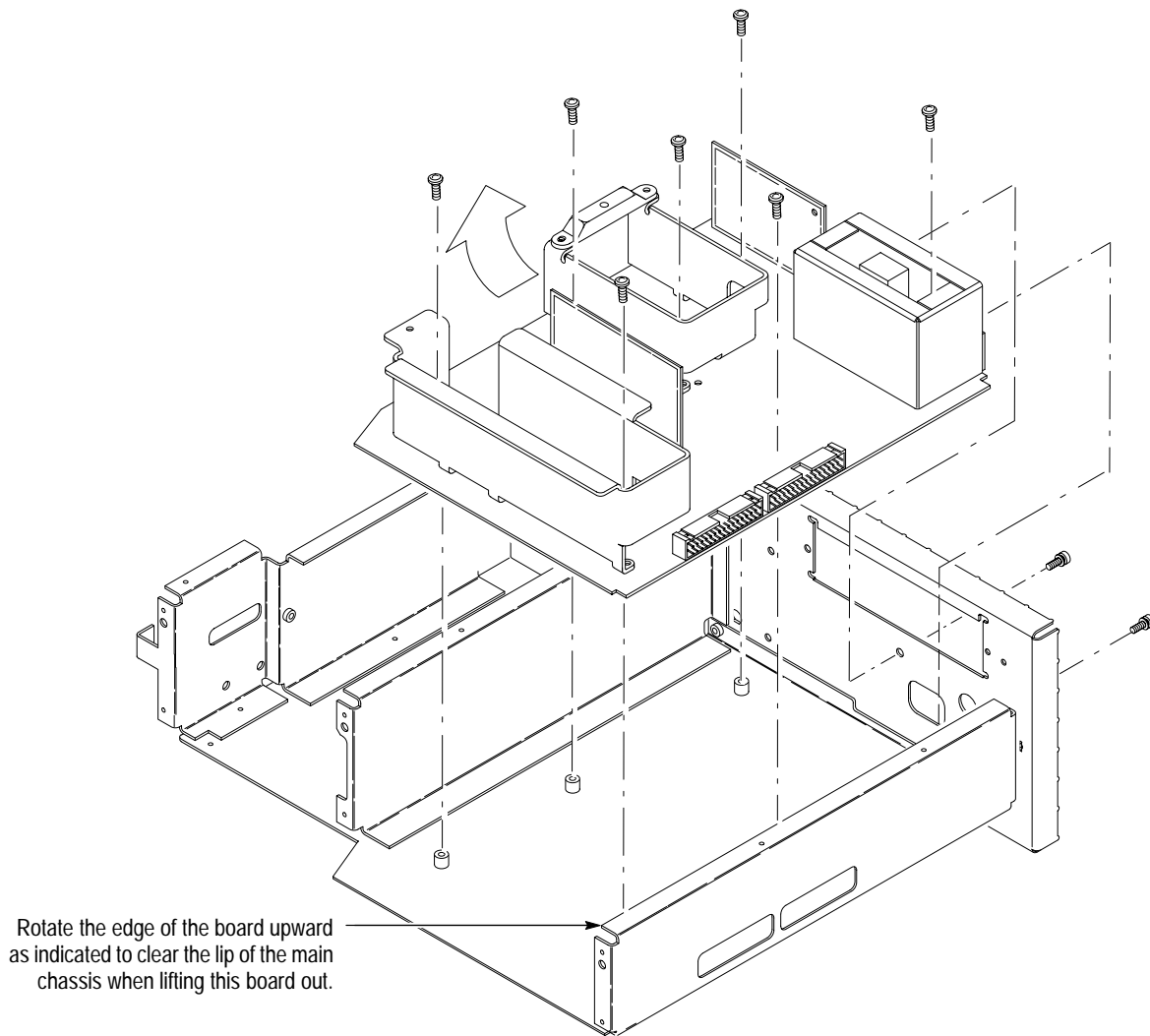


Figure 6-21: A16 Low Voltage Power Supply Removal

A30 Display Assembly and Supply Fuse

NOTE. The display and the display-driver board are a single module and must be removed and replaced as such. They are listed as a single module in the Replaceable Parts List.

1. *Assemble equipment and locate modules to be removed:* Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2). Locate the modules to be removed in the locator diagram *Inner-Chassis Modules*, Figure 6-2, page 6-13.

2. *Orient the logic scope:* Set the logic scope so its bottom is down on the work surface and its rear is facing you.
3. *Remove the high-voltage fuse:* If you are servicing this fuse, remove the fuse from its fuse holder on the display-driver board. Reverse the procedure to reinstall.



WARNING. Display tube handling: Use care when handling a display tube. If you break a display tube it may implode, scattering glass fragments with high velocity and possibly injuring you. Wear protective clothing, including safety glasses (preferably a full-face shield). Avoiding striking the display tube with or against any object.

Display tube storage: Store the display tube face down in a protected location, placing it on a soft, nonabrasive surface to prevent scratching the face plate.

4. *Remove the display tube:* Take the precautions outlined in the warning above. Reference Figure 6-22 while doing the following substeps.
 - a. Unplug the display tube connector from the back of the display tube and the display tube yoke connector from the display circuit board (J340).
 - b. Remove the two screws that secure the band circling the front of display tube to the front subpanel. Carefully guide display tube forward to partially remove it from the front subpanel and to access the anode lead connected to the display tube.



WARNING. High-voltage is present on the anode lead. Before unplugging the anode in the following substep, you must discharge it: ground a flat-bladed screwdriver (Item 5) with an insulated handle to the chassis through a suitable grounding strap. Next, probe under the insulating cap of the anode lead and touch the lead's metal conductor to discharge. Repeat. After unplugging the anode in substep d, touch its metal conductor to the chassis for a few minutes to further ensure discharge.

- c. Discharge the anode lead as described in the immediately preceding **WARNING**, unplug it from the display tube, and discharge that lead (again see **WARNING**).
- d. Be sure you have read the **WARNING** on display tube handling and storage found at the start of this display tube removal procedure. Then pull the display tube out through the front subpanel to complete removal. Store as directed in the **WARNING** message.

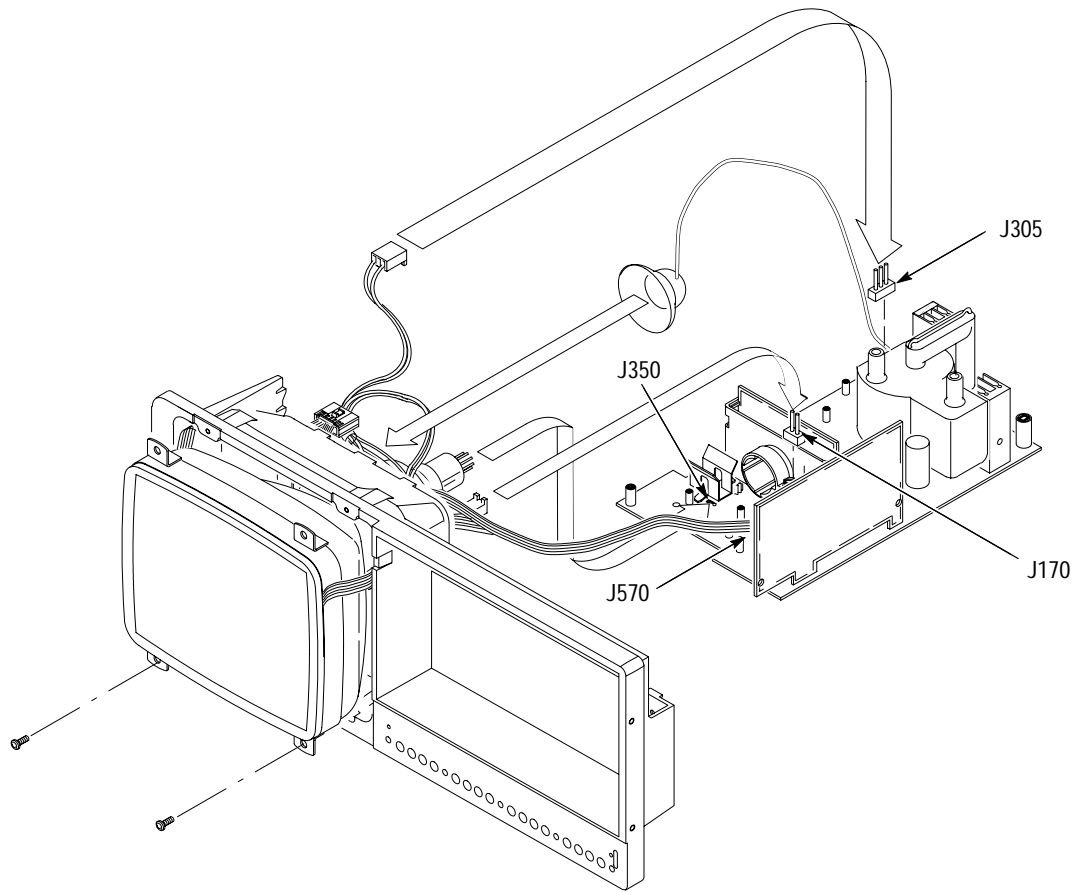


Figure 6-22: Display Assembly Removal

5. *Remove the display-driver board: Use Figure 6-23 as a guide.*



CAUTION. *If any RTV Silicon is removed from the logic scope, it must be replaced in order to maintain the warranted characteristics for random vibration.*

- a. Remove the six screws that mount the display-driver board to the main chassis.
- b. Now, grasp the display-driver board at the points indicated and move the board forward about an inch to clear the retainer built into the left side of the main chassis.
- c. Once the retainer is cleared, work from the front and top to tilt the board so its right edge is up and its left side is down and lift it out of the top of the logic scope's main chassis.

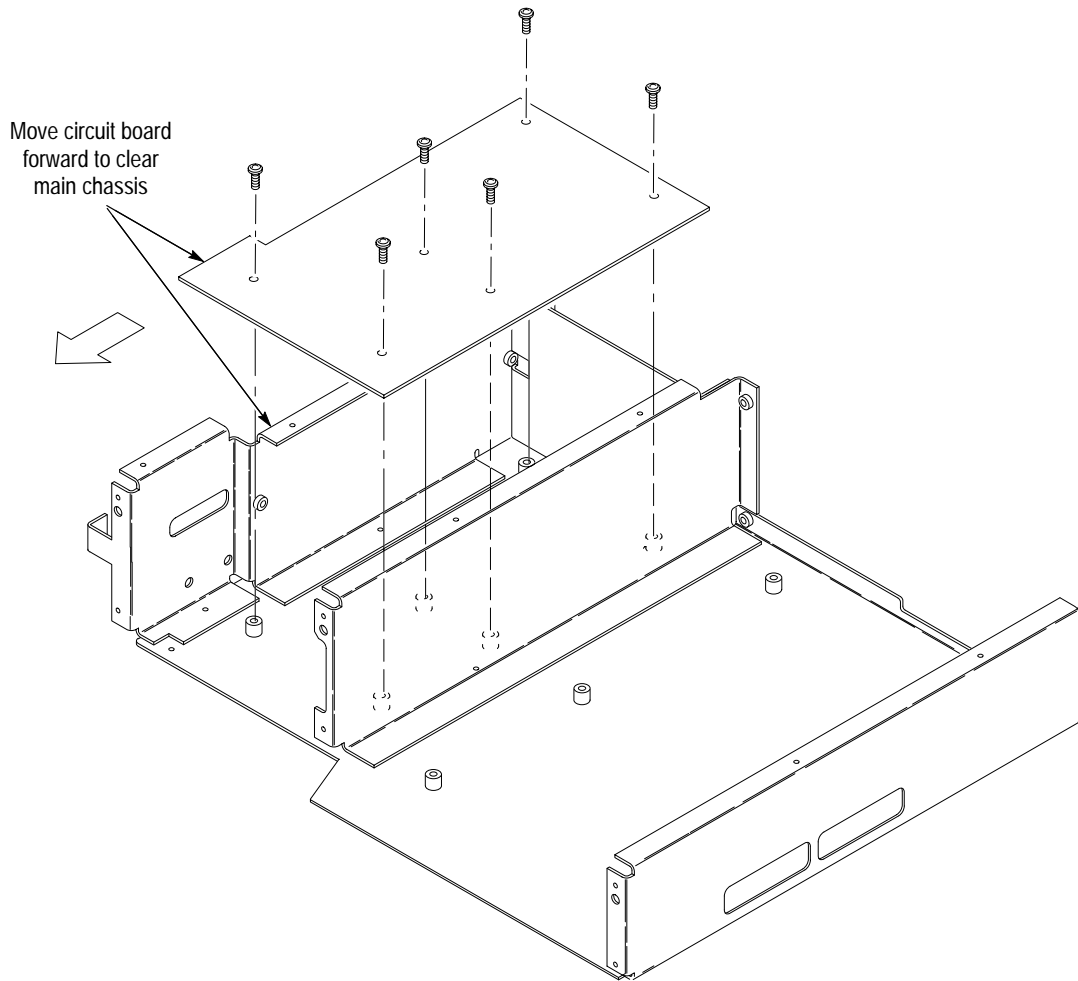


Figure 6–23: Display-Driver Board Removal

6. Reinstallation:

- a. Do, in reverse order, substeps 5a–5c, reversing each step to reinstall Display-Driver board.
- b. Do, in reverse order, substeps 4a–4d, reversing each step to reinstall the display tube if removed.
- c. See step 3 to reinstall the supply fuse if it was removed.
- d. See the following procedures, in order, to complete reassembly of the logic scope:
 - *Top Cover and Board Brackets* (top cover only) on page 6–39
 - *All Processor/Display Board* (page 6–37)

- *A14 DI Bus and Analog-Power and Digital-Power Cables* (page 6–33)
- *Display-Frame Assembly* (page 6–48)
- *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6–21)
- *Rear Cover and Cabinet* (page 6–19) (completes reassembly)

Front Subpanel

1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2).
 - b. Do the procedure *A30 Display Assembly and Supply Fuse* (page 6–48). Do not remove the display-driver board.
 - c. Locate the modules to be removed in the locator diagram *Inner-Chassis Modules*, Figure 6–2, page 6–13.
2. *Orient the logic scope:* Set the logic scope so its rear is down on the work surface and its bottom is facing you.
3. *Partially remove the Input Cable Assembly:*
 - a. Working from the front, remove the five screws mounting the input cable assembly to the front subpanel. (The heads of these screws were exposed when you removed the input panel, which was removed during the access procedure.)
 - b. Lift the *Input Cable Assembly* out of the front subpanel (do not unplug the assembly from the A10 Acquisition Board) and route it out of the way. Reverse the procedure to reinstall.
4. *Remove the front subpanel:* Remove the six screws securing the front subpanel to the main chassis. (See Figure 6–24 for screw locations.) Lift the front subpanel up away from the main chassis to complete the removal.
5. *Reinstallation:* Do the following substeps to reinstall the front subpanel and reassemble the remainder of the logic scope:
 - a. Align the front subpanel to the main chassis, taking care to ensure that the main chassis slips into its alignment slot on the front subpanel (see magnified view, Figure 6–24.) Then reinstall the six screws removed in step 4.
 - b. Reverse steps 3a and 3b to reinstall the input cable assembly.
 - c. See the procedure *A30 Display Assembly and Supply Fuse* (page 6–48) to reinstall the display-frame assembly and display tube.

- d. See the following procedures, in the order listed, for instructions for reinstalling the remaining modules.
- *A12 Front-Panel Assembly and A13 Firmface Board*
 - *Top Cover and Board Brackets* (page 6–39)
 - *A11 Processor/Display Board* (page 6–37)
 - *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6–33)
 - *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6–21)
 - *Rear Cover and Cabinet* (page 6–19)

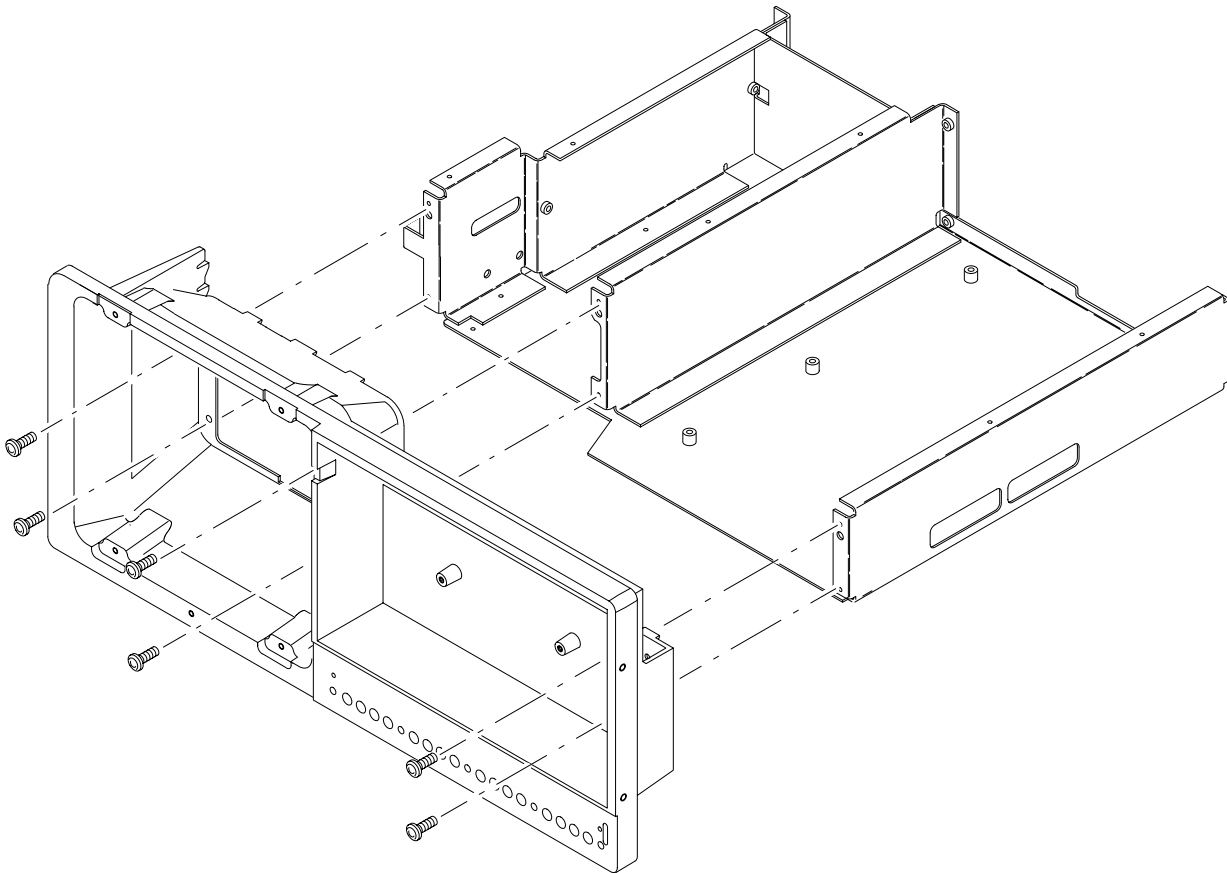


Figure 6–24: Front Subpanel Removal

Main Chassis *Additional Modules Removed: All.*

1. *Remove the main chassis:* Since the removal of the main chassis requires the removal of virtually all modules, do the procedure *Disassembly for Cleaning* that follows. While doing *Disassembly for Cleaning*, you will remove the front-panel assembly. Ignore the instructions to disassemble that assembly.
2. *Reinstallation:* See reinstallation instructions in *Disassembly for Cleaning*.

Disassembly for Cleaning

This procedure is for disassembly of the TLS 216 Logic Scope into its individual modules so they can be cleaned. For the cleaning instructions, see *Inspection and Cleaning*, which begins this section.

1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2), a T-20 Torx® tip (Item 4), a flat-bladed screwdriver (Item 5), and a pair of angle-tip tweezers (Item 9).
 - b. Familiarize yourself with the modules illustrated in Figures 6-1, 6-2, and 6-3.
2. *Remove external modules:* Do in order the following procedures. They are found under *Procedures for External Modules* which starts on page 6-15.
 - a. *Line Fuse and Line Cord* (page 6-17)
 - b. *Rear Cover and Cabinet* (page 6-19)
 - c. *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6-21)
 - d. *Front Subpanel* (page 6-52) and *Display-Frame Assembly* (page 6-48)
3. *Remove the outer-chassis modules:* Do in order the following procedures. They are found under *Procedures for Outer-Chassis Modules* which start on page 6-29.
 - a. *Fan* (page 6-33)
 - b. *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-33)
 - c. *A23 SerPar Board* (page 6-35)
 - d. *All Processor/Display Board* (page 6-37)
 - e. *Top Cover and Board Brackets* (page 6-39)
 - f. *Input Cable Assembly* (page 6-29)

- *Top Cover and Board Brackets* (page 6–39)
 - *A11 Processor/Display Board* (page 6–37)
 - *A23 SerPar Board* (page 6–35)
 - *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6–33)
 - *Fan* (page 6–33)
 - *A10 Acquisition Board* (page 6–41)
- d. *Reinstall external modules:* Do in the order listed the following procedures. When doing these procedures, do the steps in reverse order. These procedures are found under *Procedures for External Modules* which starts on page 6–15.
- *Front Subpanel* (page 6–52)
 - *Display-Frame Assembly* (page 6–48)
 - *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6–21)
 - *Rear Cover and Cabinet* (page 6–19)
 - *Line Fuse and Line Cord* (page 6–17)

Troubleshooting

This section contains information and procedures designed to help you isolate faulty modules in the TLS 216 Logic Scope. If a module needs to be replaced, follow the *Removal and Installation Procedures* located in this section.

Diagnostics

The logic scope has two levels of internal diagnostics that focus on verifying, adjusting, and if need be, isolating faulty modules.

Both levels of internal diagnostics report any bad modules and/or interfaces. If a bad module and/or interface is found, use the troubleshooting procedures in this section to determine which module needs to be replaced.

The two levels of diagnostics are the short confidence set and the extended set that tests the logic scope circuitry in-depth and takes more time. At power-on, the logic scope automatically executes the short set. The extended set is optional and is executed by using the following procedure:

STOP. To perform the following procedure **AS WELL AS THOSE THAT FOLLOW** in this section, the extended diagnostics must be enabled. To ensure that they are, check S3 on dip switch S1001. S1001 is located near the front edge of the A11 Processor/Display board. Set S3 to the closed position to enable the diagnostics.

Prerequisites: Power on the logic scope and allow a 20 minute warm-up before doing this procedure.

1. *Display the System diagnostics menu:*
 - a. Press **SHIFT**; then press **UTILITY**.
 - b. Repeatedly press the main-menu button **System** until **Diag/Err** is highlighted in the pop-up menu.
2. *Run the System Diagnostics:* Press the main-menu button **Execute**; then press the side-menu button **OK Confirm Run Test**.
3. *Wait:* The internal diagnostics do an exhaustive verification of proper logic scope function. This verification will take about two minutes. When finished, the logic scope will display a report of any bad modules and/or interfaces.



Firmware Updates

The TLS 216 Firmware updates are easy to do. Simply install the Firmware disks on your PC and follow the instructions in the README file located on the first disk.

NOTE. You must set the Protection switch to the unprotected position before updating the Firmware. Figure 6–25 shows how to set the switch. After loading the Firmware, be sure you set the switch back to the protected position and cycle power.

If you want to order a Firmware update, see *Optional Accessories, Mechanical Parts List* in Section 10 for the part number.

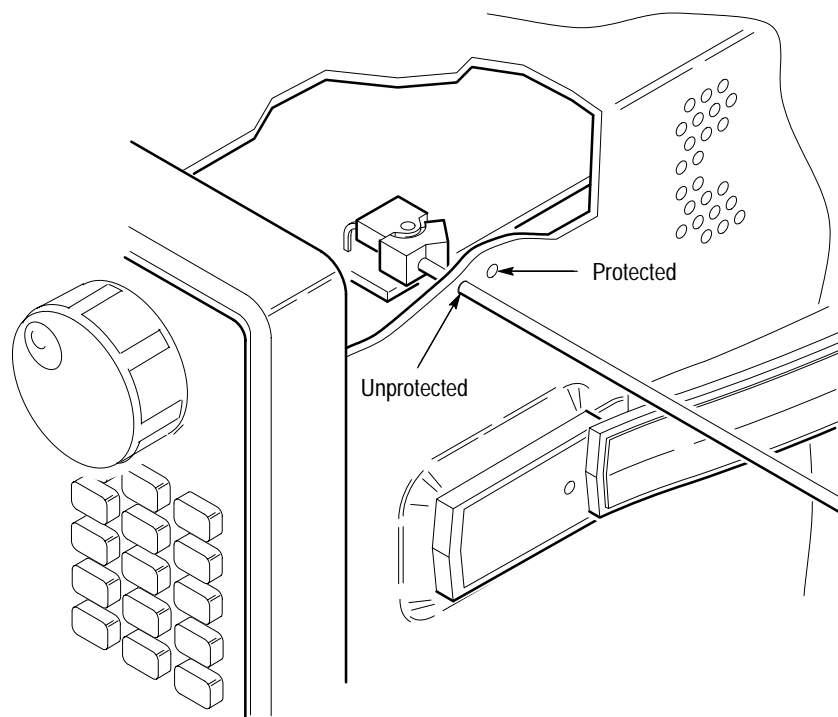


Figure 6–25: Accessing the Protection Switch

Troubleshooting Procedures

Use the procedures that follow to aid in isolating failures to a module. Be sure to read *Diagnostics* on page 6–57. You may also find the block and interconnect diagrams located in Section 9 helpful when troubleshooting this product.

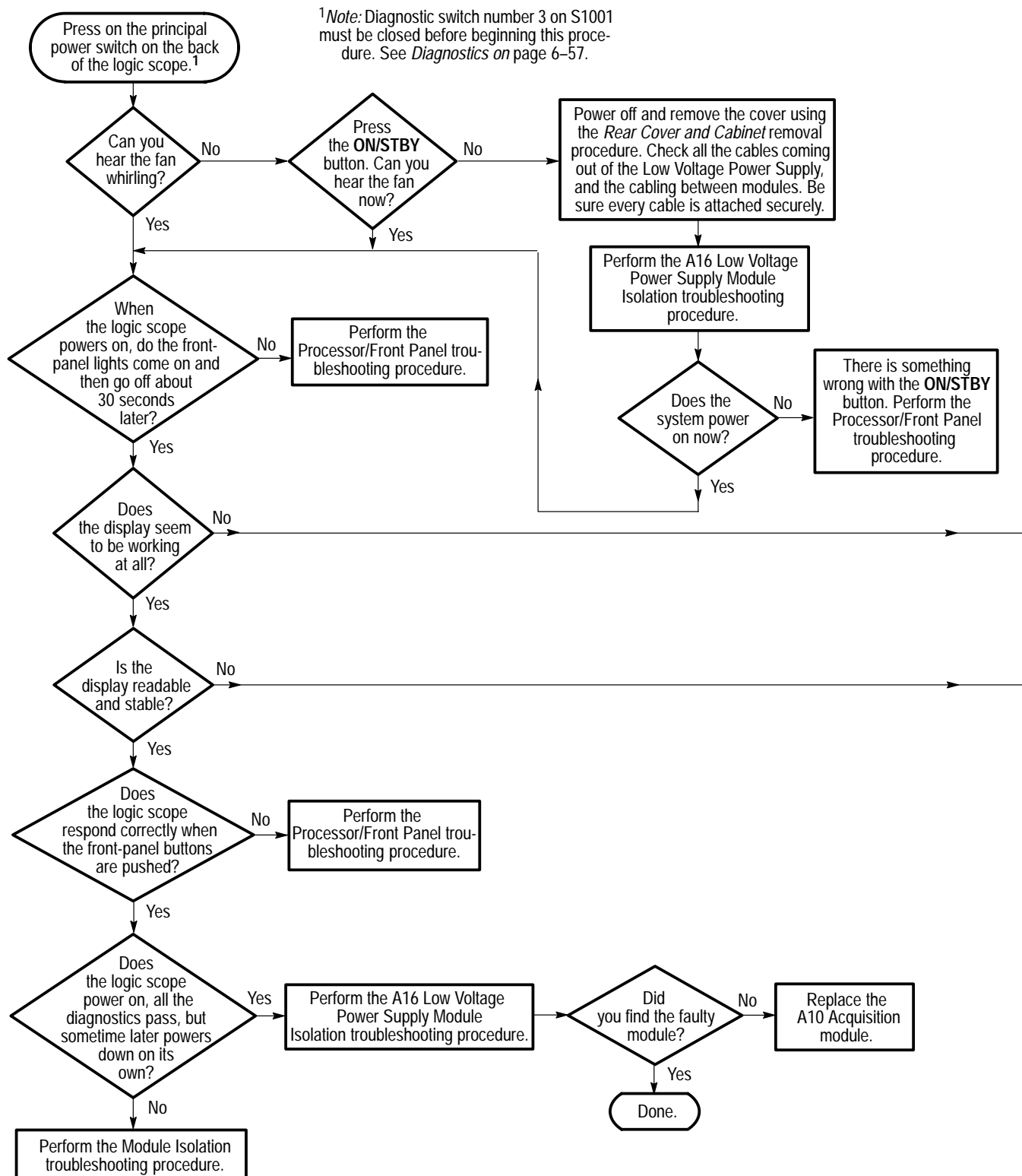


Figure 6-26: Primary Troubleshooting Procedure

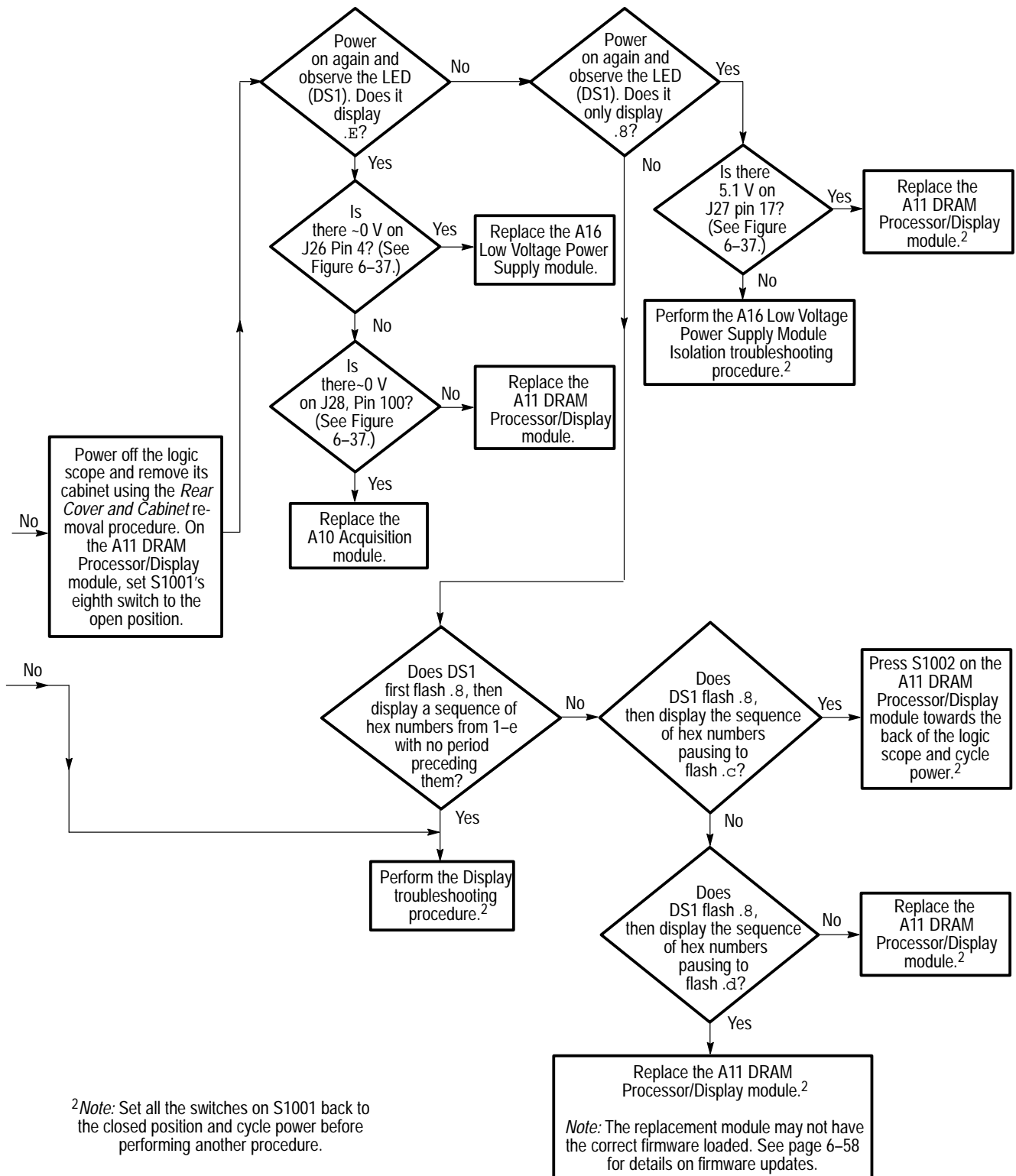


Figure 6-26: Primary Troubleshooting Procedure (Cont.)

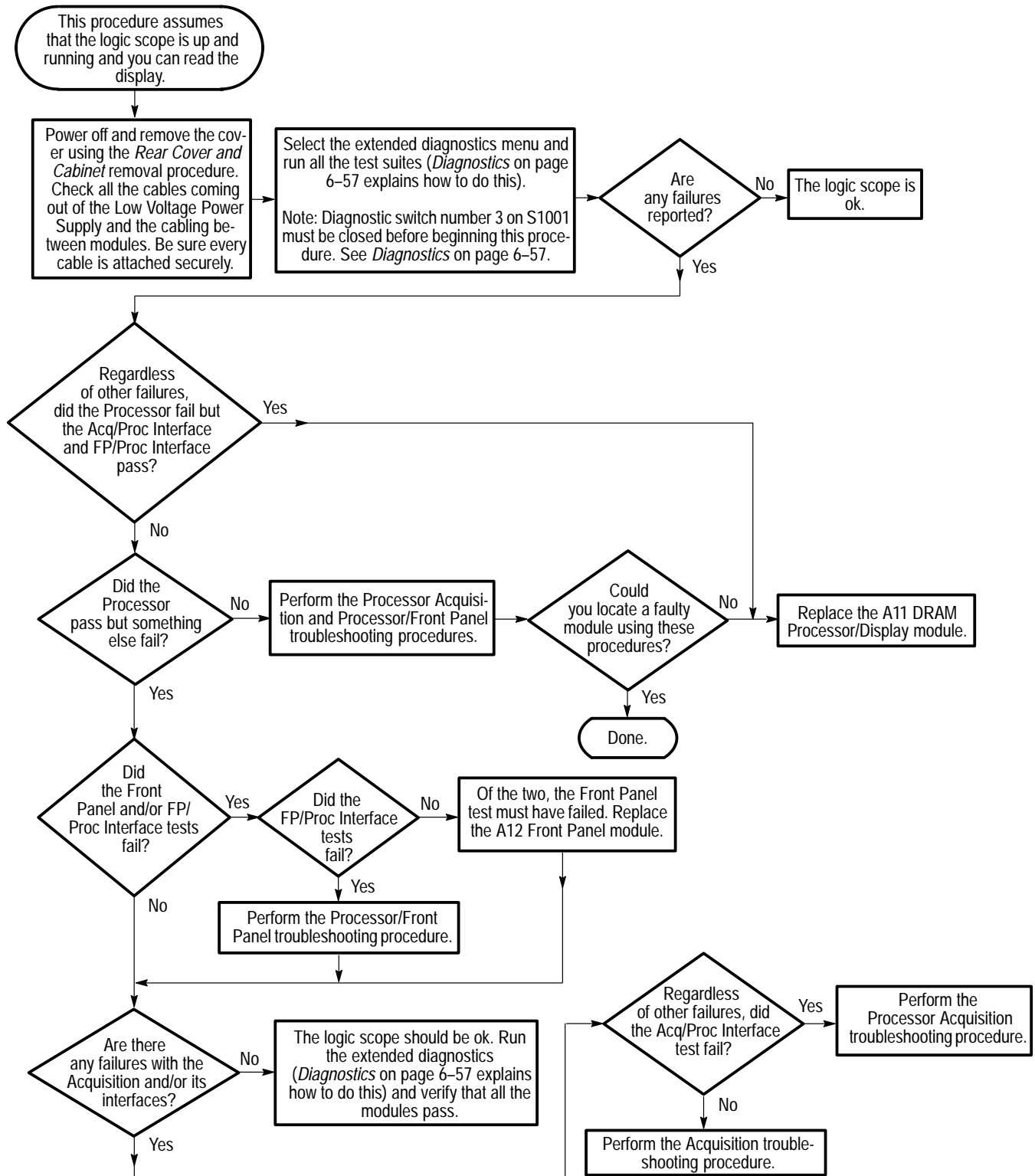


Figure 6-27: Module Isolation Troubleshooting Procedure

Table 6-5: Normal Supply Voltages (Measured on J26 and J27 on the A11 DRAM Processor/Display Module; see 6-37 on page 6-72)

Supply	Lower Limit	Upper Limit
Ground (J26 or J27 pin 15)		
+5.1 VA (J27 pin 5)	+5.0 V	+5.2 V
+5.1 VB (J27 pin 17)	+5.0 V	+5.2 V
+25 V (J27 pin 1)	+23.5 V	+27.5 V
+5 V (J26 pin 39)	+4.9 V	+5.1 V
-5.1 V (J26 pin 17)	-4.9 V	-5.2 V
+15 V (J26 pin 11)	+14.7 V	+15.3 V
-15 V (J26 pin 7)	-14.7 V	-15.3 V

Table 6-6: No-Load Supply Voltages (Measured on J5 and J6 on the A16 Low Voltage Power Supply Module)

Supply	Lower Limit	Upper Limit
Ground (J5 or J6 pin 15)		
+5.1 VA (J6 pin 5)	+4.95 V	+5.25 V
+5.1 VB (J6 pin 17)	+4.95 V	+5.25 V
+25 V (J6 pin 1)	+23.5 V	+27.5 V
+5 V (J5 pin 39)	+0.59 V	+0.81 V
-5.1 V (J5 pin 17)	-0.39 V	-0.61 V
+15 V (J5 pin 11)	+1.05 V	+1.75 V
-15 V (J5 pin 7)	-1.05 V	-1.75 V

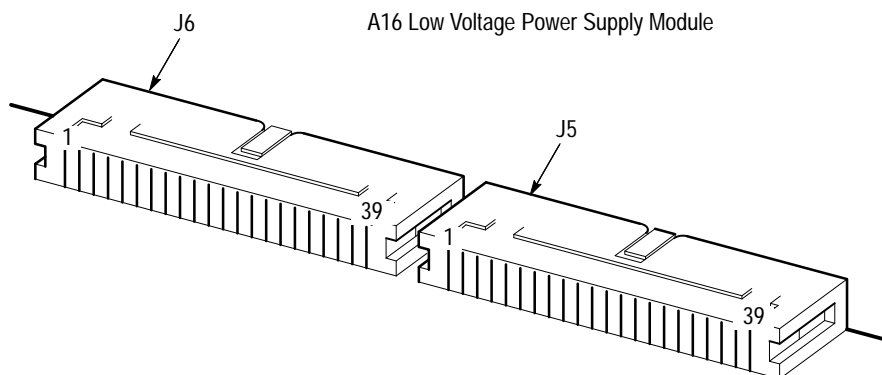


Figure 6-28: Power Supply Voltage Measurement Locations

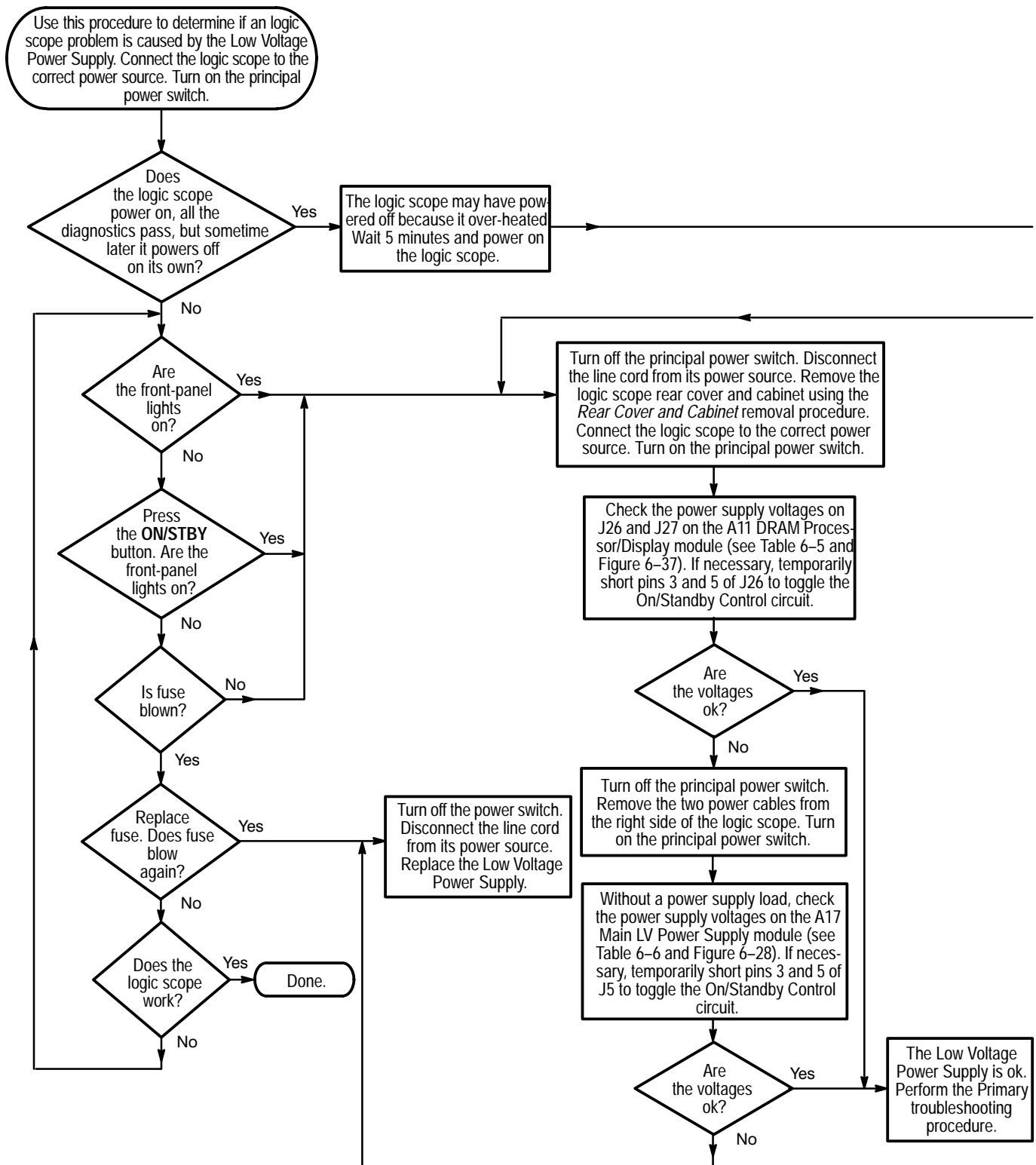


Figure 6-29: A16 Low Voltage Power Supply Module Isolation Troubleshooting Procedure

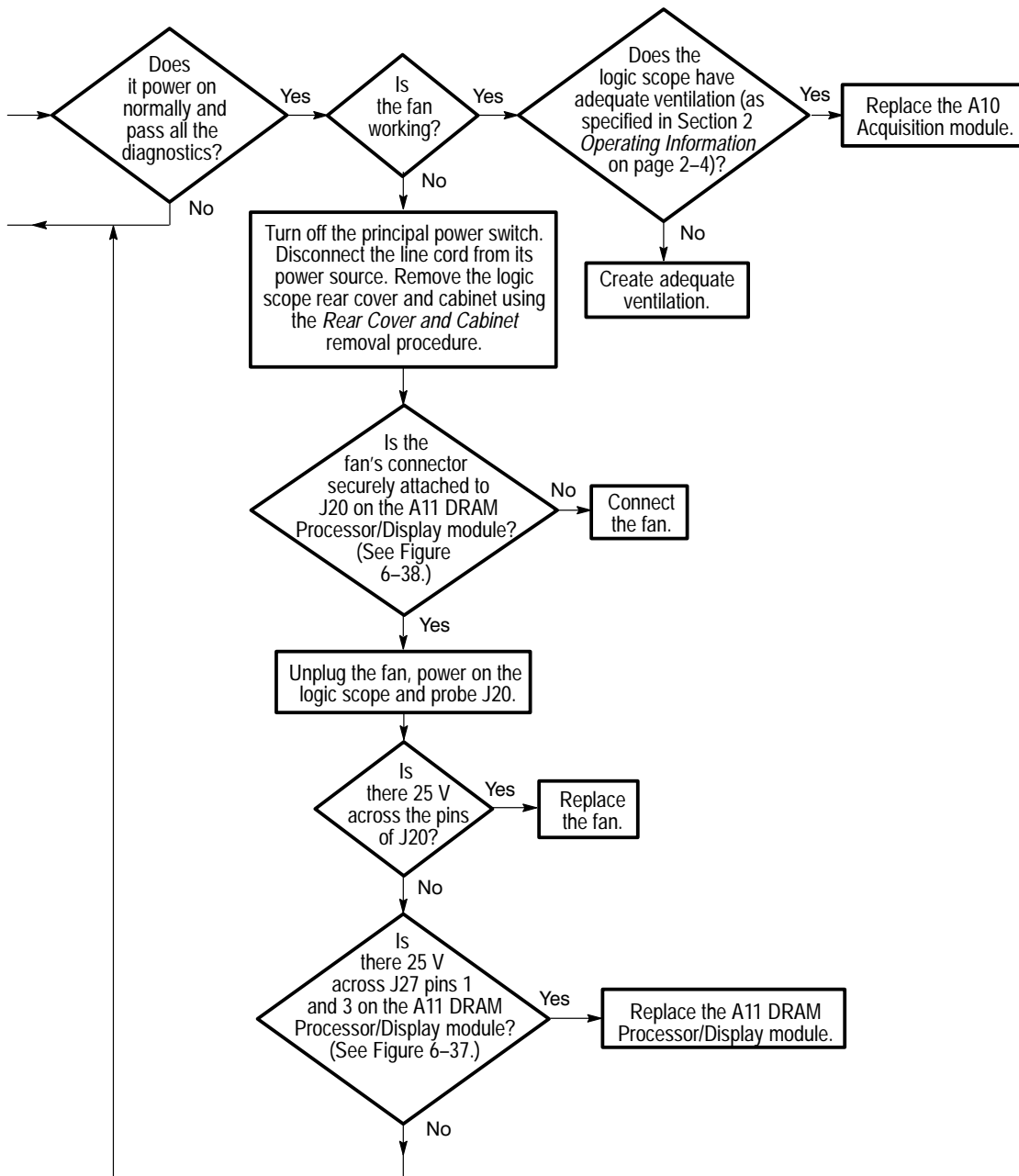


Figure 6-29: A16 Low Voltage Power Supply Module Isolation Troubleshooting Procedure (Cont.)

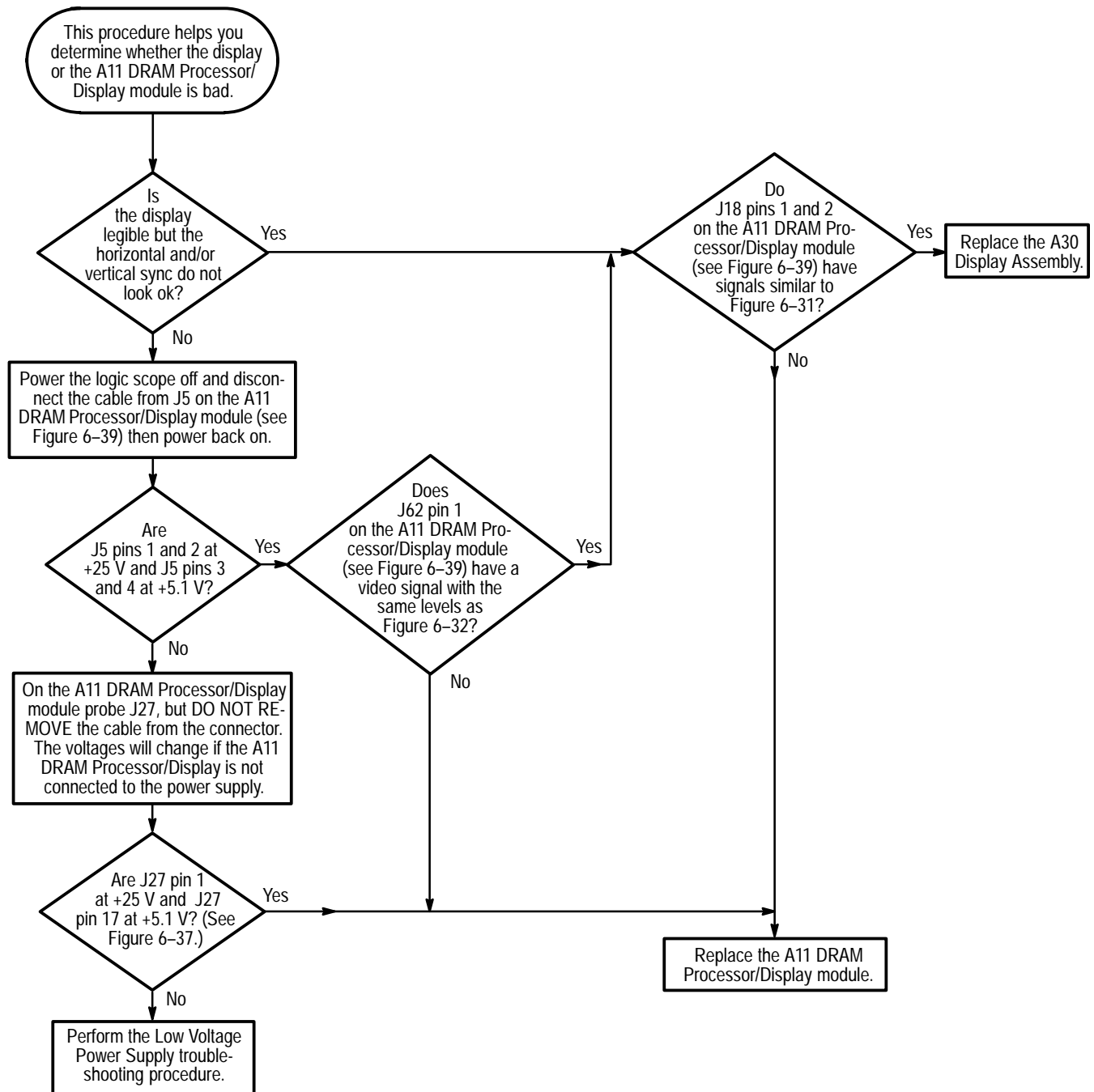


Figure 6-30: Display Troubleshooting Procedure

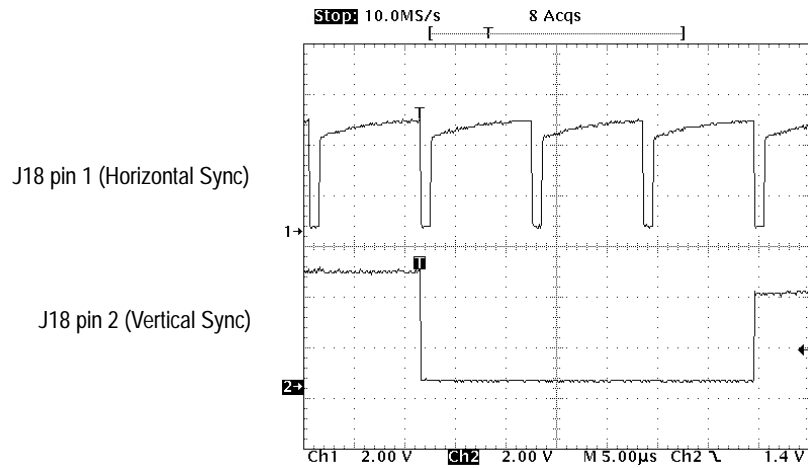


Figure 6–31: Horizontal and Vertical Sync Signals

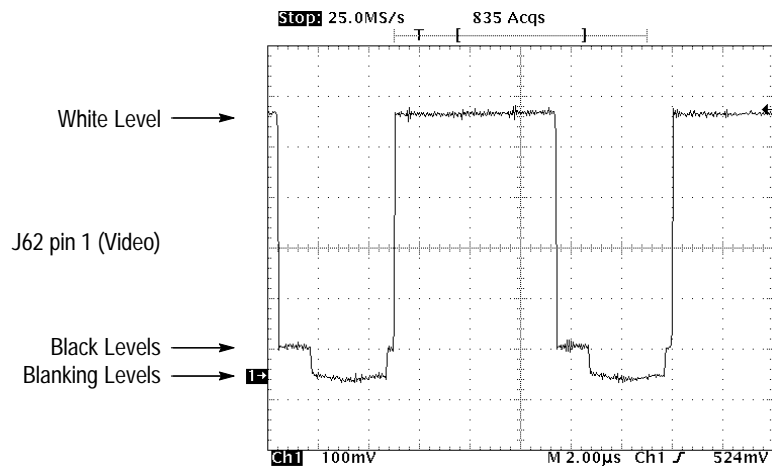


Figure 6–32: A Video Signal with White, Black, and Blanking Levels

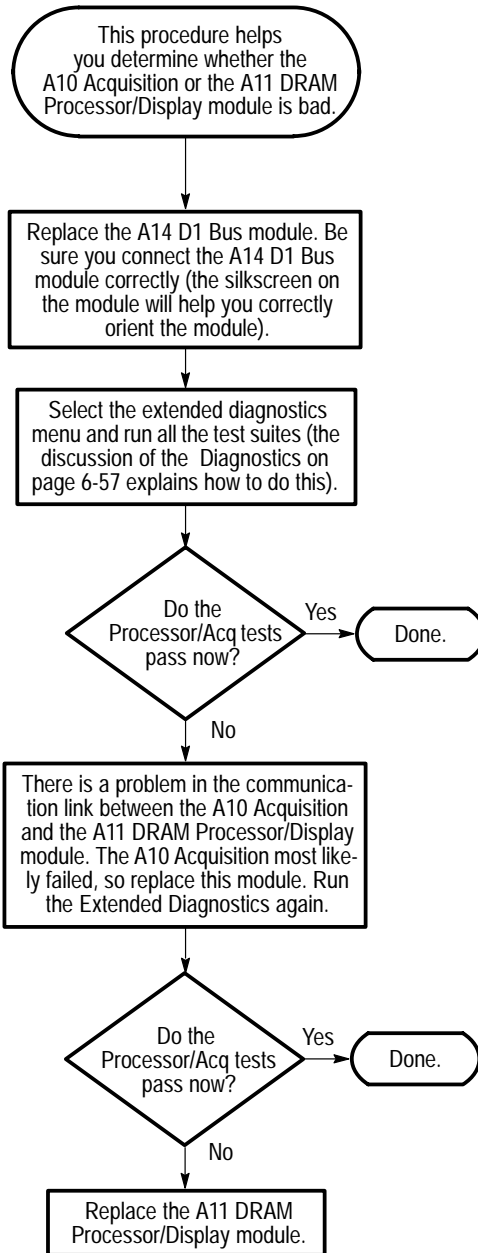


Figure 6-33: Processor/Acquisition Troubleshooting Procedure

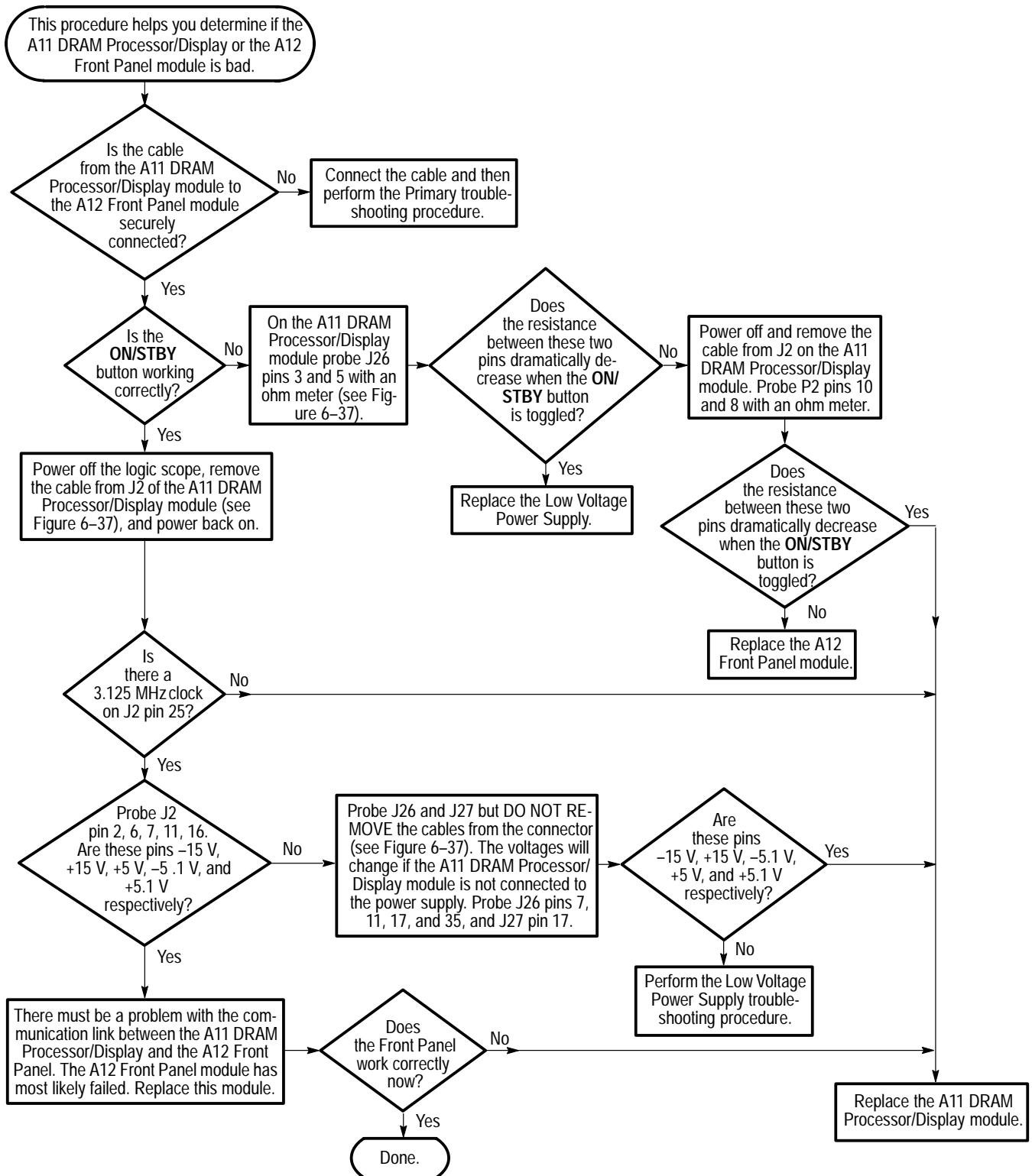


Figure 6-34: Processor/Front Panel Troubleshooting Procedure

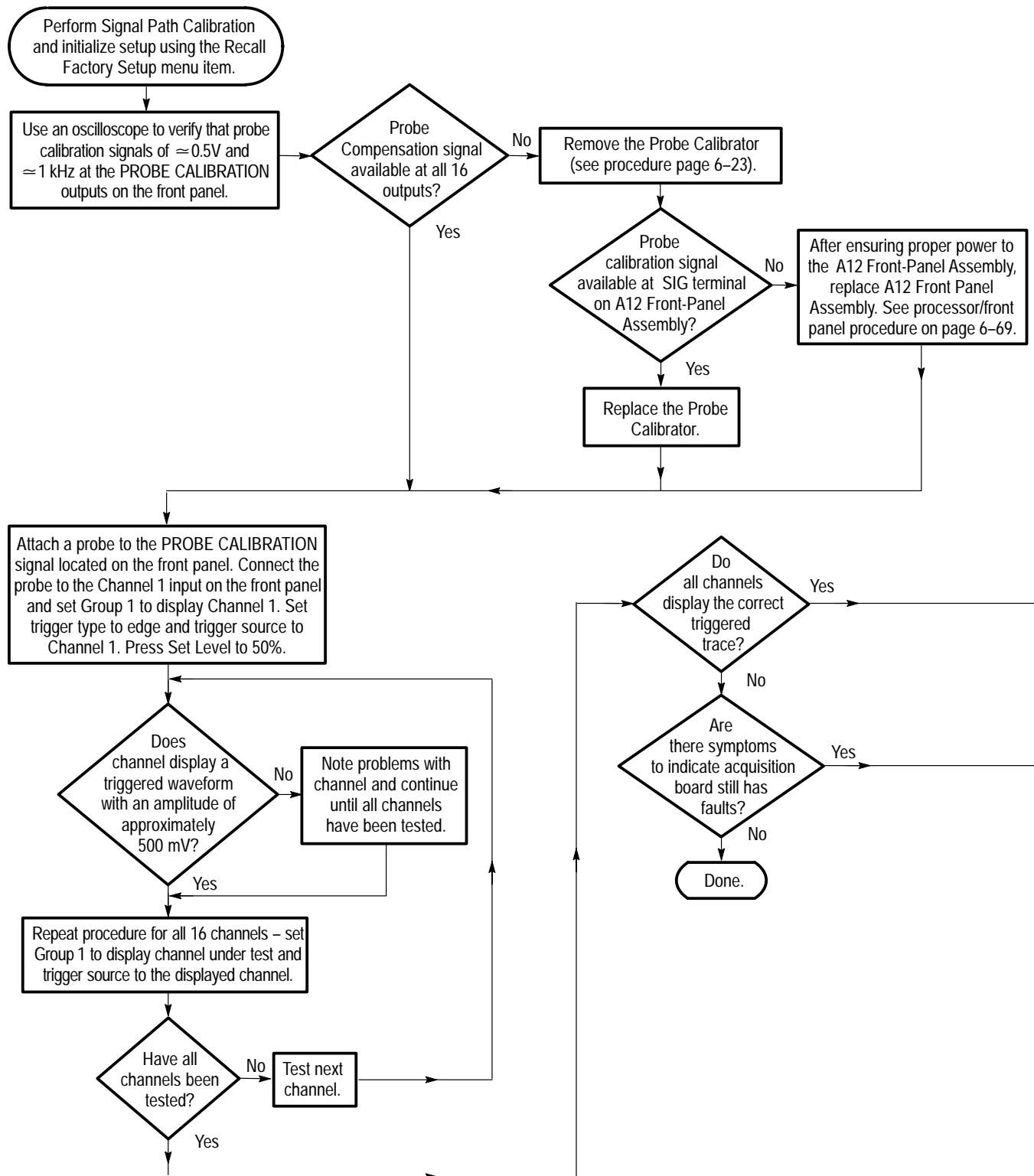


Figure 6-35: Acquisition Troubleshooting Procedure

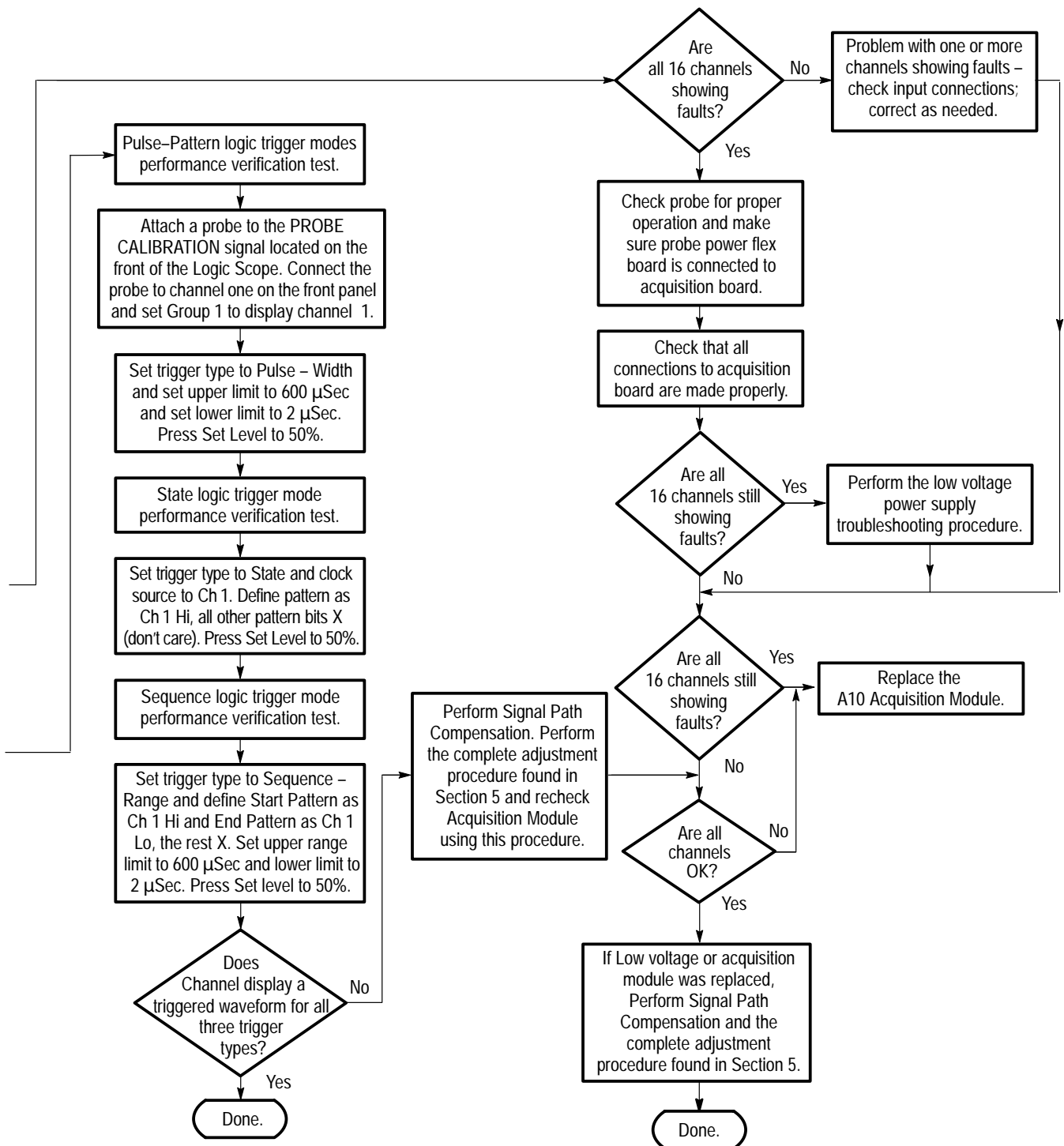


Figure 6–36: Acquisition Troubleshooting Procedure (Cont.)

CAUTION

Only probe points specified in the procedures. You can cause catastrophic damage if you attempt to probe other points.

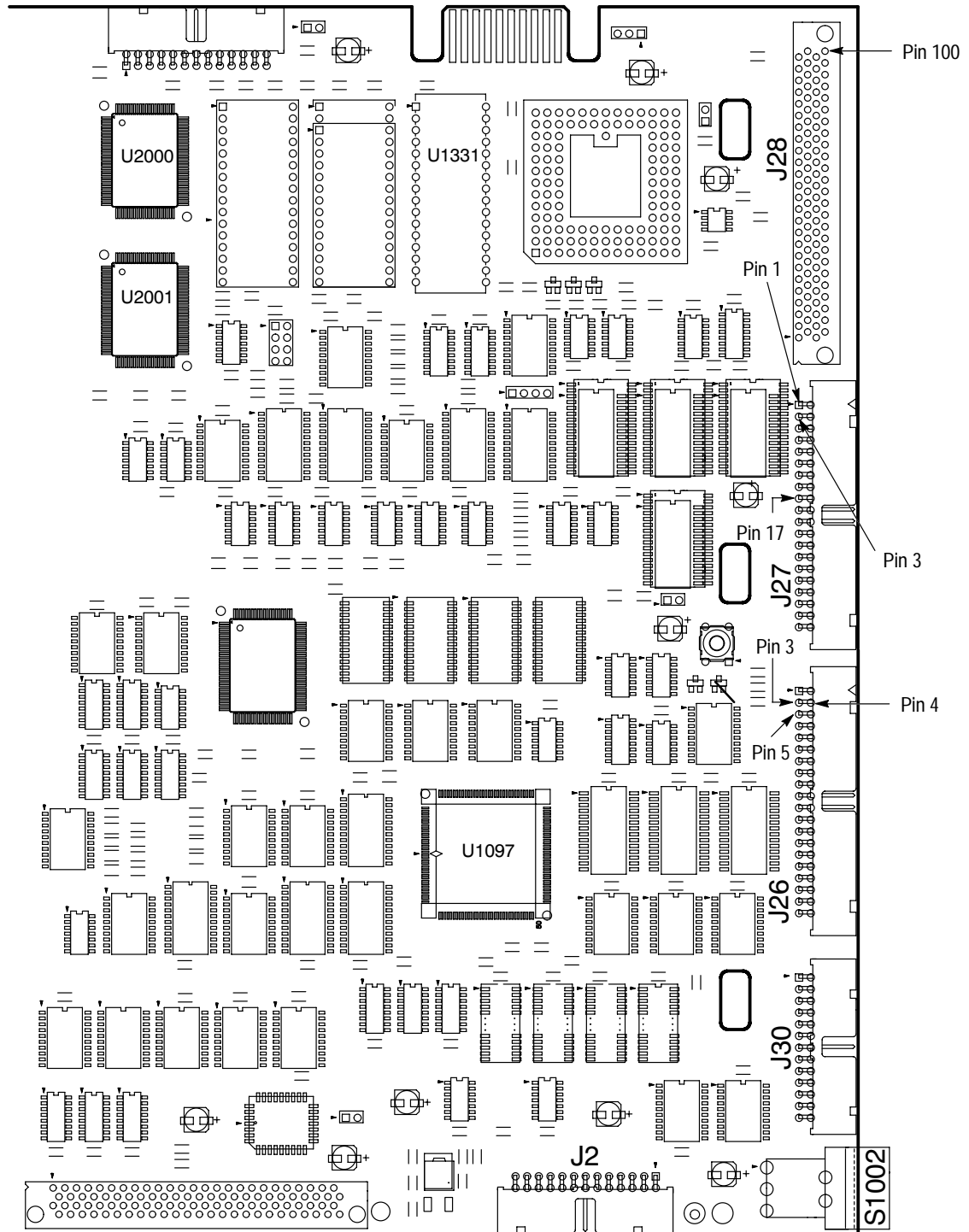


Figure 6-37: A11 DRAM Processor/Display Module (View of Right Side)

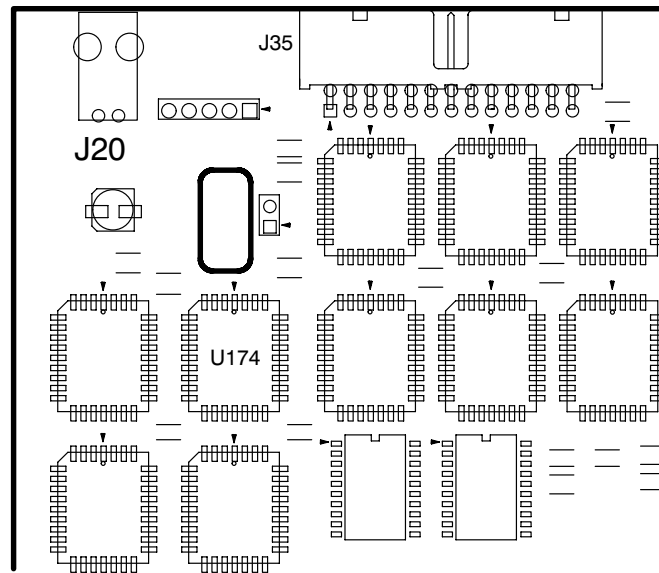


Figure 6-38: A11 DRAM Processor/Display Module (View of Upper Left Corner)

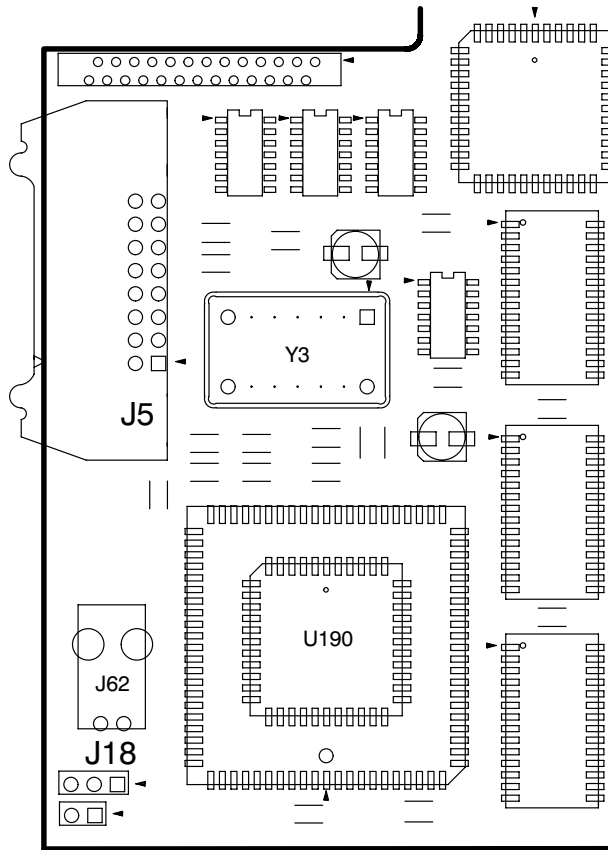


Figure 6-39: A11 DRAM Processor/Display Module (View of Lower Left Corner)

Options and Accessories

This section describes the various options as well as the standard and optional accessories that are available for the TLS Logic Scope.

Options

The following options are available:

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 with the logic scope when ordered by the customer.

Table 7–1: 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

Option B1: Service Manual

When Option B1 is ordered, Tektronix ships a service manual with the logic scope.

Option 1B: Coaxial Adapter Set

With this option, Tektronix ships a set of 16 coaxial adapters. These adapters replace the standard P6240 probes and provide a 50 Ω SMA connection to the instrument.

Option 1K: K420 Instrument Cart

With this option, Tektronix ships the K420 Instrument Cart. The cart can help you transport the logic scope around many lab environments.

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. When Option M2 is ordered, Tektronix adds two years of repair service to the standard warranty.

- Option M3. When Option M3 is ordered, Tektronix adds four logic scope calibrations (one per year in the second through fifth years of service) to the Option M2 service.
- Option M8. When Option M8 is ordered, Tektronix adds four logic scope calibrations (one per year in the second through fifth years of service) to the standard warranty.

Option 1P: HC100 4 Pen Plotter

With this option, Tektronix ships a four-color plotter designed to make waveform plots directly from the logic scope without requiring an external controller. It handles A4 and US letter size media.

Option 1R: Rackmounted Logic Scope

Tektronix ships the Logic Scope, when ordered with Option 1R, configured for installation in a 19 inch wide instrument rack. Customers with instruments not configured for rackmounting can order a rackmount kit (016-1236-00 for field conversions).

Instructions for rackmounting the Logic Scope are shipped with the option 1R.

Option 2P: Phaser 200e Color Printer

With this option, Tektronix ships a Tektronix Phaser 200e, 300 dpi, thermal transfer, color printer. It handles letter or A4 size Tektronix thermal paper and transparencies. It can handle laser copy (plain) paper with the ColorCoat Transfer Roll.

Option 9C: Certificate of Calibration and Test Data Report

Tektronix ships a Certificate of Calibration which 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 US MIL-STD-45662A. This option also includes a test data report for the instrument.

Standard Accessories

The following standard accessories are included with the logic scope:

Table 7-2: Standard Accessories

Accessory	Part Number
User Manual	070-8834-00
Programmer Manual	070-8835-00
Reference	070-8833-00

Table 7-2: Standard Accessories (Cont.)

Accessory	Part Number
Performance Verification and Specifications Technical Reference	070-8832-00
Front Cover	200-3696-00
U.S. Power Cord	161-0230-01
Probes, 2.5 pf FET (Qty. 16)	P6240 (single unit)
Y-Leadset (Qty. 2 pkgs. of 10) (Used with probe)	020-2008-00
SMT KlipChip (Qty. 3 pkgs. of 12) (Used with probe)	020-1386-01
One-to-Two Adapter (Qty. 2) (Used with probe)	013-0280-00
Hand-Held Adapter (Qty. 2) (Used with probe)	013-0281-00
Marker Tags (Qty. 3) (Used with probe)	334-8632-00
Eight-Cable Loom (Qty. 6) (Used with probe)	352-1039-01
Logic Scope to Coax Adapter (Qty. 2)	013-0282-00

Optional Accessories

You can also order the following optional accessories:

Table 7-3: Optional Accessories

Accessory	Part Number
TLS Service Manual	070-8831-00
Plotter (GPIB and Centronics Standard)	HC100
Instrument Cart	K420
Rack Mount Kit (for field conversion)	016-1236-00
Oscilloscope Camera	C9
Oscilloscope Camera Adapter	016-1154-00
Soft-Sided Carrying Case	016-0909-01
Transit Case	016-1135-00
GPIB Cable (1 meter)	012-0991-01
GPIB Cable (2 meter)	012-0991-00
Logic Scope to Coax Adapter	013-0282-00
FlexLead Adapter (Used with probe)	PJ25x25
16-Pin SOIC Adapter (Used with probe)	013-0242-00
24-Pin DIP Adapter (Used with probe)	003-0823-00
68-Pin PLCC Adapter (Used with probe)	013-0250-00

Accessory Software The following optional accessories are Tektronix software products recommended for use with your logic scope:

Table 7-4: Accessory Software

Software	Part Number
EZ-Test Program Generator	S45F030
Wavewriter: AWG and waveform creation	S3FT400
TekTMS: Test management system	S3FT001
LabWindows	S3FG910

Warranty Information Check for the full warranty statements for this product, the probes, and the products listed above on the page or pages immediately following the title and copyright pages in the manual for each product.



Electrical Parts List

The modules that make up this instrument are often a combination of mechanical and electrical subparts. Therefore, all replaceable modules are listed in under *Replaceable Parts List* which begins on page 10–1. Refer to that list for locating all replaceable parts and their part numbers when using this manual.

Diagrams

This section contains the interconnection diagram and the block diagram for the TLS 216 Logic Scope.

Symbols

Graphic symbols and class designation letters are based on ANSI Standard Y32.2–1975. Abbreviations are based on ANSI Y1.1–1972.

Logic symbology is based on ANSI/IEEE Std 91–1984 in terms of positive logic. Logic symbols depict the logic function performed and can differ from the manufacturer's data.

The tilde (~) preceding a signal name indicates that the signal performs its intended function when in the low state.

Other standards used in the preparation of diagrams by Tektronix, Inc. are:

- Tektronix Standard 062–2476 Symbols and Practices for Schematic Drafting
- ANSI Y14.159–1971 Interconnection Diagrams
- ANSI Y32.16–1975 Reference Designations for Electronic Equipment
- MIL–HDBK–63038–1A Military Standard Technical Manual Writing Handbook

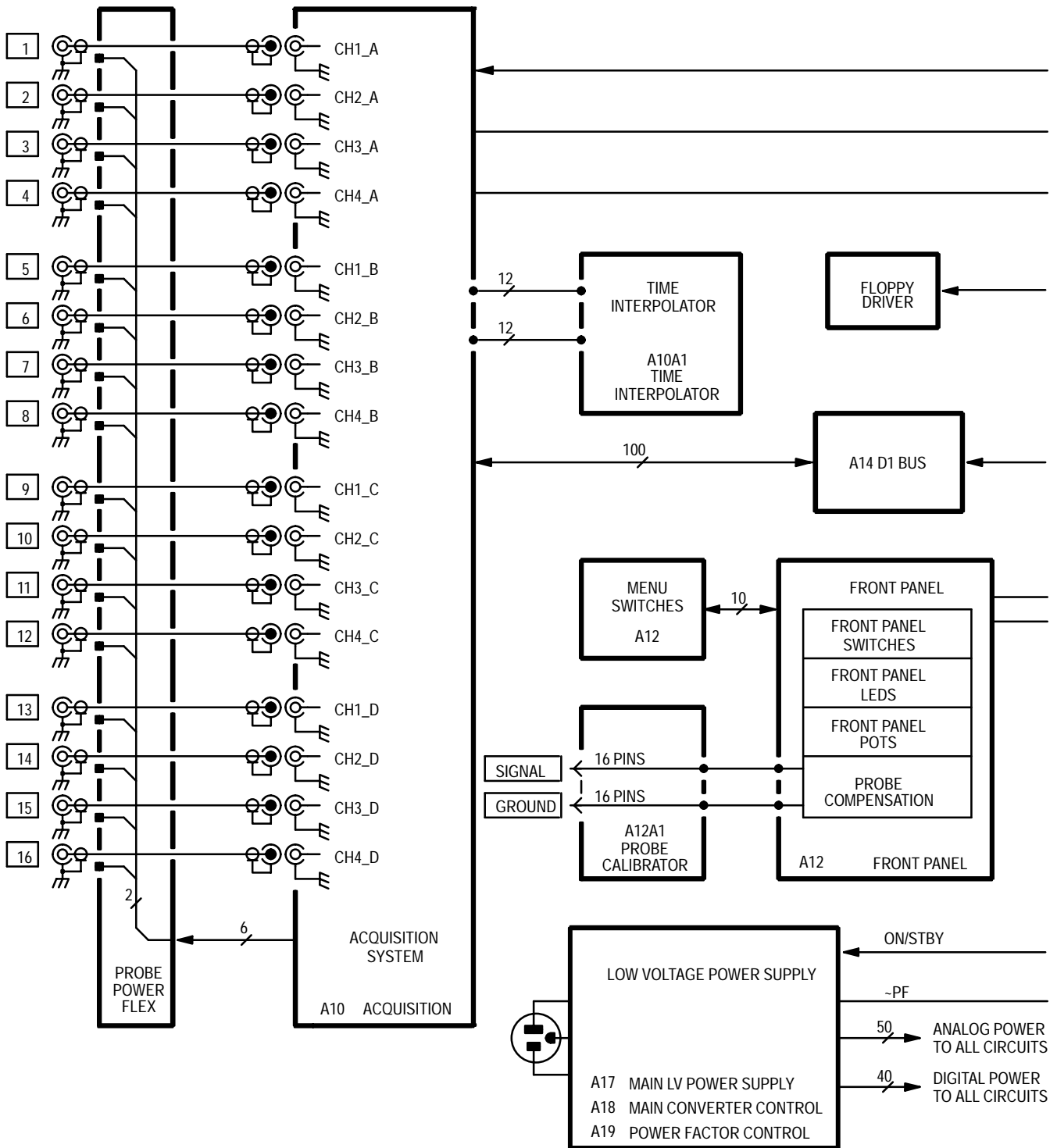


Figure 9-1: TLS 216 Block Diagram

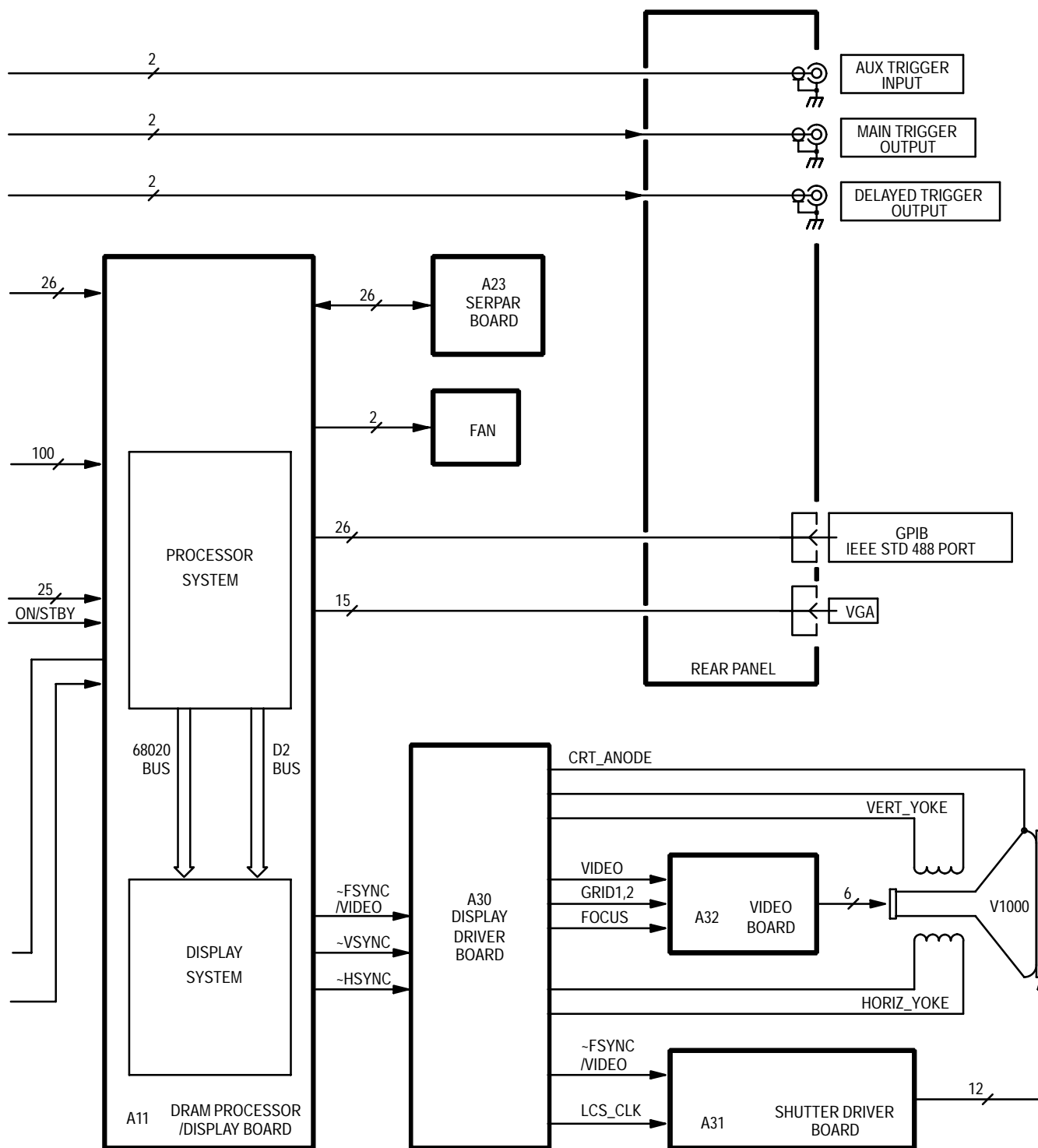


Figure 9-1: TLS 216 Block Diagram (Cont.)

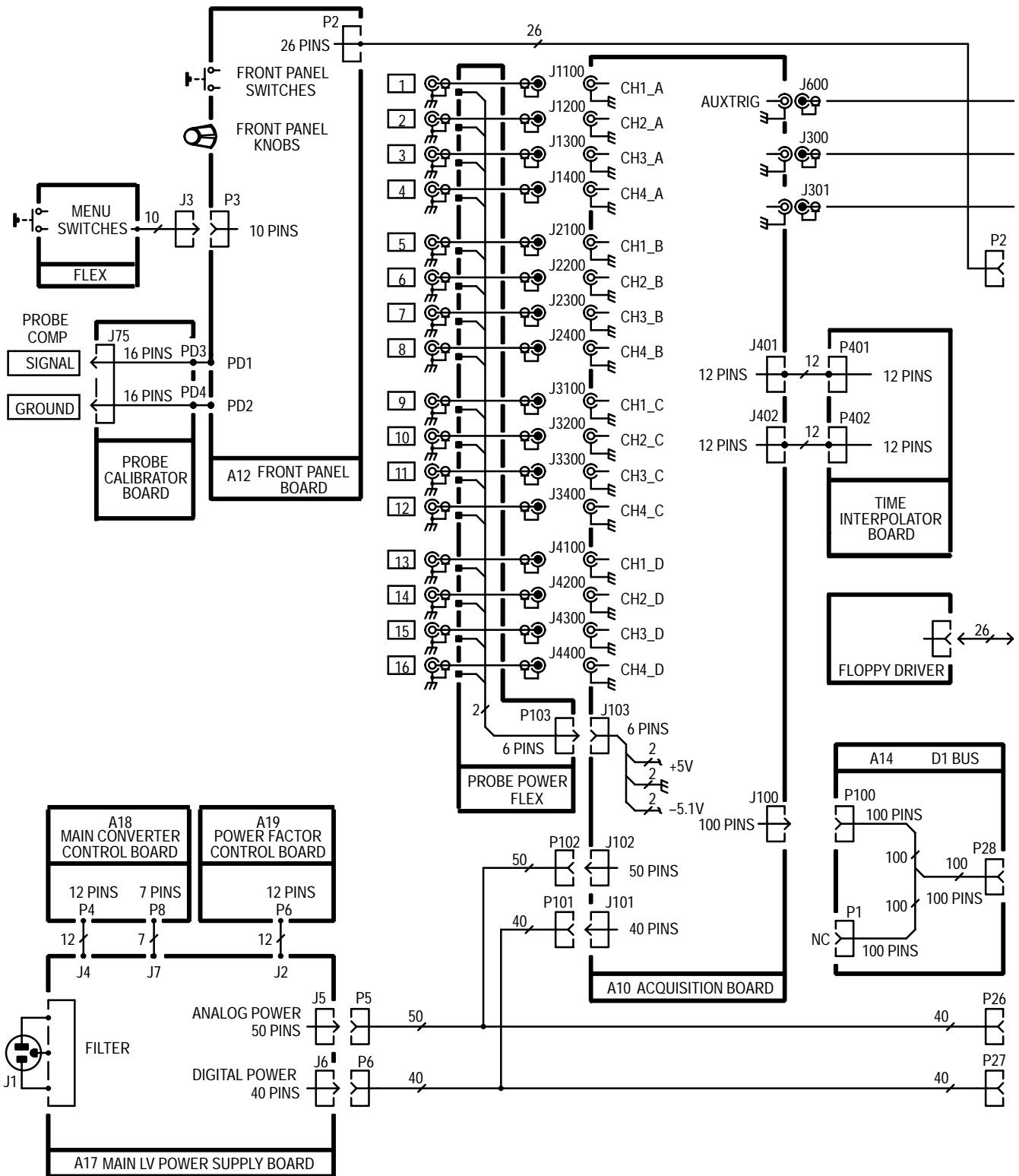


Figure 9-2: TLS 216 Interconnect Diagram

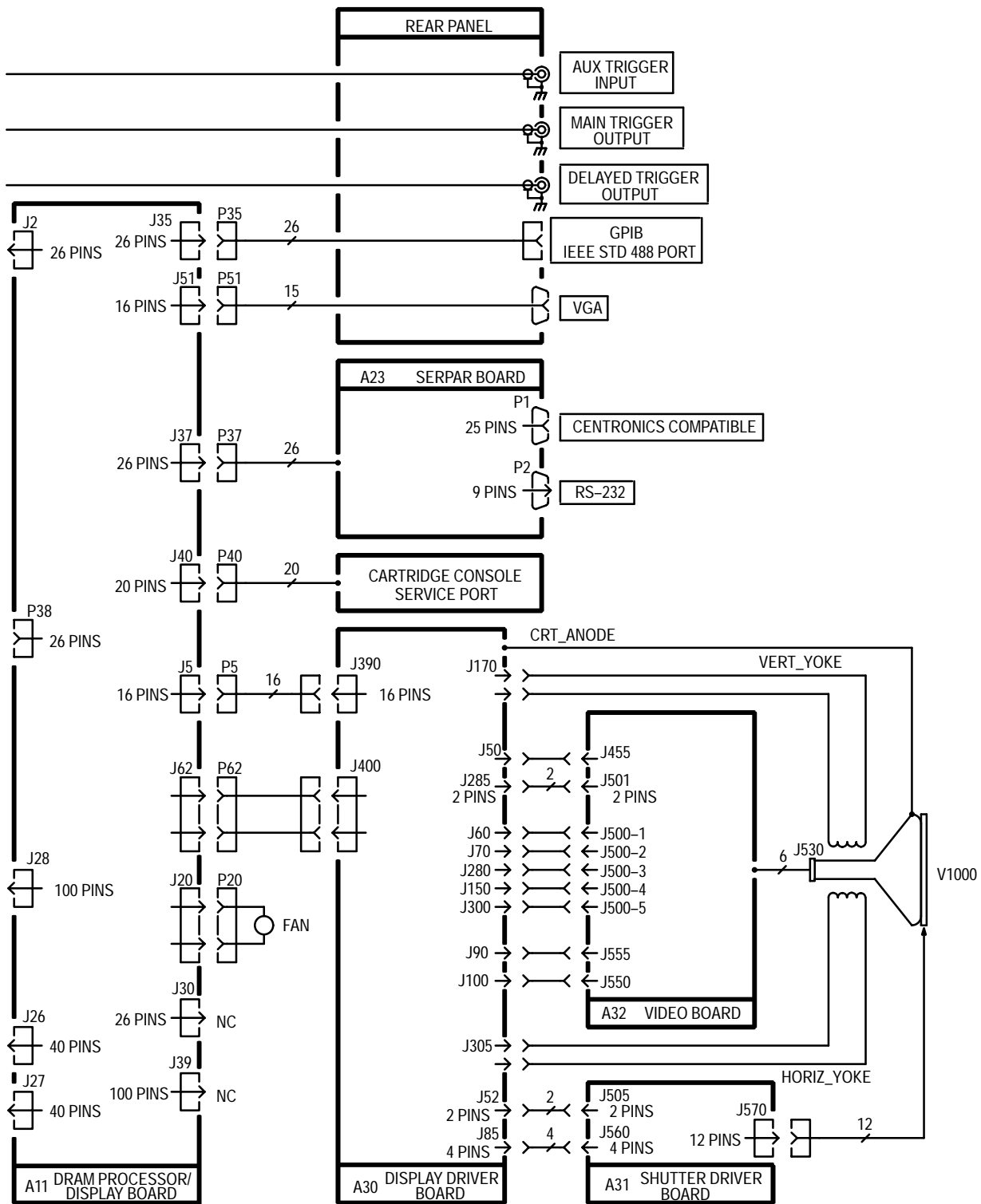


Figure 9-1: TLS 216 Interconnect Diagram (Cont.)

Replaceable Parts List

This section contains a list of the modules that are replaceable for the TLS 216 Logic Scope. 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.

Module Replacement

The logic scope is serviced by module replacement. There are three options you should consider:

- **Module Exchange.** In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1-800-TEKWIDE, ext. 6630.
- **Module Repair.** You may ship your module to us for repair, after which we will return it to you.
- **New Modules.** You may purchase new replacement modules in the same way as other replacement parts.

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:

<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>Name & Description</i>
					<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
S3629	SCHURTER AG H C/O PANEL COMPONENTS CORP	2015 SECOND STREET	BERKELEY CA 94170
TK0IK	MODERN METALS	UNIT A/K, 5/F GOLD KING IND. BLDG NO. 35-41 TAI LIN ROAD	KWAI-CHUNG N.T. HONG KONG
TK0488	CURRAN COIL SPRING INC	635 NW 16TH	PORTLAND OR 97209-2206
TK0588	UNIVERSAL PRECISION PRODUCTS	1775 NW 216TH	HILLSBORO OR 97123
TK1163	POLYCAST INC	9898 SW TIGARD ST	TIGARD OR 97223
TK1465	BEAVERTON PARTS MFG CO	1800 NW 216TH AVE	HILLSBORO OR 97124-6629
TK1499	AMLAN INC	97 THORNWOOD RD	STAMFORD CT 06903-2617
TK1899	MINNESOTA MINING AND MFG CO	5400 RT B PO BOX 1228	COLUMBIA MO 65205
TK2162	DERBY MFG	24350 STATE ROAD 23 SOUTH	SOUTH BEND IN 46614-9696
TK2193	PHOTO AND SOUND	820 NW 18TH AVENUE	PORTLAND OR 97209
TK2248	WESTERN MICRO TECHNOLOGY	1800 NW 169TH PL SUITE B-300	BEAVERTON OR 97006
TK2338	ACC MATERIALS	ED SNYDER BLDG 38-302	BEAVERTON OR 97077
TK2432	UNION ELECTRIC	15/F #1, FU-SHING N. ROAD	TAIPEI, TAIWAN ROC
TK2469	UNITREK CORPORATION	3000 LEWIS & CLARK WAY SUITE #2	VANCOUVER WA 98601
TK2500	SOLECTEK ACCESSORIES CORP	6370 NANCY RIDGE DR SUITE 109	SAN DIEGO CA 92121
OJR05	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER WA 98661-2999
OJ9P9	GEROME MFG CO INC	PO BOX 737 403 NORTH MAIN	NEWBERG OR 97132
OKB01	STAUFFER SUPPLY	810 SE SHERMAN	PORTLAND OR 97214
OKB05	NORTH STAR NAMEPLATE	1281-S NE 25TH	HILLSBORO OR 97124
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
07416	NELSON NAME PLATE CO	3191 CASITAS	LOS ANGELES CA 90039-2410
1DM20	PARLEX CORPORATION LAMINATED CABLE DIV	7 INDUSTRIAL WAY	SALEM, NH 03079
1JJ96	KAM ELECTRIC CO	11866 SLATER AVE NE	KIRKLAND WA 98034
2W733	COOPER INDUSTRIES INC BELDEN DIVISION	2200 US HIGHWAY 27 SOUTH PO BOX 1980	RICHMOND IN 47375-0010
22526	BERG ELECTRONICS INC (DUPONT)	857 OLD TRAIL RD	ETTERS PA 17319
24931	SPECIALTY CONNECTOR CO INC	2100 EARLYWOOD DR PO BOX 547	FRANKLIN IN 46131
30817	INSTRUMENT SPECIALTIES CO INC	EXIT 53 RT 80 BOX A	DELAWARE WATER GAP PA 18327
34416	PARSONS MFG CORP	1055 OBRIAN DR	MENLO PARK CA 94025-1408
5Y921	COMAIR ROTRON, A KLI COMPANY	2675 CUSTOMHOUSE COURT	SAN YSIDRO CA 92173
50356	TEAC AMERICA INC	7733 TELEGRAPH RD PO BOX 750	MONTEBELLO, CA 90640-6537
53387	MINNESOTA MINING MFG CO	PO BOX 2963	AUSTIN TX 78769-2963
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. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
10-1-1	200-3695-03		1	REAR COVER ASSY:W/LABEL	80009	200369503
-2	161-0230-01		1	CABLE ASSY,PWR,;3,18 AWG,92 L,SVT,TAN (STANDARD ACCESSORY)	TK2432	ORDER BY DESC
-3	343-1213-00		1	CLAMP,PWR CORD:POLYIMIDE (STANDARD ACCESSORY)	TK1163	ORDER BY DESC
-4	200-2264-00		1	CAP,FUSEHOLDER:3AG FUSES (AMERICAN)	S3629	FEK 031 1666
	200-2265-00		1	CAP,FUSEHOLDER:5 X 20MM FUSES (EUROPEAN)	S3629	FEK 031.1663
-5	159-0013-00		1	FUSE,CARTRIDGE:3AG,6A,250V,FAST BLOW (AMERICAN)	75915	312006
	159-0210-00		1	FUSE,CARTRIDGE:DIN 5 X 20MM,5AMP,250V SLOW BLOW (EUROPEAN)	S3629	TYPE FST 034-31
-6	650-3039-00		1	CABINET ASSY:	0J9P9	650-3039-00
-7	367-0247-01		1	HANDLE,CARRYING:11.54 L,W/CLIP	80009	367024701
-8	200-2191-00		2	CAP,RETAINER:PLASTIC	0JR05	ORDER BY DESC
-9	437-0443-00		1	CABINET,SCOPE:ALUMINUM	0J9P9	407-0443-00
-10	348-1110-02		4	FOOT,CABINET:	80009	348111002
-11	348-1254-01		4	PAD,FOOT:TEK BLACK,SANTOPRENE	80009	348125401
-12	348-0875-00		1	FLIPSTAND,CAB.:	TK0488	ORDER BY DESC
-13	348-1109-01		2	GASKET,SHIELD:45.0 L	80009	348110901
-14	200-3696-01		1	COVER,FRONT:PLASTIC (STANDARD ACCESSORY)	80009	200369601
-15	101-0142-00		1	TRIM,DECORATIVE:FRONT	TK1163	ORDER BY DESC
-16	334-8580-00		1	MARKER,IDENT:MKD TLS216	0KB05	334-8580-00
-17	214-4287-00		1	ACTUATOR:ELASTOMER MAT,FRONT PANEL,RUBBER	TK0IK	ORDER BY DESC
-18	650-2927-00		1	REPLACEABLE AS:DISPLAY FRAME WITH FLEX	80009	650292700
-19	334-8560-00		1	MARKER,IDENT:MARKED FLEX	07416	334-8560-00
-20	386-6405-00		1	PANEL,INPUT:POLYCARBONATE	TK1163	386-6405-00
-21	377-0579-00		5	INSERT,KNOB:PLASTIC	TK1163	ORDER BY DESC
-22	210-0457-00		2	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	0KB01	ORDER BY DESC
-23	614-0901-00		1	FRONT PNL ASSY: (A12)	80009	614090100
-24	366-2170-00		1	KNOB:DIMPLED GPK,1.7 DIA	TK1163	ORDER BY DESC
-25	366-2111-00		3	KNOB:SMALL,FLUTED	TK1163	ORDER BY DESC
-26	200-4128-00		1	CALIBRATOR	TK1163	ORDER BY DESC
-27	366-2114-00		2	KNOB:LARGE,DETENTED	TK1163	ORDER BY DESC

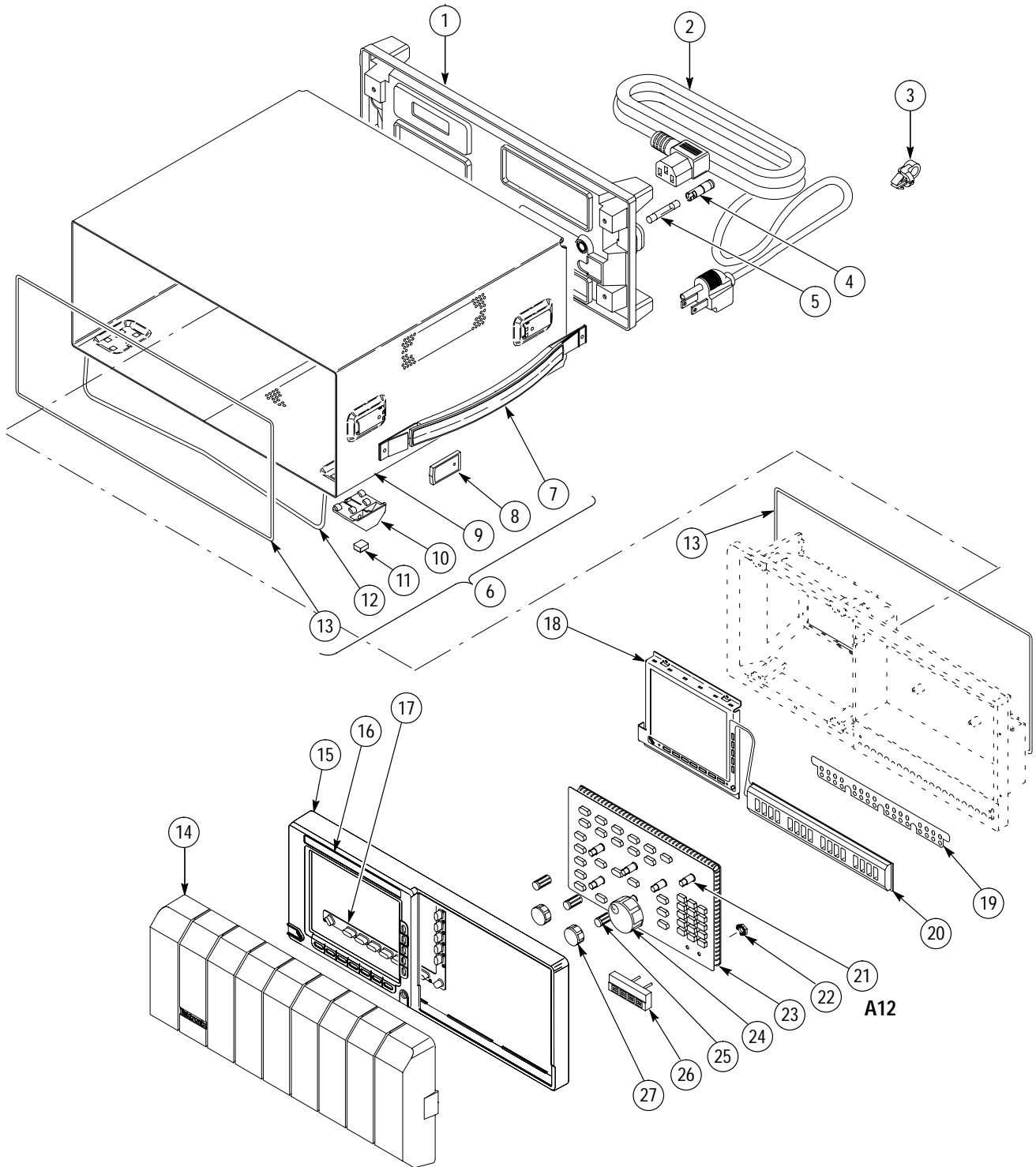


Figure 10-1: Cabinet and Front Panel

Replaceable Parts List

Fig. & Index No.	Tektronix Part No.	Serial No.		Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Dscont				
10-2-1	212-0189-00			4	SCREW,MACHINE:8-32 X 0.500,PAN HEAD,TORX	0KB01	ORDER BY DESC
-2	119-5044-00			1	FAN,DC:TUBE AXIAL:20-28V,0.275A,5W	5Y921	JQ24F4V/031349
-3	671-2413-00			1	CIRCUIT BD ASSY:COLOR PROCESSOR DISPLAY (A11)	80009	671241300
-4	441-1902-01			1	CHASSIS,SCOPE:REAR	0J9P9	ORDER BY DESC
-5	334-8617-00			1	MARKER,IDENT:REAR,BNC,VGA,CONN IDENT	07416	334-8617-00
-6	131-1315-01			3	CONN,RF JACK:BNC/PNL,;50 OHM,FEMALE,STR,PELTOLA	24931	28JR306-1
-7	407-3825-00			2	BRACKET,CKT BD:PLASTIC,REAR	TK1163	ORDER BY DESC
-8	386-6182-00			1	PLATE,REAR:ALUMINUM,RS232/CENTRONIC	0J9P9	386-6182-00
-9	211-0730-00			2	SCREW,ASSEM WSHR:6-32 X 0.375,PNH,STL CD PL	0KB01	ORDER BY DESC
-10	131-0890-01			4	CONN,HARDWARE:DSUB,JACK SCREW;4-40 X 0.312L	00779	205818-2
-11	348-1300-00			2	SHLD,GSKT,ELEK:3.165 L,CLIP ON	30817	0098-0564-09-03
-12	671-2437-00			1	CIRCUIT BD ASSY:RS232/CENTRONIC (A23 SerPar)	80009	671243700
-13	671-2846-00			1	CIRCUIT BD ASSY:D1 BUS (A14)	80009	671284600
-14	174-3146-00			1	CA ASSY,SP:COAXIAL,;RFD/KIT,16.75 OHM,RG197,12.0 L	80009	174314600
-15	259-0100-00			1	FLEX CIRCUIT:PROBE	80009	259010000
-16	672-2552-02			1	CIRCUIT BD ASSY:ACQUISITION,TESTED (A10)	80009	672255202
-17	407-3878-00			6	BRACKET,CKT BD:PLASTIC	TK1163	ORDER BY DESC
-18	407-3877-00			2	BRACKET,CKT BD:PLASTIC	TK1163	ORDER BY DESC
-19	441-1901-01			1	CHASSIS,SCOPE:TOP	0J9P9	ORDER BY DESC

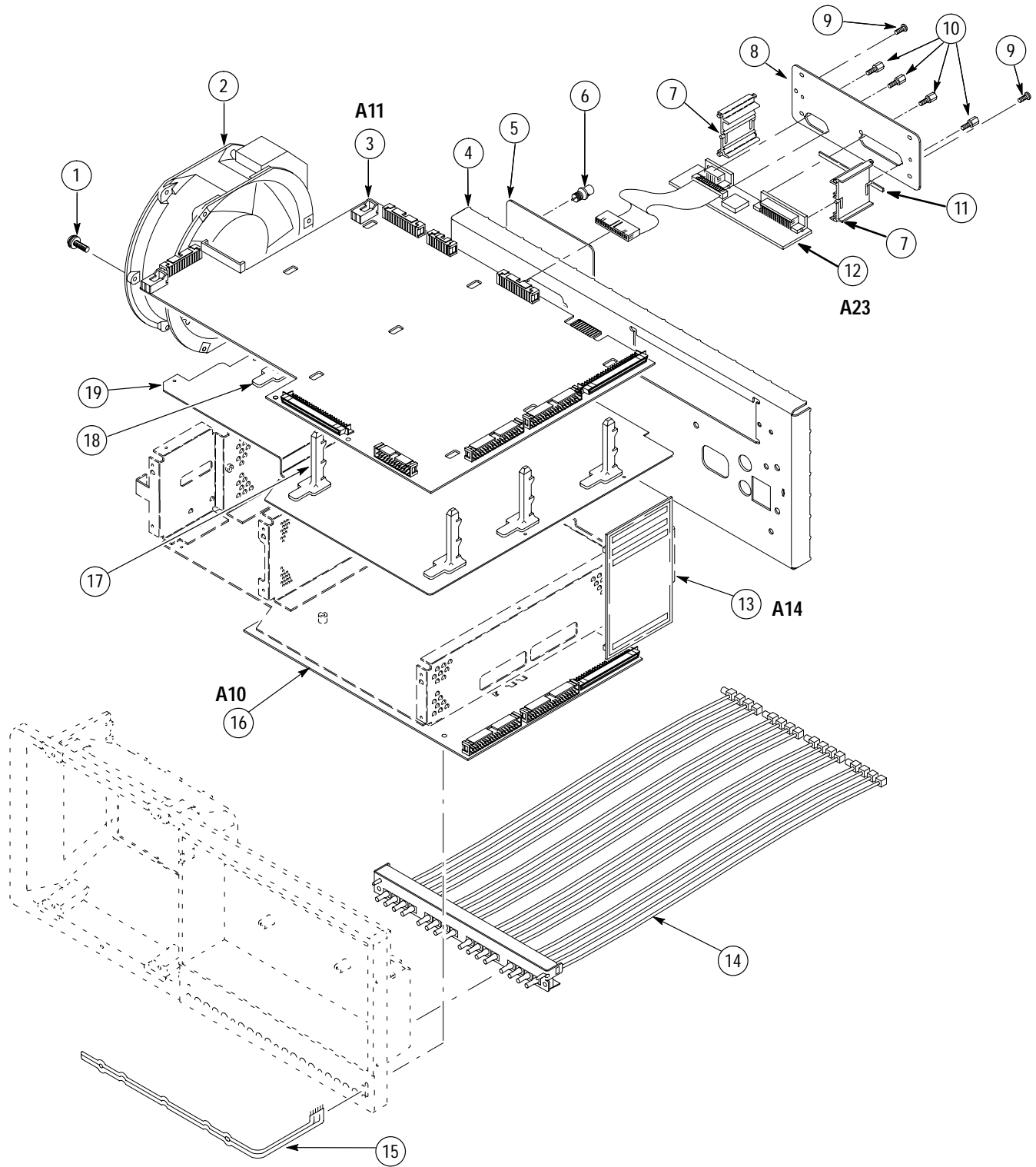


Figure 10-2: Outer-Chassis Modules

Replaceable Parts List

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
10-3-1	640-0077-02			1	DISPLAY MODULE:COLUMBIA FULL COLOR (A30)	80009	640-0077-02
-2	407-4099-00			1	BRKT,PWR SPLY:LVPS,POLYCARBONATE	80009	407409900
-3	348-1300-00			2	SHLD,GSKT,ELEK:3.165 L,CLIP ON	30817	0098-0564-09-03
-4	620-0063-00			1	POWER SUPPLY:90-275 VAC,45 TO 440 HERTZ, 400 W (A16)	80009	620006300
-5	441-2017-01			1	CHASSIS,SCOPE:MAIN W/SHIELD	0J9P9	ORDER BY DESC
-6	386-6403-00			1	SUBPANEL,FRONT:	TK1465	386-6403-00

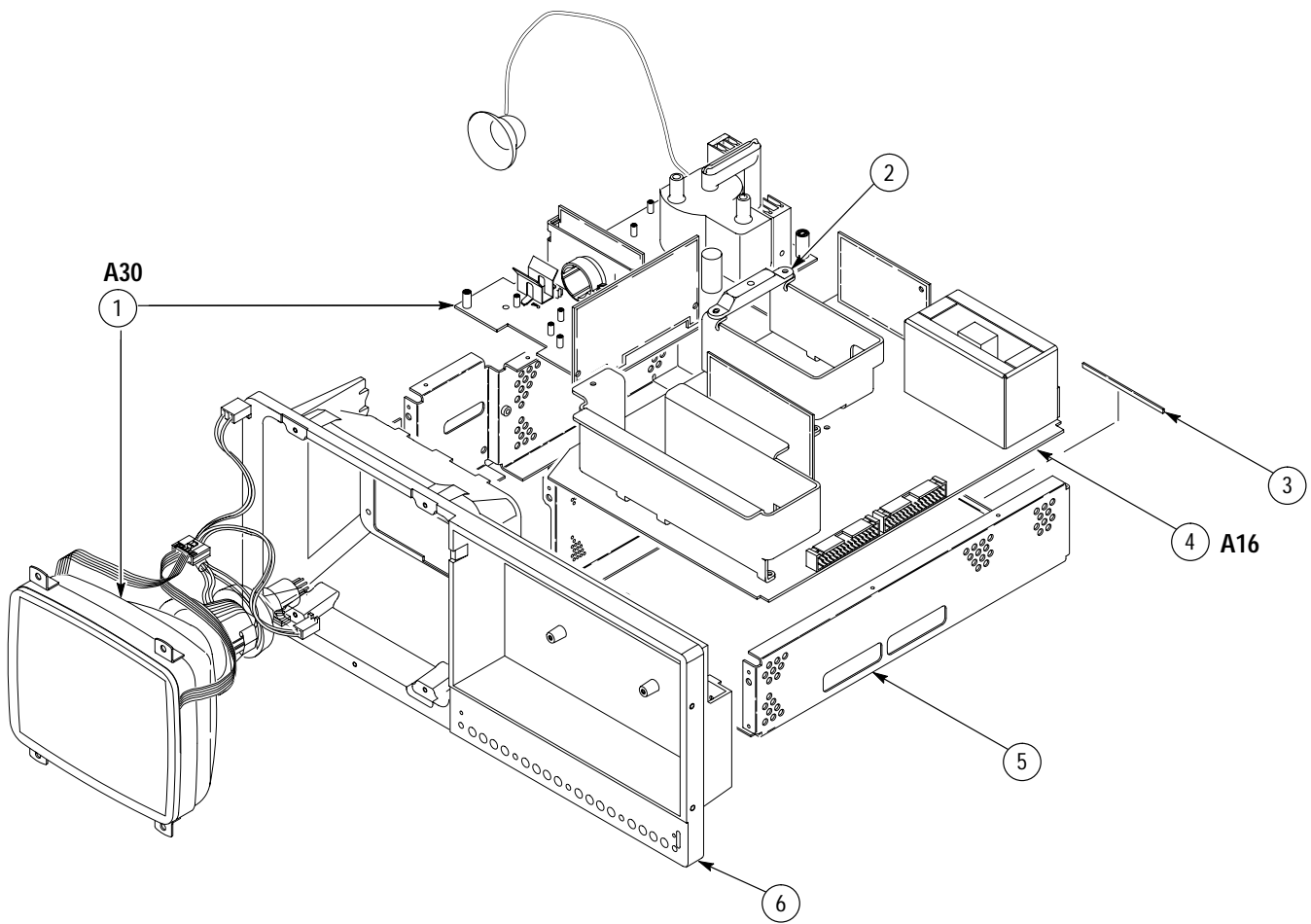


Figure 10-3: Inner-Chassis Modules

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
10-4-1	407-4460-xx		1	BRKT,DISK DRIVE:ALUMINUM	0J9P9	407-4230-00
-2	211-0840-00		2	SCREW,MACHINE:M2.6 X 0.45MM PITCH X 4.0 L	0KB01	.26C4MXPHY
-3	211-0730-00		2	SCREW,ASSEM WSHR:6-32 X 0.375,PNH,STL CD PL	0KB01	ORDER BY DESC
-4	174-2964-00		1	WIRE,ELECTRICAL:FLAT FLEX,JUMPER;26 COND,300V	1DM20	1.00MM-26-7-B
-5	276-0849-00		1	CORE,EM:EMI SUPPRESS,RBN CABLE	1JJ96	BFS33.5X8X6.5
-6	407-4230-00		1	BRKT,DISK DRIVE:ALUMINUM	0J9P9	407-4230-00
-7	337-3935-00		1	SHLD,DISK DRIVE:	0JR05	337-3935-00
-8	119-5677-01		1	DISK DRIVE:FLOPPY,3.5 INCH;2MB,0.5 INH DSDD	50356	119-5677-01
-9	105-1081-xx		1	FLOPPY DISK DRIVE BRACKET ADAPTER	TK1163	105-1081-xx
	211-0866-xx		1	SCREW PHIL M2.5X10 PHIL PNH BRZN	0KB01	211-0866-xx

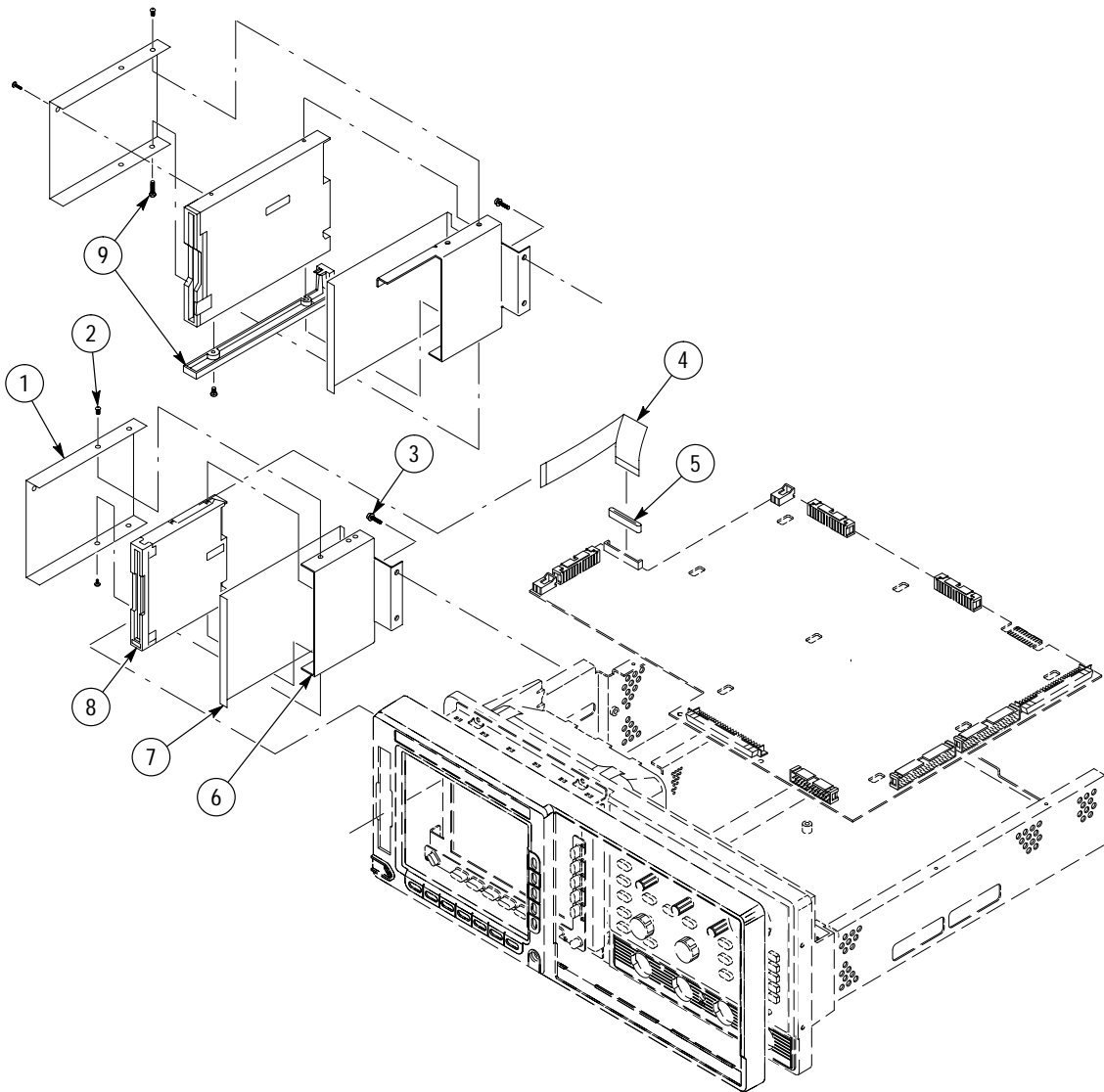


Figure 10-4: Floppy Disk

Replaceable Parts List

Fig. & Index No.	Tektronix Part No.	Serial No.		Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Dscont				
10-5-1	174-1525-00			1	CA ASSY,SP,ELEC:2 X 8-13,28 AWG,VIDEO/MONITOR BUS	TK2469	ORDER BY DESC
-2	174-2031-00			3	CABLE ASSY,RF:50 OHM COAX,6.5 L,W/BUE JKT	TK2338	174-2031-00
-3	174-2349-00			1	CABLE ASSY:7.0 L,2,2 COND,RIBBON,LDI,1X2,0.1 CTR	TK2469	ORDER BY DESC
-4	174-1524-01			1	CA ASSY,SP:RIBBON,GPIB;IDC,24,28 AWG,4.0 L,24 POS	TK2469	ORDER BY DESC
-5	129-1439-00			2	SPACER,POST:0.17 L,4-40 BRS,0.25 RND	TK0588	ORDER BY DESC
-6	174-2975-00			1	CA ASSY,SP,ELEC:16, 28 AWG, FLAT, 4.0L 15 POS	80009	174297500
-7	346-0266-00			1	STRAP,CABLE:PLASTIC	0KB05	346-0266-00
-8	174-1519-00			1	CA ASSY,SP:RIBBON,;IDC,40,28 AWG,5.4 L,2X20,0.1 CTR	TK1899	ORDER BY DESC
-9	174-2973-00			1	CA ASSY,SP:RIBBON,;IDC,40,28 AWG,1.4 L 2X25,0.1 CTR	53387	ORDER BY DESC
-10	174-1728-00			1	CA ASSY,SP:RIBBON,;IDC,26,28 AWG,6.0 L,2X13,0.1 CTR	53387	ORDER BY DESC
-11	343-0549-00			3	STRAP,TIEDOWN,E:0.098 W X 4.0 L,ZYTEL	TK1499	HW-047

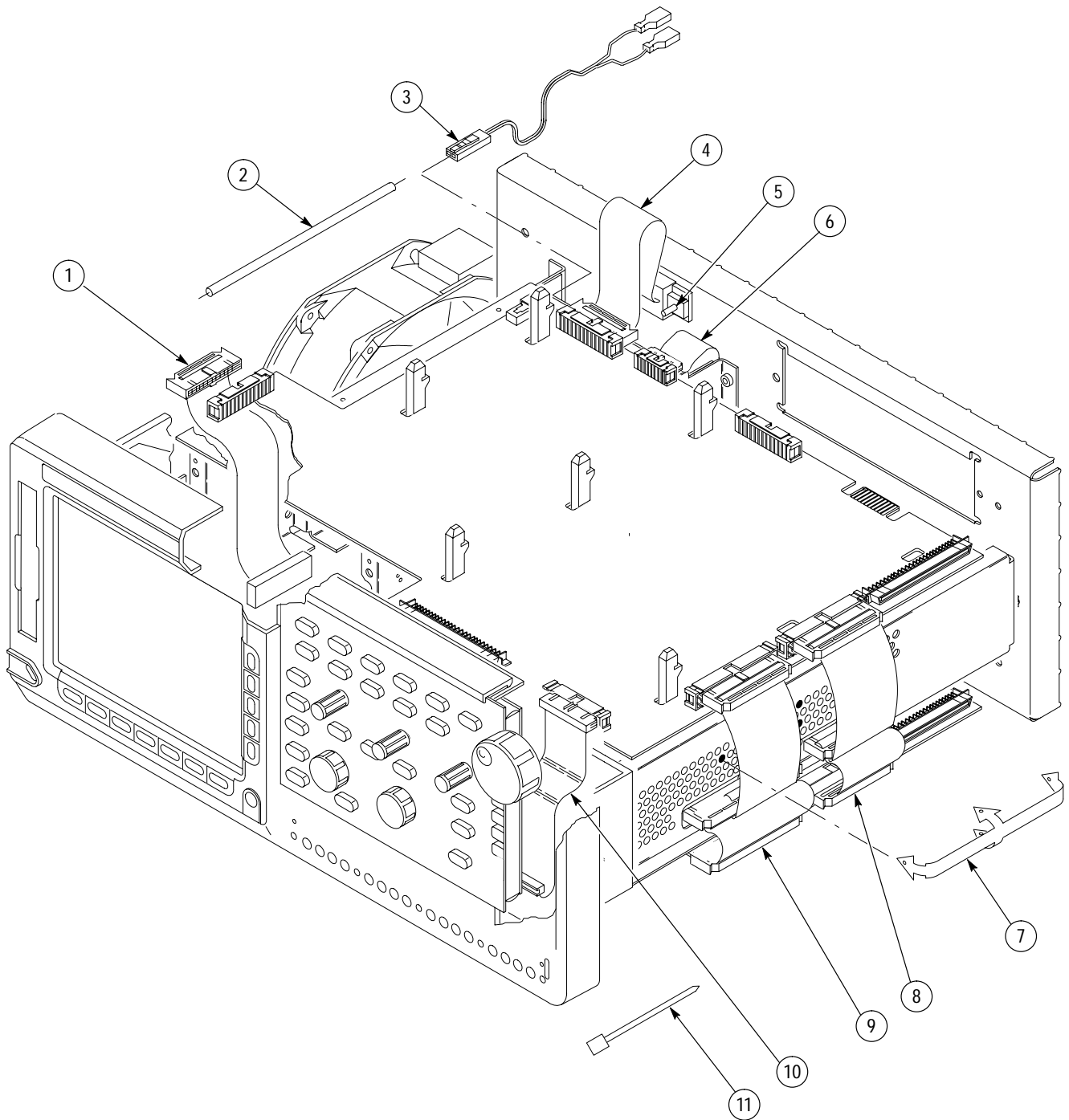


Figure 10-5: Cabling

Replaceable Parts List

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
STANDARD ACCESSORIES						
10-6-1	161-0104-05		1	CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 M,RTANG (OPTION A3-AUSTRALIAN)	S3109	SAA3-OD3CCFC3X
-2	161-0104-06		1	CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 METER,RTANG (OPTION A1-EUROPEAN)	S3109	VIIGSOPO-HO5VVF
-3	161-0104-07		1	CA ASSY,PWR:3,1.0MM SQ,240V/10A,2.5 METER,RTANG (OPTION A2-UNITED KINGDOM)	S3109	ORDER BY DESC
-4	161-0104-08		1	CA ASSY,PWR:3,18 AWG,250/10A,98 INCH L,RTANG (OPTION A4-NORTH AMERICAN)	2W733	ORDER BY DESC
-5	161-0167-00		1	CA ASSY,PWR:3,0.75MM SQ,250V/10A,2.5 M,RTANG (OPTION A5-SWITZERLAND)	S3109	ORDER BY DESC
	343-0170-00		1	RTNR,CA TO CA:U/W 0.25 OD CABLES (OPTIONS A1,A2,A3,A4,A5)	0JR05	ORDER BY DESC
	-----		1	ACCESSORY PKG:16 EA,P6240,ACTIVE PROBEW/ACCY		
	070-8832-00		1	MANUAL,TECH:PERF VERIFICATION /SPECIFICATION	80009	070883200
	070-8833-00		1	MANUAL,TECH:REFERENCE	80009	070883300
	070-8834-00		1	MANUAL,TECH:USER	80009	070883400
	070-8835-00		1	MANUAL,TECH:PROGRAMMERS	80009	070883500

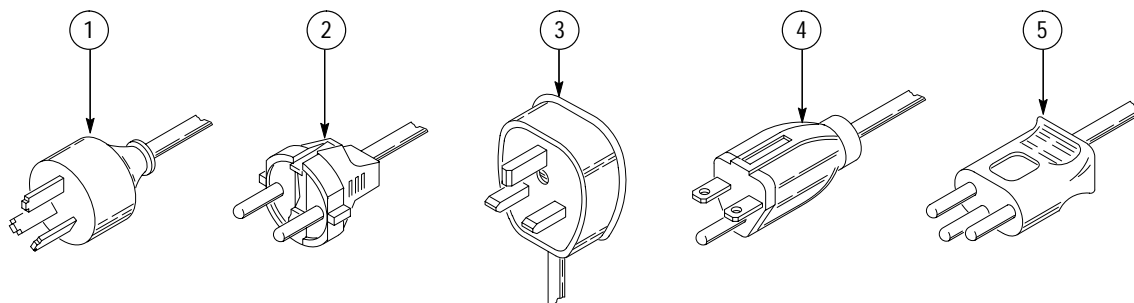


Figure 10-6: Accessories

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
OPTIONAL ACCESSORIES						
003-1457-01			1	BIT,TORX DRIVER:MODIFY THE T-20,TORX	TK1465	003-1457-01
003-1487-00			1	FIXTURE:CRT ALIGNMENT	80009	003148700
012-0991-00			1	CABLE,INTCON:SHLD CMPST,GPIB;CRC,12 TW PR,24	22526	81190-020
012-0991-01			1	CABLE,GPIB:LOW EMI,1 METER	00779	553577-2
012-1250-00			1	CABLE,INTCON:SHLD CMPST,PARALLEL CENTRONICS	TK2193	CACC 3049
012-1298-00			1	CABLE,INTCON:RS232C DB25M-DB9F SERIAL NULL	TK2500	C294-9
012-1388-00			1	CABLE ASSEMBLY:OSCILLOSCOPE SECURITY, 6 FT	80009	012138800
013-0282-00			1	ADAPTER,PROBE:50 TO 75 OHM ADAPTER	80009	013028200
016-0909-01			1	CASE,CARRYING:SOFTSIDED FOR 3002C,P,R,25PIN	TK2162	0587
016-1135-00			1	CASE,CARRYING:26 X 22 X 15,HARD TRANS W/WHEELS	34416	2622RW-7T-7B
016-1145-00			1	HOOD ASSEMBLY:	80009	016114500
016-1236-00			1	MOUNTING KIT:RACK MOUNT KIT	80009	016123600
063-1645-00			1	SOFTWARE PKG:FIELD ADJ,VER 1-3.5 AND 1-5.25 DISK	80009	063164500
070-8831-xx			1	MANUAL,TECH:SERVICE	80009	0708831xx
103-0340-00			1	ADAPTER,FLEX:FLEX CKT,25 CONTACT,0.025 PITCH	80009	103034000
067-0232-00			1	FIXTURE,CAL ADAPTER,ZERO LOSS;P6240	80009	067023200

