Service Manual

Tektronix

TDS 820
Digitizing Oscilloscope

070-8514-03

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.

Instrument Serial Numbers

Each instrument manufactured by Tektronix has a serial number on a panel insert or tag, or stamped on the chassis. The first letter in the serial number designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B010000	Tektronix, Inc., Beaverton, Oregon, USA
E200000	Tektronix United Kingdom, Ltd., London
J300000	Sony/Tektronix, Japan
H700000	Tektronix Holland, NV, Heerenveen, The Netherlands

Instruments manufactured for Tektronix by external vendors outside the United States are assigned a two digit alpha code to identify the country of manufacture (e.g., JP for Japan, HK for Hong Kong, IL for Israel, etc.).

Tektronix, Inc., P.O. Box 500, Beaverton, OR 97077

Printed in U.S.A.

WARRANTY

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of three (3) years from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THIS PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

Table of Contents

Specifications

Operating Information

Theory of Operation

Performance Verification

Adjustment Procedures

Maintenance

List of Figures

List of Figures

List of Tables

Safety Summary

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

Symbols and Terms

These two terms appear in manuals:

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

These two terms appear on equipment:

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

This symbol appears in manuals:

Static-Sensitive Devices

These symbols appear on equipment:

DANGER
High Voltage

Protective
ground (earth)
terminal

ATTENTION
Refer to
manual

Specific Precautions

Observe all of the following precautions to ensure your personal safety and to prevent damage to either the TDS 800 or equipment connected to it.

Do Not Perform Service While Alone

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

Use Care When Servicing With Power On

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

Power Source

The TDS 800 is intended to operate from a power source that will not apply more than 250 V_{RMS} between the supply conductors or between either supply conductor and ground. A protective ground connection, through the grounding conductor in the power cord, is essential for safe system operation.

Grounding TDS 800 Digitizing Oscilloscopes

The TDS 800 is grounded through the power cord. To avoid electric shock, plug the power cord into a properly wired receptacle where earth ground has been verified by a qualified service person. Do this before making connections to the input or output terminals of the TDS 800.

Without the protective ground connection, all parts of the TDS 800 are potential shock hazards. This includes knobs and controls that may appear to be insulators.

Use the Proper Power Cord

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

Use the Proper Fuse

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

Do Not Remove Covers or Panels

To avoid personal injury, do not operate the TDS 800 without the panels or covers.

Do Not Operate in Explosive Atmospheres

The TDS 800 provides no explosion protection from static discharges or arcing components. Do not operate the TDS 800 in an atmosphere of explosive gasses.

Electric Overload

Never apply a voltage to a connector on the TDS 800 that is outside the range specified for that connector.

Take Antistatic Precautions

Wear an antistatic grounding wrist strap when working with the input connectors on the digitizing oscilloscope.

Product Description

This subsection begins with a general description of the traits of TDS 800 Digitizing Oscilloscopes. Three subsections follow, one for each of three classes of traits: *nominal traits, warranted characteristics,* and *typical characteristics*.

General

Tektronix TDS 800 Digitizing Oscilloscopes are portable, two-channel instruments suitable for use in a variety of test and measurement applications and systems. Key features include:

- 6 GHz with delay line or 8 GHz with Option 1D
- Pretrigger view (not available with Option 1D)
- Two-channel acquisition (You can use and display all channels simultaneously)
- Two 14-bit digitizers
- Up to 15,000-point record length per channel
- Full GPIB software programmability
- Complete measurement and documentation ability
- Intuitive graphical icon operation blended with the familiarity of traditional horizontal and vertical knobs
- On-line help at the touch of a button
- Specialized display modes, such as variable persistence, gray scaling, and waveform averaging

User Interface

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

Menus

Those functions for which control settings are usually changed less often, such as vertical coupling and horizontal mode, are set indirectly. That is, pressing one (sometimes two) front-panel button, such as vertical menu, displays a menu of functions at the bottom of the screen related to that button. (For the button **VERTICAL MENU**, the menu displayed contains

functions such as offset, fine scale, etc.) Using the buttons below this *main* menu to select a function, such as **Offset**, displays a *side* menu of settings for that function, such as set to 0 volts, at the right side of the screen. Use the buttons to the right of the menu to select a setting, such as **Set to 0 V**.

Indicators

Several on-screen readouts help you keep track of the settings for various functions, such as vertical and horizontal scale and trigger level. There are also readouts to display the results of measurements made using cursors or using the automatic parameter extraction feature (called measure) and readouts to display the status of the instrument.

General Purpose Knob

Using menus you can assign the general purpose knob to adjust a selected parameter function. The method employed is the same as for *selecting* a function, except the final selection in the side menu causes the general purpose knob to *adjust* some function, such as the position of measurement cursors on screen, or the fine gain setting for a channel.

GUI

The user interface also makes use of a GUI, or Graphical User Interface, to make setting functions and interpreting the display more intuitive. Some menus and status are displayed using iconic representations of function settings such as those shown here for rising edge trigger, falling edge trigger, and intensified. Such icons allow you to more readily determine status or the available settings.

Signal Acquisition System

The signal acquisition system provides two vertical channels with calibrated vertical scale factors from 2 mV to 200 mV per division (1 mV to 100 mV per division with Option 1D). The acquisition system can acquire all channels simultaneously. Each channel can be independently offset.

Besides the input channels, up to three math waveforms and four reference waveforms are available for display. (A math waveform results when you specify dual waveform operations, such as add, on any two channels; a reference waveform results when you save a live waveform in a reference memory.)

Horizontal System

There are three horizontal display modes: main only, main intensified, and delayed only. You can select among various horizontal record length settings (see Table 1-1).

Table 1-1: Record Length Versus Divisions per Record

Record Length	Divisions per Record (50 Points/Division)
15000	300 divisions
5000	100 divisions
2500	50 divisions
1000	20 divisions
500	10 divisions

Both the delayed only display and the intensified zone on the main intensified display may be delayed by time with respect to the trigger.

You can independently deskew each channel to compensate for differences in external cable and probe delays.

Trigger System

The oscilloscope can be triggered from three sources:

- **CH 1** or **CH 2**: A trigger signal picked from either of the two input channels. This trigger source has a bandwidth of 1 GHz (not available with Option 1D).
- **External Input**: An external trigger input, which has a bandwidth of 2 GHz.
- **Internal Clock**: An internal rate generator, which can be programmed from the front panel or the GPIB to rates from 10 Hz to 500 kHz.

In addition, programmable trigger holdoff allows synchronizing on a repetitive pulse burst.

On-Board User Assistance

Two features that help you set up this digitizing oscilloscope to make your measurements are help and autoset.

Help

Help displays operational information about any front-panel control. When help mode is in effect, manipulating any front-panel control causes the digitizing oscilloscope to display information about that control. When help is first invoked, the oscilloscope displays an introduction to help.

Autoset

Autoset automatically sets up the digitizing oscilloscope for a viewable display based on the input signal.

Measurement Assistance

Once you set up the digitizing oscilloscope to make your measurements, the features cursor and measure can help you quickly make those measurements.

Cursor

Three types of cursors are provided for making parametric measurements on the displayed waveforms. Voltage can be measured between the positions of H Bar (horizontal) cursors and time can be measured between V Bar (vertical) cursors. These are delta measurements; that is, measurements based on the difference between two cursors. Paired cursors measure both vertical parameters and horizontal parameters simultaneously.

Both V Bar and H Bar cursors can also be used to make absolute measurements — measurements relative to a defined level or event. In the case of the H Bars, either cursor can be selected to read out its voltage with respect to any channel's ground reference level; in the case of the V Bars, its time with respect to the trigger point (event) of the acquisition.

For time measurements, units can be either seconds or Hertz (for 1/time).

Measure

Measure can automatically extract parameters from the signal input to the digitizing oscilloscope. You may display any four out of the more than 20 available parameters to the screen. The displayed parameters are extracted continuously and the results updated on-screen as the digitizing oscilloscope continues to acquire waveforms.

You can also pop up a display (a snapshot) of almost all the automated measurements. Snapshot can execute all the single waveform measurements available on the selected waveform once and display the results.

Digital Signal Processing (DSP)

An important component of the multiprocessor architecture of this digitizing oscilloscope is the proprietary digital signal processor, the DSP. This dedicated processor supports advanced analysis of your waveforms when doing such compute-intensive tasks as interpolation, waveform math, and signal averaging. It also teams with a custom display system to deliver specialized display modes (See *Display*, later in this description.)

Storage and I/O

You may save acquired waveforms in any of four nonvolatile REF (reference) memories. Any or all of the saved waveforms may be displayed for comparison with the waveforms being currently acquired.

The source and destination of waveforms to be saved may be chosen. Assignment can be made to save any of the four channels to any REF memory or to move a stored reference from one REF memory to another. Reference waveforms may also be written into a REF memory location by way of the GPIB interface.

The digitizing oscilloscope is fully controllable and capable of sending and receiving waveforms over the GPIB interface (IEEE Std 488.1−1987/IEEE Std 488.2−1987 standard). This feature makes the instrument ideal for making automated measurements in a production or research and development environment that calls for repetitive data taking. Self-compensation and self-diagnostic features built into the digitizing oscilloscope to aid in fault detection and servicing are also accessible using commands sent from a GPIB controller.

Another standard feature is hardcopy. This feature allows you to output waveforms and other on-screen information to a variety of graphic printers and plotters from the digitizing oscilloscope front panel, providing hard copies without requiring you to put the digitizing oscilloscope into a system-controller environment. The hard copies obtained are WYSIWYG (What-You-See-Is-What-You-Get), based on the display at the time hardcopy is invoked.

Display

TDS 800 Digitizing Oscilloscopes offer flexible display options. You can customize the following attributes of your display:

- Intensity: waveforms, readouts, graticule, etc.
- Style of waveform display(s): vectors or dots, intensified or non-intensified samples, and infinite or variable persistence
- Display format: XY or YT and graticule type

This digitizing oscilloscope also provides an easy way to focus in on those waveform features you wish to examine up close. By invoking zoom, you can magnify the waveform parameter using the vertical and horizontal controls to expand (or contract) and position it for viewing.

Nominal Traits

This subsection contains a collection of tables that list the various *nominal traits* that describe TDS 800 Digitizing Oscilloscopes. Included are electrical and mechanical traits.

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

Table 1-2: Nominal Traits — Signal Acquisition System

Name	Description
Digitizers, Number of	Two
Digitized Bits, Number of	14 bits[1]
Input Channels, Number of	Two
Input Coupling	DC
Input Connector Type	SMA
Input Impedance	50 Ω nominal
Ranges, Sensitivity	1 mV/div – 100 mV/div for Option 1D 2 mV/div – 200 mV/div for the delay line version of the TDS 820
Ranges, Offset, All Channels	±1.00 V at all volts per division settings for Option 1D ±2.00 V at all volts per division settings for the delay line version of the TDS 820
Range, Position	±5 divisions

[1]The number of digitization levels (DLs) is approximately 13,100. In instruments with delay lines, each DL is equal to approximately 150 μV at all vertical scale settings. Without delay lines (Option 1D), each DL is equal to approximately 75 μV.

Table 1-3: Nominal Traits — Time Base System

Name	Description	
Sample Acquire Rate	0 to 50 ksamples per second[1]	
Range, Seconds per Division	20 ps per division to 2 ms per division in a 1−2−5 sequence. Settable in calibrated 5 ps per division increments through the keypad.	
Range, Time Base Position	Main Time base	≥16 ns to 20 ms
	Delayed Time Base	≥16 ns to 20 ms, but never less than the main time base position
Record Length	500 points, 1000 points, 2500 points, 5000 points, or 15000 points	
Rate Generator, Internal Programmable	10 Hz to 500 kHz	
Deskew Resolution, Between Channel	Adjustable in 1 ps steps	
Deskew Range, Between Channel	0 to 10 ns	
Holdoff Range	15 µs to 2 s	

[1]The sample acquire rate is less than or equal to the slower of the trigger rate or the reciprocal of the trigger holdoff time.

Table 1-4: Nominal Traits — Triggering System

Name	Description	
Trigger Sources	External (DC Coupled)	
	Internal rate generator	
	Channel 1 or 2 DC coupled (for the delay line version of the TDS 820 only)	
Ranges, Trigger Level	**Source**	**Range**
	External Trigger	±1 V
	CH 1 or CH 2 Trigger	±4 V (for the delay line version of the TDS 820 only)
Resolution, Trigger Level	**Source**	**Range**
	External Trigger	0.5 mV increments
	CH 1 or CH 2 Trigger	2 mV increments (for the delay line version of the TDS 820 only)
Internal Clock Out	Square wave out into 50 Ω:	
	−0.175 V to 0.100 V low level	
	0.850 V to 1.100 V high level	
1 MHz Clock Out	Square wave out into 50 Ω:	
	−0.350 V to −0.200 V low level	
	0.200 V to 0.350 V high level	

Table 1-5: Nominal Traits — Display System

Name	Description
Video Display Resolution	640 pixels horizontally by 480 pixels vertically in a display area of 5.2 inches horizontally by 3.9 inches vertically
Waveform Display Graticule	401 × 501 pixels for single, 8 × 10 division graticule with 1 cm by 1 cm square divisions
Waveform Display Gray Scale	Sixteen levels in infinite-persistence and variable persistence display styles

Table 1-6: Nominal Traits — GPIB Interface, Output Ports, and Power Fuse

Name	Description
Interface, GPIB	GPIB interface complies with IEEE Std 488.1-1987 and IEEE Std 488.2-1987
Fuse Rating	Either of two fuses[1] may be used: a 0.25″ × 1.25″ (UL 198.6, 3AG): 6 A FAST, 250 V, or a 5 mm × 20 mm, (IEC 127): 5 A (T), 250 V.

[1]Each fuse type requires its own fuse cap.

Table 1-7: Nominal Traits — Mechanical

Name	Description
Cooling Method	Forced-air circulation with no air filter
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 Tektronix Blue vinyl material.
Finish Type	Tektronix Blue vinyl-clad aluminum cabinet
Weight	Digitizing Oscilloscope without delay lines 13.2 kg (29 lbs), with front cover. 23.2 kg (51 lbs), when packaged for domestic shipment. Delay line version of the TDS 820 13.6 kg (30 lbs), with front cover. 23.6 kg (52 lbs), when packaged for domestic shipment. Rackmount conversion kit 2.3 kg (5 lbs), parts only; 3.6 kg (8 lbs), when kit is package for domestic shipping.
Overall Dimensions	Standard Digitizing Oscilloscopes Height: 236 mm (9.3 in), when feet and accessories pouch are installed. 193 mm (7.6 in), without the accessories pouch installed. Width: 445 mm (17.5 in), with handle. Depth: 432 mm (17.0 in), with front cover installed. Rackmount Digitizing Oscilloscopes Height: 178 mm (7.0 in). Width: 483 mm (19.0 in). Depth: 558.8 mm (22.0 in).

Warranted Characteristics

This subsection lists the various *warranted characteristics* that describe TDS 800 Digitizing Oscilloscopes. Included are electrical and environmental characteristics.

Warranted characteristics are described in terms of quantifiable performance limits that are warranted.

NOTE

In these tables, those warranted characteristics that are checked in the Performance Verification*, appear in* ***boldface type*** *under the column* **Name**.

As stated above, this subsection lists only warranted characteristics. A list of *typical characteristics* starts on page 1-17.

Performance Conditions

The electrical characteristics found in these tables of warranted characteristics apply when the oscilloscope has been adjusted at an ambient temperature between +20° C and +30° C after a warm-up period of at least 20 minutes, is operating at an ambient temperature between 0° C and +50° C (unless otherwise noted), and the user compensation has been initiated. Ambient temperature should not vary more than ±5° C during the measurement, unless otherwise noted.

Table 1-8: Warranted Characteristics — Signal Acquisition System

Name	Description
Input Voltage, Maximum Operating	±1.5 Volt net offset range, 1.0 V peak-to-peak ±3.0 Volt net offset[1] range, 2.0 V peak-to-peak for the delay line version of the TDS 820
Range, Dynamic	1 V peak-to-peak AC 2 V peak-to-peak AC for the delay line version of the TDS 820
Input Resistance	50 Ω ±0.5 Ω 50 Ω ±1 Ω for the delay line version of the TDS 820
Accuracy, DC Gain	±0.7% ±0.005% ($T_{amb} - T_{adj}$) (after user vertical compensation) at 0 to 50° C ±0.7% ±0.015% ($T_{amb} - T_{adj}$) (after user vertical compensation) at 0 to 50° C for the delay line version of the TDS 820 T_{adj} is the ambient temperature at which offset gain was adjusted.

Table 1-8: Warranted Characteristics — Signal Acquisition System (Cont.)

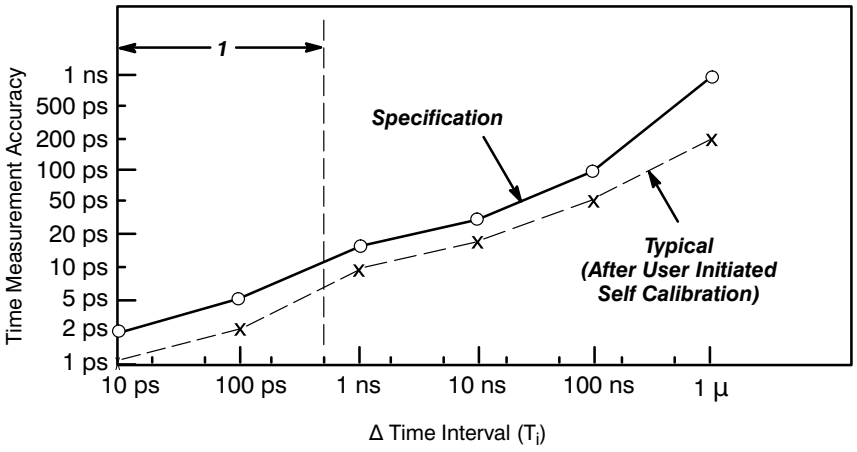
Name	Description	
Nonlinearity, DC	**Integral** $<\pm 0.2\%$ of full scale dynamic range (after user vertical compensation) **Differential** <1 DL (improves with averaging)	
Accuracy, DC Voltage Measurement, Averaged	**Measurement Type**	**DC Accuracy**
	Average of ≥16 waveforms	
	Single point relative to ground	±DC Gain Accuracy × (reading − Net Offset[1]) ± Integral DC Nonlinearity ± Net Offset Accuracy
	Delta voltage	DC Gain Accuracy × Reading + 2 × Integral DC Nonlinearity
Rise Time[2]	43.8 ps maximum; 57.8 ±0.1 ps per °C (T_{amb}−25°C) maximum for the delay line version of the TDS 820	
Accuracy, Net Offset	±(0.3% ±0.005% per °C (T_{amb} − T_{adj}))(offset − position × Volts per division) +2 mV+(T_{amb} − T_c)(0.1 mV/°C) (after vertical calibration) ±(0.3% ±0.015% per °C (T_{amb} − T_{adj}))(offset − position × Volts per division) +4 mV+(T_{amb} − T_c)(0.2 mV/°C) (after vertical calibration) for the delay line version of the TDS 820 T_{adj} is the ambient temperature at which offset gain was adjusted. T_{amb} is the ambient temperature. T_c is the ambient temperature when a vertical compensation was performed. Net Offset[1] is the nominal voltage level at the center of the A/D converter dynamic range. Offset Accuracy is the accuracy of this voltage level. Net offset gain is calibrated against an external precision voltage reference, at an ambient temperature between 20° C and 30° C. Stability of net offset gain depends on the voltage reference internal to the A/D converter. The 40 parts per million (ppm) temperature coefficient of the voltage reference is included in the accuracy specification. Net Offset balance is compensated during the user initiated vertical calibration procedure.	
Cross Talk (Channel Isolation)	≤0.2% (<500 μV) when any other channel is driven by 067−1338−00 step generator (250 mV amplitude)	
Random Noise	≤600 μV_{RMS} ≤1.2 mV_{RMS} for the delay line version of the TDS 820	

[1]Net Offset = Offset − (Position × Volts per Division). Net Offset is the voltage level at the center of the A-D converter's dynamic range. Offset Accuracy is the accuracy of this Voltage level.

[2]Measured using an 067−1338−00 reference calibration step generator. Rise time is calculated using SRSS method.

Table 1-9: Warranted Characteristics — Time Base System

Name	Description	
Accuracy, Delta Time Measurement, Single Channel	**Time Interval (T_i)**	**Measurement Accuracy**
	≥1 ns	0.1% × measured time intervals +15 ps. For intervals <1 ns interpolate between cardinal time interval points.
	100 ps[1]	5 ps
	10 ps[1]	2 ps



Accuracy, Delta Time Measurement, Between Channels

$$30\ ps + 0.1\%(\text{measured delta time} + \text{first channel deskew} - \text{second channel deskew}) + 30\ ps\left(\text{smaller of remainder between}\frac{\text{first channel deskew} - \text{second channel deskew}}{3.2768\ ns}\ \text{and}\ \frac{\text{first channel deskew} - \text{second channel deskew} + 1.6384\ ns}{3.2768\ ns}\right)$$

Example: 1) First channel deskew = second channel deskew = 0 ps
Measured delta time = 10 ns

Accuracy = 30 ps + 0.001 × 10 ns = 40 ps

2) First channel deskew = 0 ps; second channel deskew = 1.5 ns
Measured delta time = 10 ns

Accuracy = 30 ps + 0.001(10 ns + 1.5 ns) + 30 ps × 0.457 = 20 + 11.5 +13.7 = 55.2 ps

[1]**For Δ time intervals <500 ps measured at (time per division X the number of divisions) ≤500 ps.**

Table 1-10: Warranted Characteristics — Triggering System

Name	Description	
Sensitivity, Trigger	**Trigger Source**	**Sensitivity**
	External	40 mV peak-to-peak from DC to 200 MHz, linearly increasing to 200 mV peak-to-peak at 2 GHz
	CH 1 and CH 2	60 mV peak-to-peak from DC to 625 MHz, linearly increasing to 150 mV peak-to-peak at 1.0 GHz for the delay line version of the TDS 820
Jitter, Trigger Delay	3 ps rms + 30 parts per million (ppm) of the selected delay	
Accuracy, Trigger Level	**Trigger Source**	**Accuracy**
	External	0.10 × level + 0.05 V
	CH 1 and CH 2	0.10 × level + 0.05 V for the delay line version of the TDS 820

Table 1-11: Warranted Characteristics — Power Requirements

Name	Description
Source Voltage	90 to 250 VAC_{RMS}, continuous range
Source Frequency	47 Hz to 63 Hz
Power Consumption	≤185 W (450 VA)

Table 1-12: Warranted Characteristics — Environmental and Reliability

Name	Description
Atmospherics	Temperature: 0° C to +50° C, operating; −40° C to +75° C, non-operating Relative humidity: 0 to 95%, at or below +40° C; 0 to 75%, from +41° C to 50° C Altitude: To 15,000 ft. (4570 m), operating; to 40,000 ft. (12190 m), non-operating
Dynamics	Random vibration: 0.31 g_{RMS}, from 5 to 500 Hz, 10 minutes each axis, operating 2.46 g_{RMS}, from 5 to 500 Hz, 10 minutes each axis, non-operating

Table 1-12: Warranted Characteristics — Environmental and Reliability (Cont.)

Name	Description
Emissions	Meets or exceeds the requirements of the following standards: MIL-STD-461C CE-03, part 4, curve #1, RE-02, part 7 VDE 0871, Category B FCC Rules and Regulations, Part 15, Subpart J, Class A
Electrostatic Discharge	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

Typical Characteristics

This subsection contains tables that list the various *typical characteristics* that describe TDS 800 Digitizing Oscilloscopes.

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

This subsection lists only typical characteristics. A list of warranted characteristics starts on page 1-11.

Table 1-13: Typical Characteristics — Signal Acquisition System

Name	Description	
Input Voltage, Absolute Maximum	±3 Volts maximum ±6 Volts maximum for the delay line version of the TDS 820	
Bandwidth, Analog[1]	8 GHz 6 GHz for the delay line version of the TDS 820	
Strobe Kickout	Less than 0.6 × (input signal − net offset) Less than 0.3 × (input signal − net offset) for the delay line version of the TDS 820 In both cases the dominant impulse lasts less than 150 ps.	
VSWR, Input	≤1.1:1 from DC to 6 GHz ≤1.3:1 from 6 GHz to 8 GHz ≤1.3:1 from DC to 6 GHz for the delay line version of the TDS 820	
Crosstalk, Sine or Square Wave Input	≥1000:1 from DC to 8 GHz ≥150:1 at V_{in} ≤200 mV p-p (for the delay line version of the TDS 820), less for larger input signals	
Step Response Aberrations, Full Bandwidth	**With delay line (for the delay line version of the TDS 820)** +3% to −2% ≤300 ps ±2% 300 ps to 100 ns ±0.5% >100 ns	**Without delay line** +6% to −3% ≤500 ps ±1% 500 ps to 5 ns ±0.5% 5 ns to 50 ns ±0.25% >50 ns Less than: ±1.5% 10 ns to 20 ps before step
	Measured using 067−1338−00 reference flat calibration step generator.	

Table 1-13: Typical Characteristics — Signal Acquisition System (Cont.)

Name	Description
Random Noise	300 μV_{RMS} 600 μV_{RMS} for the delay line version of the TDS 820

[1]**Bandwidth is calculated from measured rise time using the following formula:** $Bandwidth = \frac{0.35}{Rise\ \ Time}$

Table 1-14: Typical Characteristics — Time Base System

Name	Description
View Time, Pretrigger	1.5 ns for the delay line version of the TDS 820

Table 1-15: Typical Characteristics — Triggering System

Name	Description	
Pulse Width, Minimum Trigger	**External**	0.25 ns
	CH 1 and CH 2	0.5 ns for the delay line version of the TDS 820 only

Table 1-16: Typical Characteristics — Data Handling

Name	Description
Retention Time, Nonvolatile Memory[1,2]	≥5 years

[1]**The time that reference waveforms, stored setups, and calibration constants are retained when there is no power to the oscilloscope.**

[2]**Small lithium-thionyl-chloride batteries internal to the memory ICs maintain the data. The amount of lithium is so small in these ICs that they can typically be safely disposed of with ordinary garbage in a sanitary landfill.**

Using this Manual

This section contains information needed to properly use this manual to service TDS 800 Digitizing Oscilloscopes, as well as general information critical to safe and effective servicing of this oscilloscope.

Before Servicing

This manual is for servicing TDS 800 Digitizing Oscilloscopes. To prevent injury to yourself or damage to the oscilloscope, do the following before you attempt service:

- Be sure you are a qualified service person;
- Read the Safety Summary found at the beginning of this manual;
- Read *Strategy for Servicing* and *Supplying Operating Power* in this section.

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

Strategy for Servicing

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

This manual contains all the information needed for periodic maintenance of TDS 800 Digitizing Oscilloscopes. (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, *Parts List.* To isolate a failure to a module, use the fault isolation procedures found in Section 6, *Maintenance.* To remove and replace any failed module, follow the instructions in *Removal and Installation Procedures*, also found in Section 6.

Manual Structure

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

Sections containing procedures also contain introductions to those procedures. Be sure to read these introductions, because they provide information needed to do the service correctly and efficiently. The following is a brief description of each manual section.

- *Specification* — contains a product description of TDS 800 Digitizing Oscilloscopes and tables of the characteristics and descriptions that apply to it.
- *Operating Information* — includes a description of how this manual is structured as well as general information and operating instructions at the level needed to safely power up and service this oscilloscope. A statement of the service strategy that this manual supports, and instructions for shipment of the digitizing oscilloscope are 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 digitizing oscilloscope functions properly and meets warranted limits.
- *Adjustment Procedures* — contains a collection of procedures for adjusting this digitizing oscilloscope to meet warranted limits.
- *Maintenance* — contains information and procedures for doing preventive and corrective maintenance of this digitizing oscilloscope. 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 oscilloscope.
- *Electrical Replaceable Parts* — 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.
- *Replaceable Parts* — includes a table of all replaceable modules, their descriptions, and their Tektronix part numbers.

Manual Conventions

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

Modules

Throughout this manual, any replaceable component, assembly, or part of this digitizing oscilloscope is referred to 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 oscilloscope 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:

The “stop sign” icon labels information which 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 oscilloscope 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.

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 TDS 800 Digitizing Oscilloscopes. 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. (The warranty appears on the back of the title page in this manual.) Tektronix technicians provide warranty service at most Tektronix service locations worldwide. Your Tektronix product catalog lists all service locations worldwide.

Repair or Calibration Service

The following services may be purchased to tailor repair and/or calibration of TDS 800 Digitizing Oscilloscopes to fit your requirements.

Option 9C — When you order your digitizing oscilloscope with option 9C, it is shipped with a *Certificate of Calibration and Test Data.* This certificate provides traceability to the National Institute of Standards and Technology (NIST). It certifies procedures used to calibrate the oscilloscope 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 oscilloscope.

Of these services, the annual maintenance agreement offers a particularly cost-effective approach to service for many owners. 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 oscilloscope 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.

Finding Other Information

TDS 800 Digitizing Oscilloscopes come with the following manuals:

TDS 820 User Manual contains a tutorial to quickly show you how to operate TDS 800 Digitizing Oscilloscopes and an in depth discussion of how to more completely use their features. Applications are also discussed.

TDS 820 Reference contains a brief overview of oscilloscope operation.

TDS 820 Programmer Manual contains information for programmed operation via the GPIB interface. Included is the complete command set, set up information, and programming examples.

Supplying Operating Power

Read all information and heed all warnings in this subsection before connecting TDS 800 Digitizing Oscilloscopes to a power source.

WARNING

AC POWER SOURCE AND CONNECTION. The digitizing oscilloscope 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 TDS 800 has a suitable two-pole, three-terminal grounding-type plug.

GROUNDING. This instrument 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.

WARNING

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 instrument's input or output terminals.

Power Cord Information

A power cord with appropriate plug configuration is supplied with each digitizing oscilloscope. 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 Figure 2-1, Power-Cord Plug 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

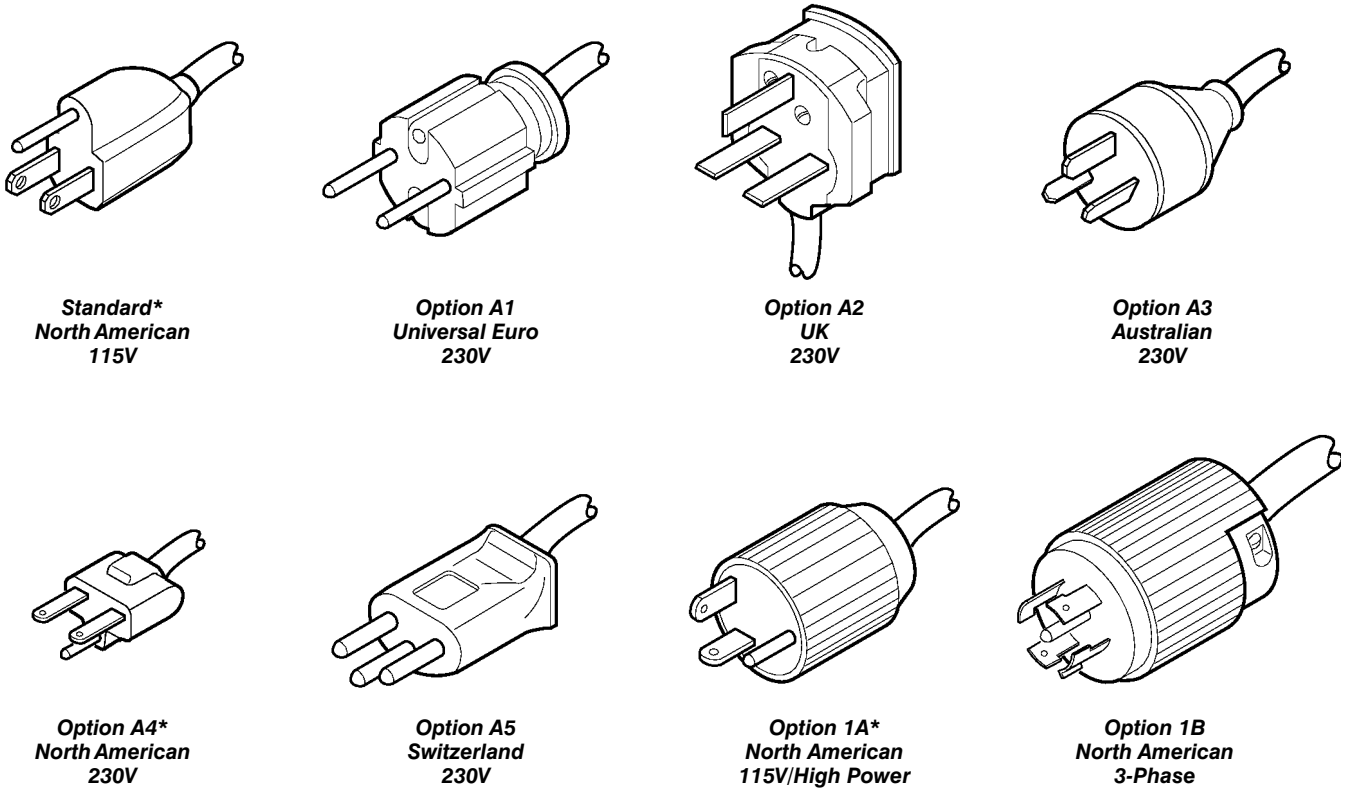


Figure 2-1: Power-Cord Plug Identification

Operating Voltage

This oscilloscope 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 TDS 800 Digitizing Oscilloscopes 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 (instrument 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-up may indicate that the memory modules need to be replaced.

Operating Environment

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

Operating Temperature

TDS 800 Digitizing Oscilloscopes can be operated where the ambient air temperature is between 0° C and +50° C and can be stored in ambient temperatures from −40° C to +75° 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 digitizing oscilloscope is cooled by air drawn in and exhausted through its cabinet side panels by an internal fan. To ensure proper cooling of the instrument, allow at least two inches clearance on both sides and 3/4 inch on the bottom of the digitizing oscilloscope. (The feet on the bottom of the oscilloscope provide the required clearance when set on flat surfaces.) The top of the oscilloscope does not require ventilation clearance.

CAUTION

If air flow is restricted, the power supply may temporarily shut down.

Applying and Interrupting Power

Consider the following information when you power up or power down the instrument, or when power is interrupted due to an external power failure.

Power-Up

Upon power-up, the oscilloscope runs its power-on self check. If it passes, the oscilloscope displays a “passed” status message and a prompt to press CLEAR MENU to continue. If it fails, the oscilloscope 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-Down

CAUTION

DO NOT power down the oscilloscope 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 down the instrument when doing operations that affect the data types listed in Table 2-2. Wait for the instrument to finish the operation when doing adjustments, saving waveforms, or saving setups.

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

Table 2-2: Effects of Corrupted Data

Corrupted Data Type	Results
Adjustment Constants	A signal path compensation is required.
Error Log	Errors logged are lost.
Reference Waveforms	Waveform Lost.
Saved Setups	Setup Lost.

Repackaging Instructions

Use a corrugated cardboard shipping carton having a test strength of at least 275 pounds (125 kg) and with an inside dimension at least six inches (15 cm) greater than the instrument dimensions.

If the instrument 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 instrument, 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.

Installed Options

Your instrument may be equipped with one or more instrument options. Except for the line-cord options described by Table 2-1 (on page 2-8 of this section), all options and optional accessories are listed and described in Section 7, *Options*. For further information and prices of instrument options, see your Tektronix Products catalog or contact your Tektronix Field Office.

General Operating Instructions

Before doing service, read the following operating instructions. These instructions are at the level appropriate for servicing this digitizing oscilloscope. The complete operators instructions are found in the *TDS 820 User Manual*.

Additional instructions are integrated into the service procedures found in later sections of this manual. The general instructions for operating the internal diagnostic routines are found in Section 6, *Maintenance.* You may also find the *Product Description* in Section 1 useful for understanding how the oscilloscope functions.

CAUTION

Inputs to this oscilloscope can be damaged by static discharge. Wear your antistatic wrist strap whenever making connections the oscilloscope.

NOTE

Torque all SMA connections to 8−1/2 in-lb (0.96 N · m). Put SMA short circuit terminations on unused inputs.

Screen Layout

The screen layout is illustrated in Figure 2-2 on page 2-14. Note that the figure illustrates a full graticule; you may also select a grid, crosshair, or frame graticule from the display menu.

Basic Procedures

Use these procedures for basic operating instructions. More detailed operating instructions are in the user manual.

How to Power Up

Push the principal power switch found on the rear panel of the digitizing oscilloscope, then push the **ON**/**STBY** (standby) switch to toggle the digitizing oscilloscope into operation. The switch at the rear panel is the true power disconnect switch. The **ON**/**STBY**(standby) switch simply toggles operation on and off.

WARNING

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

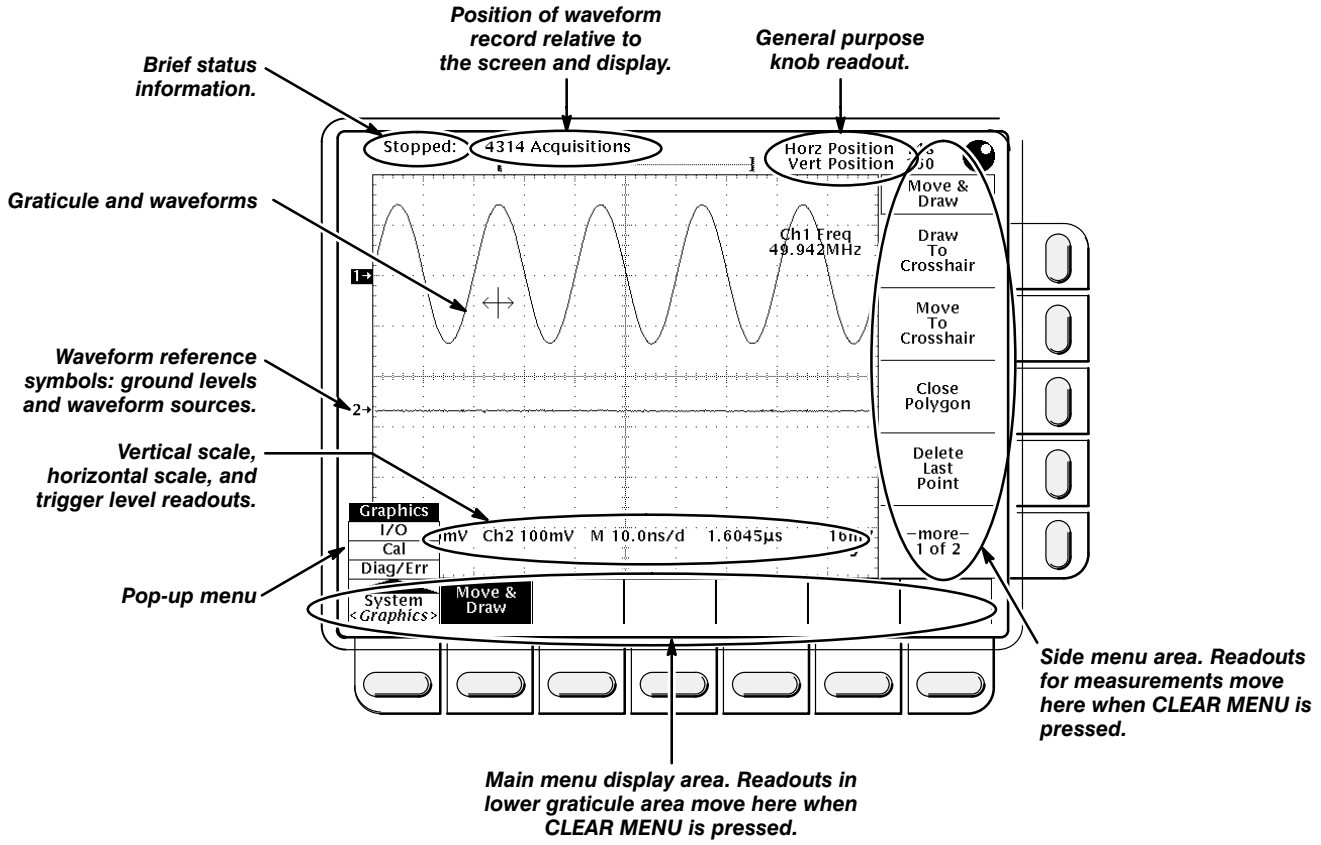


Figure 2-2: Map of Display Functions

How to Use Help

Push the **HELP** front-panel button to enter help mode. 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.

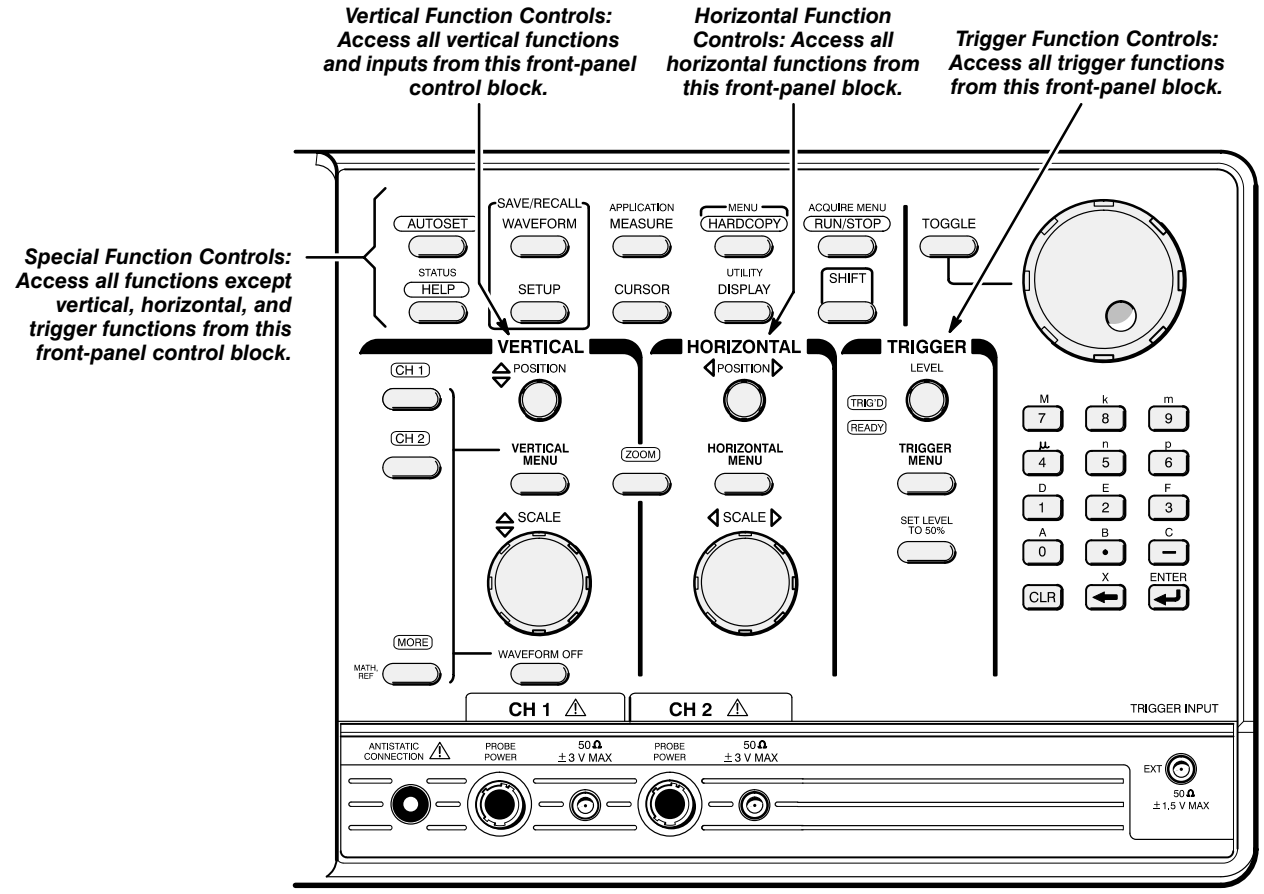
How to Use the Status Menu

Push the **SHIFT**, then the **STATUS** front-panel buttons to display the status menu. You will find messages reflecting the state of the acquisition system, whether it is running or stopped (and if it is stopped, why), as well as setup-related information.

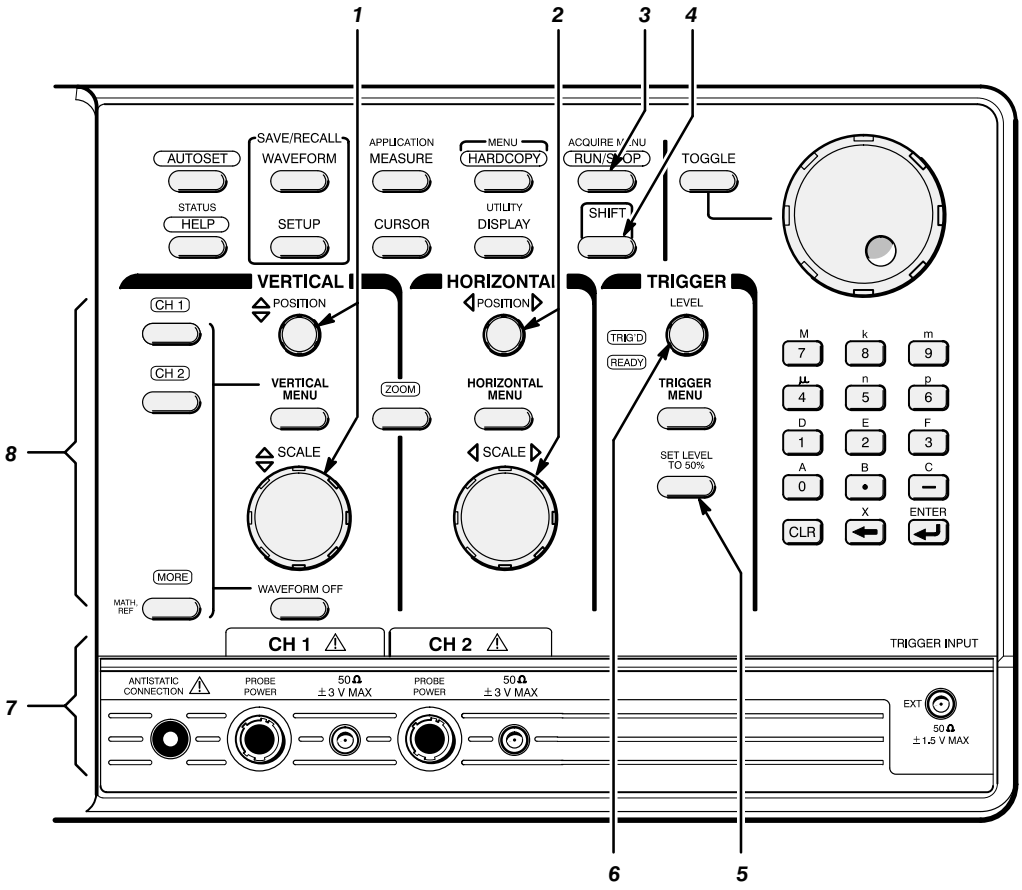
How to Set Functions

Most functions can be set either by using one or two front-panel buttons or knobs, or by pushing a front-panel button to use a main menu, and then a side menu to set the function. The following steps illustrate both procedures.

1. Locate the block that contains the function to be set.



2. Select the waveform source(s). Position, scale, and set trigger level for waveform source(s) directly from the front-panel. (Examples of possible control selections are given in the steps that follow.)



a. Input waveforms into these channels (7). Example: **CH 1**.

b. Push any channel's button (8) to display its waveform. The last channel turned on determines which waveform is positioned and scaled. The indicator above the channel last selected is lighted. Example: Push **CH 1**; then **CH 2**.

c. Vertically (1) and horizontally (2) scale and position the waveform(s) selected. Example: Set the scale to 100 mV/div and center the waveform on screen.

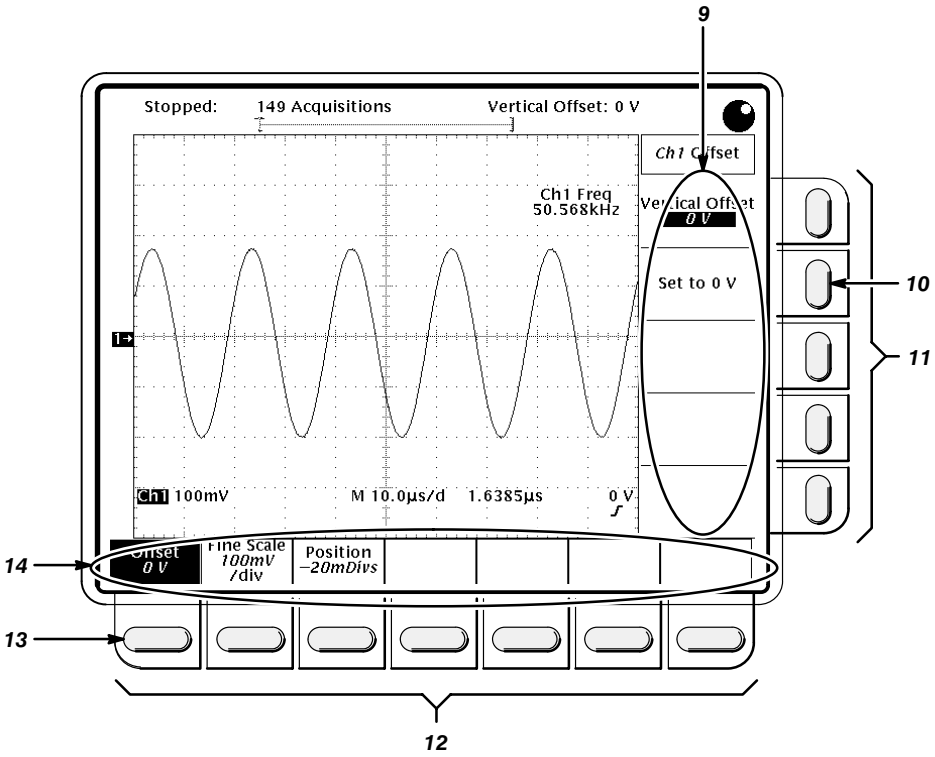
d. Stop and start acquiring waveforms (3). Example: Push **RUN/STOP** if not acquiring.

e. Adjust trigger level (6) to trigger the waveform(s) selected or use this button (5) to set a trigger level at the mid-amplitude level of the selected waveform. Example: Push **SET LEVEL TO 50%**.

3. Set all other functions using menus.

   a. Choose the waveform source (8) first if setting a vertical function; else skip to step b. Example: Push **CH 2**.

   b. Push **SHIFT** (4) if the function to be set is highlighted in blue; else skip to step c.



   c. 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 **VERTICAL 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. **Offset** is currently set to ***0 V***.

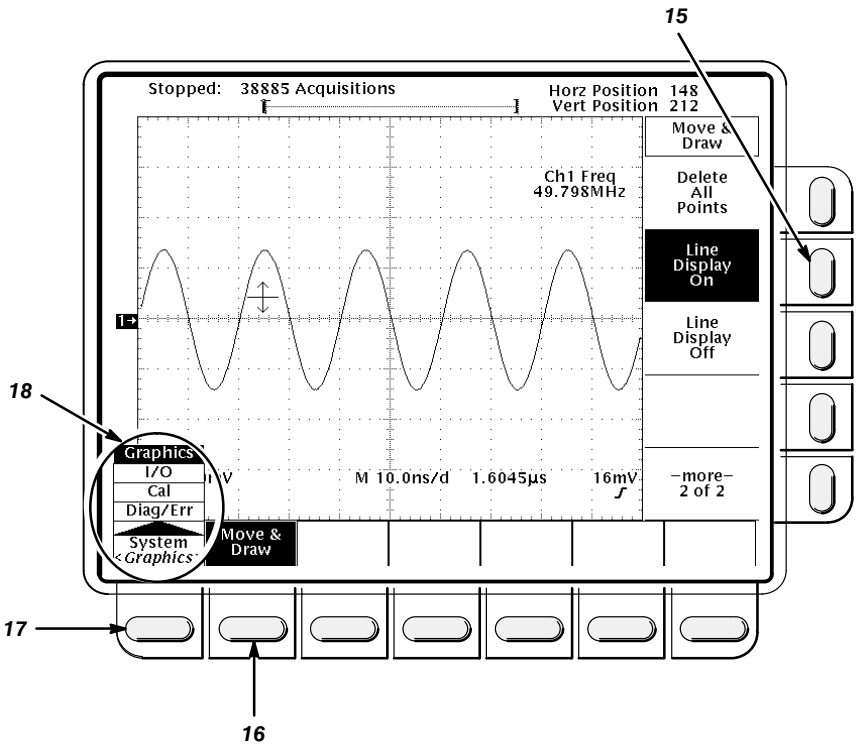
   d. Select a function from the main menu using the main menu buttons (12). A side menu for selecting among the available settings for that function appears. Example: Push **Offset** (13).

   e. Select the setting for the function from the side menu (9) using the side menu buttons (11). Example: Push **Set to 0 V** (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, the side menu, or both are modified to supply additional choices. The procedures that follow show both schemes.

1. Set up a function using pop-up menus:



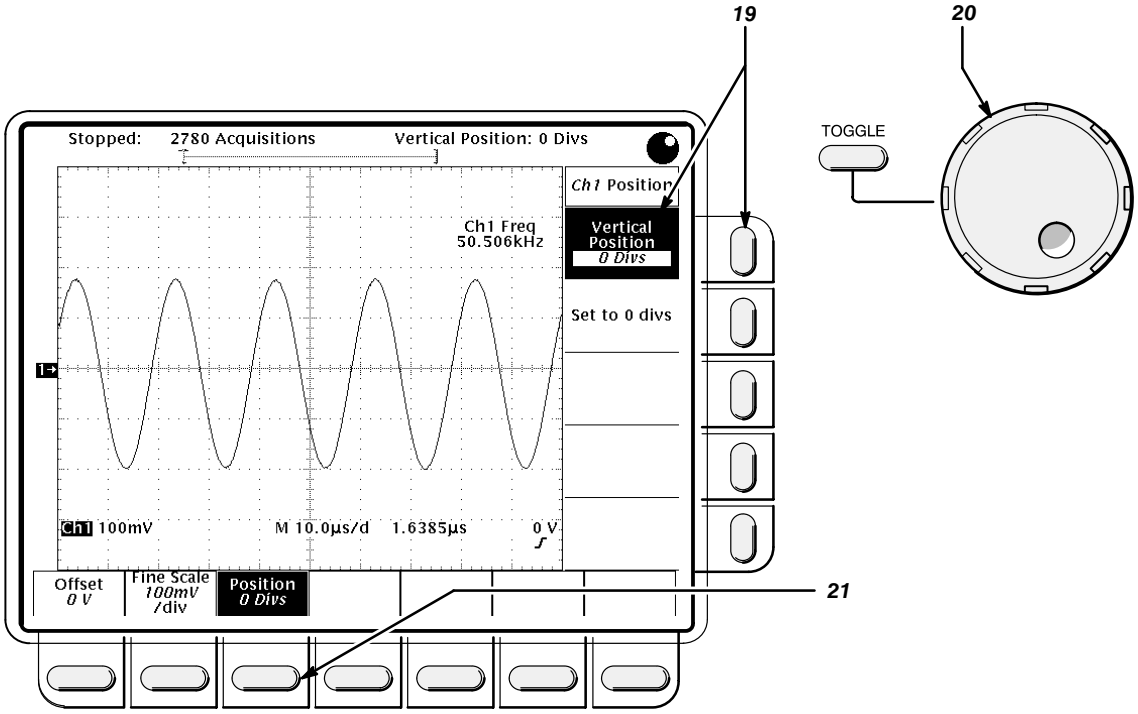
   a. For some selections, pushing a main menu button pops up a menu (18) of subfunctions. Example: Push **System** (17).

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

   b. Pushing the button that popped up the menu (17) toggles through the pop-up menu choices. Example: Repeatedly push **System** to toggle through the pop-up menu. Notice the other main-menu button labels change accordingly. Toggle back to **Graphics**.

   c. Complete the setting of the desired mode by selecting from the main menu and the side menu that results. Example: Push **Move, Draw** (16), and then push **Line Display On** (15).

2. Set up a function using the general purpose knob (20). (The examples of possible menu selections in substeps that follow assume you've pushed **VERTICAL MENU**.)



   a. Pushing some main menu buttons displays a side menu with labels containing readouts that can be varied. Example: Push **Position** (21).

   b. Pushing the side-menu button assigns the knob to control the readout appearing in the button label. It also copies the readout to the general purpose knob readout area in the right corner of the screen. Example: Push **Vertical Position** (19).

   c. Use the general purpose knob (20) to adjust the vertical position to the setting desired. Example: Turn the knob to **−0 Divs**.

More About the General Purpose Knob — As you have just seen, the general purpose knob can be used to extend the number of choices available to a side menu button. The general purpose knob can also be assigned to control the following functions:

- Cursor positioning
- Display intensities
- Main position
- Trigger level
- Holdoff

- Offset
- 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 settings within icon labels 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 2-2.) 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 left 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.
- To assign the general purpose knob to control a function, display the menu containing the function; then select the function. (Note that not all functions can be controlled by the general purpose knob.)
- Whenever the menu is removed, the general purpose knob is not assigned and does not 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.)
- The general purpose knob also has a **TOGGLE** button. The toggle 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:

- Intensity: waveforms, readouts, graticule, etc.
- Style of waveform display(s): vectors or dots and infinite or variable persistence.
- Display format: XY or YT.
- 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.

Circuit Description

This section describes the electrical operation of Tektronix TDS 800 Digitizing Oscilloscopes 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 digitizing oscilloscope 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 digitizing oscilloscope is a portable, two-channel oscilloscope. Each channel provides a calibrated vertical scale factor. All of the channels can be acquired simultaneously.

Input Signal Path

A signal enters the oscilloscope through an SMA input connector connected either to the A10 Acquisition board (oscilloscopes without delay lines) or to the Compensation Pickoff (oscilloscopes with delay lines).

Compensation Pickoff — The compensation pickoff circuit is used in digitizing oscilloscopes with delay lines. The compensation pickoff compensates for the losses of the delay line. It also picks off a portion of the input signal for use by the trigger circuitry.

Interconnect — Compensation pickoff control voltages and probe power voltages pass through the interconnect board.

Delay Line — In digitizing oscilloscopes without delay lines, the delay line is replaced with a short length of semi-ridged coaxial cable. The delay lines connect the signal outputs from the compensation pickoff to the input of the sampler in the acquisition system.

Acquisition System — The acquisition system amplifies the input signals, 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 oscilloscope. It also includes a GPIB interface and a digital signal processor. The digital signal processor processes each waveform as directed by software downloaded from the A13 Firmface 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.

Firmface

The A13 Firmface contains the firmware program for the oscilloscope. The firmware can be reprogrammed by reburning the ROMs using the GPIB and an external software package.

Tube Assembly

All information (waveforms, text, graticules, and pictographs) is displayed by the A20 Display (tube) assemblyA20 CRT Driver. It 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 pots. 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.

Rear Panel

The **GPIB** connector provides access to stored waveforms, and allows external control of the oscilloscope. Other rear panel connectors are the **INTERNAL CLOCK OUTPUT** and a **1 MHz TEST SIGNAL OUTPUT**.

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 oscilloscope.

The principal **POWER** switch, located on the rear panel, controls all power to the oscilloscope including the Low Voltage Power Supply. The **ON**/**STBY** switch, located on the front panel, also controls all of the power to the oscilloscope 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 oscilloscope. It connects to +25 V from the Low Voltage Power Supply by way of the A11 DRAM Processor/Display module.

Brief Procedures

The *Self Tests* use internal routines to confirm basic functionality and proper adjustment. No test equipment is required to do these test procedures.

The *Functional Tests* utilize the 1 MHz Test Signal output at the rear panel as a test-signal source for further verifying that the oscilloscope functions properly. Standard-accessory SMA cables, included with this oscilloscope, are the only equipment required.

General Instructions

Besides the *Brief Procedures,* the set of procedures that can be used to verify oscilloscope performance includes 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 this oscilloscope functions and was adjusted properly, just do the procedures under *Self Tests*, which begin on page 4-3.

  Advantages: These procedures are quick to do, require no external equipment or signal sources, and perform extensive functional and accuracy testing to provide high confidence that the oscilloscope will perform properly. They can be used as a quick check before making a series of important measurements.

- To further check functionality, first do the *Self Tests* just mentioned; then do the procedures under *Functional Tests* that begin on page 4-5.

  Advantages: These procedures require minimal additional time to perform, require no additional equipment other than standard-accessory SMA cables, and more completely test the internal hardware of this oscilloscope. They can be used to quickly determine if the oscilloscope is suitable for putting into service, such as when it is first received.

- If more extensive confirmation of performance is desired, do the *Performance Tests*, beginning on page 4-11, after doing the *Functional* and *Self Tests* just referenced.

  Advantages: These procedures add direct checking of warranted specifications. They require more time to perform and suitable test equipment is required. (See *Equipment Required* on page 4-11.)

If you are not familiar with operating this oscilloscope, read *General Operating Instructions* in Section 3 of this manual. These instructions will acquaint you with the use of the front-panel controls and the menu system.

Conventions

Throughout these procedures the following conventions apply:

- Tighten all SMA connectors to 8.5 inch pounds (0.96 N · m).
- Each test procedure uses the following general format:

  Title of Test

  Equipment Required

  Prerequisites

  Procedure

- Each procedure consists of as many steps, substeps, and subparts as required to do the test. Steps, substeps, and subparts are sequenced as follows:

  1. First Step
     a. First Substep
        - First Subpart
        - Second Subpart

     b. Second Substep
  2. Second Step

- In steps and substeps, the lead-in statement in italics instructs you what to do, while the instructions that follow tell you how to do it: in the example step below, *"Initialize the oscilloscope"* by doing "Press save/recall **SETUP**. Now, press the main-menu button."

  Initialize the oscilloscope: Press save/recall **SETUP**. Now, press the main-menu button **Recall Factory Setup**; then the side-menu button **OK Confirm Factory Init**.

- Where instructed to use a front-panel button or knob, or select from a main or side menu, or verify a readout or status message, the name of the button or knob appears in boldface type: "press **SHIFT**; then **ACQUIRE MENU**", "press the main-menu button **Slope**", or "verify that the status message is ***Pass***".

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

- 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 buttons to the right of the display. “Pop-up menu” refers to a menu that pops up the when a main-menu button is pressed.

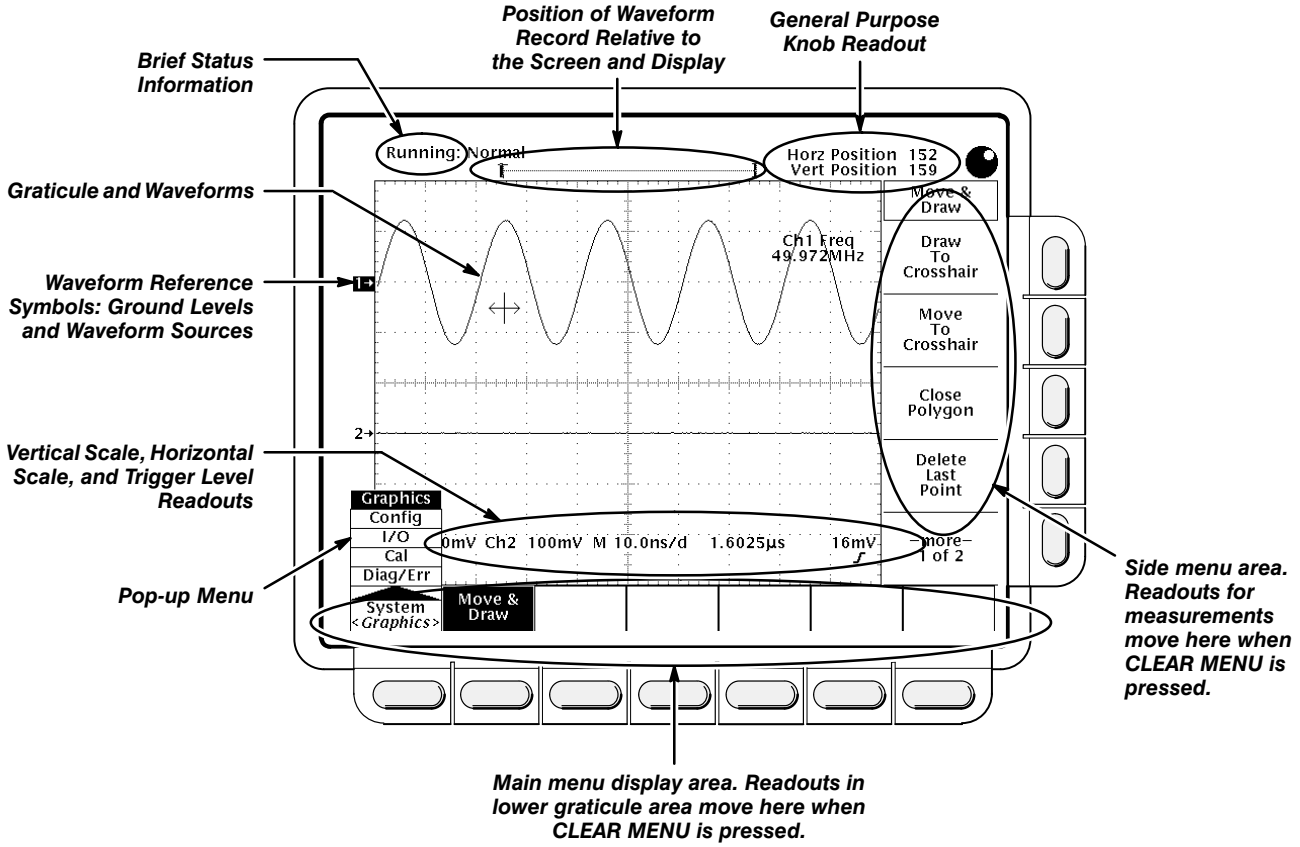


Figure 4-1: Map of Display Functions

Self Tests

This procedure uses internal routines to verify that this oscilloscope functions and was adjusted properly. No test equipment or hookups are required.

Verify Internal Adjustment, Self Compensation, and Diagnostics

Equipment Required: None.

Prerequisites: Power up the digitizing oscilloscope and allow a 20 minute warm-up before doing this procedure.

Procedure:

1. *Verify that internal diagnostics pass:* Do the following substeps to verify passing of internal diagnostics.

   a. *Display the System diagnostics menu:*

   - Press **SHIFT**; then press **UTILITY**.
   - Repeatedly press the main-menu button **System** until **Diag**/**Err** is highlighted in the pop-up menu.

   b. *Display the Area diagnostics menu:* Repeatedly press the main-menu button **Area** until **All** is highlighted in the pop-up menu.

STOP Remove all input signals from the inputs.

   c. *Run the System Diagnostics:* Press the main-menu button **Execute**; then press the side-menu button **OK Confirm Run Test**.

   d. *Wait:* The internal diagnostics do an exhaustive verification of proper oscilloscope function. When finished, the resulting status will appear on the screen.

   e. *Confirm no failures are found:* Verify that no failures are found and reported on-screen.

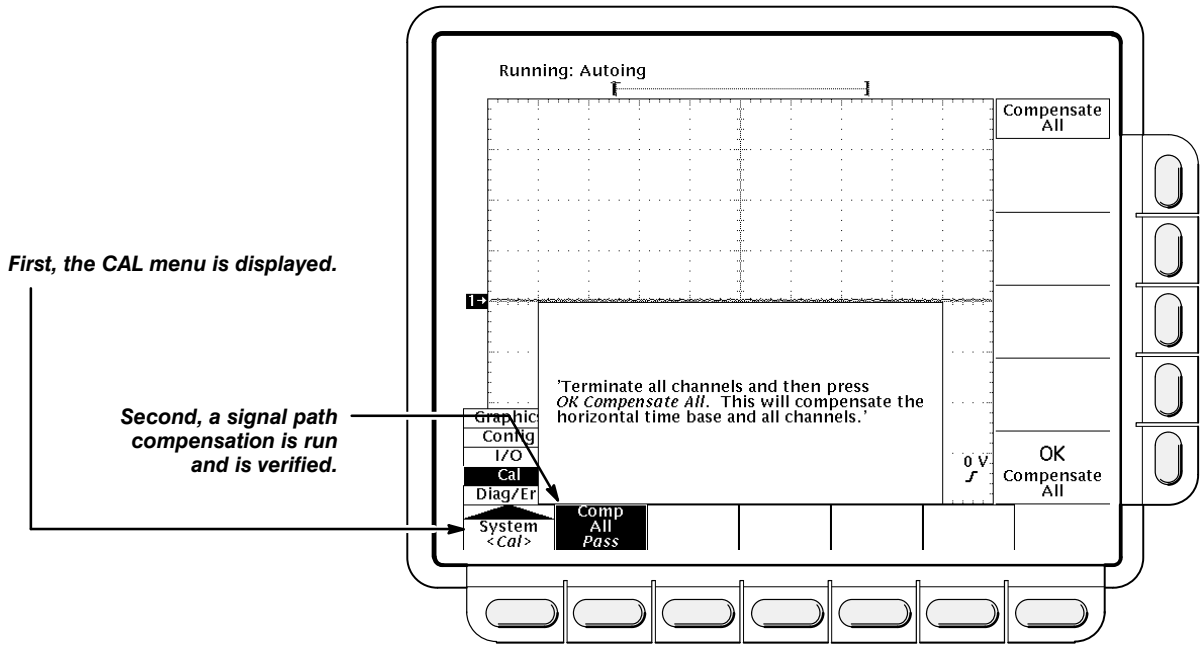


Figure 4-2: Verifying Adjustments and Signal-Path Compensation

   f. *Run the signal-path compensation:*

   - Press **SHIFT**; then press **UTILITY**.

- Press the main menu button **System** until **Cal** is highlighted in the pop-up menu.
- Press the main-menu button **Comp All**; then press the side-menu button **OK Compensate All**.

g. *Wait:* Signal-path compensation runs in about thirty seconds. While it progresses, a "clock" icon (shown at left) is displayed on-screen. When compensation completes, the status message will be updated to *Pass* or *Fail* in the main menu (see step h).

h. *Confirm signal-path compensation returns passed status:* Verify the word ***Pass*** appears under **Comp All** in the main menu. (See Figure 4-2.)

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

Functional Tests

The purpose of these procedures is to confirm that this oscilloscope functions properly. The only equipment required is one of the standard-accessory SMA cables.

These procedures verify functions; that is, they verify that oscilloscope features *operate*. They do *not* verify that they operate within limits.

Therefore, when the instructions in the functional tests that follow call for you to verify that a signal appears on-screen "that is about five divisions in amplitude" or "has a period of about six horizontal divisions", etc., do *NOT* interpret the quantities given as limits. Operation within limits is checked in *Performance Tests*, which begin on page 4-11.

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 oscilloscope 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.

When you are instructed to press a menu button, the button may already be selected (its label will be highlighted). If this is the case, it is not necessary to press the button.

Verify All Input Channels

Equipment Required: Three SMA cables and a T connector.

Prerequisites: None.

Procedure:

1. *Install the test hookup and preset the oscilloscope controls:*

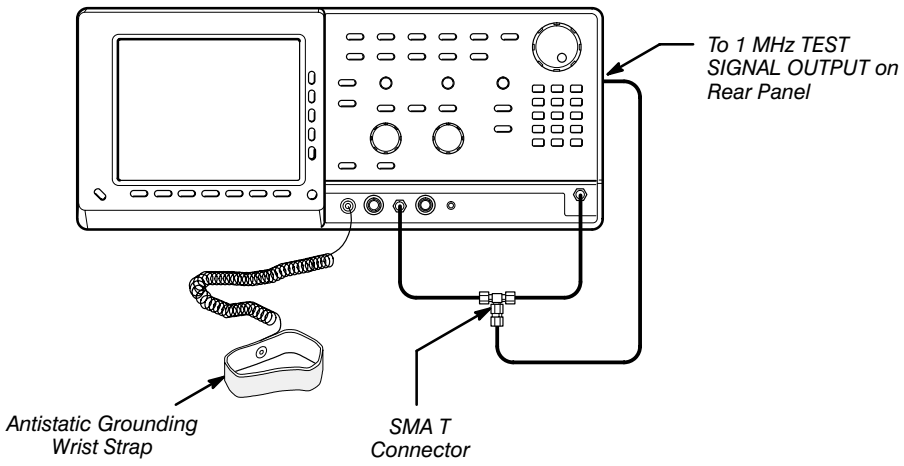


Figure 4-3: Universal Test Hookup for Functional Tests

CAUTION

Inputs to this oscilloscope can be damaged by static discharge. Wear your antistatic wrist strap whenever making connections the oscilloscope.

a. *Hook up the signal source:* Connect one end of an SMA cable to the **1 MHz TEST SIGNAL OUTPUT** on the rear panel. Connect the other end of the cable to the T connector. Connect the T connector, through SMA cables, to the **CH 1** input and the **EXT TRIGGER INPUT** on the front panel.

b. *Initialize the oscilloscope:*

- Press save/recall **SETUP**.
- Press the main-menu button **Recall Factory Setup**.
- Press the side-menu button **OK Confirm Factory Init**.

2. *Verify that all input channels operate:* Do the following substeps — test CH 1 first, *skipping substep a since CH 1 is already set up for verification from step 1.*

a. *Select an unverified channel:*

- Press **WAVEFORM OFF** to remove from display the channel just verified.
- Press the front-panel button that corresponds to the channel you are to verify.
- Move the SMA cable to the channel you selected.

b. *Set up the selected channel:*

- Press **AUTOSET** to obtain a viewable, triggered display in the selected channel.
- Set the horizontal **SCALE** to 200 ns. Press **CLEAR MENU** to remove any menu that may be on the screen.

c. *Verify that the channel is operational:* Confirm that the following statements are true.

- The vertical scale readout for the channel under test shows a setting of either 50 mV or 100 mV, and a square-wave signal about 350 mV to 700 mV in amplitude is on-screen. (See Figure 4-1 on page 4-3 to locate the readout.)
- The vertical **POSITION** knob moves the signal up and down the screen when rotated.
- Turning the vertical **SCALE** knob counterclockwise decreases the amplitude of the waveform on-screen, turning the knob clockwise increases the amplitude, and returning the knob to its original setting (50 mv or 100 mV) returns the amplitude to its original number of divisions.

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

- **NORMAL** 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 that was present in Normal mode reduced.

e. *Test all channels:* Repeat substeps a through d until all input channels are verified.

3. *Remove the test hookup:* Disconnect the SMA cables and T connector from the front panel inputs and the **1 MHz TEST SIGNAL OUTPUT** connector.

Verify the Time Base

Equipment Required: Three SMA cables and a T connector.

Prerequisites: None.

Procedure:

CAUTION

Inputs to this oscilloscope can be damaged by static discharge. Wear your antistatic wrist strap whenever making connections the oscilloscope.

1. *Install the test hookup and preset the oscilloscope controls:*
   a. *Hook up the signal source:* Connect one end of an SMA cable to the **1 MHz TEST SIGNAL OUTPUT** on the rear panel. Connect the other end of the cable to the T connector. Connect the T connector, through SMA cables, to the **CH 1** input and the **EXT TRIGGER INPUT** on the front panel. (See Figure 4-3 on page 4-6.)
   b. *Initialize the oscilloscope:*
      - Press save/recall **SETUP**.
      - Press the main-menu button **Recall Factory Setup**; then press the side-menu button **OK Confirm Factory Init**.
   c. *Modify default settings:*
      - Press **AUTOSET** to obtain a viewable, triggered display.
      - Set the horizontal **SCALE** to 200 ns.
      - 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 test signal is about five horizontal divisions on-screen for the 200 ns horizontal scale setting (set in step 1c).
   b. Rotating the horizontal **SCALE** knob clockwise expands the waveform on-screen (more horizontal divisions per waveform period), and that counterclockwise rotation contracts it, and that returning the horizontal scale to 200 ns returns the period to about five divisions.
   c. The horizontal **POSITION** knob positions the signal left and right on-screen when rotated.
3. *Remove the test hookup:* Disconnect the SMA cables and T connector from the front panel inputs and the **1 MHz TEST SIGNAL OUTPUT** connector.

Verify the Trigger System

Equipment Required: Three SMA cables and a T connector.

Prerequisites: None.

Procedure:

CAUTION

Inputs to this oscilloscope can be damaged by static discharge. Wear your antistatic wrist strap whenever making connections the oscilloscope.

1. *Install the test hookup and preset the oscilloscope controls:*

   a. *Hook up the signal source:* Connect one end of an SMA cable to the **1 MHz TEST SIGNAL OUTPUT** on the rear panel. Connect the other end of the cable to the T connector. Connect the T connector, through SMA cables, to the **CH 1** input and **EXT TRIGGER INPUT** on the front panel. (See Figure 4-3 on page 4-6.)

   b. *Initialize the oscilloscope:*

      - Press save/recall **SETUP**.
      - Press the main-menu button **Recall Factory Setup**.
      - Press the side-menu button **OK Confirm Factory Init**.

   c. *Modify default settings:*

      - Press **TRIGGER MENU**.
      - Press the main-menu button **Source**; press the side-menu button **External Input**.
      - Press the main-menu button **Mode**; press the side-menu button **Normal**.
      - Press **AUTOSET** to obtain a viewable, triggered display.
      - Set the horizontal **SCALE** to 200 ns.
      - Press **CLEAR MENU** to remove the menus from the screen.

2. *Verify that the trigger system operates:* Confirm that the following statements are true.

   - The trigger level readout for the trigger system changes with the trigger **LEVEL** knob.
   - The trigger-level 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.)

3. *Remove the test hookup:* Disconnect the standard-accessory SMA cables and T connector from the front panel inputs and the **1 MHz TEST SIGNAL OUTPUT** connector.

Performance Tests

This subsection contains a collection of procedures for checking that TDS 800 Digitizing Oscilloscopes perform as warranted.

The procedures are arranged in three logical groupings: *Signal Acquisition System Checks, Time Base System Checks,* and *Triggering System Checks*. They check all the characteristics that are designated as checked in Section 1, *Specification.* (The characteristics that are checked appear in **boldface** type under *Warranted Characteristics* in Section 1.)

These procedures *extend* the confidence level provided by the basic procedures described on page 4-1. The basic procedures should be done first, then these procedures performed if desired.

Prerequisites

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

- The cabinet must be installed on the digitizing oscilloscope.
- You must have performed and passed the procedures under *Self Tests,* found on page 4-3, and those under *Functional Tests,* found on page 4-5.
- A signal-path compensation must have been done within the recommended calibration interval (after the prerequisite warm-up period listed below) and at a temperature within ±5° C of the present operating temperature. (If at the time you did the prerequisite *Self Tests,* the temperature was within the limits just stated, consider this prerequisite met.)
- The digitizing oscilloscope 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 0° C and +50° C. (The warm-up requirement is usually met in the course of meeting the first prerequisite listed above.)

Related Information — Read *General Instructions* and *Conventions* that start on page 4-1. Also, if you are not familiar with operating this digitizing oscilloscope, read *General Operating Instructions* in Section 2 before doing any of these procedures.

Equipment Required

These procedures use external, traceable signal sources to directly check warranted characteristics. The required equipment list follows this introduction.

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	Cable, Precision Coaxial (two required)	50 Ω, 36 in, male to male BNC connectors	Tektronix part number 012−0482−00	Signal Interconnection
3	Cable, Precision Coaxial (two required)	50 Ω, 12 in, male to male SMA connectors	Tektronix part number 174−1364−00	Signal Interconnection
4	Cable, Precision Coaxial	50 Ω, 60 in, male to male SMA connectors	Tektronix part number 174−1428−00	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	Adapter, BNC to SMA	Female BNC to male SMA	Tektronix part number 015−0554−00	Various Accuracy Tests
9	Adapter, SMA	SMA female to female	Tektronix part number 015−1012−00	Various Accuracy Tests
10	Adapter, SMA	SMA male to male	Tektronix part number 015−1011−00	Various Accuracy Tests
11	Adapter, N to BNC	Male N to female BNC	Tektronix part number 103−0045−00	Various Accuracy Tests
12	Divider, Power (two required)	50 Ω, SMA Female	Tektronix part number 015−0565−00	Various Accuracy Tests
13	Generator, Function	10 kHz; Variable amplitude from 5 mV to 2 V_{p-p} into 50 Ω	TEKTRONIX FG 502 Function Generator[1]	Checking Trigger Level Accuracy

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

Table 4-1: Test Equipment (Cont.)

Item Number and Description	Minimum Requirements	Example	Purpose
14 Generator, DC Calibration	Variable amplitude to ±6 V; accuracy to 0.1%	Data Precision 8200	Checking DC Offset, Gain, and Measurement Accuracy
15 Generator, Sine-Wave, High-Frequency	10 MHz to 2 GHz; Variable amplitude to 20 mW; Accuracy $<5\times10^{-10}$/day with temperature $<5\times10^{-9}$ over 0−55° C; Resolution 1 kHz	Wiltron 67xxB−20 with Option 2	Various Accuracy Tests
16 Generator, Calibration Step		TEKTRONIX 067−1338−00 Calibration Step Generator	Checking Rise Time
17 DMM	Resistance from 0 Ω to 2 kΩ; accuracy within 2 ppm	Fluke 8842A	Checking Input Resistance Accuracy

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

Test Record

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

TDS 820 Test Record

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

Performance Test	Minimum	Incoming	Outgoing	Maximum
Net Offset Accuracy				
CH1 (With Delay Line)				
+0 V	−4 mV	_____	_____	+4 V
+1.2 V (−) −1.2 V	2.391 V	_____	_____	+2.407 V
Option 1D (Without Delay Line)				
+0 V	−2 mV	_____	_____	+2 mV
+1.0 V (−) −1.0 V	1.9935 V	_____	_____	+2.0065 V
CH2 (With Delay Line)				
+0 V	−4 mV	_____	_____	+4 V
+1.2 V (−) −1.2 V	2.391 V	_____	_____	+2.407 V
Option 1D (Without Delay Line)				
+0 V	−2 mV	_____	_____	+2 mV
+1.0 V (−) −1.0 V	1.9935 V	_____	_____	+2.0065 V
Voltage Measurement Accuracy				
CH1 (With Delay Line)				
+0.8 V (−) −0.8 V	+1.5796 V	_____	_____	+1.6204 V
Option 1D (Without Delay Line)				
+0.4 V (−) −0.4 V	+0.7902 V	_____	_____	+0.8098 V
CH2 (With Delay Line)				
+0.8 V (−) −0.8 V	+1.5796 V	_____	_____	+1.6204 V
Option 1D (Without Delay Line)				
+0.4 V (−) −0.4 V	+0.7902 V	_____	_____	+0.8098 V
Rise Time				
CH1 (With Delay Line)				
$\sqrt{\left(\begin{matrix}Measured\\Rise\\Time\end{matrix}\right)^2 - \left(\begin{matrix}Generator\\Rise\\Time\end{matrix}\right)^2}$	N/A	_____	_____	58.3 ps
Option 1D (Without Delay Line)				
$\sqrt{\left(\begin{matrix}Measured\\Rise\\Time\end{matrix}\right)^2 - \left(\begin{matrix}Generator\\Rise\\Time\end{matrix}\right)^2}$	N/A	_____	_____	43.8 ps

TDS 820 Test Record (Cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
Rise Time (Cont.)				
CH2 (With Delay Line) $\sqrt{\left(\begin{matrix}Measured\\Rise\\Time\end{matrix}\right)^2 - \left(\begin{matrix}Generator\\Rise\\Time\end{matrix}\right)^2}$	N/A	_____	_____	58.3 ps
Option 1D (Without Delay) $\sqrt{\left(\begin{matrix}Measured\\Rise\\Time\end{matrix}\right)^2 - \left(\begin{matrix}Generator\\Rise\\Time\end{matrix}\right)^2}$	N/A	_____	_____	43.8 ps
Input Resistance				
CH1 (With Delay Line)	49 Ω	_____	_____	51 Ω
Option 1D (Without Delay Line)	49.5 Ω	_____	_____	50.5 Ω
CH2 (With Delay Line)	49 Ω	_____	_____	51 Ω
Option 1D (Without Delay Line)	49.5 Ω	_____	_____	50.5 Ω
Delta Time (Between Channels)				
Delta Time Between Channels (CH 1 and CH 2 Deskew = 0)	N/A	_____	_____	20 ps
Delta Time (Single Channel)				
CH1				
1 ns	984 ps	_____	_____	1.016 ns
100 ps	95 ps	_____	_____	105 ps
10 ps	8 ps	_____	_____	12 ps
100 ns	99.885 ps	_____	_____	100.115 ns
CH2				
1 ns	984 ps	_____	_____	1.016 ns
100 ps	95 ps	_____	_____	105 ps
10 ps	8 ps	_____	_____	12 ps
100 ns	99.885 ps	_____	_____	100.115 ns
Trigger Level				
CH1 (With Delay Line)				
+400 mV	+310 mV	_____	_____	+490 mV
−400 mV	−310 mV	_____	_____	−490 mV
CH2 (With Delay Line)				
+400 mV	+310 mV	_____	_____	+490 mV
−400 mV	−310 mV	_____	_____	−490 mV
External				
+400 mV	+310 mV	_____	_____	+490 mV
−400 mV	−310 mV	_____	_____	−490 mV

TDS 820 Test Record (Cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
Trigger Sensitivity				
CH1 (With Delay Line)				
10 MHz	80 mV	_____	_____	N/A
200 MHz	80 mV	_____	_____	N/A
1 GHz	200 mV	_____	_____	N/A
CH2 (With Delay Line)				
10 MHz	80 mV	_____	_____	N/A
200 MHz	80 mV	_____	_____	N/A
1 GHz	200 mV	_____	_____	N/A
External Trigger				
10 MHz	40 mV	_____	_____	N/A
200 MHz	40 mV	_____	_____	N/A
1 GHz	200 mV	_____	_____	N/A
Random Noise				
CH1 (With Delay Line)	N/A	_____	_____	1.2 mV
Option 1D (Without Delay Line)	N/A	_____	_____	600 µV
CH2 (With Delay Line)	N/A	_____	_____	1.2 mV
Option 1D (Without Delay Line)	N/A	_____	_____	600 µV
Delay Jitter				
CH1	N/A	_____	_____	9 ps
CH2	N/A	_____	_____	9 ps

Signal Acquisition System Checks

These procedures check those characteristics that relate to the signal-acquisition system and are listed as checked under *Warranted Characteristics* in Section 1, *Specification.*

Check Accuracy of Net Offset

CAUTION

Be sure to set the DC calibration generator to 0 volts before connecting, disconnecting, and/or moving the test hookup during the performance of this procedure.

Do not connect more than ±6 V (±3 V for Option 1D) to the inputs of the oscilloscope.

Equipment Required: Two dual-banana connectors (Item 5), one BNC T connector (Item 6), one DC calibration generator (Item 14), one BNC to SMA adapter (Item 8), and two precision coaxial cables (Item 2).

Prerequisites: The oscilloscope must meet the prerequisites listed on page 4-11.

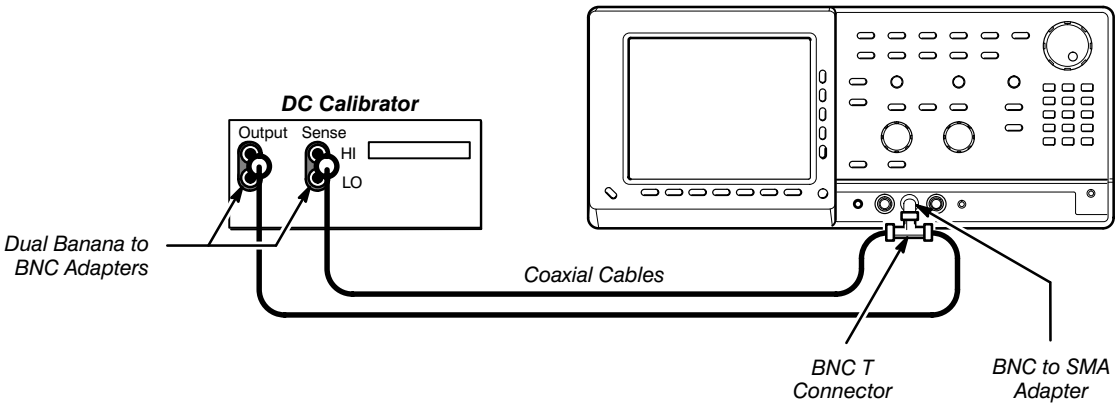


Figure 4-4: Initial Test Hookup

Procedure:

1. *Preset the instrument controls and install the test hookup:*
   a. *Initialize the oscilloscope:*
      - Press save/recall **SETUP**.
      - Press the main-menu button **Recall Factory Setup**.

- Press the side-menu button **OK Confirm Factory Init**.
- Press **SHIFT**; then **UTILITY**.
- Press the main-menu button **System** until **Cal** is highlighted in the pop-up menu.
- Press the main-menu button **Comp All**; then press the side-menu button **OK Compensate All**.

- Wait for the oscilloscope to finish the compensation.
- Press **CLEAR MENU** to remove the menus from the screen.

b. *Hook up the test-signal source:*

- Set the output of a DC calibration generator to 0 volts.
- Connect the output of a DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector.
- 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. Connect the BNC to SMA adapter to **CH 1**. Now connect the BNC T connector to the BNC to SMA adapter.

c. *Modify the default settings:*

- Set the horizontal **SCALE** to 100 ns.
- Press **SHIFT**; then **ACQUIRE MENU**.
- Press the main-menu button **Mode**; then press the side-menu button **Average 16**.
- Press **DISPLAY**.
- Press the main-menu button **Graticule**; then press the side-menu button **Frame**.
- Press **TRIGGER MENU**.
- Press the main-menu button **Source**; then press the side-menu button **Internal Clock**.
- Press **MEASURE**.
- Press the main-menu button **Select Measurement**
- 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**.

- Press **CLEAR MENU**.

2. *Confirm input channels are within limits for offset accuracy:* Do the following substeps — test CH 1 first, *skipping substep a since CH 1 is already set up to be checked from step 1.*

a. *Select an unchecked channel:*

- Press **WAVEFORM OFF** to remove the channel just confirmed from the display. Then, press the front-panel button that corresponds to the channel you are to confirm.

Table 4-2: Net Offset at 20° C to 30° C[b] — With Delay Line

Vertical Scale Setting	Generator Voltage Setting[a]	Vertical Position Setting[a]	Offset Setting[a]	Measurement	Offset Accuracy Limits
200 mV	0 V	0	0 V	V_1	−4 mV to 4 mV
	1.2 V	0	1.2 V	V_2	Record measurement as V_2
	−1.2 V	0	−1.2 V	V_3	Record measurement as V_3
					$V_2 - V_3 = 2.3910$ V to 2.4070 V

[a]Vertical position is set to 0 divisions and vertical offset to 0 V when the oscilloscope is initialized in step 1.

[b]Outside the 20° C to 30° C range, calculate accuracy limits using the specification.

Table 4-3: Net Offset at 20° C to 30° C[b] — Without Delay Line

Vertical Scale Setting	Generator Voltage Setting[a]	Vertical Position Setting[a]	Offset Setting[a]	Measurement	Offset Accuracy Limits
100 mV	0 V	0	0 V	V_1	−2 mV to 2 mV
	1.0 V	0	1.0 V	V_2	Record measurement as V_2
	−1.0 V	0	−1.0 V	V_3	Record measurement as V_3
					$V_2 - V_3 = 1.9935$ V to 2.0065 V

[a]Vertical position is set to 0 divisions and vertical offset to 0 V when the oscilloscope is initialized in step 1.

[b]Outside the 20° C to 30° C range, calculate accuracy limits using the specification.

- Press **MEASURE**.
- Press the main-menu button **Select Measurement**
- 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**.

b. *Set the vertical scale, generator voltage, position, and offset:* Change the setup to one of the settings listed in Table 4-2 or Table 4-3 that is not yet checked. (Start with the first setting listed.) Table 4-2 is for instruments with a delay line (standard instrument). Table 4-3 is for instruments without delay lines (Option 1D).

- Set the vertical **SCALE** to the setting in the table.

- Set the generator voltage to the setting in the table.
- Press **VERTICAL MENU**.
- Press the main-menu button **Position**; and then set the vertical position to the setting in the table.
- Press the main-menu button **Offset**; and then set the offset to the setting in the table.
- Press **CLEAR MENU**.

c. *Display the test signal:* The baseline DC test level was initialized for all channels in step 1. Be sure *not* to use the vertical **POSITION** knob while checking any channel for accuracy of offset, since varying the position invalidates the check.

d. Read the measurement results at the mean readout on screen. See Figure 4-5. Record the results for later use.

e. *Check against limits:* Do the following subparts in the order listed.

- CHECK that the measured or calculated offset is within the limits listed for the current vertical scale and generator voltage setting.
- Repeat substeps b through e until all settings listed in Table 4-2 or Table 4-3 are checked for the channel under test.

f. *Test all channels:* Repeat substeps a through e for all input channels.

3. *Disconnect the hookup:*

a. *Set the generator output to 0 V.*

b. Then disconnect the cable from the generator output at the input connector of the channel last tested.

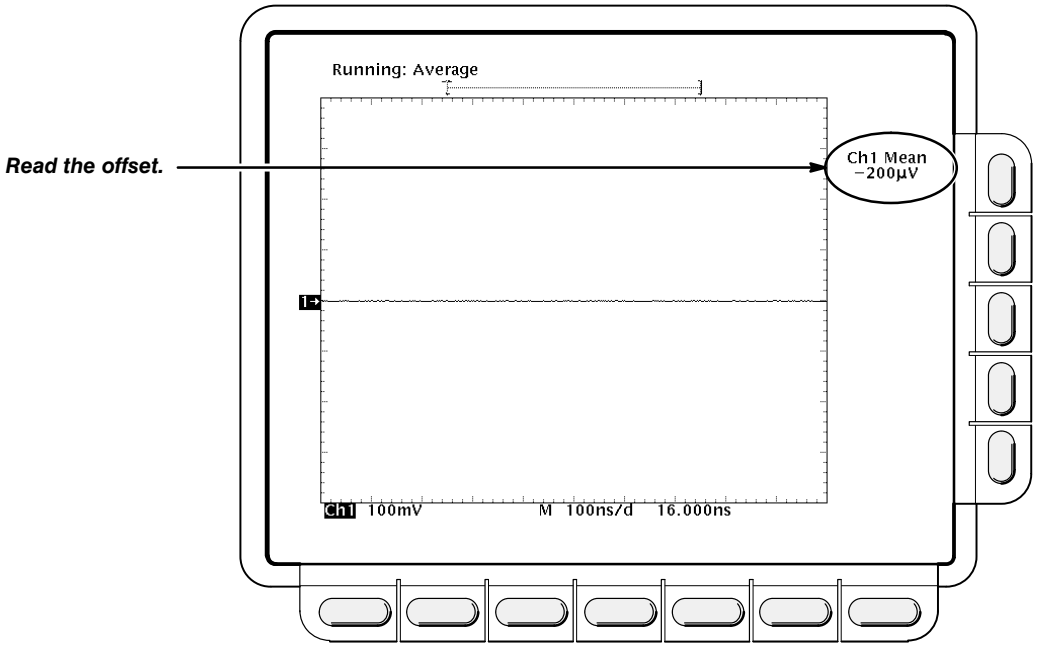


Figure 4-5: Measurement of DC Offset Accuracy

Check Voltage Measurement Accuracy

CAUTION

Be sure to set the DC calibration generator to 0 volts before connecting, disconnecting, and/or moving the test hookup during the performance of this procedure.

Do not connect more than ±6 V (±3 V for Option 1D) to the inputs of the oscilloscope.

Equipment Required: Two dual-banana connectors (Item 5), one BNC T connector (Item 6), one DC calibration generator (Item 14), one BNC to SMA adapter (Item 8), and two precision coaxial cables (Item 2).

Prerequisites: The oscilloscope must meet the prerequisites listed on page 4-11.

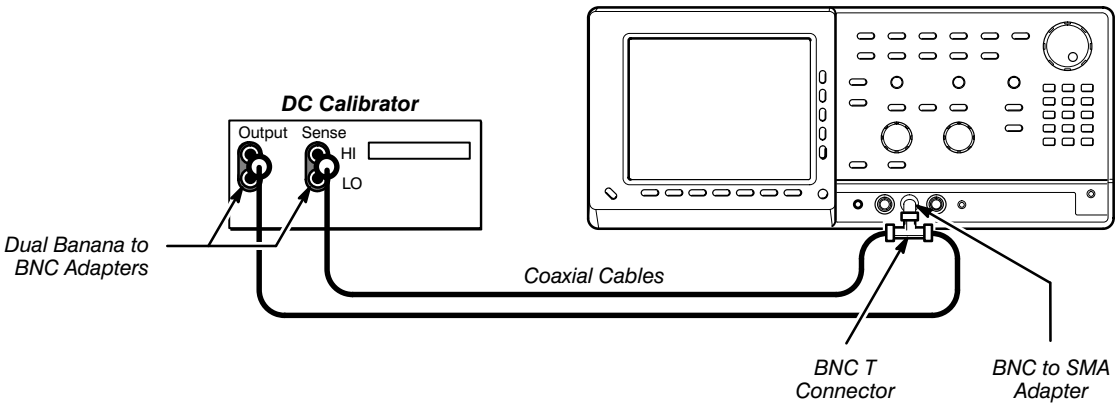


Figure 4-6: Initial Test Hookup

Procedure:

1. *Install the test hookup and preset the instrument controls:*

   a. *Initialize the oscilloscope:*

   - Press save/recall **SETUP**.
   - Press the main-menu button **Recall Factory Setup**.
   - Press the side-menu button **OK Confirm Factory Init**.
   - Press **SHIFT**; then **UTILITY**.
   - Press the main-menu button **System** until **Cal** is highlighted in the pop-up menu.
   - Press the main-menu button **Comp All**; then press the side-menu button **OK Compensate ALL**.
   - Press **CLEAR MENU** to remove the menus from the screen.

   b. *Hook up the test-signal source:*

   - Set the output of a DC calibration generator to 0 volts.
   - Connect the output of a DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector.
   - 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. Connect the BNC to SMA adapter to **CH 1**. Now connect the BNC T connector to the BNC to SMA adapter.

   c. *Modify the default settings:*

   - Set the horizontal **SCALE** to 100 ns.
   - Press **SHIFT**; then **ACQUIRE MENU**.

- Press the main-menu button **Mode**; then press the side-menu button **Average 16**.
- Press **DISPLAY**.
- Press the main-menu button **Graticule**; then press the side-menu button **Frame**.
- Press **TRIGGER MENU**.
- Press the main-menu button **Source**; then press the side-menu button **Internal Clock**.
- Press **MEASURE**.
- Press the main-menu button **Select Measurement**
- 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**.

- Press **CLEAR MENU**.

2. *Confirm input channels are within limits for voltage measurement accuracy:* Do the following substeps — test CH 1 first, *skipping substep a since CH 1 is already set up to be checked from step 1.*

   a. *Select an unchecked channel:*

   - Press **WAVEFORM OFF** to remove the channel just confirmed from the display. Then, press the front-panel button that corresponds to the channel you are to confirm.

Table 4-4: Voltage Measurement at 20° C to 30° C[b] — With Delay Line

Vertical Scale Setting	Generator Voltage Setting[a]	Vertical Position Setting[a]	Offset Setting[a]	Measurement	Offset Accuracy Limits
200 mV	0.8 V	0	0 V	V_1	Record measurement as V_1
	−0.8 V	0	0 V	V_2	Record measurement as V_2
					$V_1 - V_2$ = 1.5796 V to 1.6204 V

[a]Vertical position is set to 0 divisions and vertical offset to 0 V when the oscilloscope is initialized in step 1.

[b]Outside the 20° C to 30° C range, calculate accuracy limits using the specification.

Table 4-5: Voltage Measurement at 20° C to 30° C[b] — Without Delay Line

Vertical Scale Setting	Generator Voltage Setting[a]	Vertical Position Setting[a]	Offset Setting[a]	Measurement	Offset Accuracy Limits
100 mV	0.4 V	0	0 V	V_1	Record measurement as V_1
	−0.4 V	0	0 V	V_2	Record measurement as V_2
					$V_1 - V_2 = 0.7902$ V to 0.8098 V

[a]Vertical position is set to 0 divisions and vertical offset to 0 V when the oscilloscope is initialized in step 1.

[b]Outside the 20° C to 30° C range, calculate the accuracy limits using the specification.

- Press **MEASURE**.
- Press the main-menu button **Select Measurement**
- 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**.

b. *Set the vertical scale, generator voltage, position, and offset:* Change the setup to one of the settings listed in Table 4-4 or Table 4-5 that is not yet checked. (Start with the first setting listed.) Table 4-4 is for instruments with a delay line (standard instrument). Table 4-5 is for instruments without delay lines (Option 1D).

- Set the vertical **SCALE** to the setting in the table.
- Set the generator voltage to the setting in the table.
- Press **VERTICAL MENU**.
- Press the main-menu button **Position**; and then set the vertical position to the setting in the table.
- Press the main-menu button **Offset**; and then set the offset to the setting in the table.
- Press **CLEAR MENU**.

c. *Display the test signal:* The baseline DC test level was initialized for all channels in step 1. Be sure *not* to use the vertical **POSITION** knob while checking any channel for accuracy of voltage measurement, since varying the position invalidates the check.

d. Read the measurement results at the mean readout on screen. Record the results for later use. See Figure 4-7.

e. *Check against limits:* Do the following subparts in the order listed.

- Repeat substeps b through e until all settings listed in Table 4-4 or Table 4-5 are checked for the channel under test.
- CHECK that the calculated voltages are within the limits listed for the vertical scale and generator voltage settings.

f. *Test all channels:* Repeat substeps a through e for all input channels.

3. *Disconnect the hookup:*

   a. *Set the generator output to 0 V.*

   b. Then disconnect the cable from the generator output at the input connector of the channel last tested.

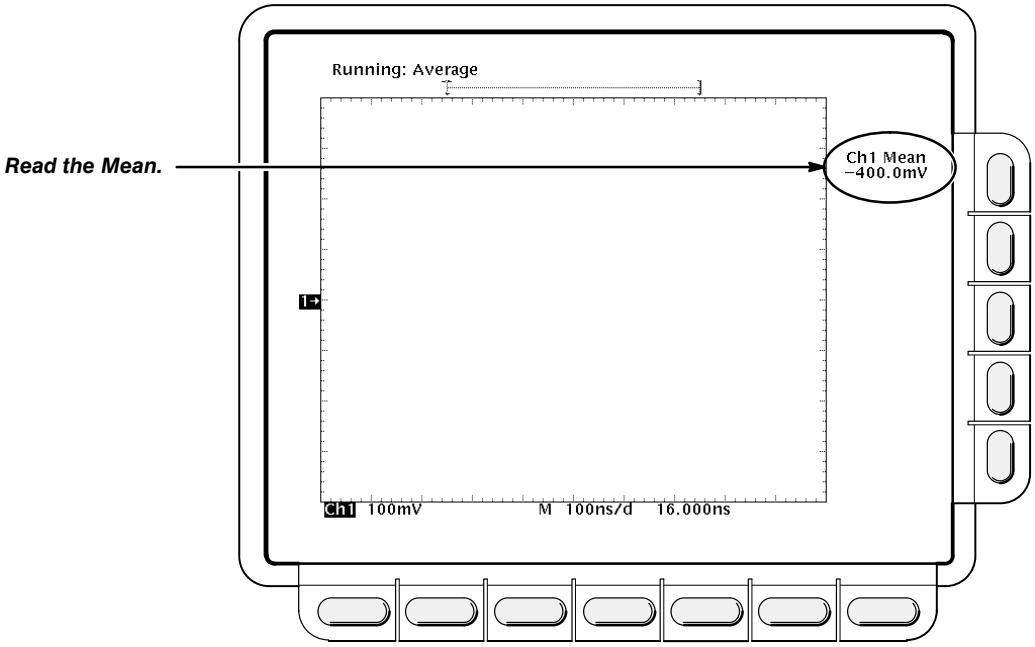


Figure 4-7: Measurement of Voltage Measurement Accuracy

Check Rise Time

Equipment Required: One calibration step generator (Item 16), and an SMA cable (Item 4).

Prerequisites: *See page 4-11.*

Procedure:

1. *Preset the instrument and controls Install the test hookup:*

   a. *Initialize the oscilloscope:*

      - Press save/recall **SETUP**. Then press the main-menu button **Recall Factory Setup**.
      - Press the side-menu button **OK Confirm Factory Init**.

   b. *Modify the default settings:*

      - Press **MEASURE**.
      - Press the main-menu button **Reference Levels**; then press the side-menu button **Set Levels in**.
      - Set the horizontal **SCALE** to 100 ns.
      - Press **SHIFT**; then **ACQUIRE MENU**.
      - Press the main-menu button **Mode**; then press the side-menu button **Average**. Press **128**, on the keypad; then press **ENTER**.
      - Press **TRIGGER MENU**.
      - Press the main-menu button **Source**.
      - Press the side-menu button **Internal Clock**. Press **100**, **SHIFT**, **k**, and then **ENTER**, on the keypad.

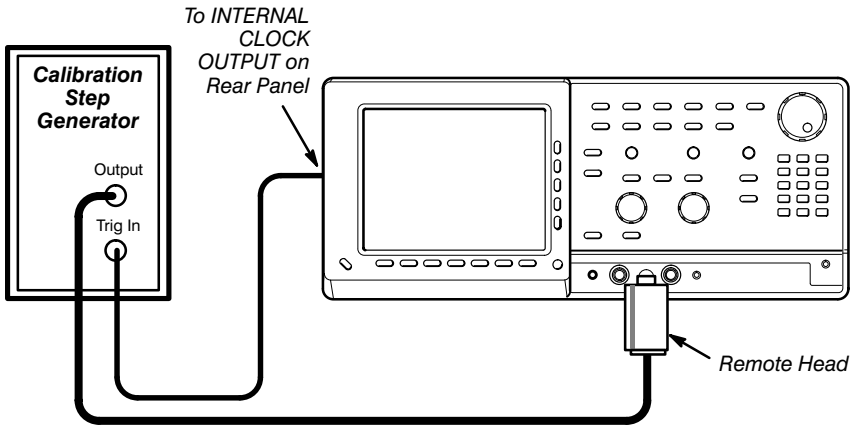


Figure 4-8: Initial Test Hookup

c. *Hook up the test-signal source:*

- Connect, through its remote head, the output of the calibration step generator to **CH 1**.
- Turn on the output of the calibration step generator.
- Using an SMA cable, connect the trigger input of the calibration step generator to the **INTERNAL CLOCK OUTPUT** at the rear of the oscilloscope

2. *Confirm the input channels are within limits for rise time:* Do the following substeps — test CH 1 first, *skipping substep a since CH 1 is already set up for testing from step 1.*

a. *Select an unchecked channel:*

- Press **WAVEFORM OFF** to remove the channel just confirmed from display.
- Press the front-panel button that corresponds to the channel you are to confirm.
- Move the remote head to the channel you select.
- Set the Horizontal **SCALE** to 100 ns.
- Press **HORIZONTAL MENU**.
- Press the main-menu button **Time Base Position**; then press **0**, and **ENTER** on the keypad. (On instruments without delay lines this step sets the time base position to 16 ns.)

b. *Set the vertical scale:*

- Set the vertical **SCALE** to 50 mV.
- Press **VERTICAL MENU**.
- Press the main-menu button **Offset**. Press **−125**, **SHIFT**, **m**, and **ENTER** on the keypad.

c. *Display the test signal:* Do the following subparts to first display the reference signal and then the test signal.

- Press **MEASURE**; then press the main-menu button **Select Measurement for CHx**.

- Now press the side menu button **more** until the menu label **Rise Time** appears in the side menu (its icon is shown at the left). Press the side-menu button **Rise Time**.

- Now press the side menu button **more** until the menu labels **High** and **Low** appear in the side menu (their icons are shown at the left). Press the side-menu buttons **High** and **Low**.
- Press the main-menu button **High-Low Setup**; then press the side-menu button **Histogram**.
- Read and record the high and low readouts for later use.

- Calculate the 10% and 90% points:

$$\Delta V = V_{high} - V_{low}$$

$$90\%\ point = V_{high} - 0.1(\Delta V)$$

$$10\%\ point = V_{low} + 0.1(\Delta V)$$

- Press the main-menu button **Reference Levels**.
- Press the side-menu button **High Ref**; then use the keypad to enter the 90% voltage point calculated above.
- Press the side-menu button **Low Ref**; then use the keypad to enter the 10% voltage point calculated above.
- Press the main-menu button **Remove Measrmnt**; then press the side-menu buttons **Measurement 3** and **Measurement 2**.
- Set the horizontal **SCALE** to 20 ps.
- Press **HORIZONTAL MENU**.
- Press the main-menu button **Time Base Position**; then press the side-menu **Main Position**.
- Turn the general purpose knob to position the rising edge of the waveform to the center of the screen (approximately 35 ns).

d. *Measure the test signal:* Read, and record for later use, the results at the CHx Rise Time readout, which will automatically measure the rise time of the test signal.

e. *Check against limits:*

- If your oscilloscope *has* delay lines (standard instrument), CHECK that the measured rise time is

$$\begin{matrix}Instrument\\RiseTime\end{matrix} = \sqrt{\left(\begin{matrix}Observed\\RiseTime\end{matrix}\right)^2 - \left(\begin{matrix}Generator\\RiseTime\end{matrix}\right)^2} \leq 58.3^a\ ps$$

[a]Outside the 20° C to 30° C range, calculate the limits using the specification.

- If your oscilloscope *does not* have delay lines (Option 1D), CHECK that the measured rise time is

$$\begin{matrix}Instrument\\RiseTime\end{matrix} = \sqrt{\left(\begin{matrix}Observed\\RiseTime\end{matrix}\right)^2 - \left(\begin{matrix}Generator\\RiseTime\end{matrix}\right)^2} \leq 43.8\ ps$$

f. *Test all channels:* Repeat substeps a through e for all channels.

3. *Disconnect the hookup:* Disconnect the test hook up from the input connector of the channel last confirmed.

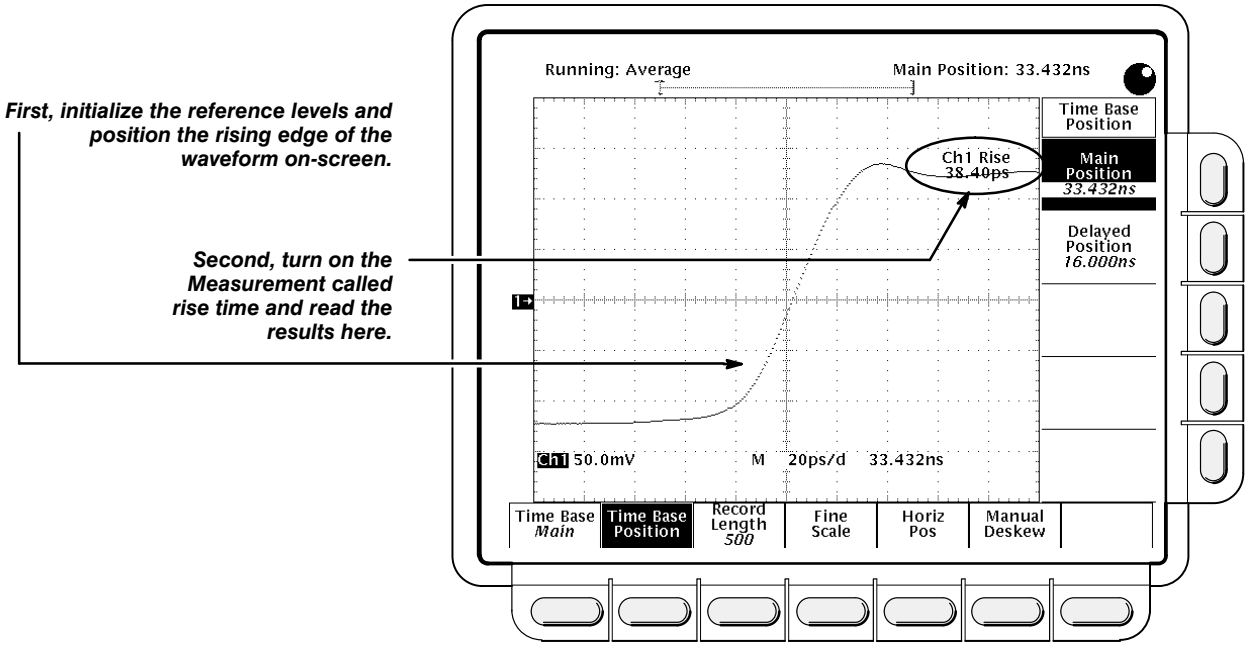


Figure 4-9: Measurement of Rise Time

Check Input Resistance

Equipment Required: One DMM (Item 17), two precision BNC cables (Item 2), one BNC to SMA adapter (Item 8), one BNC T (Item 6), and two BNC to dual banana adapters (Item 5).

Prerequisites: *See page 4-11.*

Procedure:

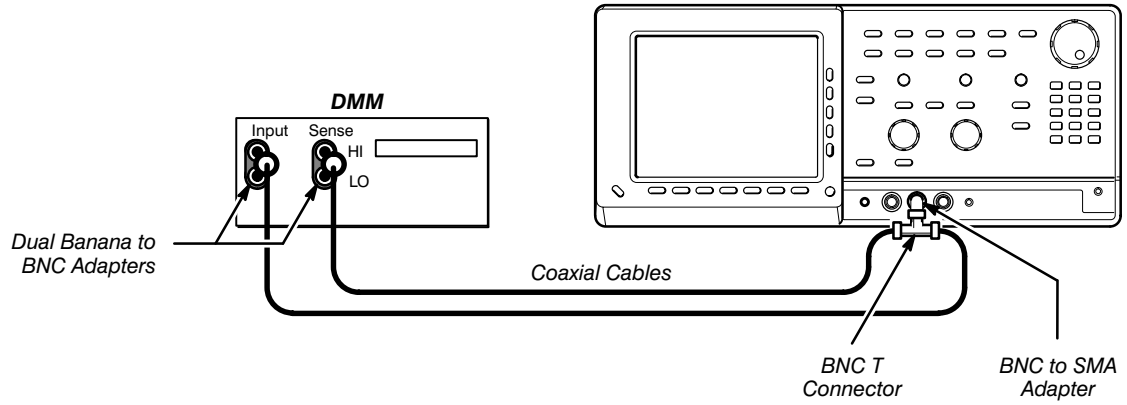


Figure 4-10: Initial Test Hookup

1. *Install the test hookup and preset the instrument controls:*

   a. *Install the test hookup and initialize the front panel controls:*

      - Set the DMM to measure ohms.
      - Connect the output of the DMM through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector. See Figure 4-10.
      - Connect the Sense output of the DMM, through a second dual-banana connector followed by a 50 Ω precision coaxial cable, to other side of the BNC T connector. Now connect the BNC T connector, through a BNC to SMA adapter, to **CH 1**.
      - Repeatedly press **WAVEFORM OFF** to remove all waveforms from the screen.

   b. *Hook up the test-signal source:*

      - Connect the BNC to SMA adapter to the CH 1 input. Connect the BNC to dual binding post adapter to the input of the DMM. Connect the BNC to dual binding post adapter to the BNC to SMA adapter through a BNC cable.
      - Set the DMM to measure ohms.

2. *Check against limits:*

   - If your oscilloscope has delay lines (standard instrument), CHECK that the DMM readout is 49 to 51 Ω.
   - If your oscilloscope does not have delay lines (Option 1D), CHECK that the DMM readout is 49.5 to 50.5 Ω.

3. *Test all channels:* Move the test hook up to the next unchecked channel, and repeat step 2.

4. *Disconnect the hookup:* Disconnect both the cable from the DMM and the two adapters.

Time Base System Checks

These procedures check those characteristics that relate to the Main and Delayed time base system and are listed as checked under *Warranted Characteristics* in Section 1, *Specification.*

Check Accuracy of Delta Time Measurement Between Channels

Equipment Required: One high-frequency sine-wave generator (Item 15), three 50 Ω SMA cables (Items 3 and 4), two 50 Ω power dividers (Item 12), one SMA male to male adapter (Item 10), one BNC to SMA adapter (Item 8), one N to BNC adapter (Item 11), and one precision coaxial cable (Item 2).

Prerequisites: *See page 4-11.*

Procedure:

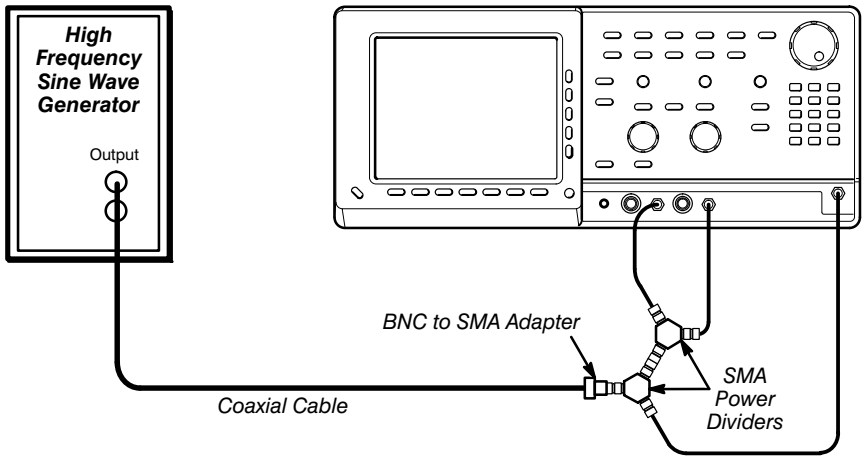


Figure 4-11: Initial Test Hookup

1. *Install the test hookup and preset the instrument controls:*

NOTE

*The two cables going to the **CH 1** and **CH 2** inputs must be the same length and they must both connect to the same power divider.*

a. *Hook up the test-signal source*:

- Connect, through an N to BNC adapter, a coaxial cable, and a BNC to SMA adapter, the sine wave generator to 50 Ω power divider.

- Connect one side of the power divider, through an SMA cable to the **EXT TRIGGER INPUT**. Connect the other side of the power divider, through an SMA male to male adapter, another power divider, and two SMA cables to the **CH 1** and **CH 2** inputs.
- Tighten SMA connectors to 8.5 inch pounds (0.96 N · m).
- Set the output of the generator to 666.666 MHz and about 400 mV.

b. *Initialize the oscilloscope:*

- Press save/recall **SETUP**.
- Press the main-menu button **Recall Factory Setup**.
- Press the side-menu button **OK Confirm Factory Init**.

c. *Modify the initialized front-panel control settings:*

- Set the vertical **SCALE** to 50 mV.
- Set the horizontal **SCALE** of the Main time base to 200 ps.
- Press **TRIGGER MENU**; then press the main-menu button **Mode**. Now press the side-menu button **Normal**.
- Press **SET LEVEL TO 50%**.
- Press **HORIZONTAL MENU**.
- Press the main-menu button **Manual Deskew**.
- If you want to restore the present deskew values after completion of this test, record the CH 1 and CH 2 deskew values for later use.
- Press the side-menu button **CH 1**. Press **0**, on the keypad; then press **ENTER**.
- Press the side-menu button **CH 2**. Press **0**, on the keypad; then press **ENTER**.
- Press the main-menu button **Time Base Position**. Using the general purpose knob, adjust the horizontal position until the waveform crosses zero at the left side of the graticule.
- Press **SHIFT**; then press **ACQUIRE MENU**. Press the main-menu button **Mode**. Press the side-menu **Average**.
- Press **CH 2**; then set the CH 2 vertical scale to 50 mV.
- Press **MEASURE**; then press the main-menu button **Select Measrmnt**.
- Press the side-menu button **−more−**, until **Pk-Pk** appears in the side menu. Press **Pk-Pk**.

- Press **CLEAR MENU**.

- Adjust the generator amplitude for a **Pk-Pk** readout of 191 mV. See Figure 4-12.
- Press **MEASURE**.
- Press the main-menu button **Remove Measrmnt**; then press the side-menu buttons **Measurement 1**.
- Press **MATH REF**.
- Press the main-menu button **Math 2**; then press the side-menu button **Change Math Waveform Definition**.
- Press the main-menu button **Dual Wfm Math**.
- Press the side-menu button **Set 1st Source to**; then, using the general purpose knob, set the source to **Ch 1**.
- Press the side-menu button **Set Operator to**; then, using the general purpose knob, set the operator to **−**.
- Press the side-menu button **Set 2nd Source to**; then, using the general purpose knob, set the source to **Ch 2**.
- Press the side-menu button **OK Create Math Wfm**.
- Set the **Math2** vertical scale to 10 mV.

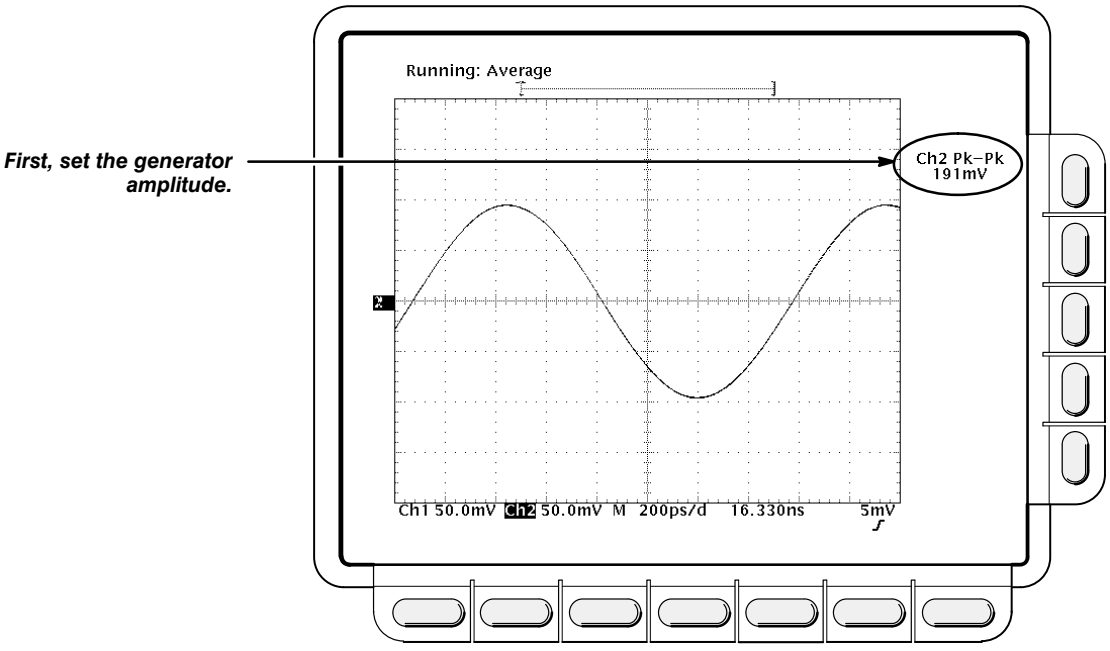


Figure 4-12: Generator Settings for Delta Time Measurement Between Channels

2. *Confirm Delta Time Measurement Between Channels is within limits for accuracies:*

   a. *Display the test signal:*

      - Press **HORIZONTAL MENU**.
      - Press the main-menu button **Fine Scale**. Press **75**, on the keypad; then press **SHIFT**. Press **n**, on the keypad; then press **ENTER**.

   b. *Check delta-time accuracy against limits:*

      - Press **CURSOR**.
      - Press the main-menu button **Function**; then press the side-menu button **H Bars**.
      - Use the general purpose knob to precisely align the active cursor to the bottom of the **Math2** waveform.
      - Press **TOGGLE**. Use the general purpose knob to precisely align the alternate cursor to the top of the **Math2** waveform.
      - Press **CLEAR MENU**.
      - CHECK that (see Figure 4-13):

$$\Delta Volts\ Readout \leq 12.0\ mV$$

Example:

$$\frac{\Delta Volts\ Readout}{Slew\ rate} \leq 30\ ps + 0.1\%(measured\ delta\ time + CH1deskew–CH2deskew) + 30\ ps\left(smaller\ of\ remainder\ between \frac{CH1deskew–CH2deskew}{3.2768\ ns}\ and\ \frac{CH1deskew–CH2deskew + 1.6384\ ns}{3.2768\ ns}\right)$$

where: $Slew\ rate = 2\ \Pi\ f\left(\frac{Pk–Pk}{2}\right)$ or for our procedure: $Slew\ rate = 2\ \Pi\ 666.666\ MHz\left(\frac{191\ mV}{2}\right) = 0.4\ \frac{mV}{ps}$

and assuming that the CH 1 and CH 2 deskews are both 0.0 ns:

$$\frac{\Delta Volts\ Readout}{0.4\ \frac{mV}{ps}} \leq 30.0\ ps$$

$$\Delta Volts\ Readout \leq 12.0\ mV$$

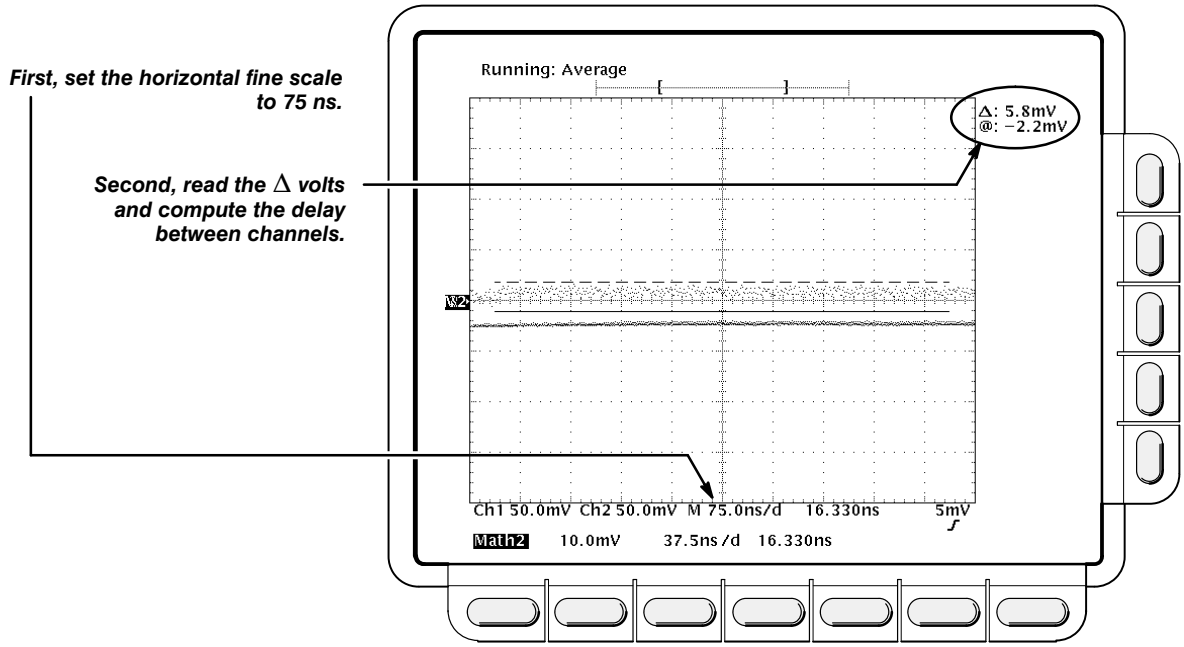


Figure 4-13: Measurement of Accuracy — Delta Time Measurement Between Channels

3. *Disconnect the hookup:* Disconnect the cables, divider, and adapter from the generator output at the input connectors of **CH 1** and **CH 2**.

Check Accuracy of Single Channel Delta Time Measurements

Equipment Required: One high-frequency sine-wave generator (Item 15), one N to BNC adapter (Item 11), one precision coaxial cable (Item 2), two 50 Ω SMA cables (Item 3), one 50 Ω power divider (Item 12), and one BNC to SMA adapter (Item 8).

Prerequisites: *See page 4-11.*

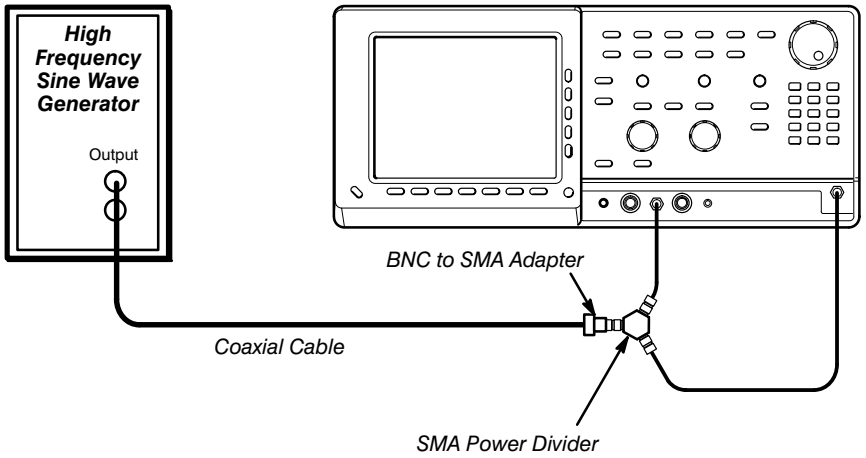


Figure 4-14: Initial Test Hookup

Procedure:

1. *Install the test hookup and preset the instrument controls:*

NOTE

*The two cables going to the **CH 1** and **EXT TRIGGER INPUT** inputs must be the same length.*

a. *Hook up the test-signal source*: Connect through an N to BNC adapter, a precision coaxial cable, a BNC to SMA adapter, a 50 Ω power divider, and two SMA cables, the sine wave generator to **CH 1** and the **EXT TRIGGER INPUT**. Set the output of the generator to 1.000 GHz.

b. *Initialize the oscilloscope:*

- Press save/recall **SETUP**.
- Press the main-menu button **Recall Factory Setup**.
- Press the side-menu button **OK Confirm Factory Init**.

c. *Modify the initialized front-panel control settings:*

- Set the horizontal **SCALE** to 200 ps.
- Set the vertical **SCALE** to 20 mV.
- Set the generator amplitude for an 8 division vertical display.
- Press **SET LEVEL TO 50%**.

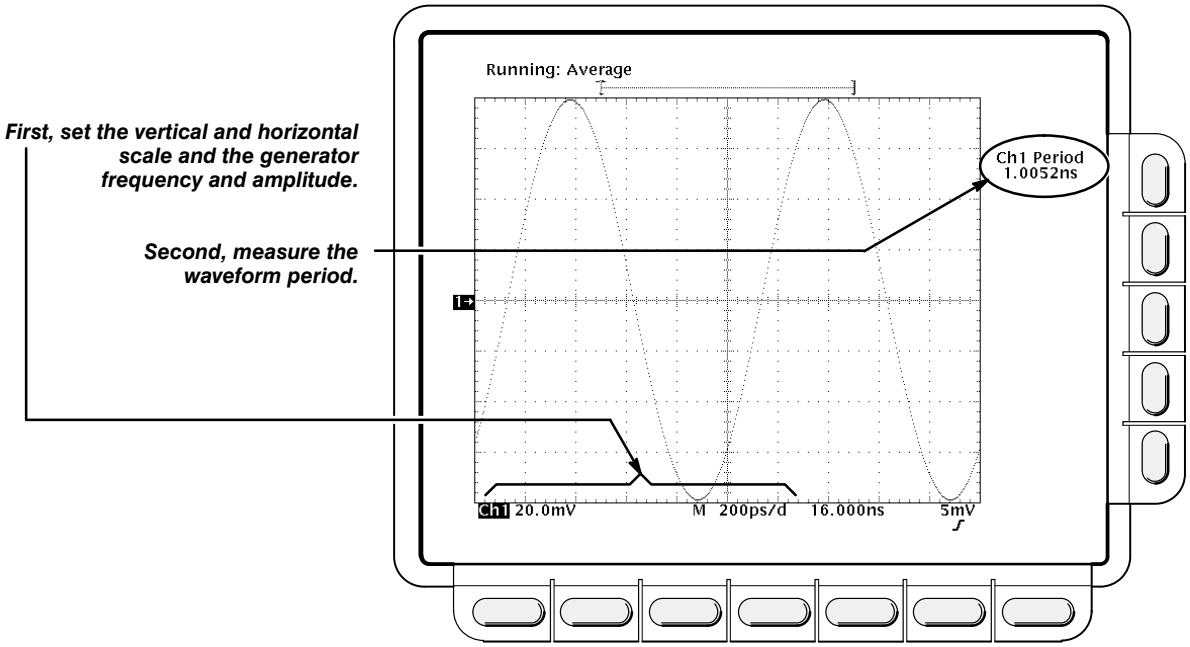


Figure 4-15: Measurement of Accuracy — Single Channel Delta Time Measurement at 1 ns

2. *Confirm that time measurements are within limits for accuracies at 1 ns:*

   a. *Display the test signal:*

   - Press **SHIFT**; then **ACQUIRE MENU**. Now press the main-menu button **Mode**; then press the side-menu button **Average**.

   b. *Check single channel delta-time measurement accuracy at 1 ns against limits:*

   - Press **MEASURE**.
   - Press the main-menu button **High-Low Setup**; then press the side-menu button **Min-Max**.
   - Press the main-menu button **Select Measurement for Chx**.
   - Press the side-menu button **−more−**, until **PERIOD** appears in the side menu. Press **PERIOD**.
   - Press **HORIZONTAL MENU**.
   - Press the main-menu button **Time Base Position**; then adjust the general purpose knob clockwise to its minimum setting (−1.5 ns for the standard instrument and 16 ns for Option 1D).
   - Press **CLEAR MENU**.
   - CHECK that the period readout is within 984 ps to 1.016 ns (see Figure 4-15).

3. *Confirm measurements are within limits for accuracies at 100 ps:*

   a. *Display the test signal:*

   - Press **MEASURE**.
   - Press the main-menu button **Select Measurement for Chx**.
   - Press the side-menu button **−more−**, until **Positive Cross** appears in the side menu. Press **Positive Cross**.
   - Press **HORIZONTAL MENU**.
   - Press the main-menu button **Time Base Position**; then adjust the general purpose knob clockwise to its minimum setting (−1.5 ns for the standard instrument and 16 ns for Option 1D).
   - If your oscilloscope contains delay lines (standard instrument) adjust the general purpose knob for a **+Cross** readout of 3.5 ns ±0.5 ns (the fourth positive crossing). If your oscilloscope does not contain delay lines (Option 1D) adjust the general purpose knob for a **+Cross** readout of 23.0 ns ±0.5 ns (the seventh positive cross).
   - Press **CLEAR MENU**.
   - Record the **+Cross** and **Period** readouts for later use.
   - Set the generator frequency to 909.090 MHz.

   b. *Set positive cross level:*

   - Adjust the Trigger **LEVEL** for the same **+Cross** readout as you recorded in substep a. If you can adjust to the same **+Cross** readout, skip to substep c.
   - Press **SET LEVEL TO 50%**.
   - Record the **+Cross** and **Period** readouts for later use.
   - Set the generator frequency to 1.000 GHz.
   - Adjust the Trigger **LEVEL** for the same **+Cross** readout as you recorded in substep b. If you still can not adjust to the same **+Cross** readout, repeat substeps a and b using one more positive crossing.

   c. *Check single channel delta-time measurement accuracy at 100 ps against limits:*

   - Press **CLEAR MENU**.
   - Read the **Period** readout.
   - Subtract the **Period** readout from the period you recorded either in substep 3a or substep 3b.
   - CHECK that the difference in periods is within 95 ps to 105 ps (see Figure 4-16).

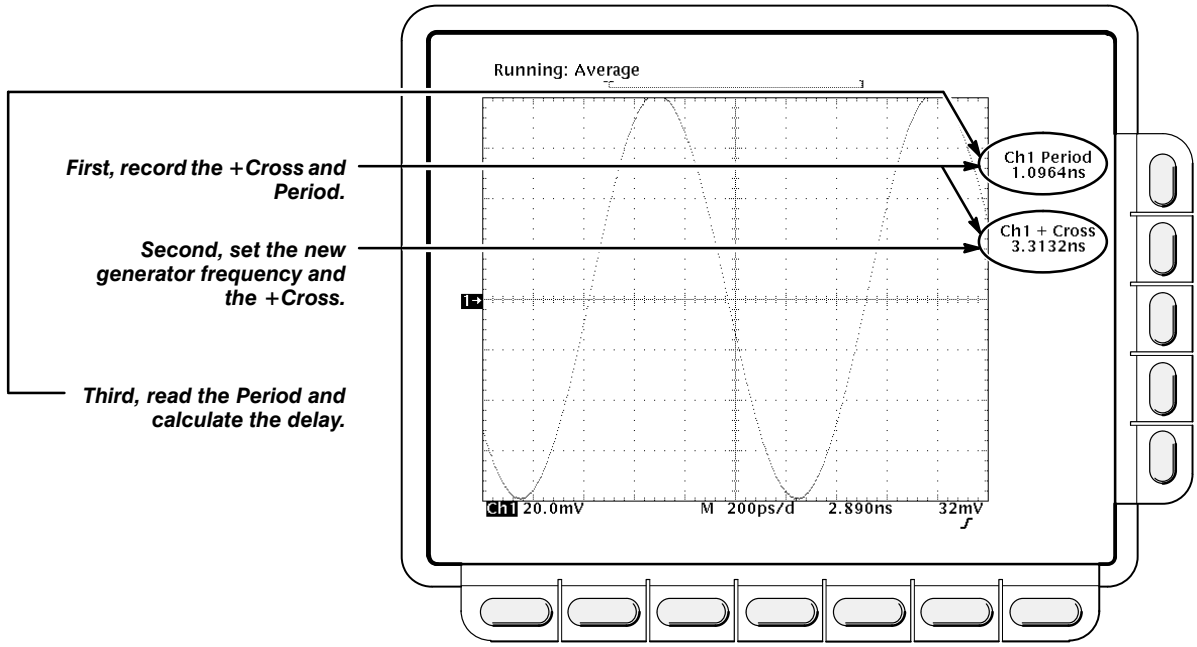


Figure 4-16: Measurement of Accuracy — Single Channel Delta Time Measurement at 100 ps

4. *Confirm measurements are within limits for accuracies at 10 ps:*

   a. *Display the test signal:*

   - Set the generator frequency to 1.000 GHz.
   - Press **SET LEVEL TO 50%**.
   - Press **HORIZONTAL MENU**.
   - Press the main-menu button **Time Base Position**; then adjust the general purpose knob clockwise to its minimum setting (−1.5 ns for the standard instrument and 16 ns for Option 1D).
   - If your oscilloscope contains delay lines (standard instrument) adjust the general purpose knob for a **+Cross** readout of 3.5 ns ±0.5 ns (the fourth positive crossing). If your oscilloscope does not have delay lines (Option 1D) adjust the general purpose knob for a **+Cross** readout of 20 ns ±0.5 ns (the fourth positive crossing).

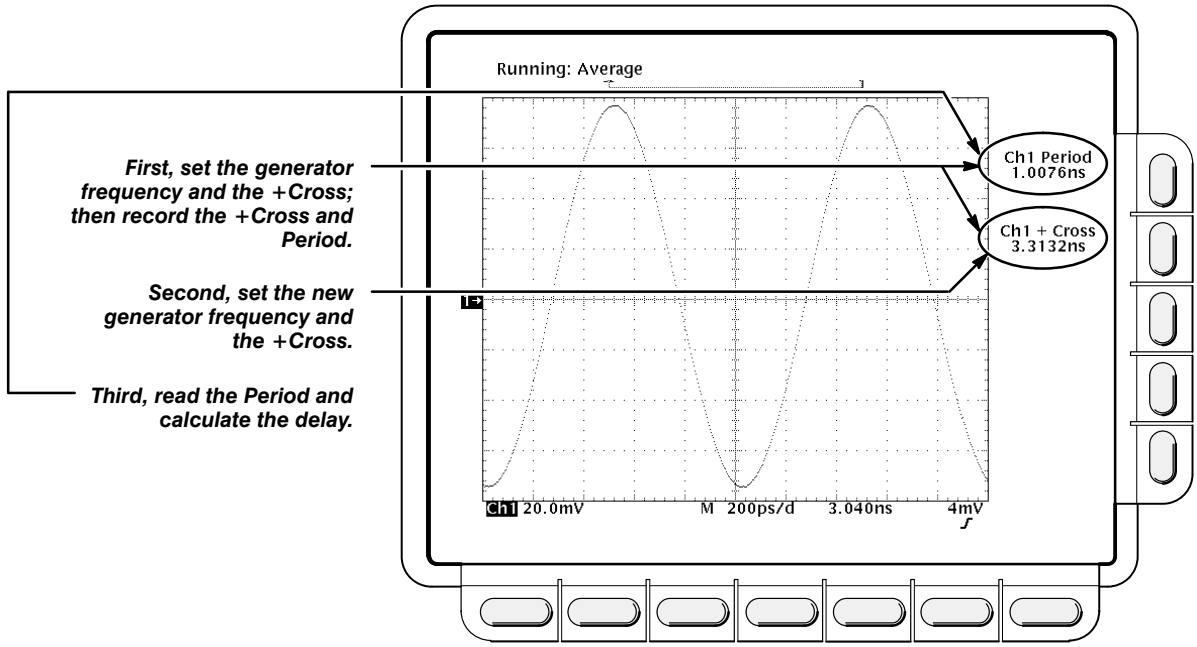


Figure 4-17: Measurement of Accuracy — Single Channel Delta Time Measurement at 10 ps

- Record the **+Cross** and **Period** readouts for later use.
- Set the generator frequency to 990.000 MHz.

b. *Set positive cross level:*

- Adjust the Trigger **LEVEL** for the same **+Cross** readout as you recorded in substep a. If you can adjust to the same **+Cross** readout, skip to substep c.
- Press **SET LEVEL TO 50%**.
- Record the **+Cross** and **Period** readouts for later use.
- Set the generator frequency to 1.000 GHz.
- Adjust the Trigger **LEVEL** for the same **+Cross** readout as you recorded in substep b.

c. *Check single channel delta-time measurement accuracy at 10 ps against limits:*

- Press **CLEAR MENU**.
- Read the **Period** readout.
- Subtract the **Period** readout from the period you recorded either in substep 3a or substep 3b.
- CHECK that the difference in periods is within 8 ps to 12 ps.

5. *Confirm measurements are within limits for accuracies at 100 ns:*

   a. *Display the test signal:*

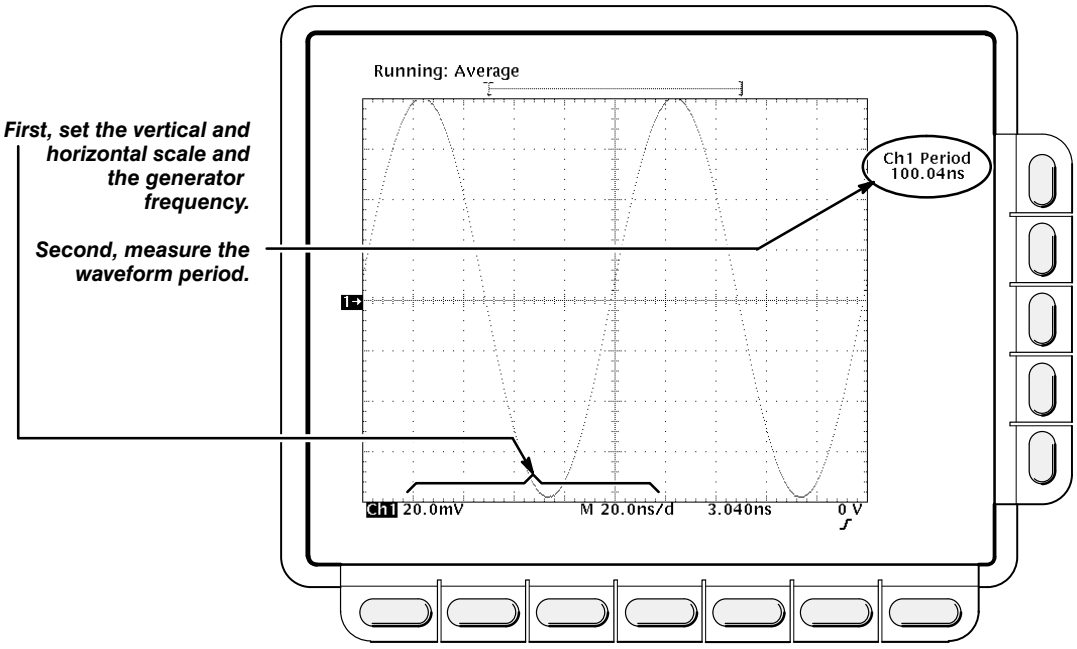


Figure 4-18: Measurement of Accuracy — Single Channel Delta Time Measurement at 100 ns

- Set the generator frequency to 10 MHz.
- Set the horizontal **SCALE** to 20.0 ns.
- Press **SET LEVEL TO 50%**.

   b. *Check single channel delta-time measurement accuracy at 100 ns against limits:*

- Press **MEASURE**.
- Press the main-menu button **Remove Measrmnt**; then press the side-menu button **Measurement 2**.
- Press **CLEAR MENU**.
- CHECK that the Period readout is within 99.885 ns to 100.115 ns.

6. *Check all channels:* Repeat steps 1c through step 5 for all channels. Move the SMA cable to the input connector that corresponds to the channel to be confirmed. Press **WAVEFORM OFF**. Press the front panel button that corresponds to the channel to be confirmed.

7. *Disconnect the hookup:* Disconnect the cables, adapters, and divider from the generator output at the input connector of the channel last confirmed.

Trigger System Checks

These procedures check those characteristics that relate to the trigger system and are listed as checked under *Warranted Characteristics* in Section 1, *Specification.*

Check Accuracy, Trigger-Level

Equipment Required: One function generator (Item 13), one BNC to SMA adapter (Item 8), one precision coaxial cable (Item 2), 50 Ω power divider (Item 12), and two SMA cables (Item 3).

Prerequisites: The oscilloscope must meet the prerequisites listed on page 4-11.

Procedure:

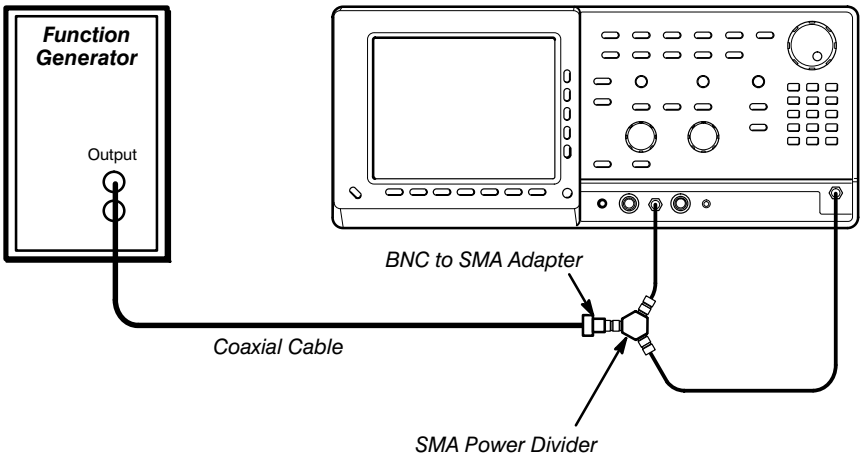


Figure 4-19: Initial Test Hookup

1. *Install the test hookup and preset the instrument controls:*
   a. *Hook up the test-signal source:*
      - Set the output of a function generator to 1 volt.
      - Connect the output of a function generator through a 50 Ω precision coaxial cable, a BNC to SMA adapter, a 50 Ω power divider and two SMA cables, to the **CH 1** and **EXT TRIGGER INPUT**.
      - Set the generator for a 10 kHz ramp.
   b. *Initialize the oscilloscope:*
      - Press save/recall **Setup**.
      - Press the main-menu button **Recall Factory Setup**.
      - Press the side-menu button **OK Confirm Factory Init**.

2. *Confirm trigger system is within limits for Trigger-level/Threshold accuracy:*

   a. *Display the test signal:*

   - Set the Horizontal **SCALE** to 10 us.
   - Press **MEASURE**.
   - Press the main-menu button **High-Low Setup**; then press the side-menu button **Min-Max**.
   - Press the main-menu button **Select Measurement for Ch x**.
   - Press the side-menu button **−more−** until **Pk-Pk** appears in the side menu (its icon is shown at the left). Press the side-menu button **Pk-Pk**.

   - Adjust the generator amplitude for a **Pk-Pk** readout of 900 mV.
   - Press the main-menu button **Remove Measrmnt**; then press the side-menu button **Remove Measurement 1**.

   b. *Measure the test signal:*

   - Turn the Horizontal **POSITION** control to position the start of the waveform one division from the left side of the graticule.
   - Press **TRIGGER MENU**; then press the main-menu button **Level**. Press **400**, **SHIFT**, **m** , and then **ENTER** on the keypad.
   - Press **VERTICAL MENU**; then press the main-menu button **offset**. Press the **400**, **SHIFT**, **m** , and then **ENTER** on the keypad.
   - Set the Horizontal **SCALE** to 10 µs.
   - Press **CURSOR**.
   - Press the main-menu button **Function**; then press the side-menu button **H Bars**. Rotate the general purpose knob to align the active cursor with the start of the waveform (see Figure 4-20).
   - Press **CLEAR MENU**.

   c. *Check against limits:*

   - CHECK that the **@ Cursor** readout is 310 mV to 490 mV.
   - Press **TRIGGER MENU**; then press the main-menu button **Level**. Press the **−400**, **SHIFT**, **m** , and then **ENTER** on the keypad.
   - Press **VERTICAL MENU**; then press the main-menu button **offset**. Press the **−400**, **SHIFT**, **m** , and then **ENTER** on the keypad.

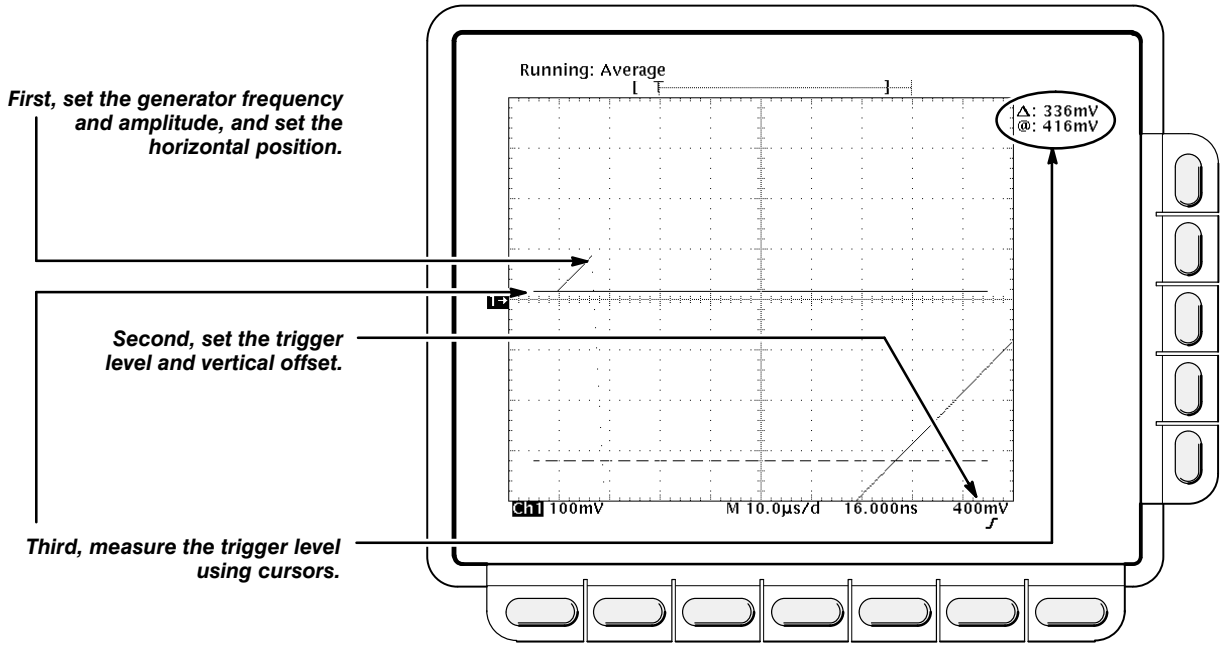


Figure 4-20: Measurement of Trigger-Level Accuracy

- Press **CURSOR**; then rotate the general purpose knob to align the active cursor with the start of the waveform.
- CHECK that the **@ Cursor** readout is −310 mV to −490 mV.

3. *If your oscilloscope has a delay line confirm each input channel trigger source:* Press **TRIGGER MENU**; then press the main-menu button **Source**. Now press the side-menu button that corresponds to the input channel trigger source you wish to confirm. Repeat substeps 2b and c for all input channel trigger sources.
4. *Disconnect the hookup:*
   a. *First set the output of the generator to 0 volts.*
   b. Then disconnect the cables and adapters from the generator output at the input connectors of channel last confirmed and the **EXT TRIGGER INPUT**.

Sensitivity, Trigger, External, CH 1, and CH 2

Equipment Required: One high-frequency leveled sine-wave generator (Item 15), one N to BNC adapter (Item 11), one precision coaxial cable (Item 2), two 50 Ω SMA cables (Item 3), one BNC to SMA adapter (Item 8), and one 50 Ω power divider (Item 12).

Prerequisites: *See page 4-11.*

Procedure:

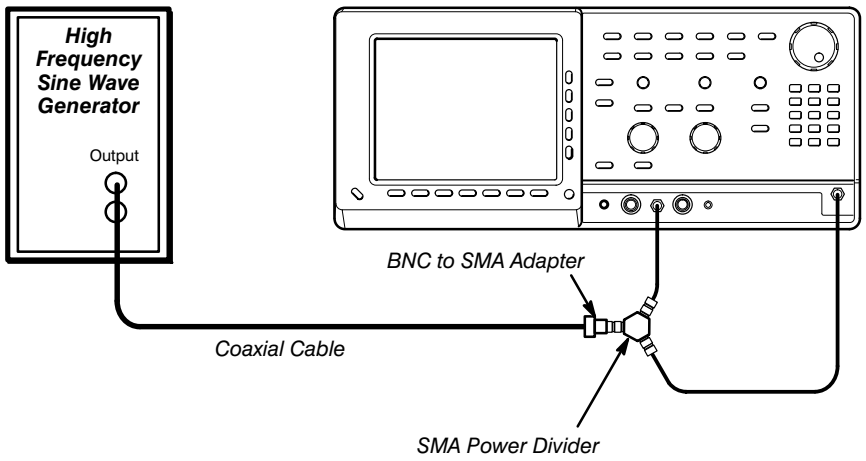


Figure 4-21: Initial Test Hookup

1. *Install the test hookup and preset the instrument controls:*
   a. *Initialize the oscilloscope:*
      - Press save/recall **SETUP**.
      - Press the main-menu button **Recall Factory Setup**.
      - Press the side-menu button **OK Confirm Factory Init**.
   b. *Hook up the test-signal source:*
      - Connect the signal output of a high-frequency sine wave generator to an N to BNC adapter and a BNC to SMA adapter through a precision coaxial cable; then connect the adapter to a power divider.
      - Connect one output of the power divider to **CH 1** through an SMA cable.
      - Connect the other output of the power divider through a second SMA cable to the **EXT TRIGGER INPUT**. See Figure 4-21.
   c. *Modify the initialized front-panel control settings:*
      - Set the horizontal **SCALE** for the **M** (main) time base to 200 ns.

- Press **TRIGGER MENU**; then press the main-menu button **Mode**. Now press the side-menu button **Normal**.
- Press the main-menu button **Source**; then press the side-menu button for the source being confirmed.
- Press **MEASURE**.
- Press the main-menu button **High-Low Setup**; then press the side-menu button **Min-Max**.
- Press the main-menu button **Select Measurement for Ch x**.
- 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**.

- Press **SET LEVEL TO 50%**.
- Press **HORIZONTAL MENU**; then press the main-menu button **Time Base**.
- Press the side-menu button **Main Only**.
- Press **SHIFT**; then press **ACQUIRE MENU**. Now press the main-menu button **Mode**; then the side-menu button **Average 16**.
- Press **CLEAR MENU**.

2. *Confirm Main trigger system is within sensitivity limits:* Only perform this step if your oscilloscope contains delay lines (it *does not* contain Option 1D).

   a. *Display the test signal:*

   - Set the generator frequency to 10 MHz.
   - Set the generator amplitude so that the oscilloscope amplitude readout indicates the amplitude is 80 mV. (Readout may fluctuate around 80 mV.)

   b. *Check the Main trigger system for stable triggering at limits:*

   - Read the following definition: A stable trigger is one that is consistent; that is, one that results in a uniform, regular display triggered on the selected slope (positive or negative). This display should *not* have its trigger point switching between opposite slopes, nor should it “roll” across the screen. At horizontal scale settings of 2 ms/division and faster, **TRIG’D** will remain constantly lit.
   - Press **SET LEVEL TO 50%**.
   - Press **TRIGGER MENU**; then press the main-menu button **Slope**. CHECK that a stable trigger is obtained for the test waveform on both the positive and negative slopes. (Use the side menu to switch between trigger slopes; use the **TRIGGER LEVEL** knob to stabilize the trigger if required.)

c. *Confirm trigger sensitivity at 200 MHz:* Repeat substeps a and b with the generator frequency set to 200 MHz and the horizontal **SCALE** set to 2 ns.

d. *Confirm trigger sensitivity at 1 GHz:* Repeat substeps 2a and 2b with the generator frequency set to 1 GHz, the horizontal **SCALE** set to 1 ns, and the generator amplitude set to 200 mV (as read on the oscilloscope amplitude readout). Leave the Main trigger system triggered on the positive slope of the waveform before continuing to the next step.

3. *Confirm all channels:* Repeat steps 1c through step 2 for all channels. Move the SMA cable to the input connector that corresponds to the channel to be confirmed. Press WAVEFORM OFF. Press the front panel button that corresponds to the channel to be confirmed. Only perform this step if your oscilloscope contains delay lines (it *does not* contain Option 1D).

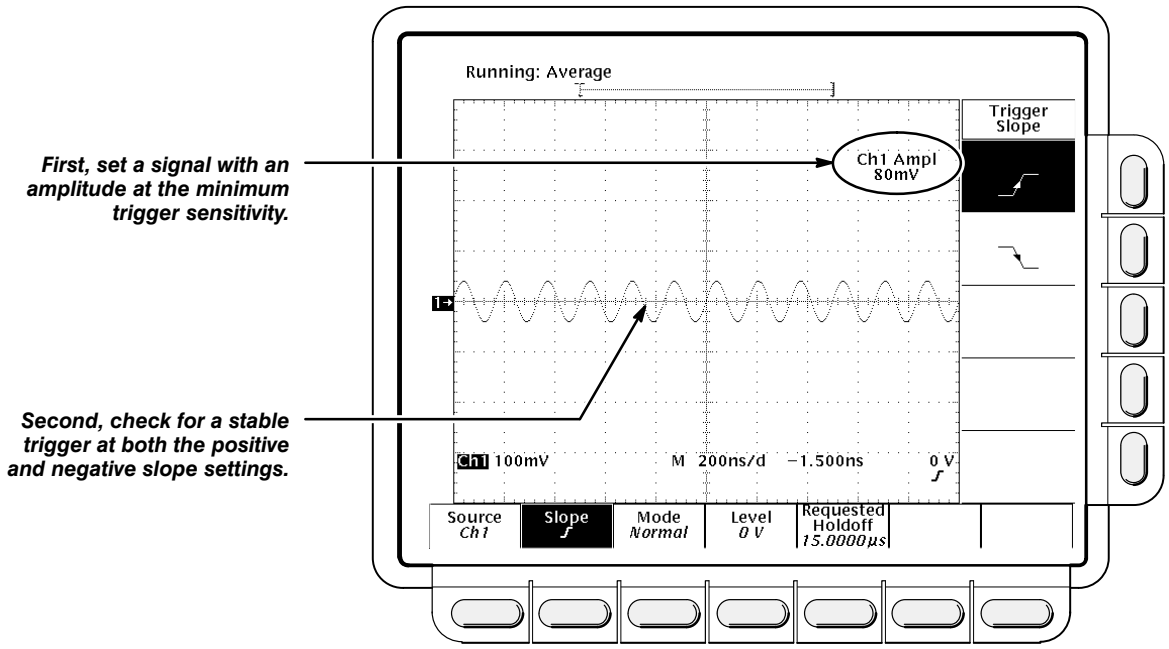


Figure 4-22: Measurement of Trigger Sensitivity

4. *Confirm the External Trigger input:*

a. *Display the test signal:*

- Set the generator frequency to 10 MHz.
- Set the horizontal **SCALE** for the **M** (main) time base to 200 ns.
- Set the generator amplitude so that the oscilloscope **CH 1 Amplitude** readout indicates the amplitude is 40 mV. (Readout may fluctuate around 40 mV.)

b. *Check for external trigger source for stable triggering at limits:* Do the following in the order listed.

- Use the definition for a stable trigger from step 2.
- Press **TRIGGER MENU**; then press the main-menu button **Source**.
- Press the side-menu button **External Trigger**.
- Press **SET LEVEL TO 50%**. CHECK that a stable trigger is obtained 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 **TRIGGER LEVEL** knob to stabilize the trigger if required.

c. Repeat substep b with the generator frequency set to 200 MHz, the horizontal **SCALE** set to 5 ns, and the generator amplitude set to 40 mV (as read on the oscilloscope amplitude readout).

d. Repeat substep b with the generator frequency set to 2 GHz, the horizontal **SCALE** set to 500 ps, and the generator amplitude set to 200 mV (as read on the oscilloscope amplitude readout). Leave the Main trigger system triggered on the positive slope of the waveform before proceeding to the next check.

5. *Disconnect the hookup:* Disconnect the cables, attenuator, adapter, and power divider from the generator output at the input connectors of the oscilloscope.

Check Trigger Delay Jitter and Random Noise

Equipment Required: One high-frequency sine-wave generator (Item 15), an N to BNC adapter (Item 11), a precision coaxial cable (Item 2), two 50 Ω SMA cables (Item 3), one 50 Ω power divider (Item 12), and one BNC to SMA adapter (Item 8).

Prerequisites: *See page 4-11.*

Procedure:

1. *Preset the instrument controls:*

a. *Initialize the oscilloscope:*

- Press save/recall **SETUP**.
- Press the main-menu button **Recall Factory Setup**.
- Press the side-menu button **OK Confirm Factory Init**.
- If your oscilloscope has delay lines (standard instrument), set the vertical **SCALE** to 2 mV. If your oscilloscope does not have delay lines (Option 1D), set the vertical **SCALE** to 1 mV.

2. Confirm input channels are within limits: Do the following substeps – test CH 1 first, skipping substep a since CH 1 is already setup to be checked from step 1.

a. *Select an unchecked channel:*

- Press **RUN/STOP**.
- Press **WAVEFORM OFF** to remove the channel just confirmed from the display. Then, press the front panel button for the channel you wish to confirm.
- If your oscilloscope has delay lines (standard instrument), set the vertical **SCALE** to 2 mV. If your oscilloscope does not have delay lines (Option 1D), set the vertical **SCALE** to 1 mV.

b. *Initialize measurement:*

- Press the front-panel button that corresponds to the channel you are to confirm.
- Press **SHIFT**; then **ACQUIRE MENU**.
- Press the main-menu button **Mode**; then press the side-menu button **Normal**.
- Press **WAVEFORM**.
- Press the main-menu button **Save Waveform**; then press the side-menu button **To Ref 1**.
- Press **SHIFT**; then **ACQUIRE MENU**.
- Press the main-menu button **Mode**; then press the side-menu button **Average**. Press **64**, on the keypad; then press **ENTER**.
- Press **WAVEFORM**.
- Press the main-menu button **Save Waveform**; then press the side-menu button **To Ref 2**.

c. *Initialize waveform math:*

- Press **MATH REF**.
- Press the main-menu button **Math 2**; then press the side-menu button **Change Math Waveform Definition**.
- Press the main-menu button **Dual Wfm Math**.
- Press the side-menu button **Set 1st Source to**; then, using the general purpose knob, set the source to **Ref 1**.
- Press the side-menu button **Set Operator to**; then, using the general purpose knob, set the operator to **−**.
- Press the side-menu button **Set 2nd Source to**; then, using the general purpose knob, set the source to **Ref 2**.
- Press the side-menu button **OK Create Math Wfm**.

d. *Confirm that random noise is within limits: Do the following substeps.*

- Press **MEASURE**.
- Press the main-menu button **Select Measurement**.

- Press the side-menu button **more** until the menu label **RMS** appears in the side menu (its icon is shown at the left). Press the side-menu button **RMS**.
- Press **CLEAR MENU**.
- If your oscilloscope has delay lines (standard instrument), CHECK that the **M2 RMS** readout on screen is ≤1.2 mV. If your oscilloscope does not have delay lines (Option 1D), CHECK that the **M2 RMS** readout on screen is ≤600 µV. See Figure 4-23
- Record the random noise for later use:

  Random noise = M2 RMS Readout

- Press **MATH REF**; then press **WAVEFORM OFF**.

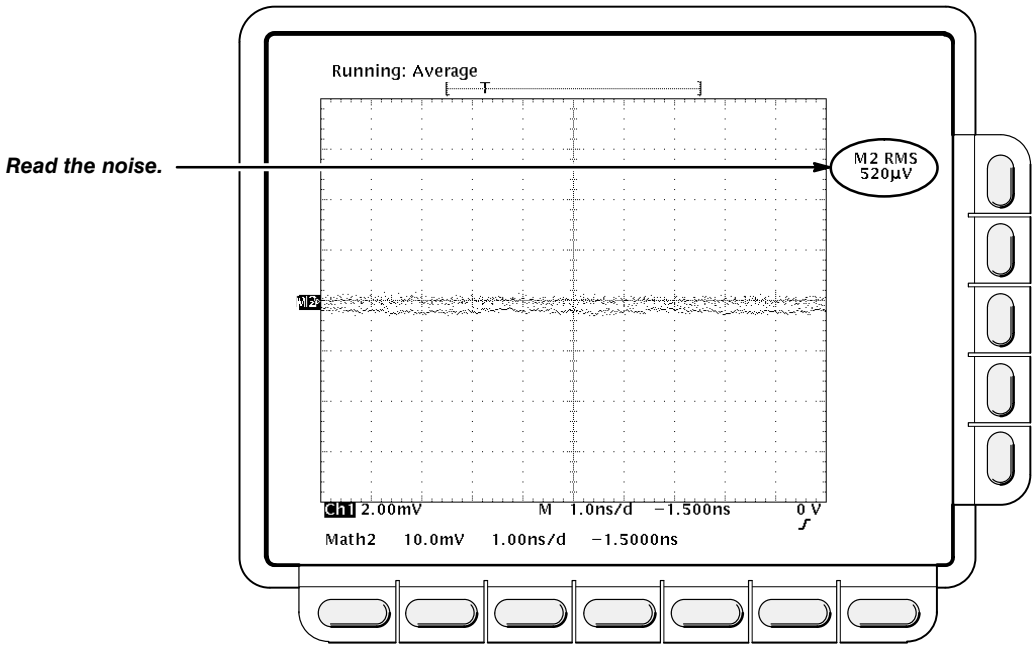


Figure 4-23: Measurement of Random Noise Accuracy

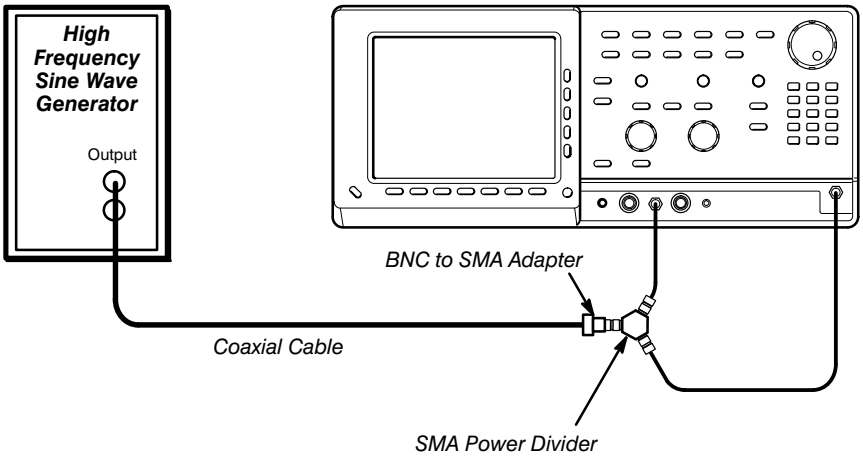


Figure 4-24: Initial Test Hookup

e. *Hook up the test-signal source*: Connect through an N to BNC adapter, a precision coaxial cable, a BNC to SMA adapter, a 50 Ω power divider, and two SMA cables, the sine wave generator to the input of the channel you are to confirm and the **EXT TRIGGER INPUT**. Set the output of the generator to 666.666 MHz.

f. *Modify the front-panel control settings:*

- Press **SHIFT**; then **ACQUIRE MENU**.
- Press the main-menu button **Mode**; then press the side-menu button **Normal**.
- Set the vertical **SCALE** to 50 mV.
- Set the horizontal **SCALE** of the Main time base to 200 ps.
- Press **TRIGGER MENU**; then press the main-menu button **Mode**. Now press the side-menu button **Normal**.
- Press **SET LEVEL TO 50%**.
- Press **MEASURE**; then press the main-menu button **Select Measrmnt for Chx**.
- Press the side-menu button **−more−**, until **Pk-Pk** appears in the side menu. Press **Pk-Pk**.
- Press **CLEAR MENU**.
- Adjust the generator amplitude for an **Pk-Pk** readout of 239 mV. See Figure 4-25.
- Press **MEASURE**.
- Press the main-menu button **Remove Measrmnt**; then press the side-menu buttons **Measurement 1**.
- Press the main-menu button **Select Measrmnt for CHx**.

- Press the side-menu button **−more−**, until **Mean** appears in the side menu. Press **Mean**.
- Press the side-menu button **−more−**, until **RMS** appears in the side menu. Press **RMS**.

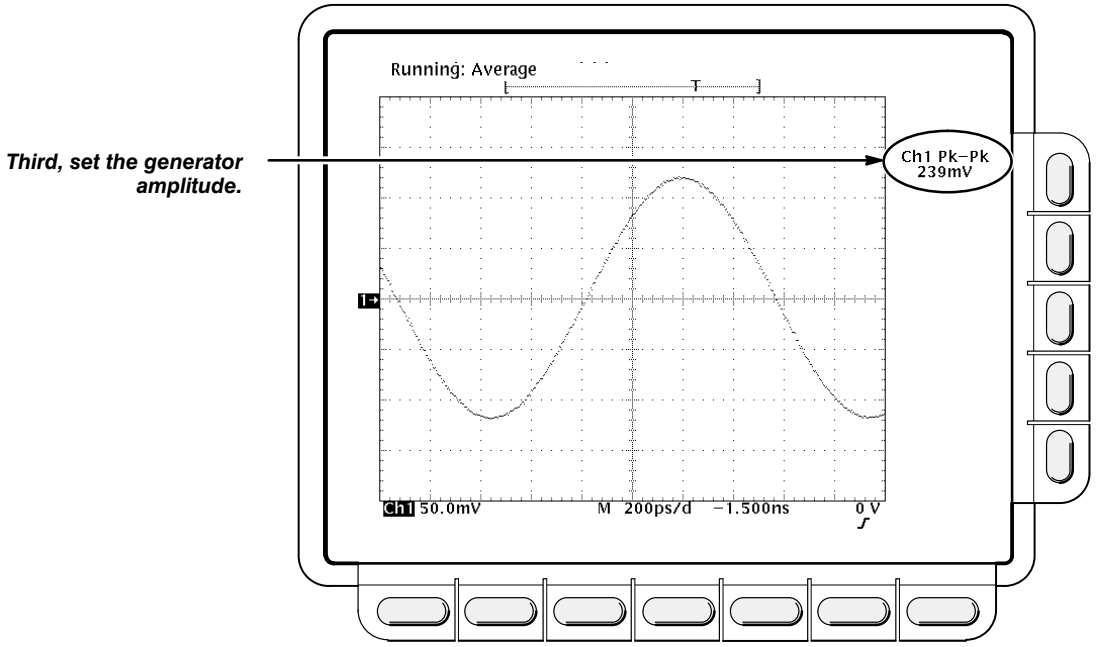


Figure 4-25: Trigger Delay Jitter Level Setting

g. *Measure the channel noise:*

- Press **TRIGGER MENU**.
- Press the main-menu button **Level**. Use the keypad to set the level to 0 V (press **0**, then **ENTER**, on the keypad).
- Press **HORIZONTAL MENU**.
- Press the main-menu button **Time Base Position**; using the general purpose knob, slowly adjust the time base position a small amount until the displayed waveform starts at 0 V (at the left center of the screen). See Figure 4-26.
- Press the main-menu button **Fine Scale**. Press **0**, on the keypad; then press **ENTER**.
- Press the main-menu button **Time Base Position**; using the general purpose knob, slowly adjust the time base position a small amount until the mean readout is as close to 0 V as possible.

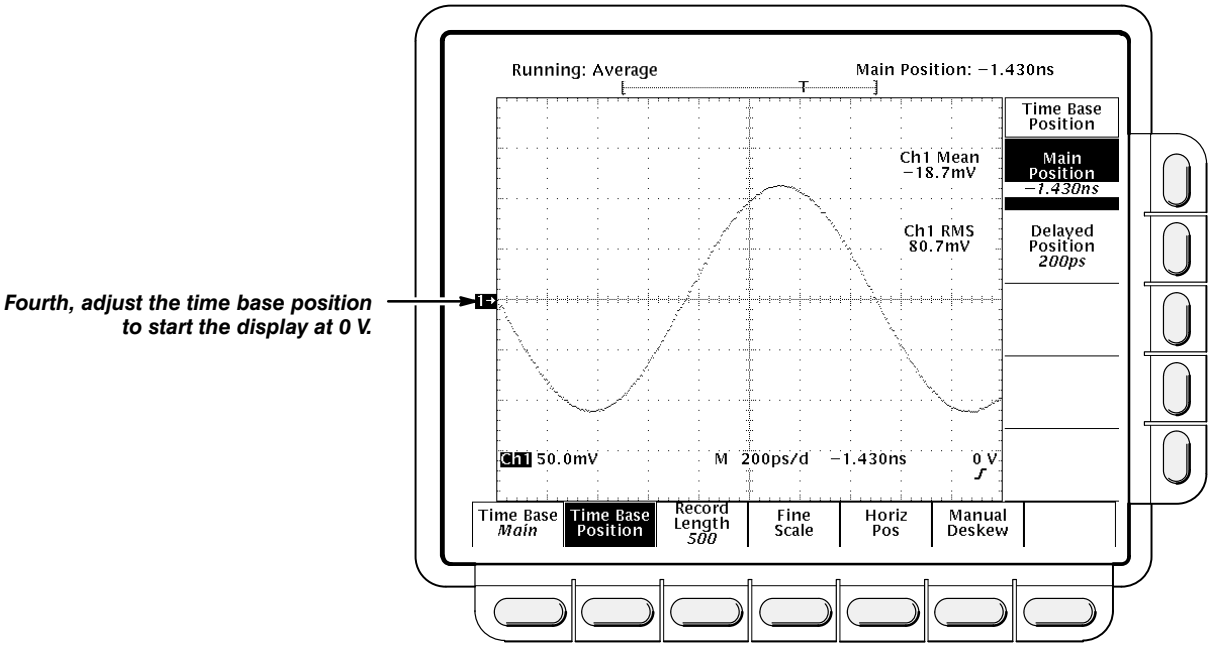


Figure 4-26: Trigger Delay Jitter Time Base Position

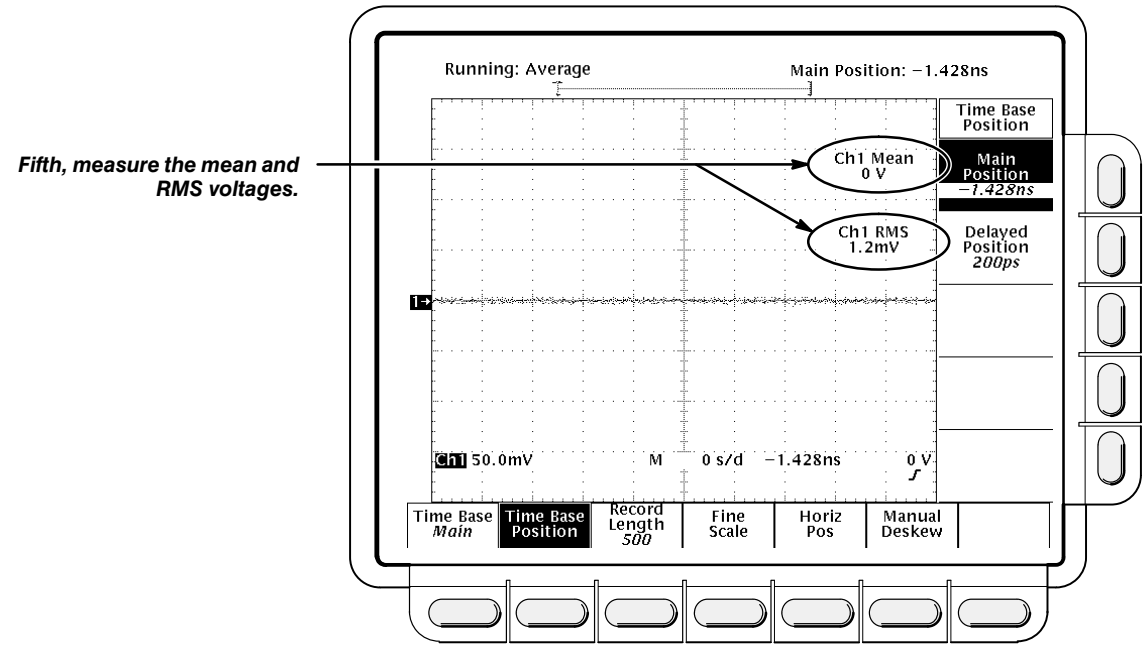


Figure 4-27: Trigger Delay Jitter Channel Noise

h. *Calculate the channel noise:*

- Press **RUN**/**STOP**.
- *Read the mean and RMS voltages from the readout display. See Figure 4-27.*
- *Calculate the noise and save the result for future use:*

$$Channel\ noise = \sqrt{(RMS\ Readout\ in\ mV)^2 - (Mean\ Readout\ in\ mV)^2}$$

i. *Calculate the vertical noise due to jitter:* Use the channel noise calculated in substep h and the random noise from substep d to calculate the vertical noise due to jitter.

$$Vertical\ noise\ due\ to\ jitter = \sqrt{(channel\ noise)^2 - (Random\ noise)^2}$$

j. *Calculate the time jitter:* Use the vertical noise due to jitter calculated in step i and the slew rate to calculate the time jitter.

$$Time\ jitter = \frac{Vertical\ noise\ due\ to\ jitter}{0.5\ \frac{mV}{ps}}$$

Example:

The formula for time jitter is:

$$Time\ jitter = \frac{Vertical\ noise\ due\ to\ jitter}{Slew\ rate}$$

where: $Slew\ rate = 2\ \Pi\ f\ \left(\frac{Pk-Pk}{2}\right)$

or for our procedure:

$$Slew\ rate = 2\ \Pi\ 666.666\ MHz\left(\frac{239\ mV}{2}\right) = 0.5\ \frac{mV}{ps}$$

$$Time\ jitter = \frac{Vertical\ noise\ due\ to\ jitter}{0.5\ \frac{mV}{ps}}$$

- CHECK that the calculated time jitter is < 3 ps.

k. *Calculate the 200 ns time jitter:*

- Press **RUN**/**STOP**.
- Use the keypad to set the time base position to 200 ns (press **200**, **SHIFT**, **n**, and then **ENTER**, on the keypad).

- Using the general purpose knob, slowly adjust the time base position a small amount until the displayed waveform starts at 0 V (at the left center of the screen) and the mean readout is as close to 0 V as possible. See Figure 4-27.
- Press **RUN**/**STOP**.
- Read the mean and RMS voltages from the readout display. See Figure 4-27.
- Calculate the jitter using the mean and RMS voltages from the readout and the random noise from substep d (**M2 RMS** value):

$$\textit{Channel noise at 200 ns} = \sqrt{(\textit{RMS Readout at 200 ns in mV})^2 - (\textit{Mean Readout at 200 ns in mV})^2}$$

$$\textit{Vertical noise due to jitter at 200 ns} = \sqrt{(\textit{Channel noise at 200 ns in mV})^2 - (\textit{Random noise in mV})^2}$$

$$\textit{Time jitter at 200 ns} = \frac{\textit{Noise due jitter at 200ns}}{\textit{Slew rate}} \leq 3\ ps + 30\ ppm \times 200\ ns \leq 9\ ps$$

$$= \frac{\textit{Noise due jitter at 200 ns}}{0.5\ \frac{mV}{ps}} \leq 3\ ps + 30\ ppm \times 200\ ns \leq 9\ ps$$

- CHECK that the calculated jitter is $\leq$9 ps.

3. *Test all channels:* Repeat step 2 for all input channels.
4. *Disconnect the hookup:* Disconnect the cables, divider, attenuator, and adapter from the generator output at the oscilloscope input connectors.

Adjustment Procedures

This section contains information needed to adjust TDS 800 Digitizing Oscilloscopes.

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

- This general information about adjusting this oscilloscope.
- Two written procedures for manually adjusting the oscilloscope and the display assembly.

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

Adjustment Interval — As a general rule, these adjustments should be done every 2000 hours of operation or once a year if 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 oscilloscope 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

The cabinet must be removed to perform this adjustment procedure. The procedure that follows will tell you how and when to remove the cabinet.

Test Equipment

The equipment list in Table 5-3 on page 5-3 lists all test equipment required to adjust this oscilloscope.

Usage

The following topics cover what is required of you when adjusting the oscilloscope. Also, the performance of individual adjustments is discussed.

Performing the Adjustments

When using the adjustment procedure, you will be required to manually adjust circuits. You must also provide external standards.

Complete Adjustment

A complete adjustment is the performance of all adjustments in this section. Throughout this section, “complete adjustment” is used as just defined.

Signal Path Compensation — The Compensate All adjustment automatically runs the Signal Path Compensation. This internal routine is not an adjustment. It compensates for vertical and horizontal gain, linearity, and offset. It also compensates for the current operating temperature to optimize oscilloscope performance.

Partial Adjustment

Usually all adjustments should be made unless you are adjusting circuits in the course of troubleshooting the oscilloscope. 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 5-1.

Table 5-1: Adjustments Required for Module Replaced

Module Replaced	Adjustment Required
Acquisition Board	Complete Adjustment
Interface Board	Complete Adjustment
Front Panel Assembly	None Required
Firm Face Board	None required[1]
Low Voltage Power Supply	Complete Adjustment
Processor Board	Complete Adjustment
Display Assembly	Display Adjustment Only

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

Adjustment Dependencies

Some adjustments depend on the successful prior completion of other adjustments (see Table 5-2). For example, all adjustments that are part of the *Acquisition Adjustments* procedure should be completed in order.

Table 5-2: Adjustments and Dependencies

Adjustment	Prior Completion Requirements
Acquisition Adjustments	None
Display Adjustment	None

Equipment Required

The test equipment required to adjust TDS 800 Digitizing Oscilloscopes is listed in Table 5-3.

Table 5-3: Test Equipment, Fixtures, and Supplies

Item Number and Description		Minimum Requirements	Example	Purpose
1	Adjustment Tool	7/32 inch hex wrench on both ends	GC Electronics #8606	Acquisition Adjustments
2	Adapter, BNC to SMA	SMA (male)-to BNC (female)	Tektronix part number 015−0554−00	Signal connection
3	Adapter, N to BNC	N (male)-to BNC (female)	Tektronix part number 103−0045−00	Signal connection
4	Adapter, SMA	SMA (male)-to SMA (male)	Tektronix part number 015−1011−00	Signal connection
5	Cable, Precision Coaxial (two required)	50 Ω, 36 in, male to male BNC connectors	Tektronix part number 012−0482−00	Acquisition Adjustments
6	Connector, BNC “T”	Male BNC to dual female BNC	Tektronix part number 103−0030−00	Acquisition Adjustments
7	Connector, Dual Banana (two required)	Female BNC to dual banana	Tektronix part number 103−0090−00	Acquisition Adjustments
8	Cable, Precision Coaxial (two required)	50 Ω, 6 in, male to male SMA connectors	Tektronix part number 015−1015−00	Signal Interconnection
9	Cable, Precision Coaxial	50 Ω, 60 in, male to male SMA connectors	Tektronix part number 174−1428−00	Signal Interconnection
10	Divider, Power (two required)	50 Ω, SMA Female	Tektronix part number 015−0565−00	Various Accuracy Tests

Table 5-3: Test Equipment, Fixtures, and Supplies (Cont.)

Item Number and Description	Minimum Requirements	Example	Purpose
11 Generator, Sine-Wave, High-Frequency	10 MHz to 2 GHz; Variable amplitude to 5 mW; Accuracy $<5\times10^{-10}$/day with temperature $<5\times10^{-9}$ over 0−55° C; Resolution 1 kHz	Wiltron 67xxB with Option 2	Various Accuracy Tests
12 Generator, DC Calibration	Variable amplitude to ±10 V; accuracy to 0.05%	Data Precision 8200	Acquisition Adjustments
13 Photometer	0.1 to 200 Footlamberts	TEKTRONIX J16 Photometer with J6503 Luminance Probe	Contrast Adjustment
14 Multimeter, Digital	200 V, ±0.05% Accuracy	TEKTRONIX DM504A Digital Multimeter[1]	Acquisition Adjustments
15 Magnifier, 6X	Standard Tool		Brightness and Focus Adjustment

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

Acquisition System Adjustments

The following instructions will guide you through setting up the oscilloscope for manual adjustment, and adjusting the oscilloscope acquisition system. See Figure 5-6 on page 5-22 for the location of the acquisition adjustments.

Equipment Required: One DMM (Item 14), an alignment tool (Item 1), a DC calibration generator (Item 12), two dual banana to BNC adapters (Item 7), one BNC T (Item 6), precision BNC cables (Items 5, 8, and 9), one BNC to SMA adapter (Item 2), an N to BNC adapter (Item 3), sinewave generator (Item 11), SMA male to male adapter (Item 4), power divider (Item 10).

Procedure:

1. *Accessing the oscilloscope:* Remove the oscilloscope cabinet using the *Rear Cover and Cabinet* removal procedure.
2. *Orient the oscilloscope:* Set the oscilloscope so its bottom is down with its face facing you.
3. *Enable oscilloscope adjustment:* 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

4. *Orient the oscilloscope:* Set the oscilloscope so its top is down with its face facing you.
5. *Adjust the SRD bias:*
   a. Note the number written on sampler U2111.
   b. Locate R2202 (see Figure 5-6).
   c. Measure the resistance from pins 3 to 2 of R2202.
   d. Adjust R2202 until its resistance equals the value written on sampler U2111.
   e. Note the number written on sampler U2110.
   f. Locate R2200.
   g. Measure the resistance from pins 3 to 2 of R2200.
   h. Adjust R2200 until its resistance equals the value written on sampler U2110.
6. *Set up the oscilloscope:*
   a. Power on the oscilloscope.
   b. Allow the oscilloscope to complete its power-up sequence.
   c. Press **SETUP**.

d. Press the main-menu button **Recall Factory Setup**; then press the side-menu button **OK Confirm Factory Init**.

e. Allow a 20 minute warm up period before you begin step f.

f. Press **DISPLAY**.

g. Press the main-menu button **Graticule**; then press the side-menu button **Grid**.

h. Press **WAVEFORM OFF** until all waveforms are removed from the display.

i. Press **SHIFT**; then press **UTILITY**.

j. Repeatedly press the main-menu button **System** until **Diag**/**Err** is highlighted in the pop up menu.

k. Repeatedly press the main-menu button **Area** until **Acquisition** is displayed in the pop up menu.

l. Press the main-menu button **Tests**; then press the side menu-button **Init. Comp. Values**.

m. Press the main-menu button **Execute**; then press the side-menu button **OK Confirm Run Test**.

NOTE

Loop 50 Times *is a suggested value. You will have to press the* ***OK Confirm Run Test*** *button more than once during some tests. Smaller values will require more button presses. Larger values will require you to wait for some tests to complete after you have finished an adjustment.* ***Loop Always*** *will require you to cycle the power and restart the adjustment procedures to go to a new step.*

n. Press the main-menu button **Loop**; then press the side menu-button **Times**. Enter **50** and **ENTER** on the keypad.

7. *Adjust the VCO frequency:*

a. Press the main-menu button **Tests**; then press the side menu-button **more** until **VCO Frequency Adjust** appears in the menu. Press the side-menu button **VCO Frequency Adjust**.

b. Press the main-menu button **Execute**; then press the side-menu button **OK Confirm Run Test**.

c. Adjust R125 until the vertical line is directly under the arrow on screen. See Figure 5-1.

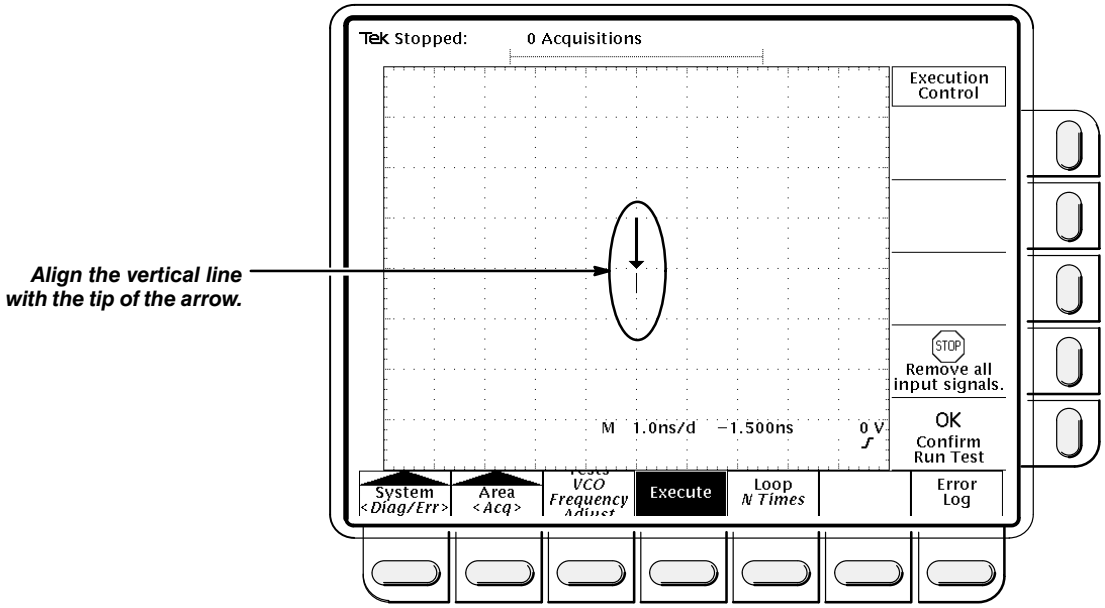


Figure 5-1: Adjustment Indicators

8. *Adjust the fine holdoff:*

   a. Press the main-menu button **Tests**; then press the side menu-button **more** until **Fine Holdoff Adjust** appears in the menu. Press the side-menu button **Fine Holdoff Adjust**.

   b. Press the main-menu button **Execute**; then press the side-menu button **OK Confirm Run Test**.

NOTE

It is normal for the vertical line to jump horizontally during this adjustment.

   c. Adjust R116 until the vertical line is directly under the arrow on screen.

9. *Adjust the holdoff clock:*

   a. Press the main-menu button **Tests**; then press the side menu-button **more** until **Holdoff Clock Adjust** appears in the menu. Press the side-menu button **Holdoff Clock Adjust**.

   b. Press the main-menu button **Execute**; then press the side-menu button **OK Confirm Run Test**.

NOTE

It is normal for the vertical line to jump around horizontally during this adjustment.

c. Adjust R151 until the vertical line is directly under the arrow on screen.

10. *Adjust the CH 1 strobe delay:*

a. Press the main-menu button **Tests**; then press the side menu-button **more** until **CH 1 Delay Adjust** appears in the menu. Press the side-menu button **CH 1 Delay Adjust**.

b. Press the main-menu button **Execute**; then press the side-menu button **OK Confirm Run Test**.

NOTE

It is normal for the vertical line to jump horizontally during this adjustment.

c. Adjust R231 until the vertical line is directly under the arrow on screen.

11. *Adjust the CH 2 strobe delay:*

a. Press the main-menu button **Tests**; then press the side-menu button **CH 2 Delay Adjust**.

b. Press the main-menu button **Execute**; then press the side-menu button **OK Confirm Run Test**.

NOTE

It is normal for the vertical line to jump horizontally during this adjustment.

c. Adjust R331 until the vertical line is directly under the arrow on screen.

d. Press the main-menu button **Loop**; then press the side menu-button **Times**. Enter **1** and **ENTER** on the keypad.

e. Press the main-menu button **Execute**; then press the side-menu button **OK Confirm Run Test**.

12. *Adjust CH 1:* Do the following substeps to adjust CH 1.

a. Press **SETUP**.

b. Press the main-menu button **Recall Factory Setup**; then press the side-menu button **OK Confirm Factory Init**.

c. *Adjust zero:*

- Remove J250.
- If your oscilloscope has delay lines (standard instrument) set the Vertical **SCALE** to 2 mV. If your oscilloscope does not have delay lines (Option 1D) set the Vertical **SCALE** to 1 mV.
- Adjust R2209 until the waveform is as near to center screen as possible.
- Replace J250.

d. *Adjust null:*

- Press **VERTICAL MENU**.
- Press the main-menu button **Offset**; then press the side-menu button **Set to 0**.
- Press the main-menu button **Position**; then press the side-menu button **Set to 0**.
- Adjust R2206 until the waveform is at center screen.

e. *Adjust offset gain:*

- Set the vertical **SCALE** to 5 mV.
- Press **SHIFT**; then press **ACQUIRE MENU**.
- Press the main-menu button **Mode**; then press the side-menu button **Average**. Press **4** and then **ENTER** on the keypad.
- Set the output of a DC calibration generator to 0 volts.
- Connect the output of a DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector.
- 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. Connect the BNC to SMA adapter to **CH 1**. Now connect the BNC T connector to the BNC to SMA adapter.
- If the waveform is not within one division of the center graticule line return to the null adjustment procedure.
- Using the Vertical **POSITION** control, adjust the waveform to the center graticule line.
- If your oscilloscope has delay lines (standard instrument) set the output of a DC calibration generator to 1.2 volts. If your oscilloscope does not have delay lines (Option 1D) set the output of a DC calibration generator to 1.0 volts.

- Press **VERTICAL MENU**.
- Press the main-menu button **Offset**. If your oscilloscope has delay lines (standard instrument) use the keypad to set the offset to 1.2 volts (press **1.2**, then **ENTER**, on the keypad). If your oscilloscope does not have delay lines (Option 1D) use the keypad to set the offset to 1 volt (press **1**, then **ENTER**, on the keypad).
- Adjust R2423 to center the waveform on the center graticule line.
- If your oscilloscope has delay lines (standard instrument) set the output of the DC calibration generator to −1.2 volts. If your oscilloscope does not have delay lines (Option 1D)) set the output of the DC calibration generator to −1.0 volts.
- Press the main-menu button **Offset**. If your oscilloscope has delay lines (standard instrument) use the keypad to set the offset to −1.2 volts (press **−1.2**, then **ENTER**, on the keypad). If your oscilloscope does not have delay lines (Option 1D) use the keypad to set the offset to −1 volt (press **−1**, then **ENTER**, on the keypad).
- The waveform should be on the center graticule line. if it is not, adjust R2423 to split the difference with the positive offset adjustment.
- Set the output of a DC calibration generator to 0 volts.

f. *Adjust offset reference:*

- Press the main-menu button **Position**.
- Press **−5** and **ENTER** on the keypad.
- If your oscilloscope has delay lines (standard instrument), set the Vertical **SCALE** to 200 mV. If your oscilloscope does not have delay lines (Option 1D), set the Vertical **SCALE** to 100 mV.
- Press the main-menu button **Offset**.
- If your oscilloscope has delay lines (standard instrument), press **2** and **ENTER** on the keypad. If your oscilloscope does not have delay lines (Option 1D), press **1** and **ENTER** on the keypad.
- Set up the DMM to volts.
- Connect the DMM between ground and TP2312 (the square pin closest to R2317) on the A10 Acquisition board.
- Adjust R2317 for a 0.4690 V reading on the voltmeter.
- Press the main-menu button **Offset**; then press the side-menu button **Set to 0**.
- Press the main-menu button **Position**; then press the side-menu button **Set to 0**.

g. *Adjust forward gain:*

- If your oscilloscope has delay lines (standard instrument), set the Vertical **SCALE** to 200 mV. If your oscilloscope does not have delay lines (Option 1D), set the Vertical **SCALE** to 100 mV.
- Press **VERTICAL MENU**; then press the main-menu button **Offset**.
- If your oscilloscope has delay lines (standard instrument), enter **600**, **SHIFT**, **m**, and **ENTER** on the keypad. If your oscilloscope does not have delay lines (Option 1D), enter **300**, **SHIFT**, **m**, and **ENTER** on the keypad.
- Adjust R2203 to center the waveform on the third graticule line below center screen.
- If your oscilloscope has delay lines (standard instrument), enter **−600**, **SHIFT**, **m**, and **ENTER** on the keypad. If your oscilloscope does not have delay lines (Option 1D), enter **−300**, **SHIFT**, **m**, and **ENTER** on the keypad.
- If the waveform is not centered on the third graticule line above center screen adjust R2203 to split the difference with the adjustment at the + offset.

13. *Adjust CH 2:* Do the following substeps to adjust CH 2.

a. *Adjust zero:*

- Press WAVEFORM OFF; then press **CH 2**.
- Press **VERTICAL MENU**.
- Remove J350.
- If your oscilloscope has delay lines (standard instrument) set the Vertical **SCALE** to 2 mV. If your oscilloscope does not have delay lines (Option 1D) set the Vertical **SCALE** to 1 mV.
- Adjust R2215 until the waveform is as near to center screen as possible.
- Replace J350.

b. *Adjust null:*

- Press the main-menu button **Offset**; then press the side-menu button **Set to 0**.
- Press the main-menu button **Position**; then press the side-menu button **Set to 0**.
- Adjust R2212 until the waveform is at center screen.

c. *Adjust offset gain:*

- Set the vertical **SCALE** to 5 mV.
- Press **SHIFT**; then press **ACQUIRE MENU**.

- Press the main-menu button **Mode**; then press the side-menu button **Average**. Press **4** and then **ENTER** on the keypad.
- Set the output of a DC calibration generator to 0 volts.
- Move the BNC to SMA adapter to the **CH 2** input.
- If the waveform is not within one division of the center graticule line return to the null adjustment procedure.
- Using the Vertical **POSITION** control, adjust the waveform to the center graticule line.
- If your oscilloscope has delay lines (standard instrument) set the output of a DC calibration generator to 1.2 volts. If your oscilloscope does not have delay lines (Option 1D) set the output of a DC calibration generator to 1.0 volts.
- Press **VERTICAL MENU**.
- Press the main-menu button **Offset**. If your oscilloscope has delay lines (standard instrument) use the keypad to set the offset to 1.2 volts (press **1.2**, then **ENTER**, on the keypad). If your oscilloscope does not have delay lines (Option 1D) use the keypad to set the offset to 1 volt (press **1**, then **ENTER**, on the keypad).
- Adjust R2420 to center the waveform on the center graticule line.
- If your oscilloscope has delay lines (standard instrument) set the output of the DC calibration generator to −1.2 volts. If your oscilloscope does not have delay lines (Option 1D)) set the output of the DC calibration generator to −1.0 volts.
- Press **VERTICAL MENU**.
- Press the main-menu button **Offset**. If your oscilloscope has delay lines (standard instrument) use the keypad to set the offset to −1.2 volts (press **−1.2**, then **ENTER**, on the keypad). If your oscilloscope does not have delay lines (Option 1D) use the keypad to set the offset to −1 volt (press **−1**, then **ENTER**, on the keypad).
- The waveform should be on the center graticule line. If it is not, adjust R2420 to split the difference with the positive offset adjustment.
- Set the output of a DC calibration generator to 0 volts.
- Disconnect the generator, cables, and adapters from the oscilloscope input.

d. *Adjust offset reference:*

- Press the main-menu button **Position**.
- Press **−5** and **ENTER** on the keypad.

- If your oscilloscope has delay lines (standard instrument), set the Vertical **SCALE** to 200 mV. If your oscilloscope does not have delay lines (Option 1D), set the Vertical **SCALE** to 100 mV.
- Press the main-menu button **Offset**.
- If your oscilloscope has delay lines (standard instrument), press **2** and **ENTER** on the keypad. If your oscilloscope does not have delay lines (Option 1D), press **1** and **ENTER** on the keypad.
- Set up the DMM to volts.
- Connect the DMM between ground and TP2313 (the square pin closest to R2313) on the A10 Acquisition board.
- Adjust R2313 for a 0.4690 V reading on the voltmeter.
- Press the main-menu button **Offset**; then press the side-menu button **Set to 0**.
- Press the main-menu button **Position**; then press the side-menu button **Set to 0**.

e. *Adjust forward gain:*

- If your oscilloscope has delay lines (standard instrument), set the Vertical **SCALE** to 200 mV. If your oscilloscope does not have delay lines (Option 1D), set the Vertical **SCALE** to 100 mV.
- Press **VERTICAL MENU**; then press the main-menu button **Offset**.
- If your oscilloscope has delay lines (standard instrument), enter **+600**, **SHIFT**, **m**, and **ENTER** on the keypad. If your oscilloscope does not have delay lines (Option 1D), enter **+300**, **SHIFT**, **m**, and **ENTER** on the keypad.
- Adjust R2201 to center the waveform on the third graticule line below center screen.
- If your oscilloscope has delay lines (standard instrument), enter **−600**, **SHIFT**, **m**, and **ENTER** on the keypad. If your oscilloscope does not have delay lines (Option 1D), enter **−300**, **SHIFT**, **m**, and **ENTER** on the keypad.
- If the waveform is not centered on the third graticule line above center screen adjust R2201 to split the difference with the adjustment at the + offset.

14. *Adjust trigger offset:* Only perform this procedure if your oscilloscope has delay lines (standard instrument). Do the following substeps to adjust the trigger offset.

CAUTION

Be careful not to damage or bend parts on the A9 Compensation Pickoff. If parts are bent or damaged, the oscilloscope may adjust properly and pass all diagnostics, but it will not meet all specifications.

a. *Remove the cover from A9 Compensation Pickoff circuit:*

- Grasp the two fingers of the cover and compress them together slightly (see Figure 5-2).
- Lift the cover off of the A9 Compensation Pickoff circuit.

b. *Initialize the oscilloscope:*

- Press **SETUP**.
- Press the main-menu button **Recall Factory Setup**; then press the side-menu button **OK Confirm Factory Init**.
- Press **TRIGGER MENU**.
- Press the main-menu button **Level**; then press 0 and ENTER on the keypad.
- Press the main-menu button **Source**; then press the side-menu button **CH 1**.

c. Set up the DMM to volts.

d. Connect the DMM between ground and the center conductor of J301.

e. Adjust R310 for a 0.0 V reading on the DMM.

f. Press the side-menu button **CH 2**.

g. Read voltage reading on the DMM.

h. Adjust R310 until the DMM reading is one half the reading measured in substep g.

i. Disconnect the DMM, and carefully reinstall the cover on the A9 Compensation Pickoff circuit.

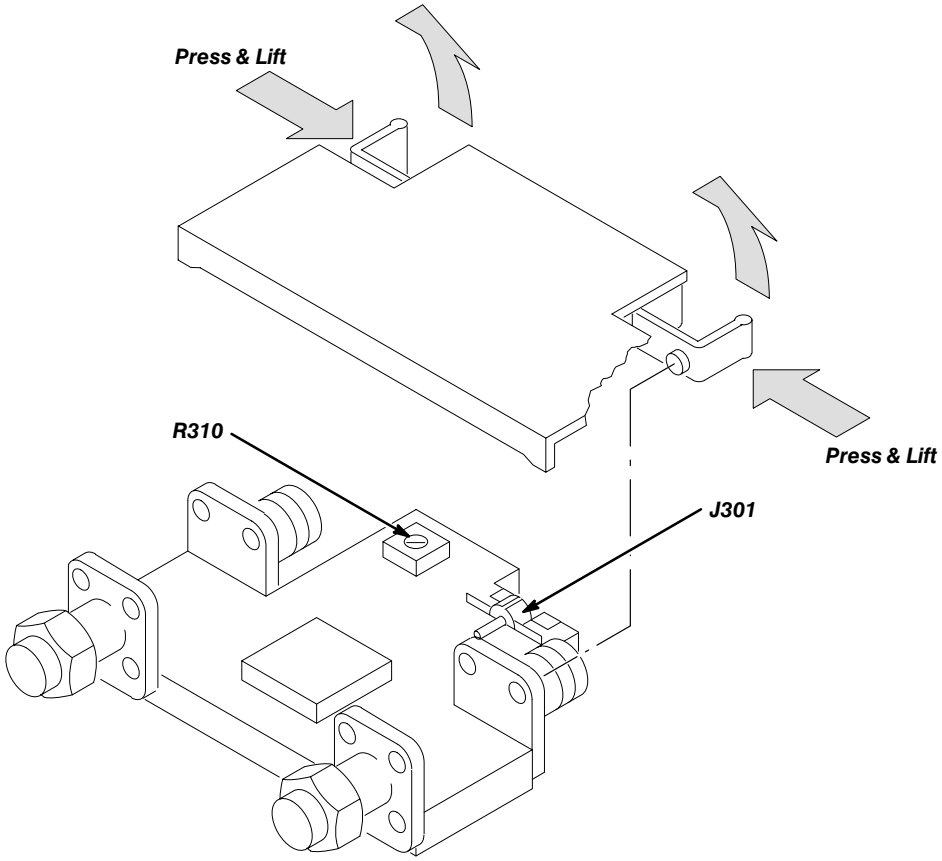


Figure 5-2: Trigger Offset Adjustment on the A9 Compensation Pickoff

15. *Adjust the time interpolator range fine adjustment:* Do the following substeps to adjust the time interpolator range to match the clock period.

    a. *Compensate the acquisition system:*

    - Press **SHIFT** and then **UTILITY**.
    - Press the main-menu button **System**, until **Cal** appears in the side menu.
    - Press the side-menu button **OK Compensate All**.

NOTE

*The two cables going to the **CH 1** and **CH 2** inputs must be the same length and they must both connect to the same power divider.*

b. *Hook up the test-signal source*:

- Connect, through an N to BNC adapter, a coaxial cable, and a BNC to SMA adapter, the sine wave generator to a 50 Ω power divider.
- Connect one side of the power divider, through an SMA cable to the **EXT TRIGGER INPUT**.
- Connect the other side of the power divider, through an SMA male to male adapter, another power divider, and two SMA cables to the **CH 1** and **CH 2** inputs.
- Set the output of the generator to 305.175 MHz and about 400 mV.

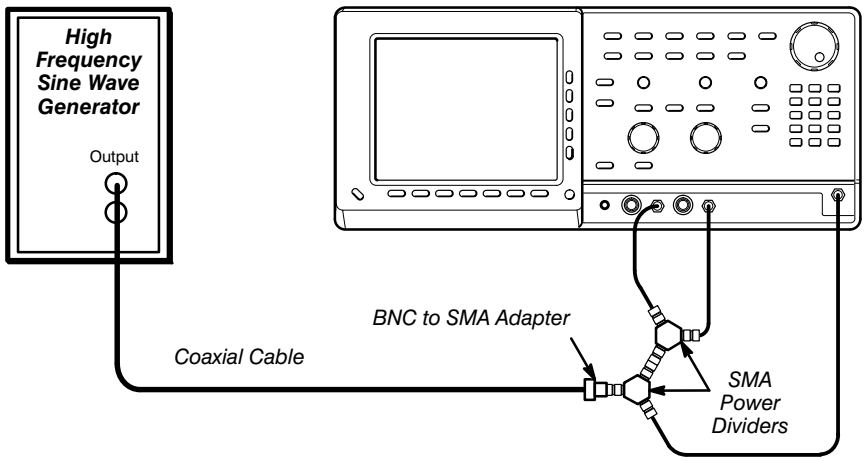


Figure 5-3: Initial Test Hookup

c. *Initialize the oscilloscope:*

- Press save/recall **SETUP**.
- Press the main-menu button **Recall Factory Setup**.
- Press the side-menu button **OK Confirm Factory Init**.

d. *Modify the initialized front-panel control settings:*

- Set the vertical **SCALE** to 100 mV.
- Set the horizontal **SCALE** of the Main time base to 500 ps.
- Press **CH 2**.
- Set the vertical **SCALE** to 100 mV.
- Press **MEASURE**; then press the main-menu button **Select Measrmnt**.
- Press the side-menu button **−more−**, until **Pk-Pk** appears in the side menu. Press **Pk-Pk**.

- Press **CLEAR MENU**.
- Adjust the generator amplitude for a **Pk-Pk** readout of 208 mV.
- Adjust the Trigger **LEVEL** so that the waveform zero crossing is at the left center of the graticule, or until just before loss of trigger.
- Press **MEASURE**.
- Press the main-menu button **Remove Measrmnt**; then press the side-menu buttons **Measurement 1**.
- Press **HORIZONTAL MENU**.
- Press the main-menu button **Manual Deskew**.
- Press the side-menu button **CH 1**. Press **0**, on the keypad; then press **ENTER**.
- Press the side-menu button **CH 2**. Press **0**, on the keypad; then press **ENTER**.
- 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 **Acquisition** is highlighted in the pop up menu.
- Press the main-menu button **Tests**; then press the side menu-button **Store Instrument Deskew**.
- Press the main-menu button **Execute**; then press the side menu-button **OK Confirm Run Test**.
- Press **HORIZONTAL MENU**.
- Press the main-menu button **Manual Deskew**.
- Use the general purpose knob to adjust the deskew of the channel whose waveform zero crossing occurs last on the display so that both waves are superimposed. If the deskew for both channels is 0 ps, adjust the deskew of one channel to 50 ps. (Two adjustments performed later are made visible by this deskew setting.)
- Record the channel deskew for latter use.
- Press **SHIFT**; then press **ACQUIRE MENU**.
- Press the main-menu button **Mode**. Press the side-menu **Average**; then press **8** and **ENTER** on the keypad.
- Press **MATHREF**; then press the main-menu button **Math2**. Set the Math2 vertical **SCALE** to 5 mV.
- Press **HORIZONTAL MENU**.

- Press the main-menu button **Time Base Position**. If your instrument has delay lines (standard instrument) press **4.4**, **SHIFT**, **n**, and then **ENTER** on the keypad. If your instrument does not have delay lines (Option 1D) press **21.9**, **SHIFT**, **n**, and then **ENTER** on the keypad.
- Press **CH 2**.
- Set the horizontal **SCALE** of the Main time base to 100 ps.
- Press **DISPLAY**.
- Press the main-menu button **Style**; then press the side-menu buttons **Vectors**.
- Press **CURSOR**; then press the side-menu button **V Bars**.
- If your instrument has delay lines (standard instrument) use the general purpose knob to adjust the @ readout to 5.054 ns ±10 ns. If your instrument does not have delay lines (Option 1D) use the general purpose knob to adjust the @ readout to 22.55 ns. (At this position you will adjust the channel whose deskew was left at 0 ps.)
- Press **TOGGLE**.
- If your instrument has delay lines (standard instrument) use the general purpose knob to adjust the @ readout to *5.054 minus the deskew of the channel you adjusted* earlier. If your instrument does not have delay lines (Option 1D) use the general purpose knob to adjust the @ readout to *22.554 minus the deskew of the channel you adjusted* earlier. (At this position you will adjust the channel whose deskew was *not* left at 0 ps.)
- Press **CLEAR MENU**.
- Adjust R331 and R231 until there is no break in the waveform. (See figures 5-4 and 5-5.)
- Press **HORIZONTAL MENU**.

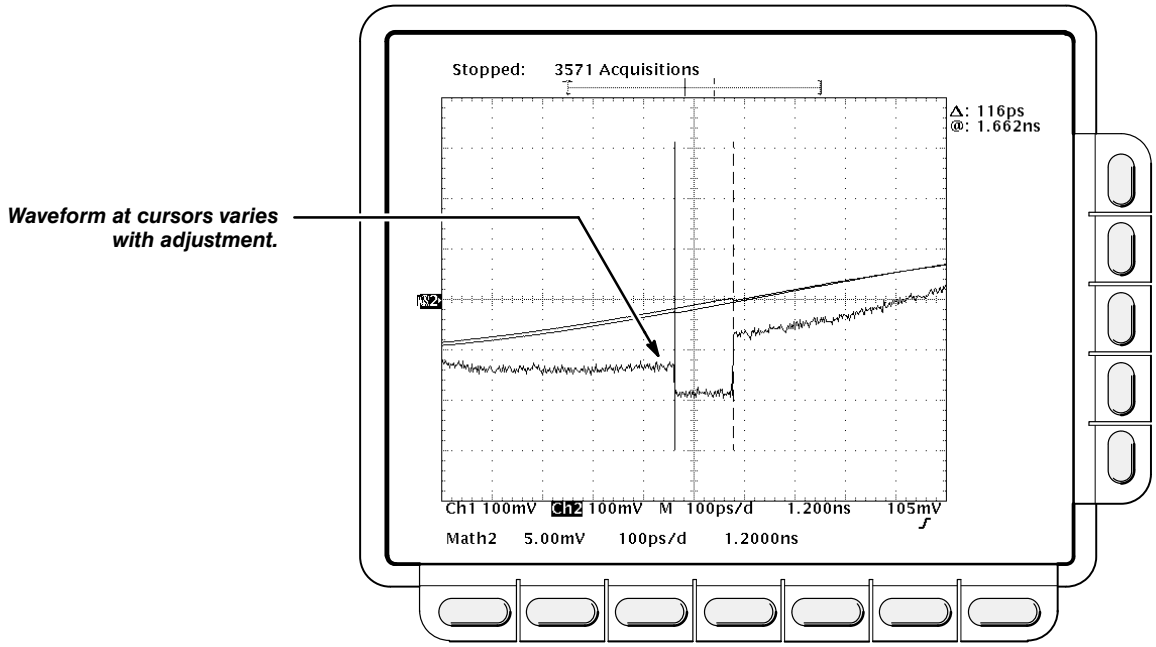


Figure 5-4: Time Interpolator Before Adjustment

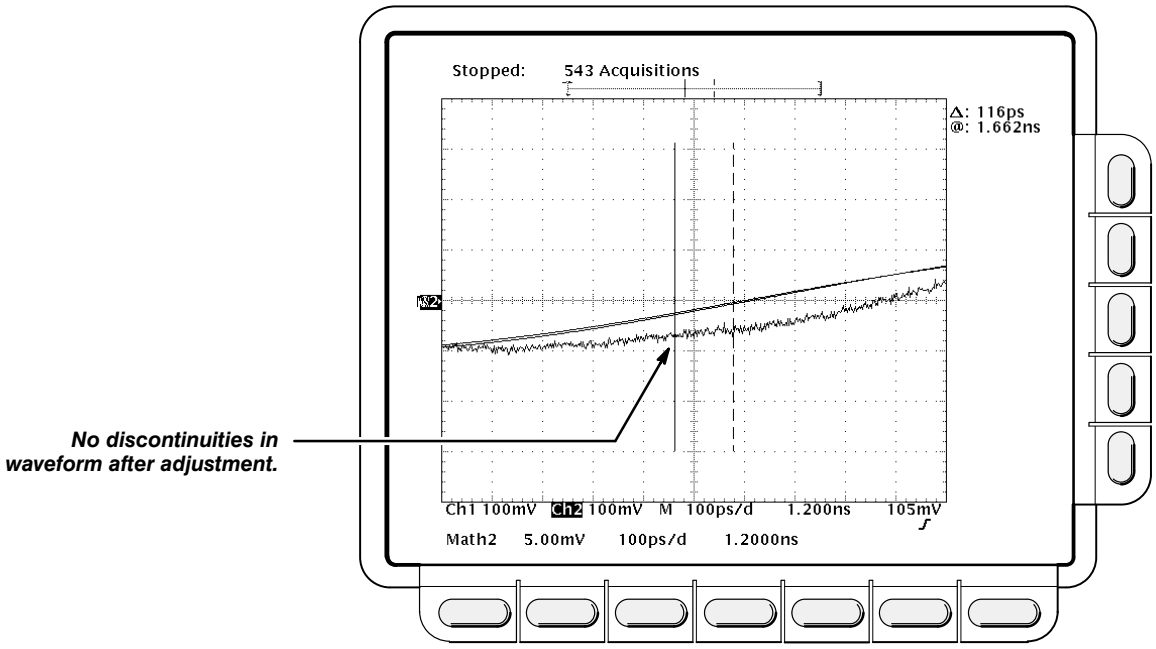


Figure 5-5: Time Interpolator After Adjustment

- Press the main-menu button **Time Base Position**. If your instrument has delay lines (standard instrument) press **14.23**, **SHIFT**, **n**, and then **ENTER** on the keypad. If your instrument does not have delay lines (Option 1D) press **31.730**, **SHIFT**, **n**, and then **ENTER** on the keypad.
- Verify that there are no discontinuities in the waveform at the cursors. If there are discontinuities in the waveform, adjust R321 and R231 to reduce the discontinuities by half.
- Press the main-menu button **Time Base Position**. If your instrument has delay lines (standard instrument) press **4.4**, **SHIFT**, **n**, and then **ENTER** on the keypad. If your instrument does not have delay lines (Option 1D) press **21.9**, **SHIFT**, **n**, and then **ENTER** on the keypad.
- Verify that there are no discontinuities in the waveform at the cursors.
- Press **CH 1**.
- Set the horizontal **SCALE** to 500 ps.
- Press **HORIZONTAL MENU**.
- Press the main-menu button **Manual Deskew**; then press the side-menu button for the channel whose deskew was adjusted because its zero crossing occurred last (see page 5-17).
- Using the general purpose knob, adjust the channel deskew for the minimum Pk-Pk math waveform.
- 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 **Acquisition** is highlighted in the pop up menu.
- Press the main-menu button **Tests**; then press the side menu-button **Store Instrument Deskew**.
- Press the main-menu button **Execute**; then press the side menu-button **OK Confirm Run Test**.
- Press **HORIZONTAL MENU**.
- Press the main-menu button **Manual Deskew**.
- Verify that the Ch 1 and Ch 2 deskew values are 0 and that the CH 1 and CH 2 waveforms are still aligned.

e. 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

f. *Verify adjustment:*

- Disconnect the SMA cables from the oscilloscope inputs.
- Press **SHIFT**; then press **UTILITY**.
- Repeatedly press the main-menu button **System** until **Cal** is highlighted in the pop up menu.
- Press the side-menu button **OK Compensate All**.
- Reconnect the SMA cables to the oscilloscope inputs.
- Press **CLEAR MENU**.
- Set the horizontal **SCALE** to 100 ps.
- Verify that the discontinuities in the waveform are still the same as you set.

16. *When adjustment is completed:*

a. Set the generator output to 0 V.

b. Disconnect the generator, cables, dividers, and BNC to SMA adapter from the oscilloscope input.

c. Reinstall the cabinet and rear cover using the *Rear Cover and Cabinet* removal procedure.

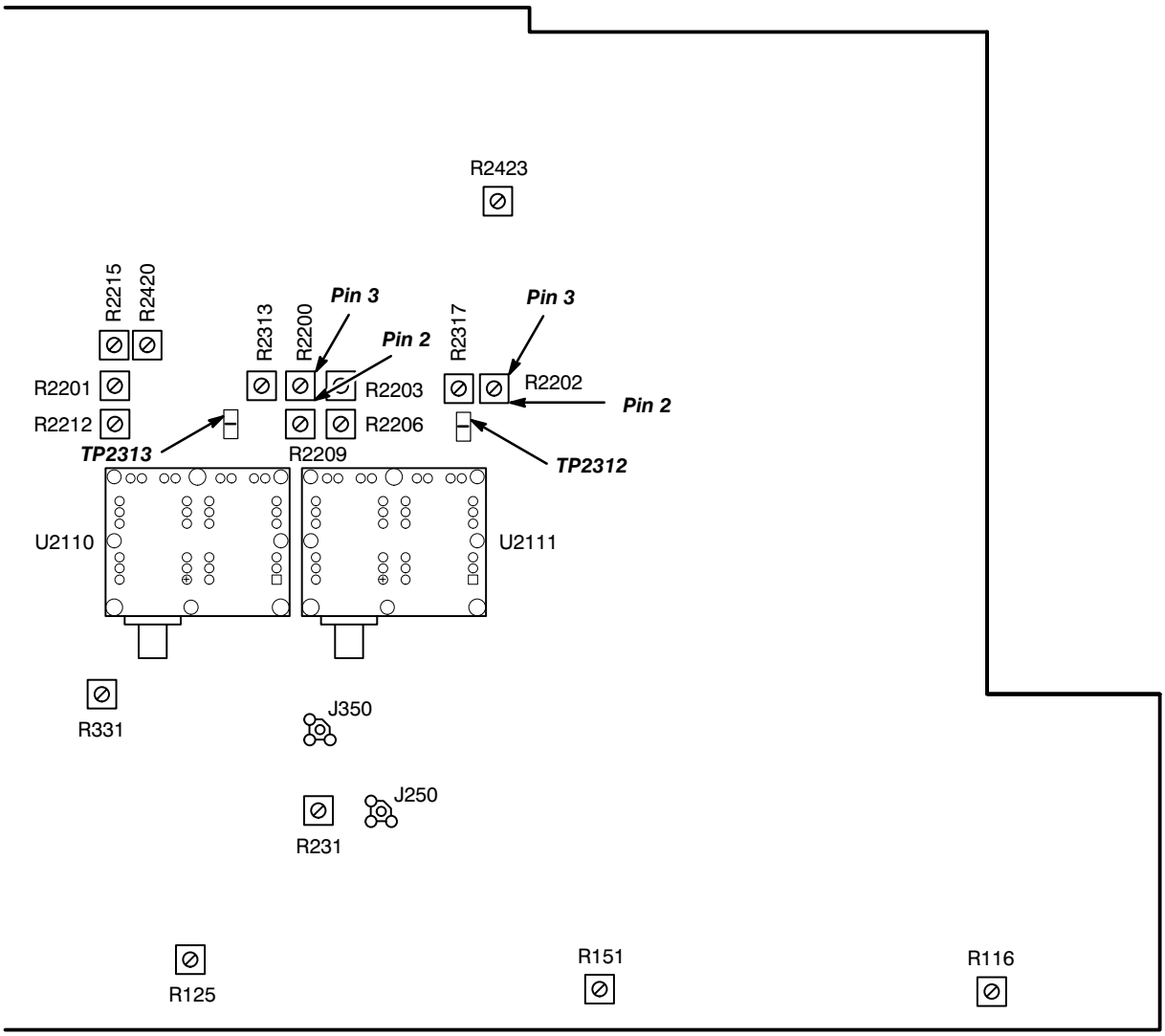


Figure 5-6: Acquisition System Adjustment Locations

Display System Adjustment

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.

The equipment required to do this procedure is listed in Table 5-3.

Equipment Required: One 6X magnifier (Item 15) and one J16 Photometer with a J6503 Luminance Probe (Item 13).

Procedure:

1. *Access the inside of the oscilloscope:* See *Removal and Installation Procedures* in Section 6 to remove the cabinet.
2. *Adjust the display brightness:*
   a. *Display the Composite test pattern:*
      - Leave the oscilloscope 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 oscilloscope.
      - Press **SHIFT** and **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 the side-menu button **Ok Confirm Run Test**.

b. *Make the brightness adjustment:*

- Locate R569 (BRIGHTNESS). It is one of two adjustments on the left side of the oscilloscope located just ahead of the fan. It is the adjustment nearest the fan.
- Observe the luminance patches using a 6X magnifier.
- Adjust R569 (BRIGHTNESS) until the background raster lines in the 5% luminance patch (see Figure 5-7) just disappear, while the lines in the 10% luminance patch are just visible, when both are viewed through the magnifier.

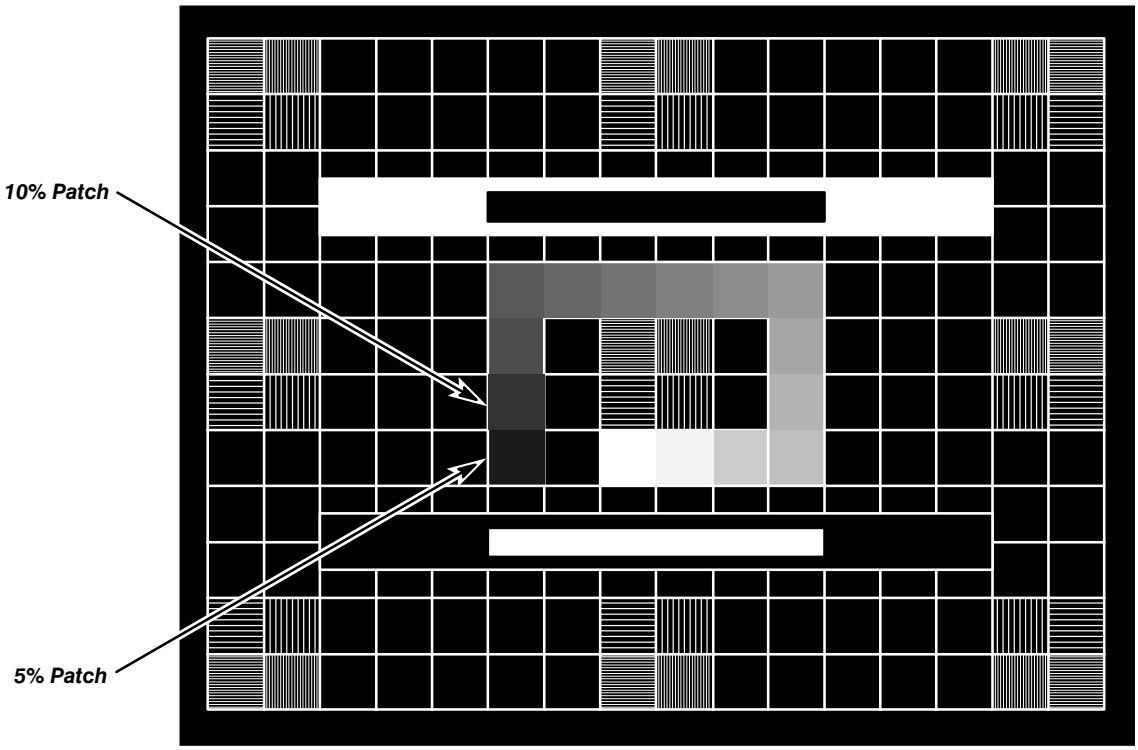


Figure 5-7: Five and Ten Percent Luminance Patches

3. *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 the side-menu button **Ok Confirm Run Test**.

b. *Make the contrast adjustment:*

- Locate R572. It is one of two adjustments on the left side of the oscilloscope located just ahead of the fan. It is the adjustment nearest the front of the oscilloscope.
- Monitor the luminance at center screen using a J16 photometer and a luminance probe.
- Adjust R572 (CONTRAST) for a reading of 50 foot lamberts if the gray display shield is installed; adjust for 110 foot lamberts if shield is missing.

4. *Restore the oscilloscope 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 oscilloscope.

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 TDS 800 Digitizing Oscilloscopes. Specifically, the following subsections are included:

- **Maintenance Information** — Includes this introduction plus general information on preventing damage to internal modules when doing maintenance.
- **Inspection and Cleaning** — Information and procedures for inspecting the oscilloscope and cleaning its external and internal modules.
- **Removal and Installation Procedures** — Procedures for the removal of defective modules and replacement of new or repaired modules. Also included is a procedure for disassembly of the oscilloscope for cleaning.
- **Troubleshooting** — Information for isolating failed modules. Included are instructions for operating the oscilloscope internal diagnostic routines 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.

- Section 2, *Operating Information*, covers instructions useful when operating the oscilloscope in order to troubleshoot it. It also details the service strategy and lists options for obtaining maintenance service and for replacing failed modules.
- Section 3, *Theory of Operation*, contains a circuit description at the module, or block, level.
- Section 4, *Performance Verification*, contains procedures that may be useful in isolating problems to modules by testing oscilloscope performance.
- Section 5, *Adjustment Procedures*, addresses after repair adjustment and the interval between periodic adjustments. It contains a procedure for adjusting the internal circuits of the oscilloscope.
- Section 9, *Diagrams*, contains a block diagram using individual modules as blocks and an interconnection diagram showing connections between the modules.
- Section 10, *Mechanical Parts List,* lists all field replaceable modules by part number.

Preventing ESD

CAUTION

Static discharge can damage any semiconductor component in this oscilloscope.

Precautions

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

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
ECL	2
Schottky signal diodes	3
Schottky TTL	4
High-frequency bipolar transistors	5
JFET	6
Linear microcircuits	7
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 ohms):

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

Inspection and Cleaning

Inspection and Cleaning describes how to inspect for dirt and damage on, and how to clean the exterior and interior of, TDS 800 Digitizing Oscilloscopes. Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, may prevent oscilloscope malfunction and enhance its reliability.

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

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

General Care

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

Inspection and Cleaning Procedures

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

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this oscilloscope. 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 oscilloscope for damage, wear, and missing parts, using Table 6-2 as a guide. Oscilloscopes that appear 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 oscilloscope.

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, bail, 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

CAUTION

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

1. Remove loose dust on the outside of the oscilloscope with a lint free cloth.
2. Remove remaining dirt with a lint free cloth dampened in a general purpose detergent-and-water solution. Do not use abrasive cleaners.
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 oscilloscope for inspection and cleaning, refer to the *Removal and Installation Procedures* in this section.

Inspect the internal portions of the oscilloscope 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 5-1 in Section 5 to see if it is necessary to adjust the oscilloscope.

CAUTION

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

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.	Replace failed module and replace with a fresh module.
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

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

1. Blow off dust with dry, low-volume, deionized air.
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.)
3. If steps 1 and 2 do not remove all of the dust or dirt, the oscilloscope may be spray washed using a solution of 75% isopropyl alcohol by doing steps 4 through 8.
4. Gain access to the parts to be cleaned by removing easily accessible shields and panels (see “Removal and Installation Procedures”).
5. Spray wash dirty parts with the isopropyl alcohol and wait 60 seconds for the majority of the alcohol to evaporate.
6. Use hot (49° C to 60° C) 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 (52° C to 65° C) circulating air.

Lubrication

There is no periodic lubrication required for this oscilloscope.

Removal and Installation Procedures

This subsection 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 oscilloscope components, read Before Servicing and Supplying Operating Power *in Section 2, and* Preventing ESD *in this section.*

This subsection contains the following:

- This preparatory information that you need to properly do the procedures that follow.
- List of equipment required to remove all modules.
- Procedures for removal and reinstallation of the electrical and mechanical modules.
- A disassembly procedure for removal of all the major modules from the oscilloscope at one time and for reassembly of those modules into the oscilloscope. Such a complete disassembly is normally only done when completely cleaning the oscilloscope. (Instructions for doing the actual cleaning are found under *Inspection and Cleaning* at the beginning of this section.)
- Three module locator diagrams for finding all the modules in this oscilloscope.

WARNING

Before doing any procedure in this subsection, 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 THESE GENERAL INSTRUCTIONS 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 oscilloscope.

If you are disassembling this oscilloscope for cleaning, go to the procedure *Disassembly for Cleaning* on page 6-52.

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 the 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 any procedure(s) (if any) that are required to access the module to be serviced, then it directs you to the procedure to remove that module.
- *Procedures for External Modules* on page 6-14 are procedures for removing modules the removal of which do not require internal access to the oscilloscope.
- *Procedures for Outer-Chassis Modules* on page 6-29 are procedures for removing modules the removal of which require access internal to the oscilloscope but external to the chassis.
- *Procedures for Inner-Chassis Modules* on page 6-45 are procedures for removing modules the removal of which require access internal to the oscilloscope and internal to the chassis.
- *Disassembly for Cleaning* on page 6-35 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 oscilloscope for cleaning.

Equipment Required — Most modules in this oscilloscope 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	003−0293−XX
2	T-15 Torx tip	Torx®-driver bit for T-15 size screw heads	003−0966−XX
3	T-20 Torx tip	Torx®-driver bit for T-20 size screw heads	003−0866−XX
4	T-20 Torx tip	Special Tool: Narrow Torx®-driver bit for T-20 size screw heads (Fan removal only)	003−1457−XX
5	Flat-bladed screwdriver	Screwdriver for removing standard-head screws	
6	Screwdriver, Pozidrive #1	Screwdriver for removing sampling heads	
7	Needle-Nose Pliers	Standard tool	
8	Nutdriver, 1/4 inch	Standard tool	
9	Torque Wrench, 5/16 inch open end, 8−1/2 in-lb (0.96 N · m)	Standard tool	
10	Wrench, 5/16 inch, open end	Standard tool	
11	Wrench, 7/16 inch, open end	Standard tool	
12	Wrench, 3/8, open end	Standard tool	
13	Wrench, 1/2, open end	Standard tool	
14	Retaining Ring Pliers	Standard tool; 1−1/8 inch minimum throw	
15	Angle-Tip Tweezers	Standard tool	
16	Pliers	Standard tool	

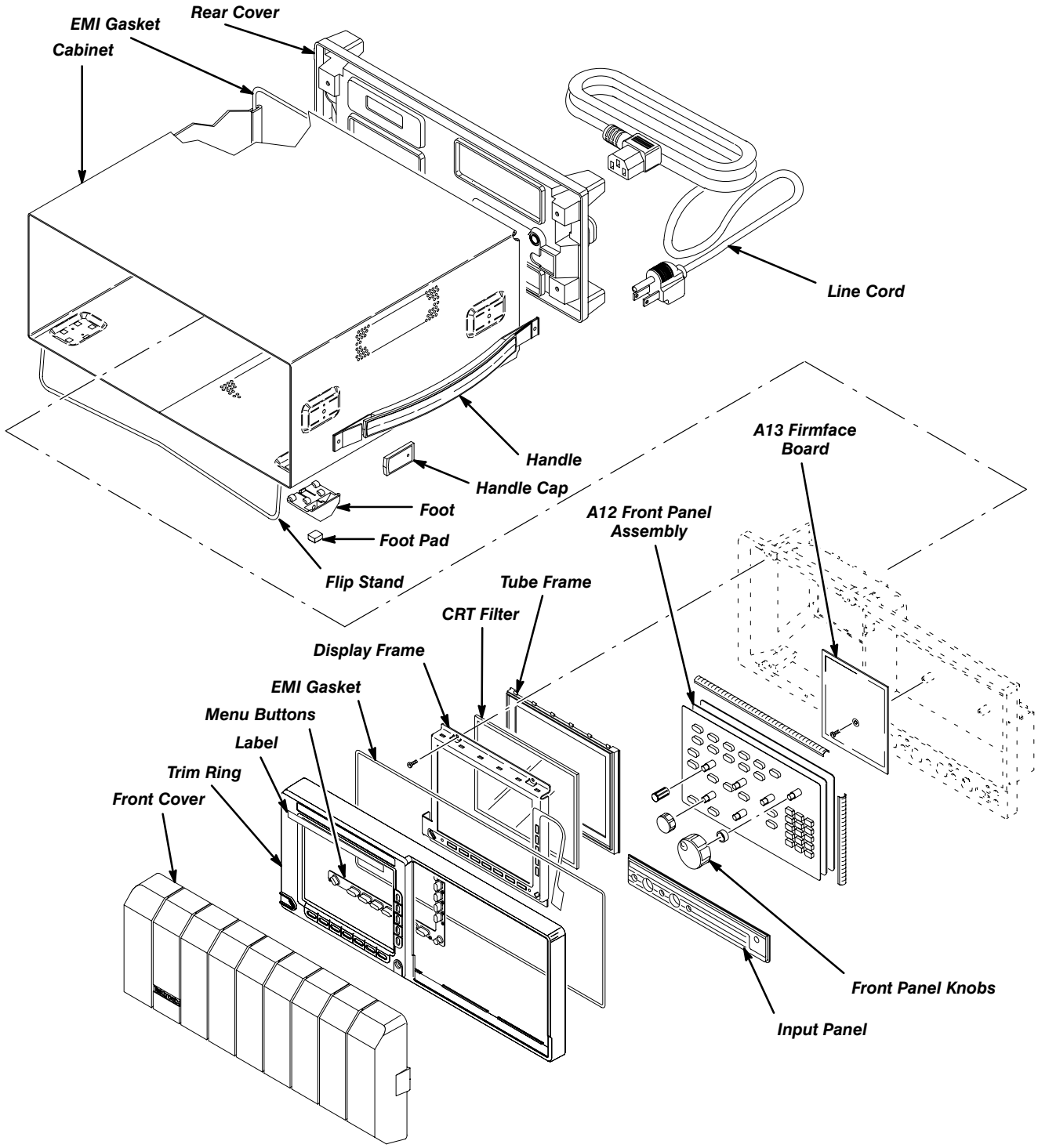


Figure 6-1: External Modules

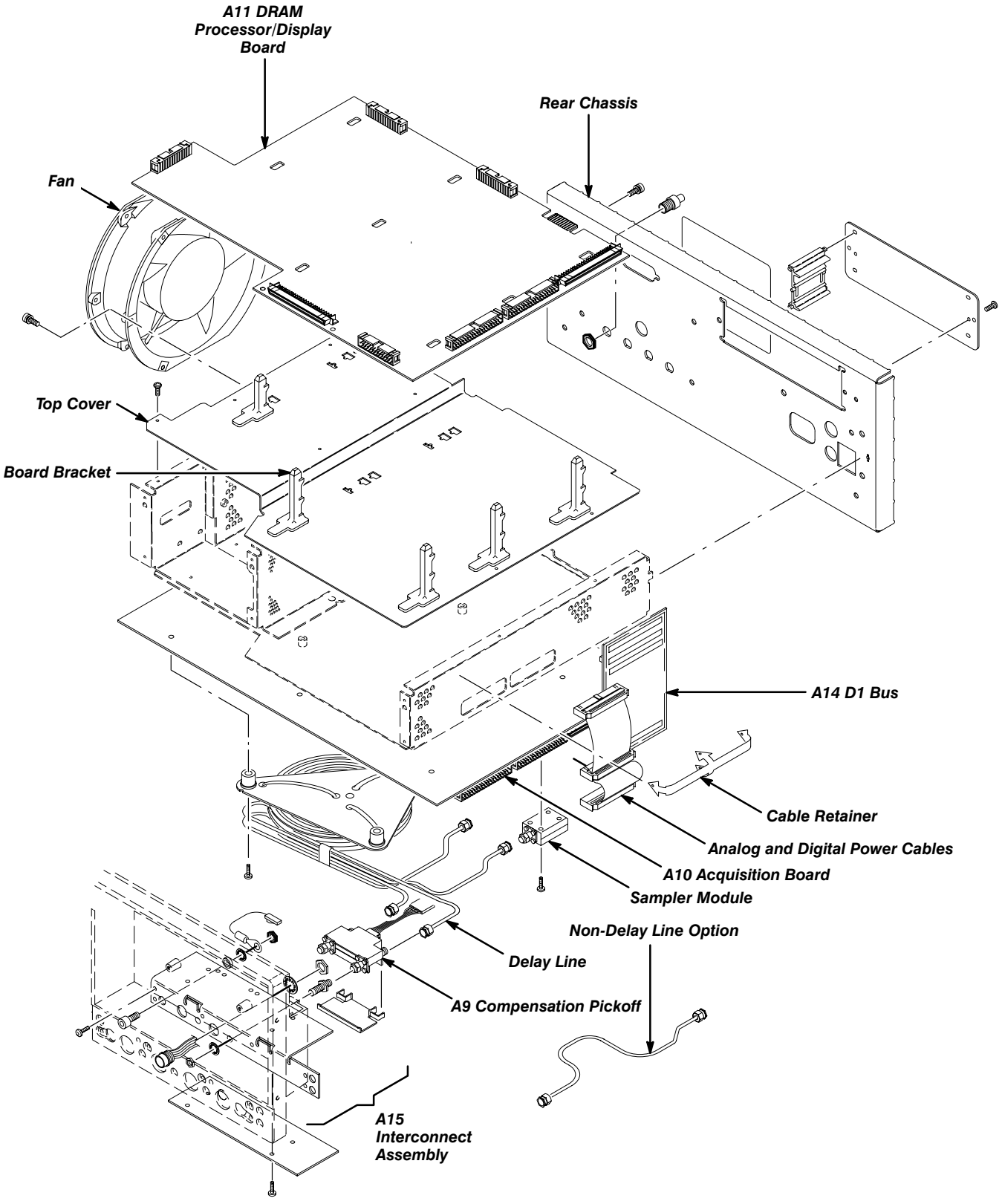


Figure 6-2: Outer-Chassis Modules

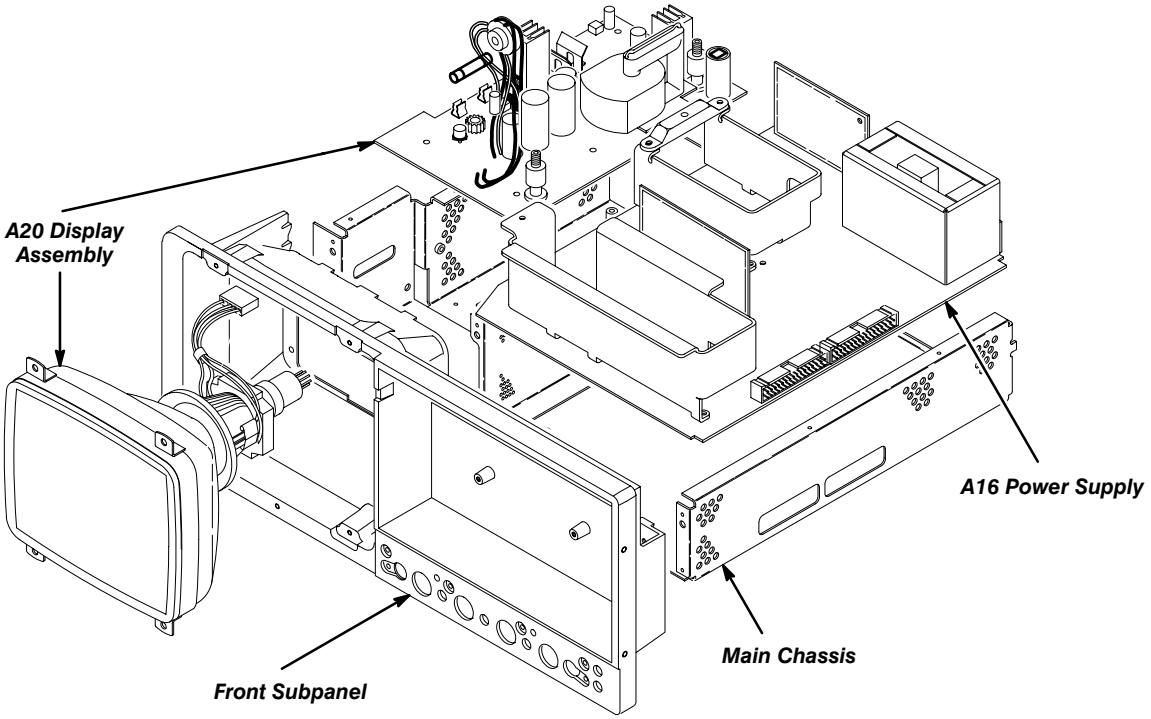


Figure 6-3: Inner-Chassis Modules

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 oscilloscope:*

   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 A15 Interconnect or 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 and A13 Firmface Board* and A15 Interconnect, also found under *Procedures for External Modules.*

   c. Do, in 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 6-45.

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 following procedures are found here and are listed in order presented.

- *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 and A13 Firmface Board*
- *Display Frame*
- *Cabinet Modules*

Front-Panel Knobs

1. *Assemble equipment and locate modules to be removed:* Have handy a angled-tip tweezers (Item 15). Find the knob(s) to be removed on the front panel.
2. *Orient the oscilloscope:* Set the oscilloscope 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 (see Figure 6-4).
4. *Reinstallation:* To reinstall, align knob to shaft and push it in until it snaps.

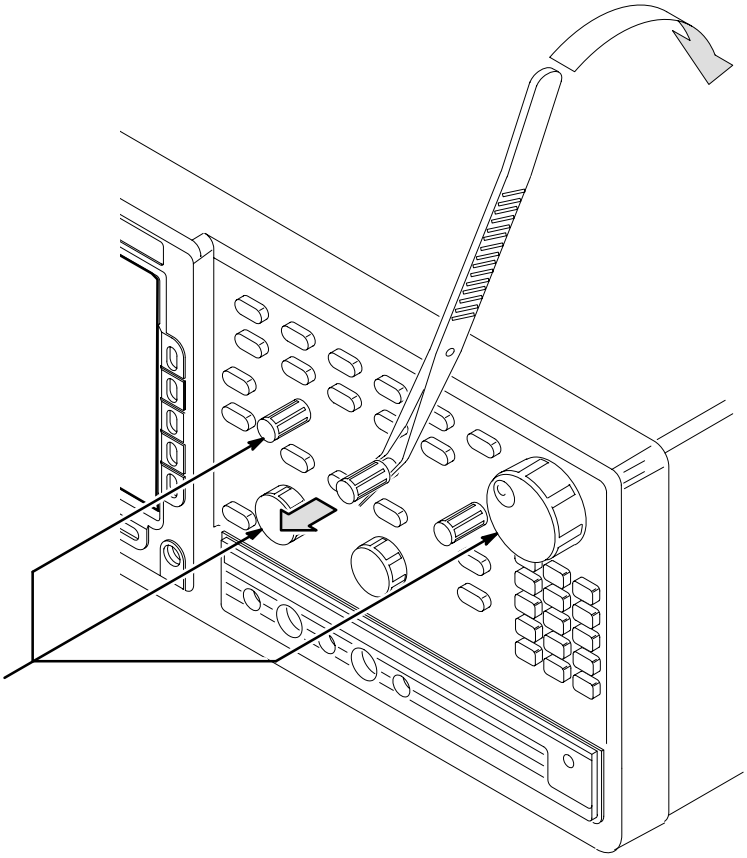


Figure 6-4: Knob Removal

Line Fuse and Line Cord

1. *Assemble equipment and locate modules to be removed:* Have handy a flat-bladed screwdriver (Item 5). Locate the line fuse and line cord in the locator diagram *External Modules*, Figure 6-1.
2. *Orient the oscilloscope:* Set the oscilloscope 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.

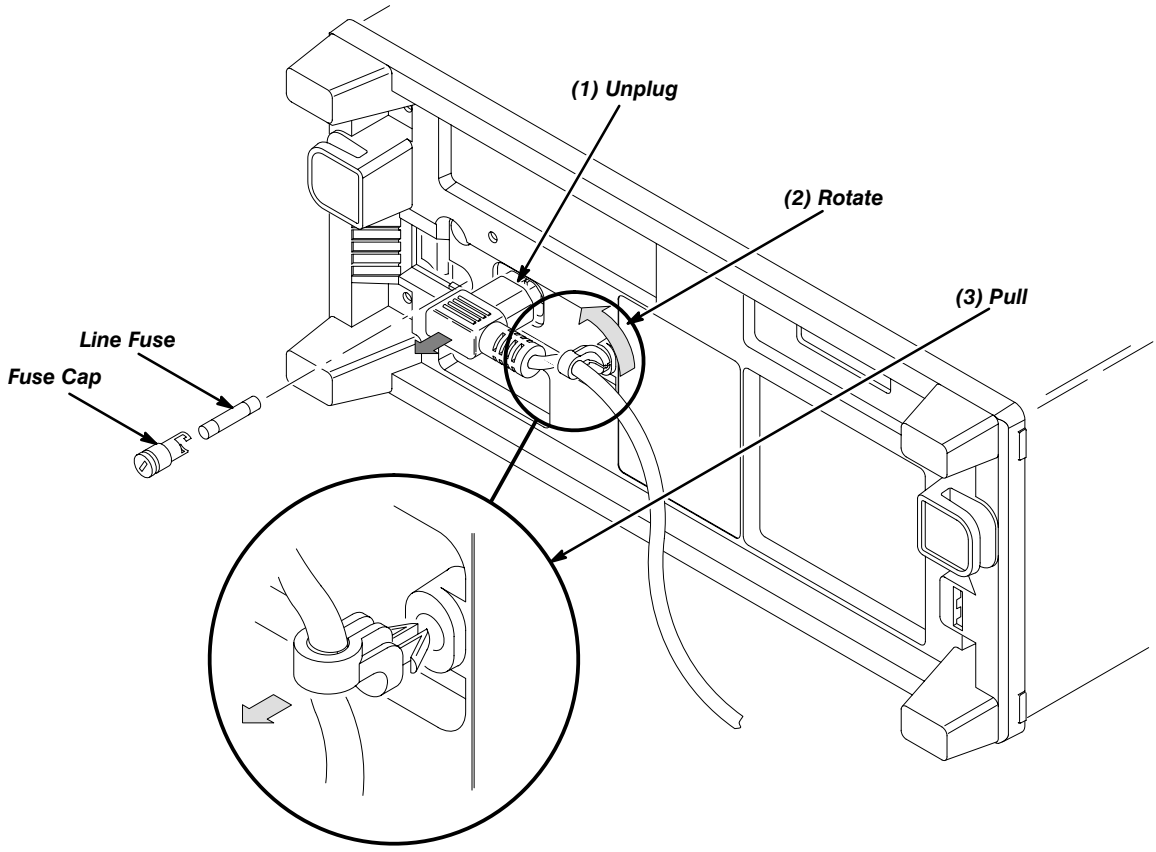


Figure 6-5: Line Fuse and Line Cord Removal

EMI Gaskets

See *Rear Cover and Cabinet* procedure on page 6-18.

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 3).

   b. Make sure the oscilloscope 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 oscilloscope:* Set the oscilloscope 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 oscilloscope. 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 oscilloscope. Take care not to bind or snag the cabinet on the oscilloscope internal cabling as you remove it.

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 oscilloscope cabinet, carefully follow the instructions given. Unless they are performed properly, the oscilloscope 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 7).

   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 the 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 through 5 to reinstall the cabinet.
    b. Take care not to bind or snag the cabinet on internal cabling; re-dress cables an necessary.
    c. When sliding the cabinet, be sure that the front edge of the cabinets 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 oscilloscope reassembly.

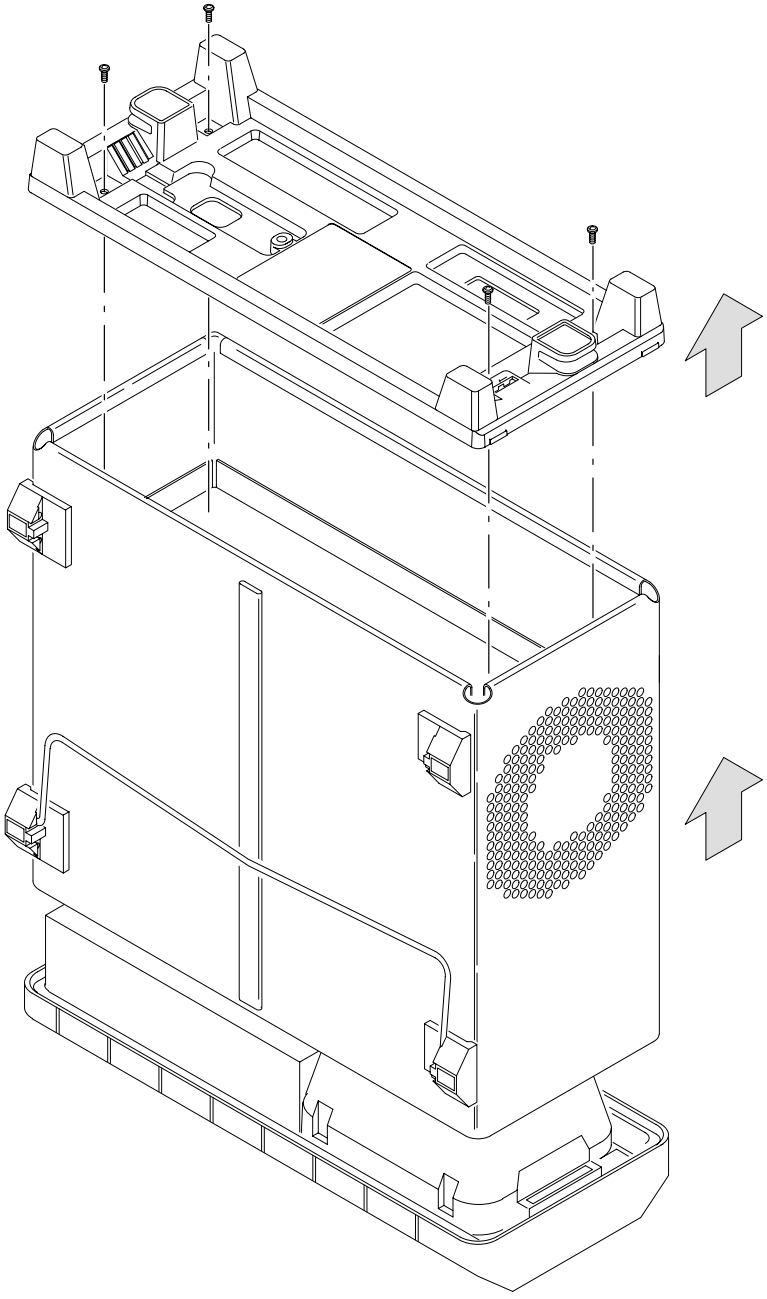


Figure 6-6: Rear Cover and Cabinet Removal

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 oscilloscope:* Set the oscilloscope 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.)

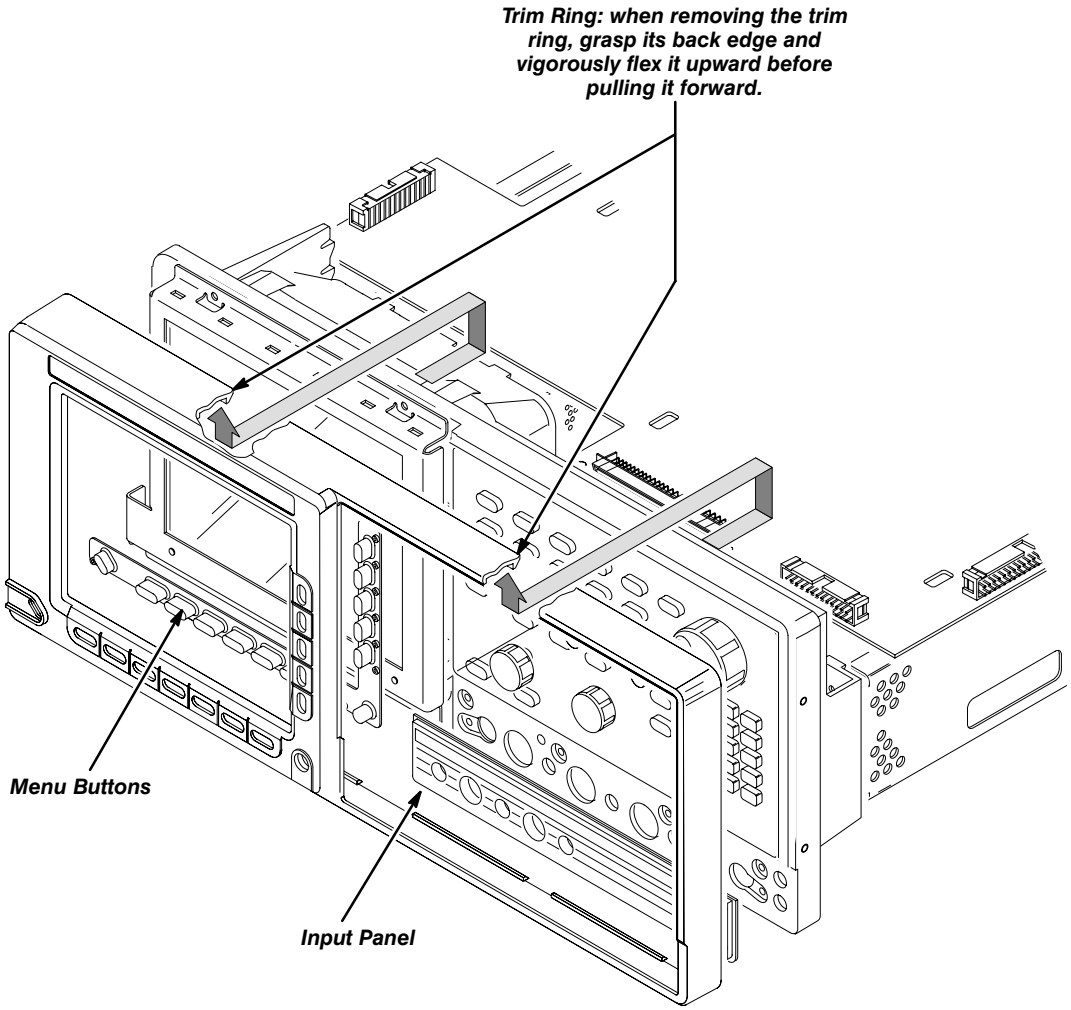


Figure 6-7: Front Cover, Trim Ring, Menu Buttons, and Input Panel Removal (Front Cover not Shown)

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.)
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 A13 Firmface Board

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 4, "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 oscilloscope:* Set the oscilloscope 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.

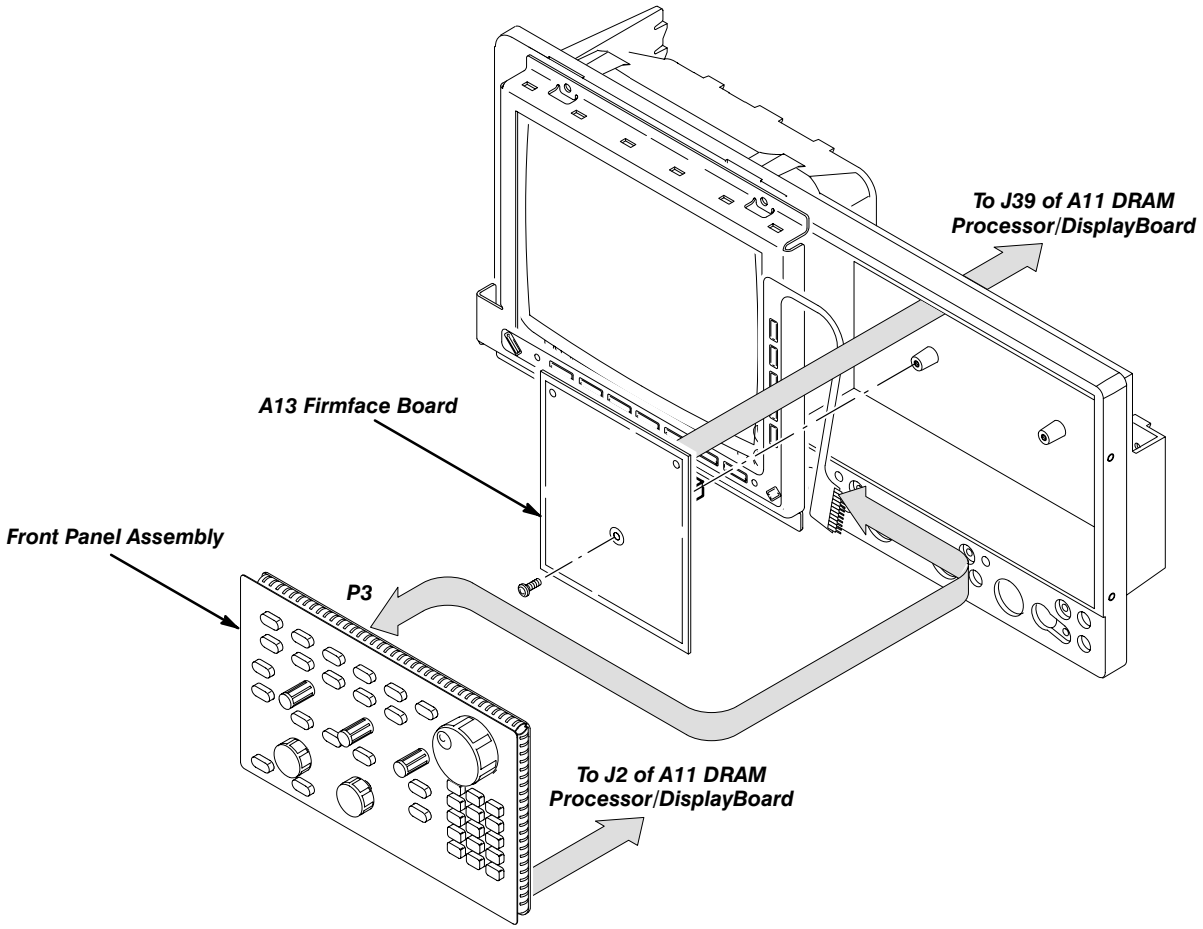


Figure 6-8: A12 Front-Panel Assembly and A13 Firmface Board Removal

4. *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 6-15.

   b. Remove the six 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.

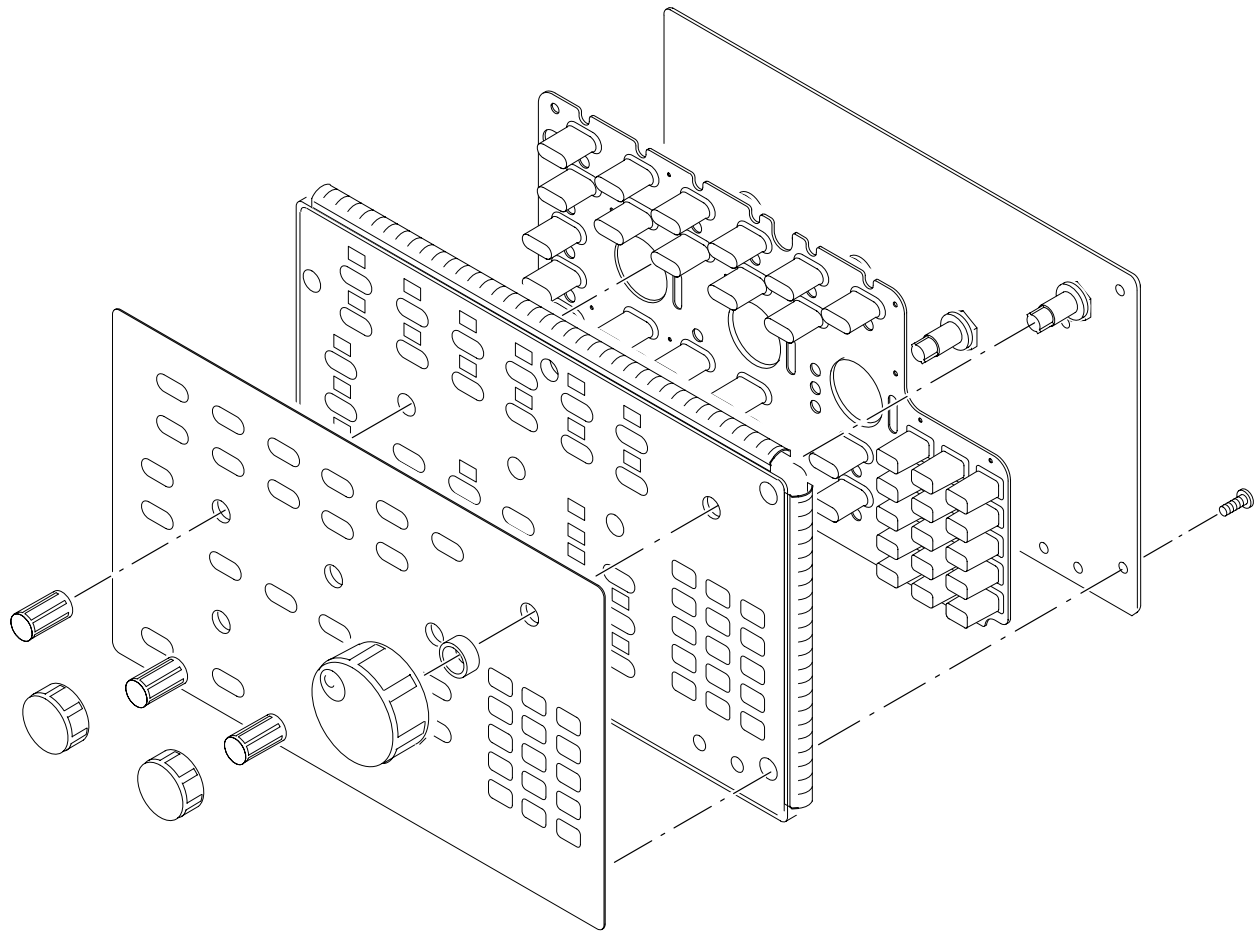


Figure 6-9: Disassembly of Front-Panel Assembly

5. *Remove the firmface board:* Remove the screw that secures the firmface board to the front subpanel. Now, grasp the firmface board and lift it straight out, disconnecting it from the processor/display board at J39, which is connected to J2 of the firmface board. (See Figure 6-8 on page 6-24.)
6. *Reinstallation:* If the front-panel assembly was further disassembled in step 4, then reverse substeps 4a−4c to reassemble, using the figure as a guide. Then do in reverse order steps 3 and 5, reversing the procedure outlined in each step. 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 6-11.
2. *Orient the oscilloscope:* Set the oscilloscope 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 oscilloscope.

Cabinet Modules

1. *Assemble equipment and locate modules to be removed:* Have handy a pair of needle-nose pliers (Item 7). Locate the modules to be removed in the locator diagram *External Modules*.
2. *Orient the oscilloscope:* Set the oscilloscope so 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 on needle-nose pliers (Item 7) into the hole of either handle cap. Push and hold to depress the handle release.
   b. While holding the handle released, pull it out of the slot in the handle cap. Repeat procedure to remove the handle from the other handle cap.
   c. Reverse procedure to reinstall.
4. *Remove the handle caps:*
   a. Insert the retaining ring pliers (Item 14) 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.
6. *Remove the flip stand foot (or feet):*
   a. Do *Rear Cover and Cabinet* (page 6-18) to gain access to 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.
   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* (page 6-18) 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.

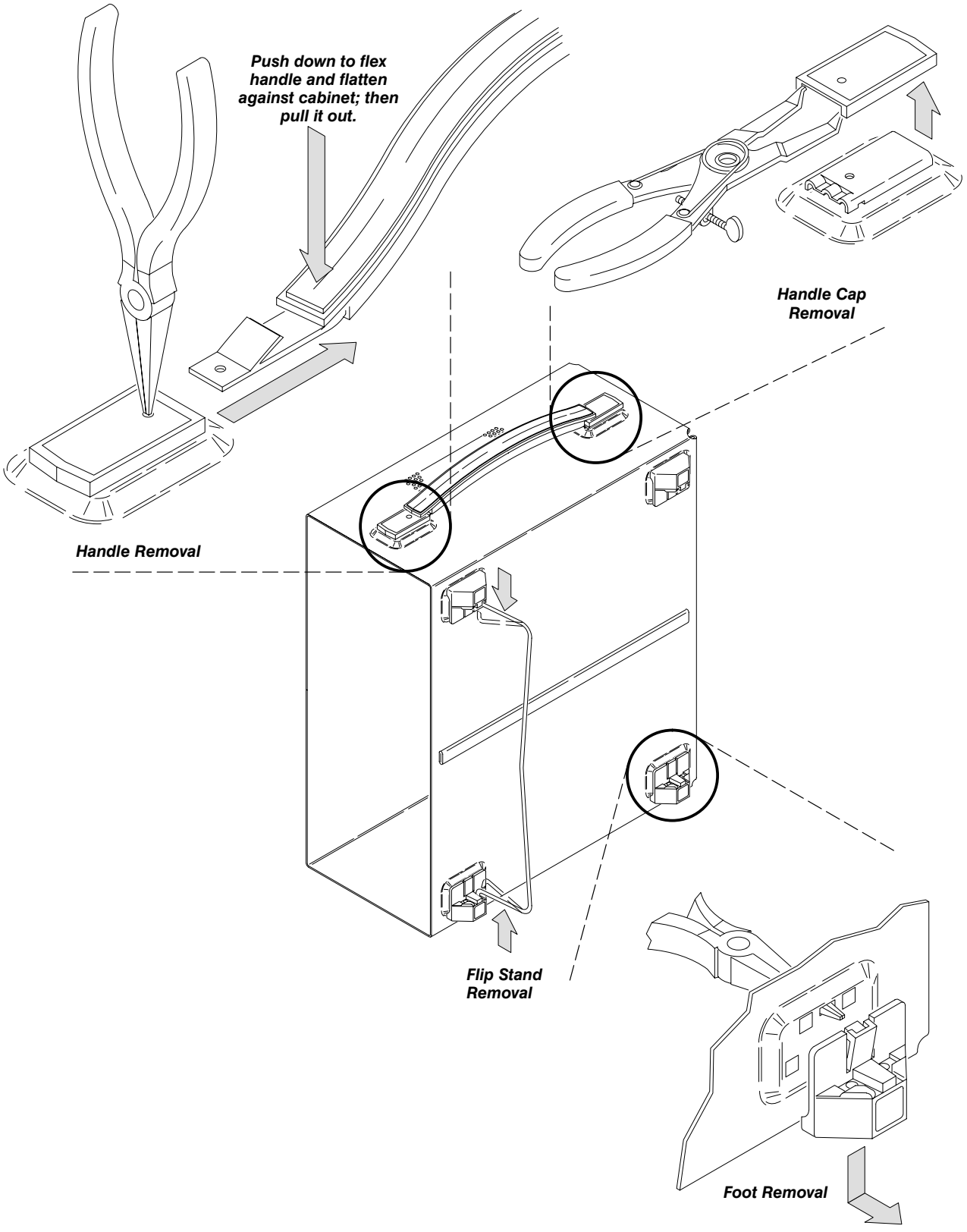


Figure 6-10: Cabinet Modules Removal

Procedures for Outer-Chassis Modules

You should complete the *Access Procedure* before doing any procedure in this section. The procedures found here, listed in order presented, follow.

- *Delay Lines*
- *Sampler Modules*
- *A15 Interconnect*
- *Fan*
- *A14 D1 Bus and Analog-Power and Digital-Power Cables*
- *A11 Processor/Display Board*
- *Top Cover and Board Brackets*
- *Rear-Panel Cables* and *GPIB Cable*
- *A10 Acquisition Board*
- *Rear Chassis*

Delay Lines

The delay lines in the standard instrument are replaced with short lengths of semirigid cable in Option 1D. If you have a standard instrument, skip step 4. If you have Option 1D, skip step 3.

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 5/16 inch open end torque wrench (Item 9).
   b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-12.
2. *Orient the oscilloscope:* Set the oscilloscope so its top is down on the work surface and its front is facing you.
3. *Remove the delay line assembly:* Perform this step only if your oscilloscope has delay lines (standard instrument).
   a. Remove each of the four connectors that connect the delay lines to the sampler assemblies and the trigger pickoff assembly. See Figure 6-15 on page 6-41.
   b. Unplug the delay lines at the sampler assemblies and the trigger pickoff assembly.
   c. Now, remove the three screws that attach the delay lines to the A10 Acquisition assembly.
   d. Lift the delay lines up and away from the A10 Acquisition assembly.

4. *Remove the semirigid cables:* Perform this step only if your oscilloscope does not have delay lines (Option 1D).

   a. Remove each of the four connectors that connect the semirigid cables to the sampler assemblies and the front panel connectors. See Figure 6-15.

   b. Unplug the semirigid cables at the sampler assemblies and the front panel.

   c. Lift the semirigid cables up and away from the oscilloscope assembly.

5. *Reinstallation:* Do in reverse order step 3 (standard instrument) or 4 (Option 1D), reversing the removal instructions in each step to reinstall the assembly. Tighten all SMA connectors to 8.5 inch pounds (0.96 N · m). Then see the *Rear Cover and Cabinet* (page 6-18) procedure to complete reassembly of the oscilloscope.

Sampler Modules

Additional modules Removed: Delay lines.

1. *Assemble equipment and locate modules to be removed:*

   a. Have a screwdriver handy (Item 6).

   b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-12.

2. *Orient the oscilloscope:* Set the oscilloscope so its top is down on the work surface and its front is facing you.

3. *Remove the delay lines:* Remove the delay lines using the *Delay Lines* removal procedure (page 6-29).

4. *Remove the Sampler Modules:*

   a. Remove the two screws that attach the sampler to the A10 Acquisition board. See Figure 6-15 on page 6-41.

   b. Pull the sampler straight up and away from the board to unplug it from the A10 Acquisition board. Reverse the procedure to reinstall. Be careful not to bend any sampler pins.

5. *Reinstallation:* Do in reverse order step 4, reversing the removal instructions to reinstall the assembly. Then see the following procedures, in the order listed, to complete reassembly of the oscilloscope.

   - *Delay Lines* (page 6-29)
   - *Rear Cover and Cabinet* (page 6-18)

A15 Interconnect and A9 Compensation Pickoff

Additional modules Removed: Delay lines.

1. *Assemble equipment and locate modules to be removed:*

   a. Have available a screwdriver with a size T-15 Torx® tip (Items 1 and 2) and a 5/16 inch open end torque wrench (Item 9).

   b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-12.

2. *Orient the oscilloscope:* Set the oscilloscope so its top is down on the work surface and its front is facing you.

3. *Remove the delay lines:* Remove the delay lines using the *Delay Lines* removal procedure (page 6-29).

4. *Remove the A15 Interconnect Assembly:*

   a. Unplug each of the four interconnect cables (J2221, J2223, J720, and J730) that connect the A15 Interconnect assembly to the Acquisition board from its jack on the Acquisition board. See Figure 6-11, page 6-33.

   b. Unplug each of the two interconnect cables (J150 and J160) that connect the A15 Interconnect assembly to the Acquisition board from its jack on the A15 Interconnect board. See Figure 6-11.

   c. Remove the SMA connector that connects the front panel **EXT TRIGGER INPUT** to the Acquisition board from its front panel connector.

   d. Unplug the cable that connects the A9 Compensation Pickoff assembly to the Acquisition board from the A9 Compensation Pickoff. See Figure 6-11.

   e. Now, remove the six screws which you exposed on the front subpanel when you performed the *Access Procedure*. See Figure 6-11.

   f. Complete the removal by lifting the A15 Interconnect 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.

5. *Remove the A9 Compensation Pickoff Assembly:*

   a. Unplug the interconnect cable (J100) that connects the A15 Interconnect assembly to the A9 Compensation Pickoff assembly from its jack on the A15 Interconnect board. See Figure 6-11, page 6-33.

   b. Unplug each of the two interconnect cables (J101 and J102) that connect the A15 Interconnect assembly to the **PROBE POWER** connectors from its jack on the A15 Interconnect board. See Figure 6-11.

c. Unplug the interconnect cable (J105) that connects the antistatic connector to the A15 Interconnect assembly from its jack on the A15 Interconnect board. See Figure 6-11.

d. Now remove the four screws from the A15 Interconnect assembly.

e. Remove the A15 Interconnect board by sliding it back and out of the assembly.

f. Remove the two SMA connectors that connect the A9 Compensation Pickoff module to the front panel connectors on the A15 Interconnect assembly.

g. Complete the removal by lifting the A9 Compensation Pickoff out of the assembly.

6. *Further disassembly:* Only perform this step if you need to replace one of the connectors on the bracket of the A15 Interconnect assembly. Only perform the substep for the connector that you need to remove.

   a. *Remove the SMA connectors:* Remove the 5/16 inch nut and washer from the front of each connector. Loosen the connector using a 3/8 inch wrench at the back of the connector. Remove the connector by pulling it out the back of the bracket.

   b. *Remove the ground connector:* Remove the nut and lockwasher. Remove the ground cable and insulator by pulling them toward the back of the assembly. Remove the rest of the connector by pulling it toward the front of the assembly.

   c. *Remove the probe power connectors:* Remove the cable clamps by pushing them up from the bottom of the bracket. Remove the nut from the connector. Push the nut and lockwasher as far back on the cable as possible. Remove the cable and its cable by carefully working the the cable through the slot in the bracket.

7. *Reinstallation:* Do in reverse order steps 4 through 6, reversing the removal instructions in each substep to reinstall the assembly. Tighten all SMA connectors to 8.5 inch pounds (0.96 N · m). Then see the following procedures, in the order listed, to complete reassembly of the oscilloscope.

   - *Delay Lines* (page 6-29)
   - *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6-15)
   - *Rear Cover and Cabinet* (page 6-18)

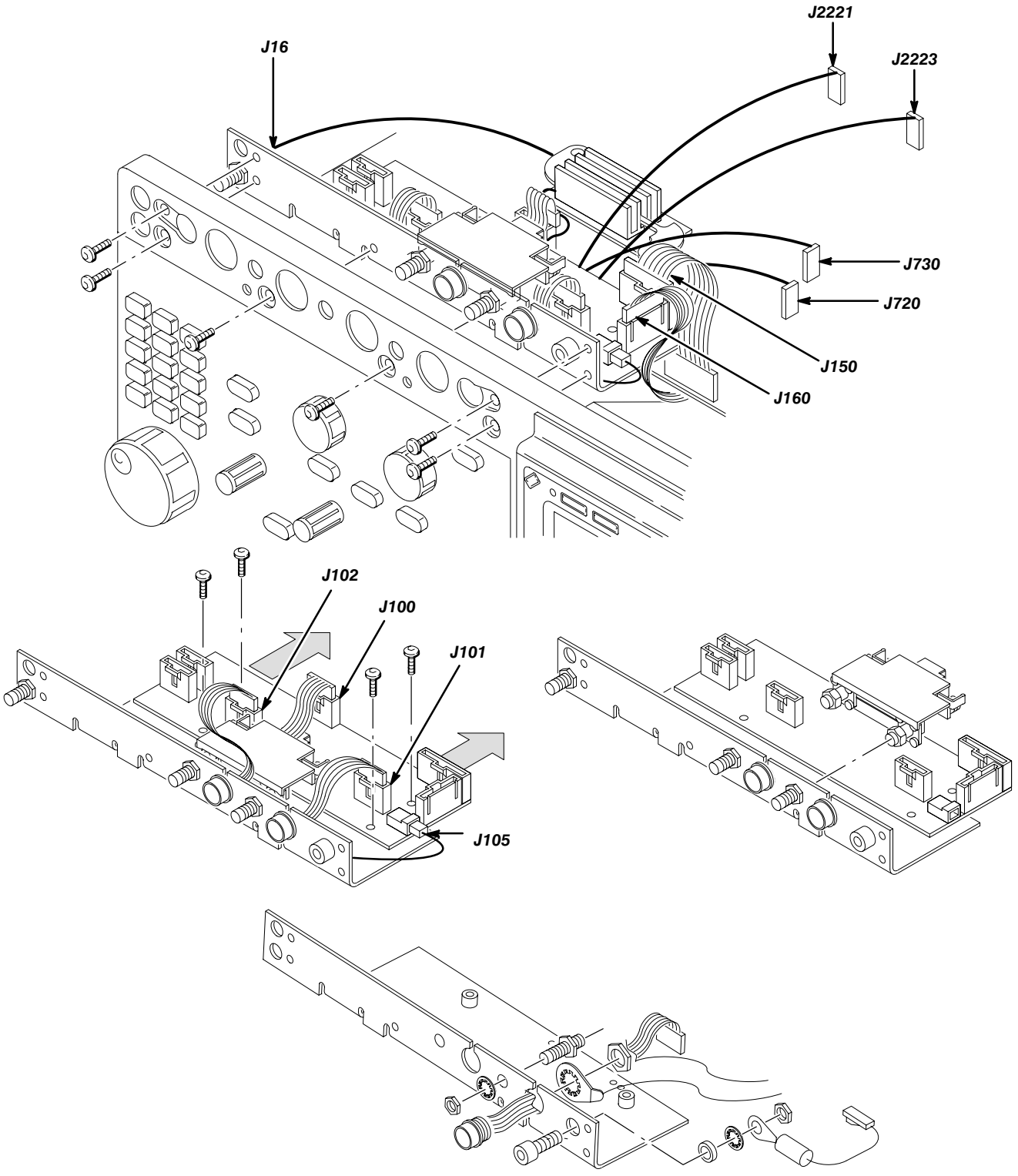


Figure 6-11: A9 Compensation Box and A15 Interconnect Removal

Fan

1. *Assemble equipment and locate module to be removed:* Have handy a screwdriver with a size T-20 Torx® tip (Items 1 and 3). Locate the fan in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-12.
2. *Orient the oscilloscope:* Set the oscilloscope 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 substeps 3 and 4, reversing the removal instructions in each substep to reinstall the assembly. See the procedure *Rear Cover and Cabinet* (page 6-18) to complete reassembly of the oscilloscope.

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

1. *Assemble equipment and locate modules to be removed:* Have a screwdriver handy 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, page 6-12.
2. *Orient the oscilloscope:* Set the oscilloscope 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 oscilloscope to unplug it from its two plug-in connectors. (J28 is the connector on the processor/display board; J1100 is on the acquisition board.) Reverse these removal instructions to reinstall.
4. *Remove the analog-power and digital-power interconnect cables:*
   a. Remove the cable retainer from the power supply shield.
   b. Unplug the analog-power cable at J26 on the display processor board, at J5 on the low-voltage power supply, and at J102 on the acquisition board.
   c. 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.

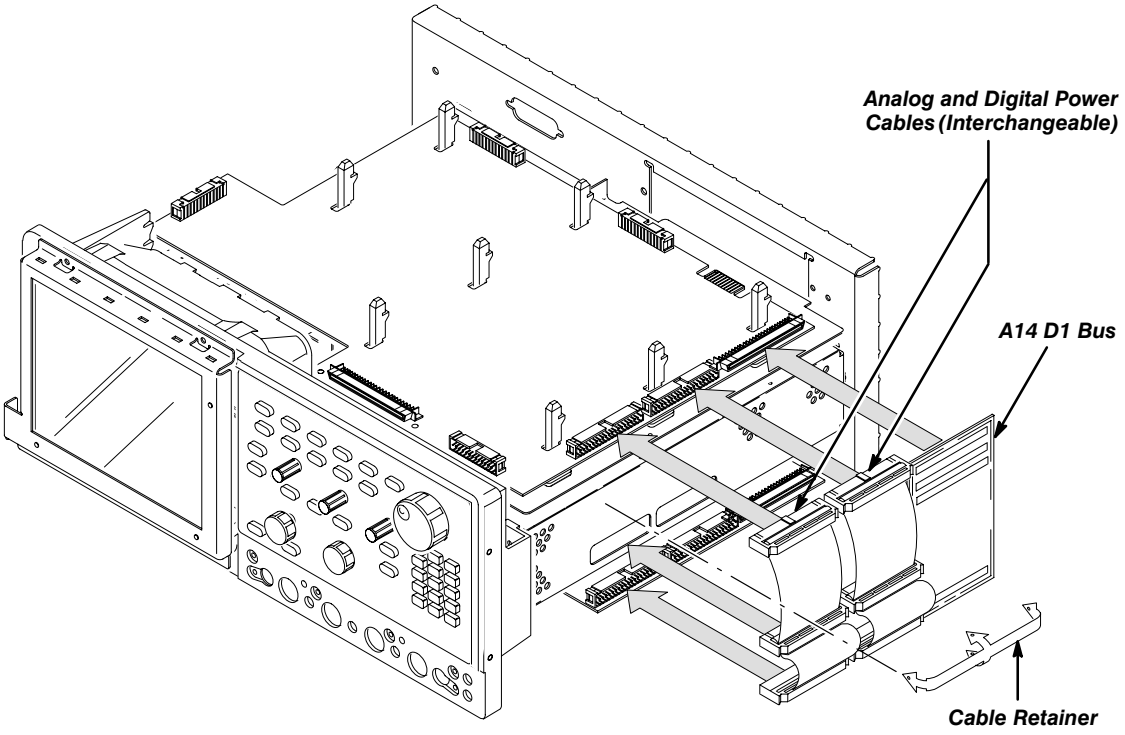


Figure 6-12: A14 D1 Bus and Analog-Power and Digital-Power Cables Removal

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 oscilloscope.

   - *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6-21)
   - *Rear Cover and Cabinet* (page 6-18)

A11 Processor/Display Board

Additional modules Removed: D1 bus and analog-and digital-power cables.

1. *Assemble equipment and locate modules to be removed*

   a. Have handy a screwdriver with a size T-20 Torx® tip (Items 1 and 2).

   b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-12.

   c. Do the procedure *A14 D1 Bus and Analog-Power and Digital-Power Cables* that immediately precedes this procedure to remove those interconnect cables.

2. *Orient the oscilloscope:* Set the oscilloscope 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 6-13 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 for the GPIB connector on the rear cover at J35 of the processor/display board. Disconnect the bus cable at J5. Disconnect the bus cable at J2.

   c. Grasp the board by its right and left sides and pull it towards the rear of the oscilloscope. This will disconnect the processor/display board from its connection to the firmface board at J39 and, at the same time, release it from the eight board mounts securing the board above the top cover.

   d. Lift the board up away from the oscilloscope chassis to complete the removal.

5. *Reinstallation:*

   a. Do, in reverse order, steps 3 through 5 reversing the removal instructions of each step to reinstall the processor/display board. (Be sure to simultaneously align the firmface board for connection at J39 when remounting the board to the eight board mounts in sub-step 4c.)

   b. See the procedures *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-34) and *Rear Cover and Cabinet* (page 6-18) to complete reassembly of the oscilloscope.

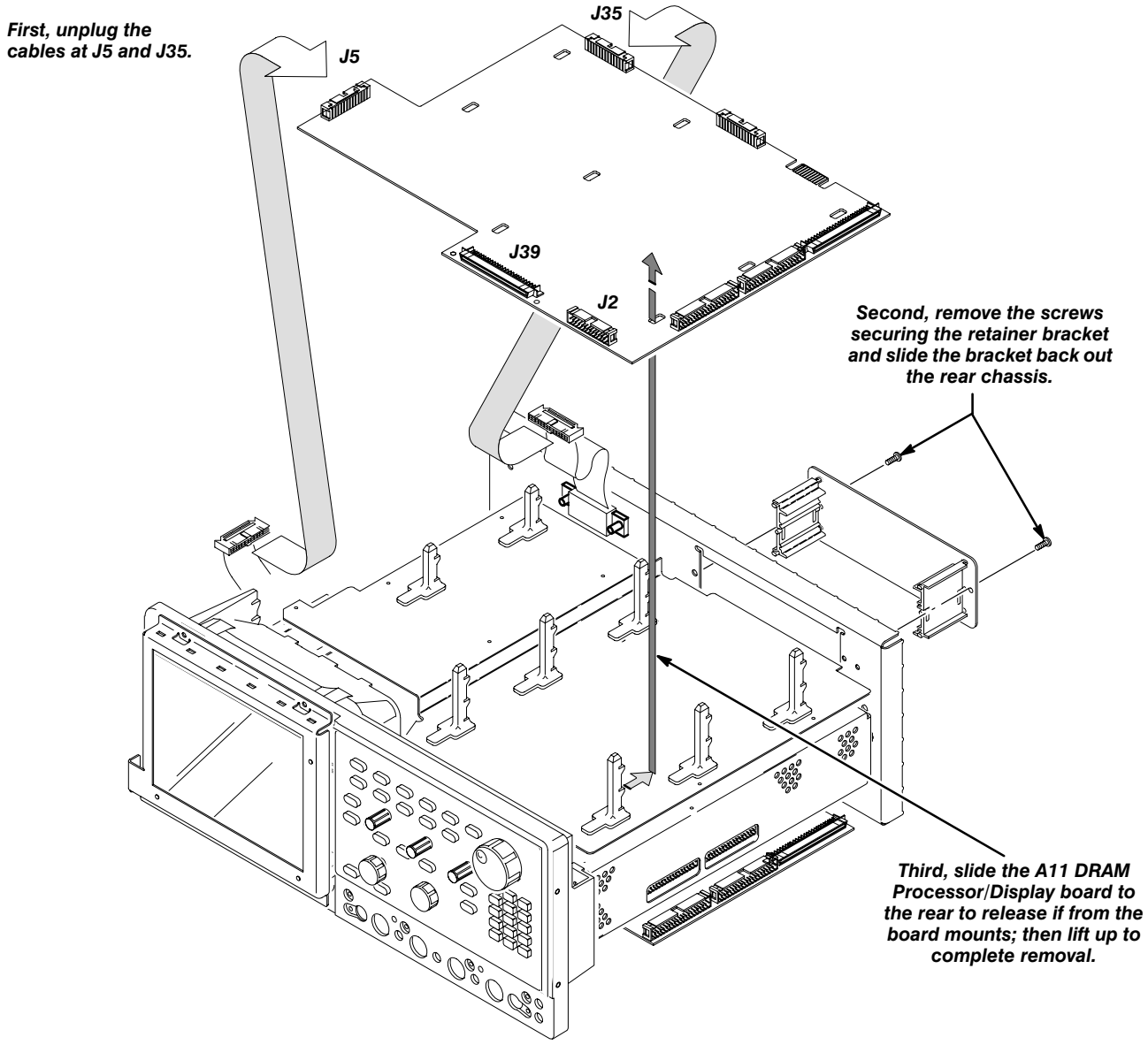


Figure 6-13: A11 Processor/Display Removal

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 bracket*, a needle-nose pliers (Item 7).

   b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-12.

c. Do the procedures *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-34) and *A11 Processor/Display Board* (page 6-36) to remove those modules.

2. *Orient the oscilloscope:* Set the oscilloscope so its bottom is down on the work surface and its front is facing you.

3. *Remove the top cover:* Remove the 13 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 needle-nose pliers to pry up the retainer lug until it clears the slot in the top cover. While holding the lug clear of the slot, push the mount towards the rear until it releases. (When reinstalling, be sure to align the lug properly and be sure it snaps into its slot.)

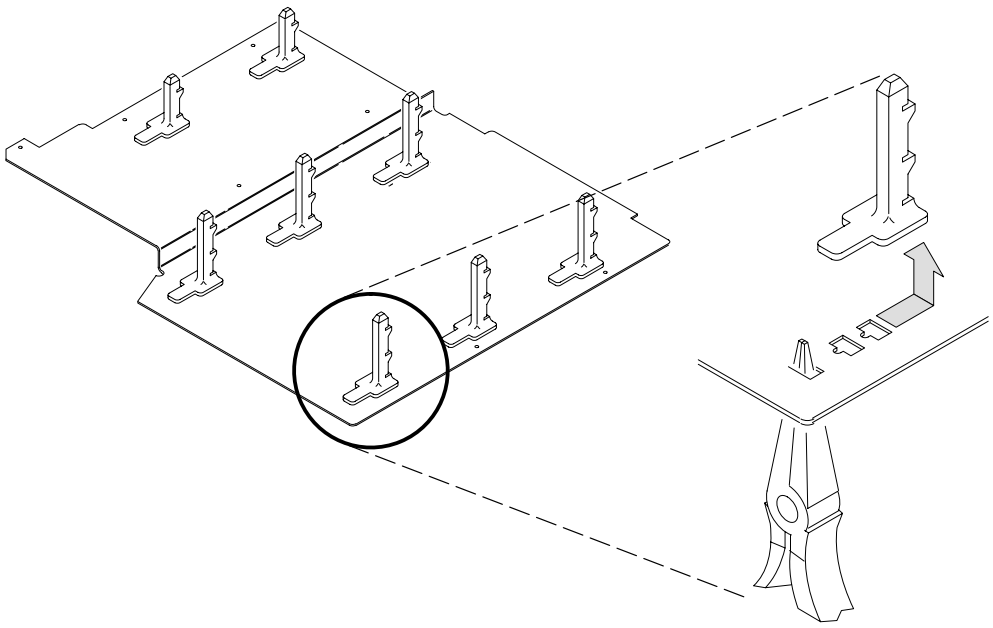


Figure 6-14: Board Bracket Removal

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 oscilloscope.

      - *A11 Processor/Display Board* (page 6-36)
      - *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-34)

- *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6-21)
- *Rear Cover and Cabinet* (page 6-18)

Rear-Panel Cables and GPIB Cable

1. *Assemble equipment and locate modules to be removed:* Have available a pair of needle nose pliers (Item 7), a 1/4 inch nut driver (Item 8), and a 7/16 inch open end wrench (Item 11).
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 oscilloscope, lift the cable connector out of the rear chassis.
3. *If removing any cable connected to the rear panel SMA connectors, do the following:*
   a. Do the procedure *A10 Acquisition Board,* on page 6-39.
   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. For the **INTERNAL CLOCK OUTPUT** cable, remove the tape from the cable on the main chassis.
   d. Note the cable color code for later reinstallation; then lift it away from the oscilloscope to remove it.
   e. *If removing any rear panel SMA connectors, do the following:*
      - Remove the nut and lockwasher from the rear of the connector
      - Pull the connector out the back of the chassis.
4. *Reinstallation:* Reverse substeps in step 2 and 3 to reinstall any cables removed. See *A10 Acquisition Board* to reinstall the acquisition board if it was removed.

A10 Acquisition Board

Additional modules Removed: D1 bus, analog-and digital-power cables, the delay lines, and the sampler modules.

1. *Assemble equipment and locate modules to be removed:*
   a. Have a screwdriver handy 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 6-12.

c. Do the procedure *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-34) to remove the D1 bus and the interconnect cables.

2. *Orient the oscilloscope:* Set the oscilloscope so its top is down on the work surface and its front is facing you.

3. *Remove the delay lines:* Remove the delay lines using the *Delay Lines* removal procedure (page 6-29).

4. *Remove the sampler modules:* Remove the sampler modules using the *Sampler Modules* removal procedure (page 6-30).

5. *Remove the Acquisition Board:* Use figures 6-15 and 6-16 as a guide.

   a. Unplug each of the four interconnect cables (J720, J730, J2221, and J2223) that connect the A15 Interconnect to the A10 Acquisition board from its jack on the A10 Acquisition board.

   b. Unplug each of the two interconnect cables that connect to U120 on the A10 Acquisition board from its jack (J1 and J2) on the A10 Acquisition board.

   c. Unplug each of the two interconnect cables (J1150 and J1060) that connect the A15 Interconnect to the A10 Acquisition board from its jack on the A10 Acquisition board.

   d. Unplug the interconnect cable that connects to the **1 MHz TEST SIGNAL OUTPUT** from its jack (J1151) on the A10 Acquisition board.

   e. Unplug the interconnect cable that connects to the **INTERNAL CLOCK OUTPUT** from its jack (J850) on the A10 Acquisition board.

NOTE

Note the color code of the cables for later reinstallation. The cable color matches the center digit of the connector number.

   f. Unplug each of the four interconnect cables (J830, J831, J840, and J841) from its jack on the A10 Acquisition board.

   g. Remove the five remaining screws that mount the acquisition board to the main chassis. Lift the board up and away from the main chassis to complete removal.

6. *Additional cable removal:* Only perform these steps if you need to remove the cables.

   a. *Remove the ribbon cable connected to the A15 Interconnect assembly:*

      - Note the dress of the cable on the chassis.
      - Remove the tape securing the cable to the chassis.

- Unplug the cable from its jack (J160) on the A15 Interconnect assembly.
- Lift the cable from the oscilloscope.

b. *Remove the flexible delay lines:*

- Note the dress of the cables on the chassis.
- Remove the tape securing the cables to the chassis.
- Lift the delay lines from the oscilloscope.

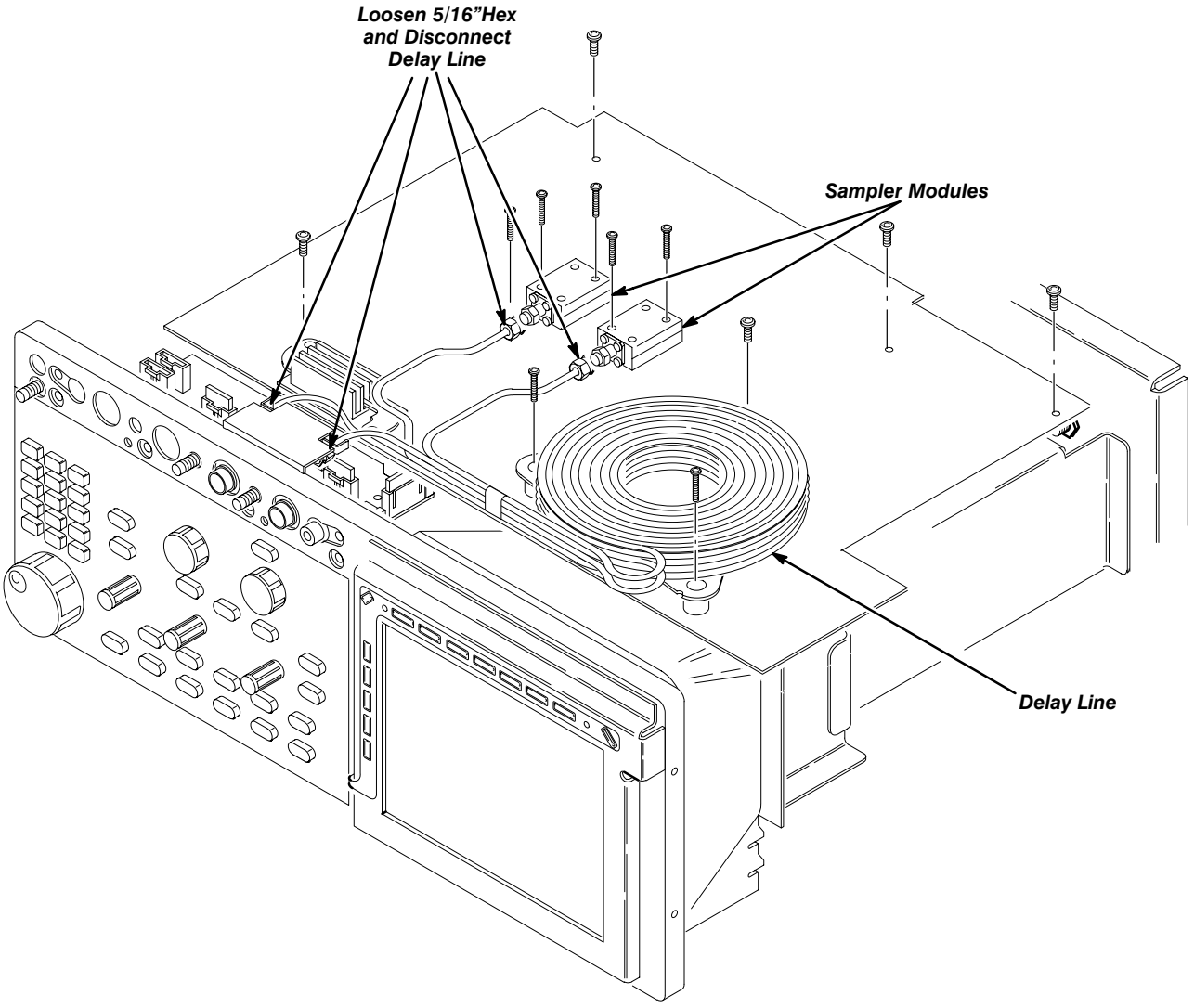


Figure 6-15: Delay Lines, Sampler Modules, and A10 Acquisition Board Removal

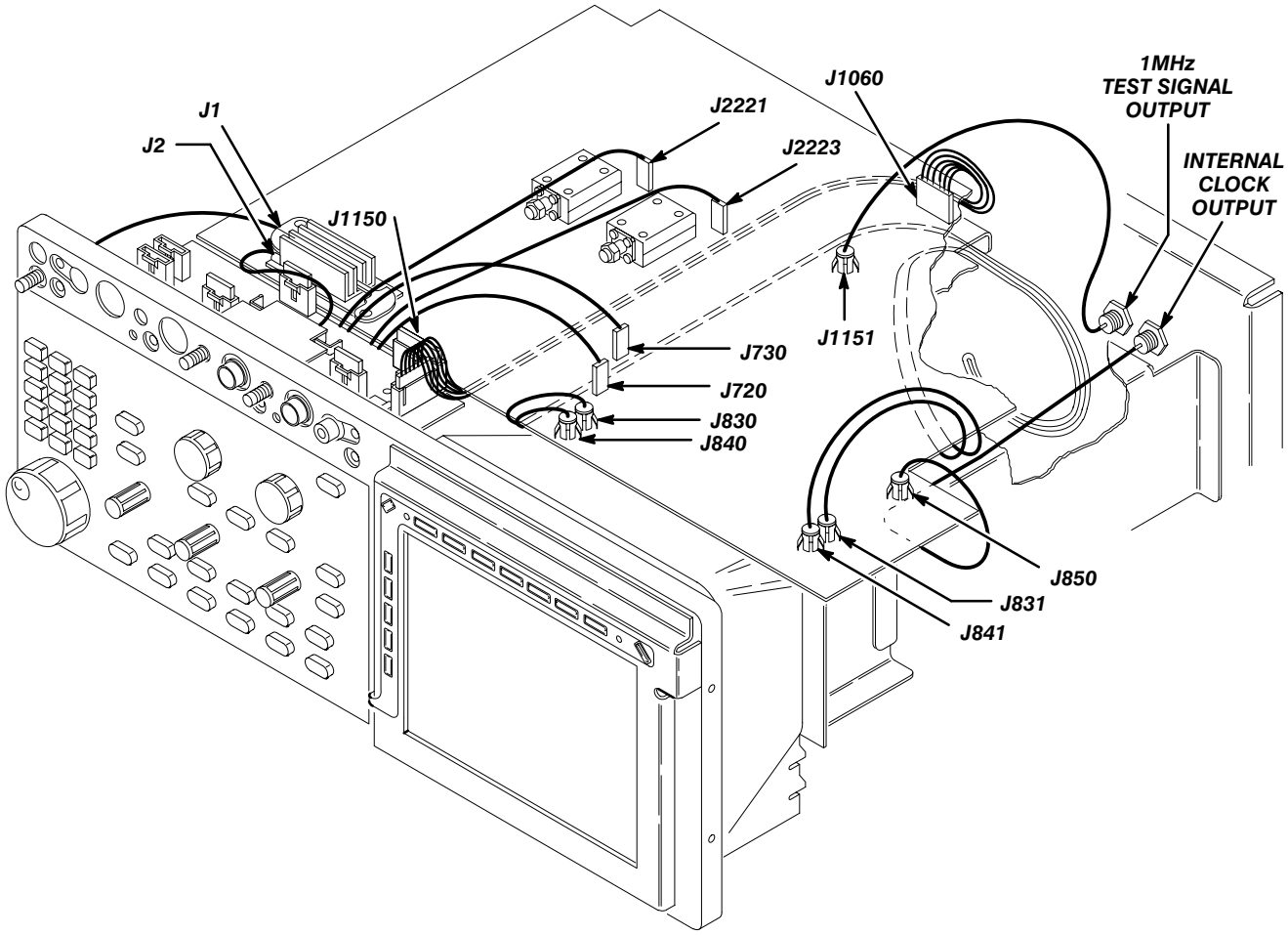


Figure 6-16: A10 Acquisition Board Removal

7. *Reinstallation:* Do, in reverse order, steps 5 and 6 reversing each step to reinstall the *acquisition board*. Then see the following procedures, in the order listed, to complete reassembly of the oscilloscope:

   - *Sampler Modules* (page 6-30).
   - *Delay Lines* (page 6-29).
   - *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-34).
   - *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6-21).
   - *Rear Cover and Cabinet* (page 6-18).

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 (Items 1 and 2).

   b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-12.

   c. Install the front cover if it's not already installed.

2. *Orient the oscilloscope:* Set the oscilloscope so its bottom is down on the work surface and its rear is facing you.

3. *Remove the rear chassis:* Use Figure 6-17 as a guide when doing the following substeps:

   a. Unplug the GPIB interconnect cable at J35 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 the cables from the **1 MHz TEST SIGNAL OUTPUT** and the **INTERNAL CLOCK OUTPUT** (J16 and J17) on the rear chassis.

4. *Reinstallation:* Do, in reverse order, substeps 3a−3b, reversing each step to reinstall the rear chassis. Then see the following procedures, in the order listed, to complete reassembly of the oscilloscope.

   - *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-34)
   - *Rear Cover and Cabinet* (page 6-18)

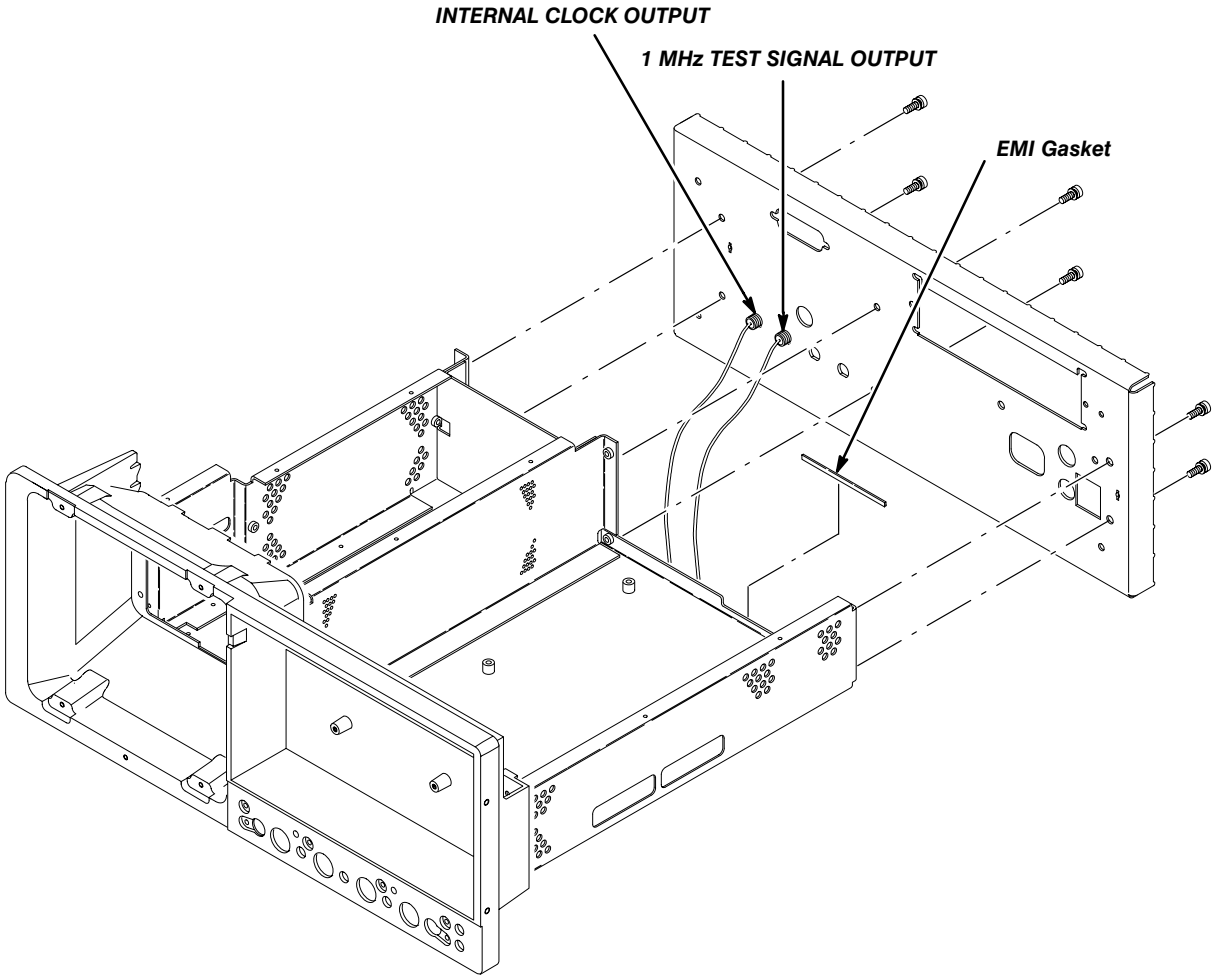


Figure 6-17: Rear Chassis Removal

Procedures for Inner-Chassis Modules

You should have done the *Access Procedure* (page 6-14) before doing any procedure in this collection. The following procedures are listed in the order presented.

A16 Low Voltage Power Supply

A20 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 6-3, page 6-13.
2. *Orient the oscilloscope:* Set the oscilloscope so its bottom is down on the work surface and its rear is facing you.
3. *Remove the low-voltage power Supply:*
   a. Working from the rear of the oscilloscope, remove the two screws securing the low-voltage power supply to the rear chassis. See Figure 6-18.
   b. Now, working from the top of the oscilloscope, remove the seven screws indicated in Figure 6-18 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 oscilloscope 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 6-37)
   - *A11 Processor/Display Board* (page 6-36)
   - *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-34)
   - *Rear Cover and Cabinet* (page 6-18)

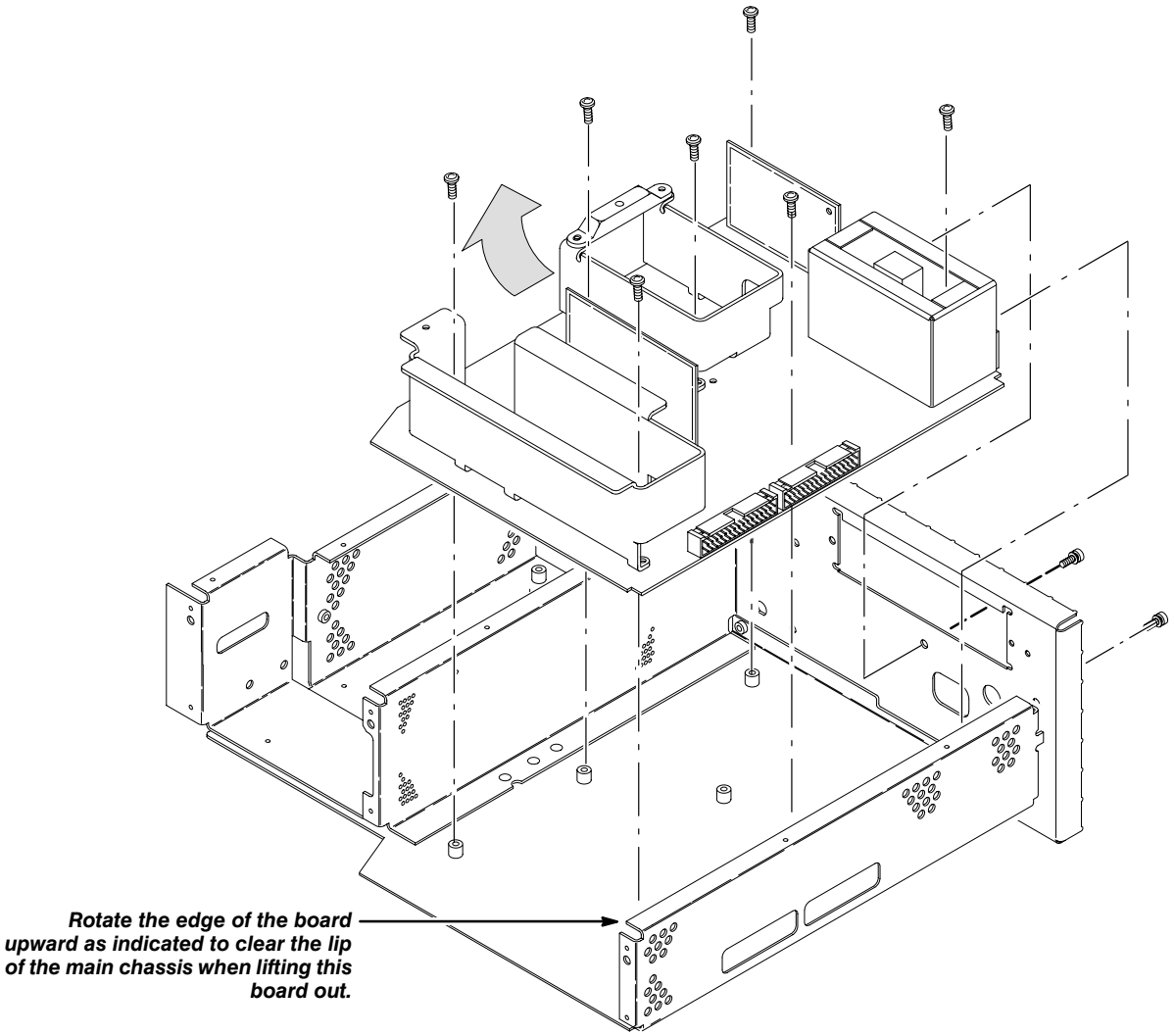


Figure 6-18: A16 Low Voltage Power Supply Removal

A20 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 6-3, page 6-13.

2. *Orient the oscilloscope:* Set the oscilloscope 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. (The fuse is located between the fan and the neck of the display tube.) 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:*
   a. Take the precautions outlined in the warning above. Reference Figure 6-19 while doing the following substeps.
   b. Unplug the display tube connector from the back of the display tube and the display tube yoke connector from the display circuit board (J340).
   c. Remove the two screws that secure the band circling the front of display tube to the front subpanel. Carefully guide the 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.

   d. Discharge the anode lead as described in the immediately proceeding ***WARNING,*** unplug it from the display tube, and discharge that lead (again see ***WARNING***).

e. 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 previous ***WARNING*** message.

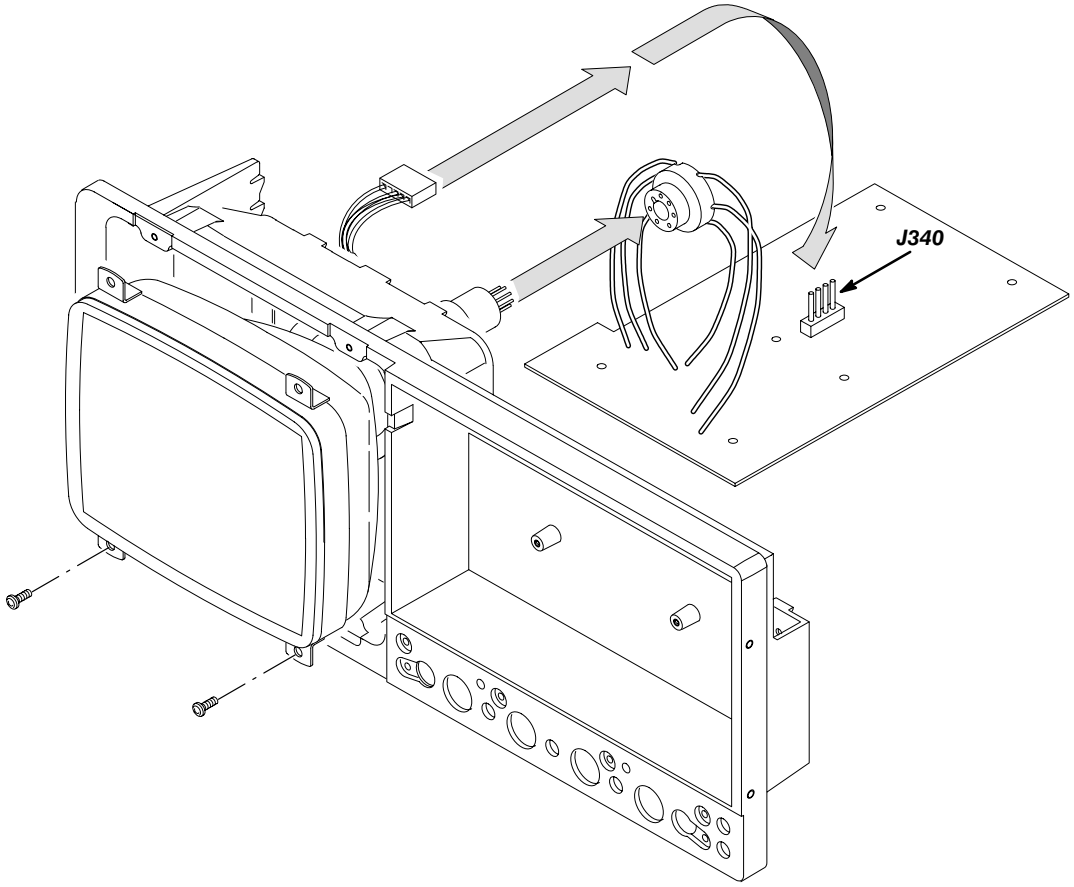


Figure 6-19: Display Assembly Removal

5. *Remove the display supply board:* Use Figure 6-20 as a guide.

   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 oscilloscope main chassis.

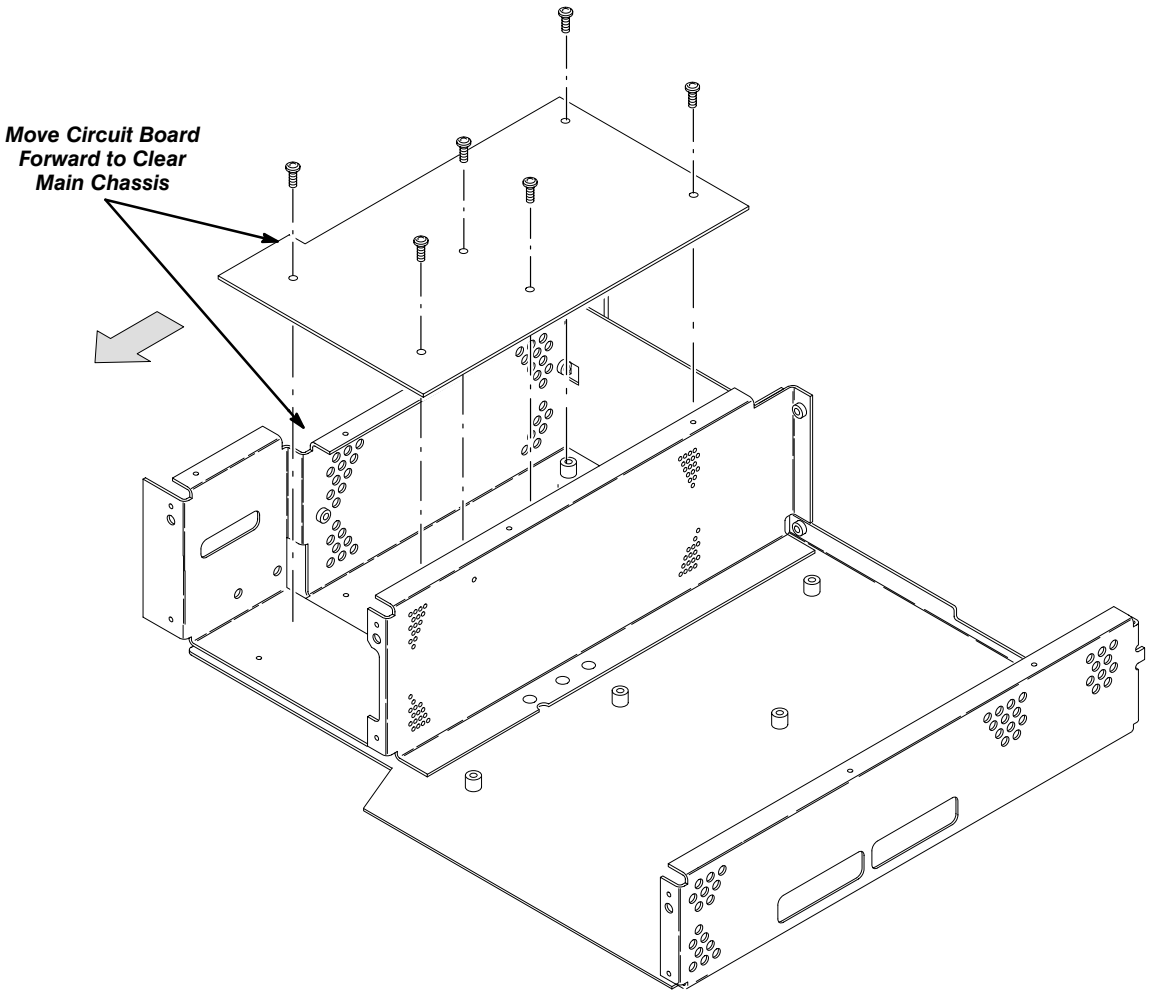


Figure 6-20: Display Driver Board Removal

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−4e, 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 oscilloscope:

      - *Top Cover and Board Brackets* (top cover only) on page 6-37
      - *A11 Processor/Display Board* (page 6-36)
      - *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-34)
      - *Display-Frame Assembly*

- *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6-21)
- *Rear Cover and Cabinet* (page 6-18) (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 *A20 Display Assembly and Supply Fuse* (page 6-46). 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 6-12.
2. *Orient the oscilloscope:* Set the oscilloscope so its rear is down on the work surface and its bottom is facing you.
3. *Remove the front subpanel:* Remove the six screws securing the front subpanel to the main chassis. (See Figure 6-21 for screw locations.) Lift the front subpanel up away from the main chassis to complete the removal.
4. *Reinstallation:* Do the following substeps to reinstall the front subpanel and reassemble the remainder of the oscilloscope:
   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 Figure 6-21.) Then reinstall the six screws removed in step 3.
   b. See the procedure *A20 Display Assembly and Supply Fuse* (page 6-46) to reinstall the display-frame assembly and display tube.
   c. 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 6-37)
      - *A11 Processor/Display Board* (page 6-36)
      - *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-34)
      - *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6-21)
      - *Rear Cover and Cabinet* (page 6-18)

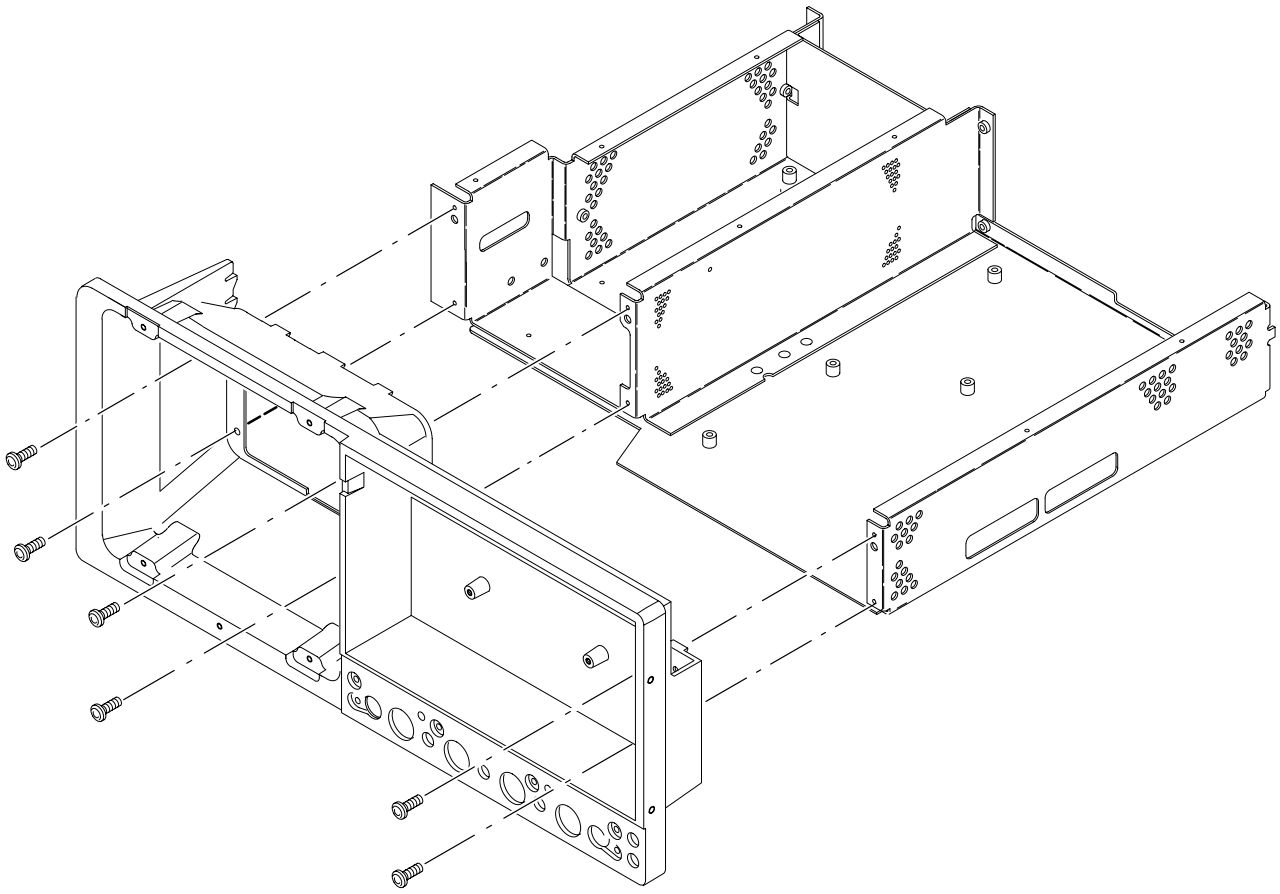


Figure 6-21: Front Subpanel Removal

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 TDS 800 Digitizing Oscilloscopes into 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 3), a flat-bladed screwdriver (Item 5), and a pair of angle-tip tweezers (Item 15).
   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 6-16)
   b. *Rear Cover and Cabinet* (page 6-18)
   c. *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6-21)
   d. *Front Subpanel* (page 6-50) and *Display-Frame Assembly*
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 6-34)
   b. *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-34)
   c. *A11 Processor/Display Board* (page 6-36)
   d. *Top Cover and Board Brackets* (page 6-37)
   e. *A15 Interconnect Assembly* (page 6-31)
   f. *A10 Acquisition Board* (page 6-39)
   g. *A23 SerPar Board — (Option 13: RS232/Centronics Hardcopy Interface)*
4. *Remove the inner-chassis modules:* Do in order the following procedures. They are found under *Procedures for Inner-Chassis Modules* which start on page 6-45.
   a. *A16 Low Voltage Power Supply* (page 6-45)
   b. *A20 Display Assembly and Supply Fuse* (page 6-46)
5. *Disassemble the chassis:*
   a. Set the assembly so its bottom is down on the work surface and its front is facing you.
   b. Remove the six screws securing the front subpanel to the main chassis. (See Figure 6-21 for screw location.)

c. Lift the front subpanel up away from the main chassis.

d. Now remove the five screws securing the rear chassis to the main chassis and separate the two chassis. (See Figure 6-17 for screw location.)

6. *Reassembly:* Do the following substeps:

a. *Reassemble the chassis:* Align the rear chassis to the main chassis and reinstall the five screws removed in step 5; align the front subpanel to the main chassis and reinstall the six screws removed in step 5.

NOTE

The following substeps refer you to procedures for installing each module removed. When reinstalling the modules, ignore any instructions that require connecting a cable or bus to a module that you have not yet installed. The necessary connections will be made when you install the missing module later.

b. *Reinstall the inner-chassis modules:* Do in the order listed the following procedures. When doing these procedures, do their steps in reverse order. These procedures are found under *Procedures for Inner-Chassis Modules* which start on page 6-45.

- *A20 Display Assembly and Supply Fuse* (page 6-46)
- *A16 Low Voltage Power Supply* (page 6-45)

c. *Reinstall the outer-chassis modules:* Do in the order listed the following procedures. When doing these procedures, do their steps in reverse order. These procedures are found under *Procedures for Outer-Chassis Modules* which start on page 6-29.

- *Top Cover and Board Brackets* (page 6-37)
- *A11 Processor/Display Board* (page 6-36)
- *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-34)
- *Fan* (page 6-34)
- *A10 Acquisition Board* (page 6-39)
- *A15 Interconnect* (page 6-31)
- *Delay Lines* (page 6-31)

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 6-50)

- *Display-Frame Assembly* (page 6-46)
- *Front Cover, Trim Ring, Menu Buttons, and Input Panel* (page 6-21)
- *Rear Cover and Cabinet* (page 6-18)
- *Line Fuse and Line Cord* (page 6-16)

Troubleshooting

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

TDS 800 Diagnostics

The oscilloscope has two levels of internal diagnostics that focus on verifying, adjusting, and isolating faulty modules.

Both levels of internal diagnostics report any bad modules and/or interfaces. If they do find a bad module and/or interface, 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 an extended set that tests the oscilloscope circuitry in-depth and takes more time. At power-up, the oscilloscope automatically executes the short set. The extended set is optional and is executed by using the following procedure:

Prerequisites: Power up the oscilloscope 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. Repeatedly press the main-menu button **Area** until **All** is highlighted in the pop-up menu.
3. *Run the System Diagnostics:* Press the main-menu button **Execute**; then press the side-menu button **OK Confirm Run Test**.

4. *Wait:* The internal diagnostics do an exhaustive verification of proper oscilloscope function. This verification will take about two minutes. When finished, the oscilloscope will display a report of any bad modules and/or interfaces.

Firmware Updates

The TDS 800 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 6-22 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*, *Replaceable Parts List* in Section 10 for the part number.

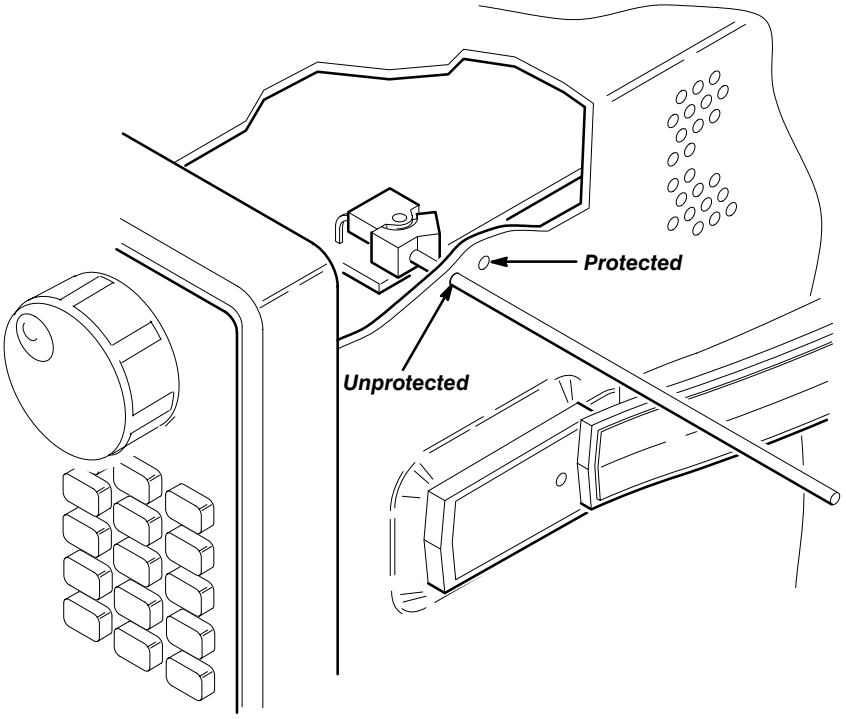
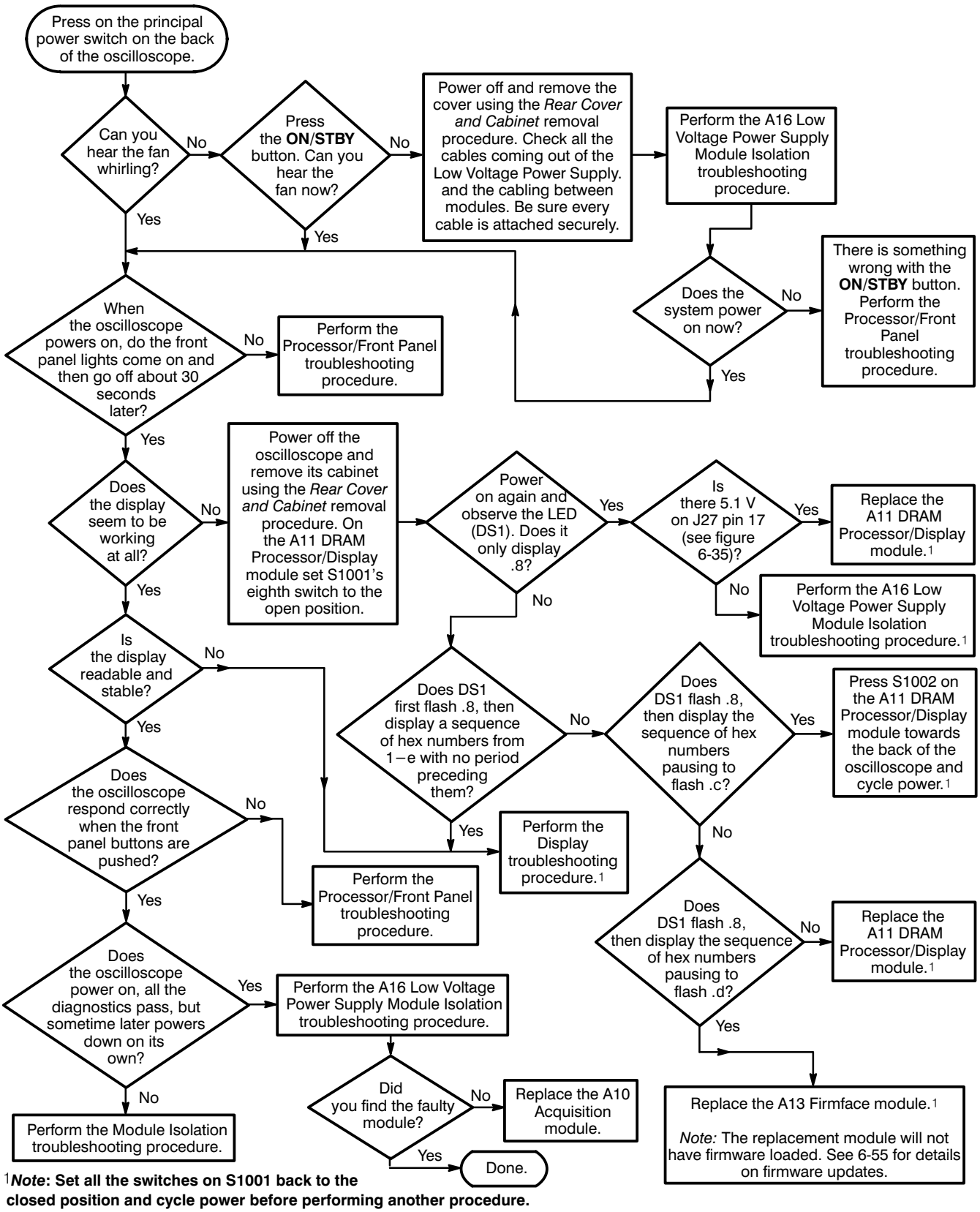


Figure 6-22: Accessing the Protection Switch



1***Note*: Set all the switches on S1001 back to the closed position and cycle power before performing another procedure.**

Figure 6-23: Primary Troubleshooting Procedure

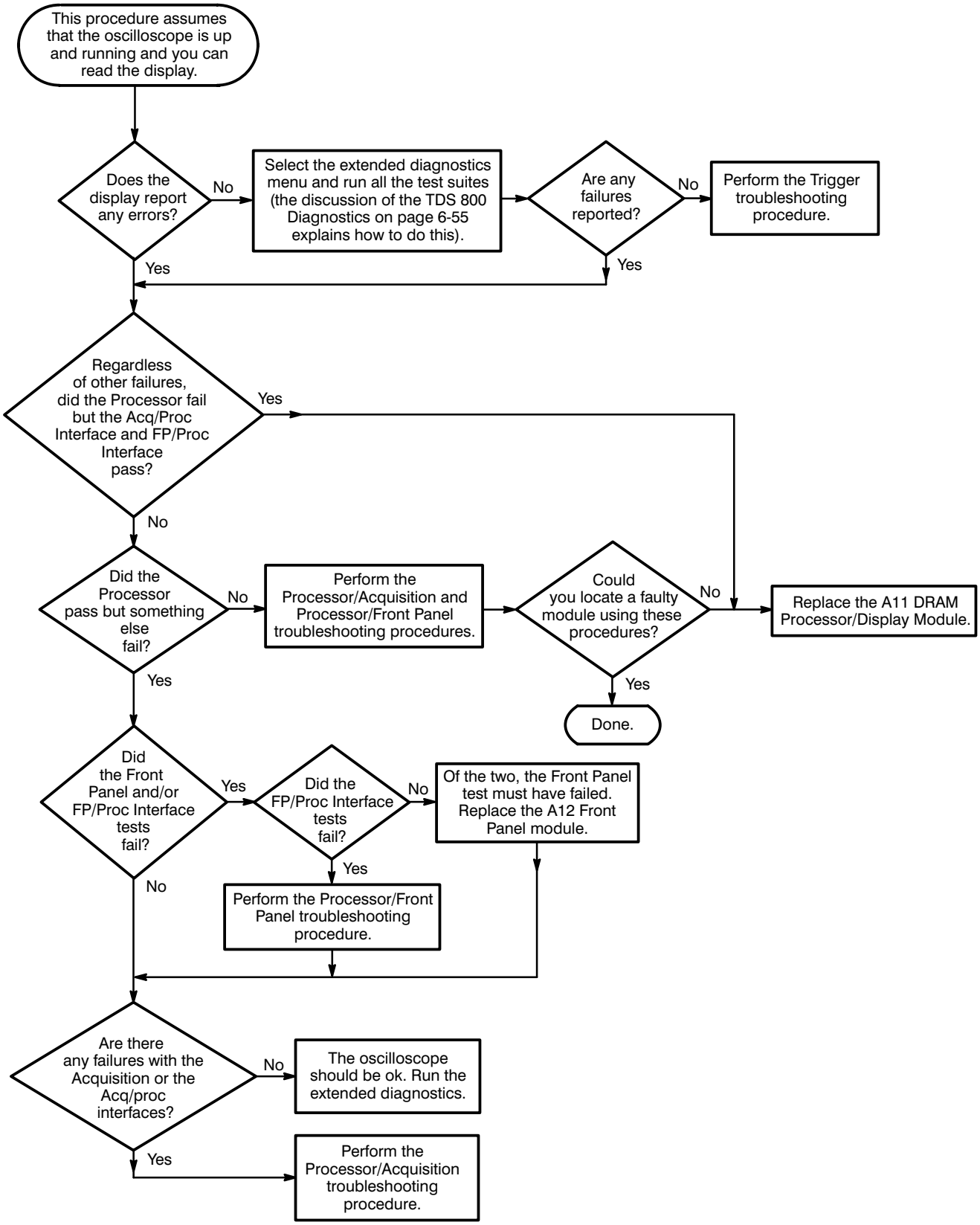


Figure 6-24: Module Isolation Troubleshooting Procedure

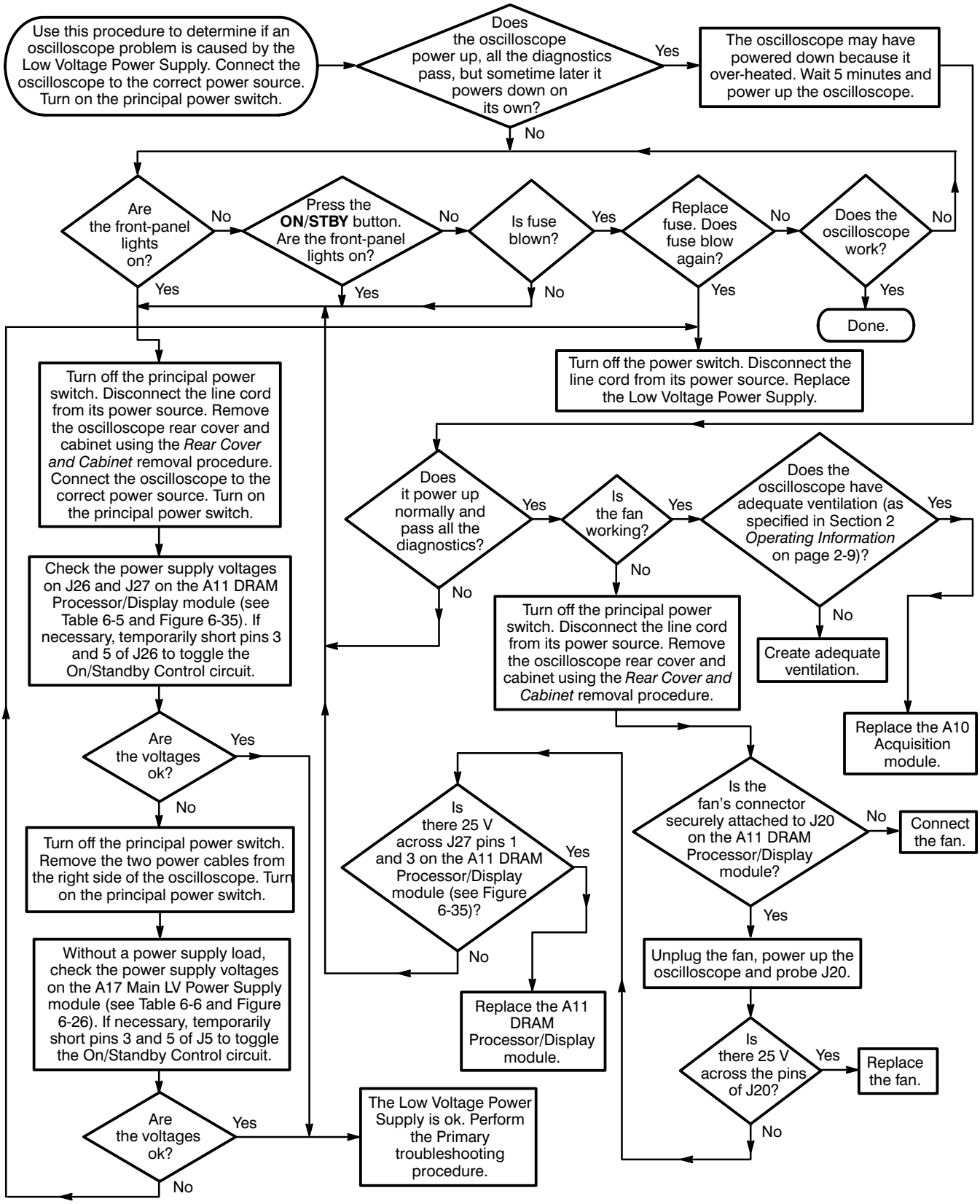


Figure 6-25: A16 Low Voltage Power Supply Module Isolation Troubleshooting Procedure

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

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 A17 Main LV 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

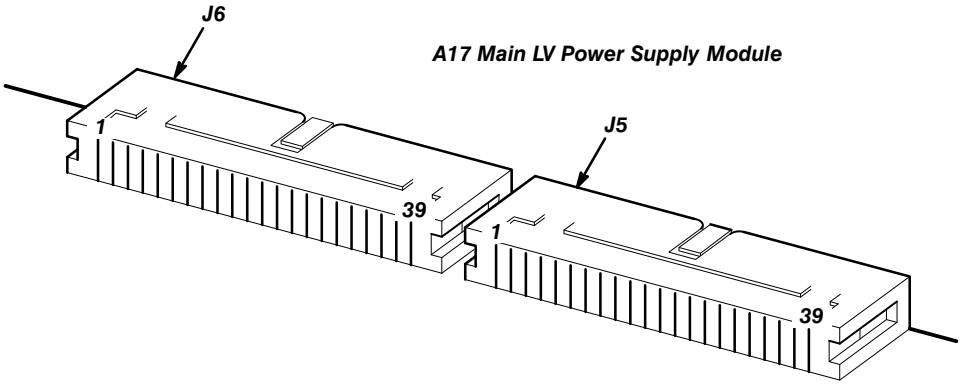


Figure 6-26: Power Supply Voltage Measurement Locations

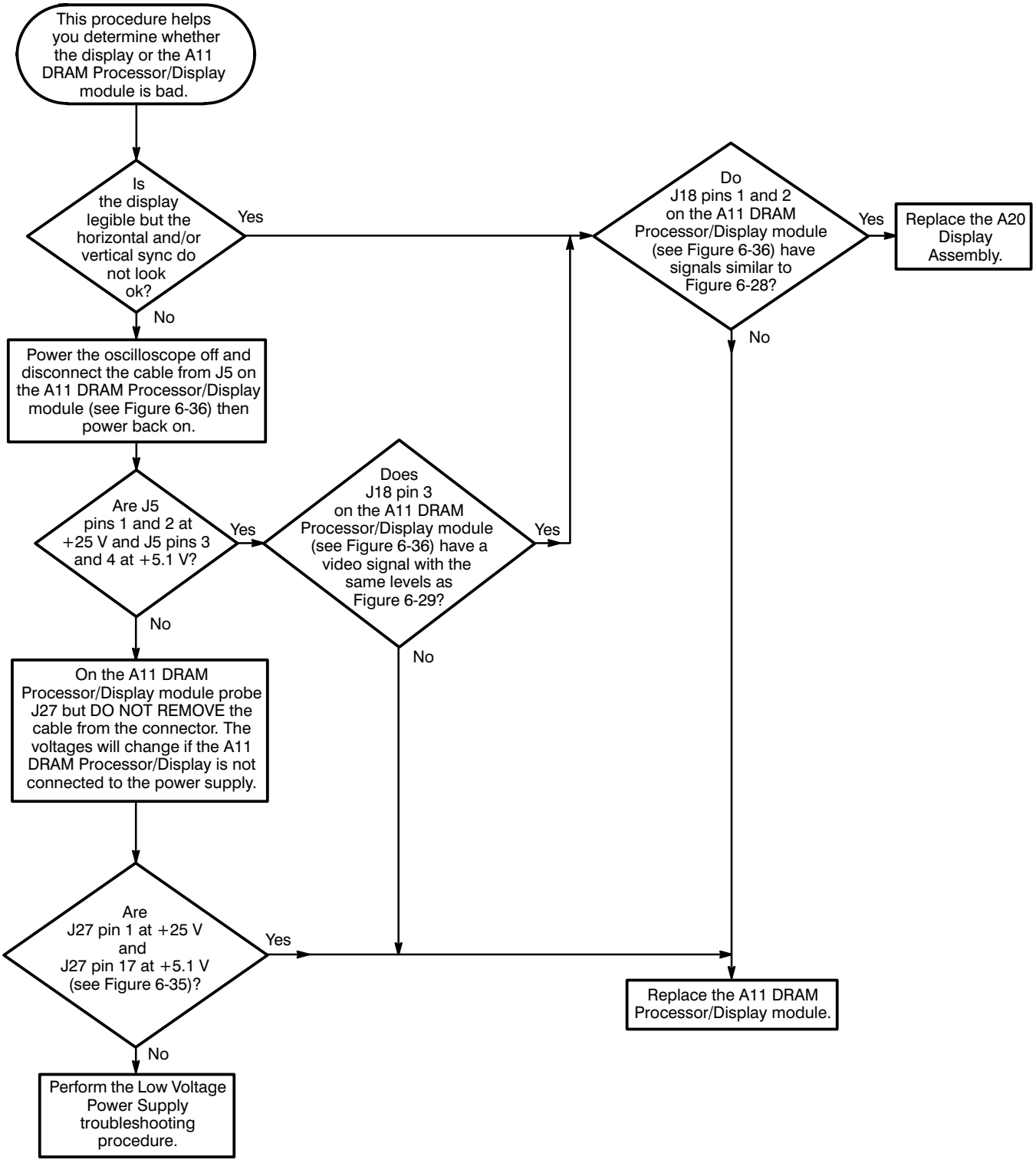


Figure 6-27: Display Troubleshooting Procedure

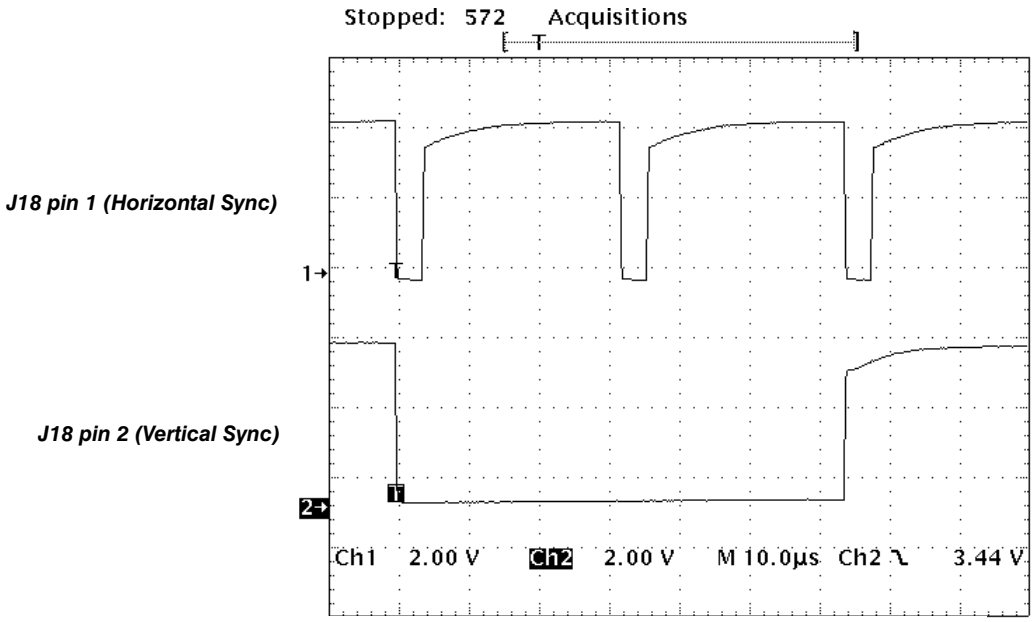


Figure 6-28: Horizontal and Vertical Sync Signals

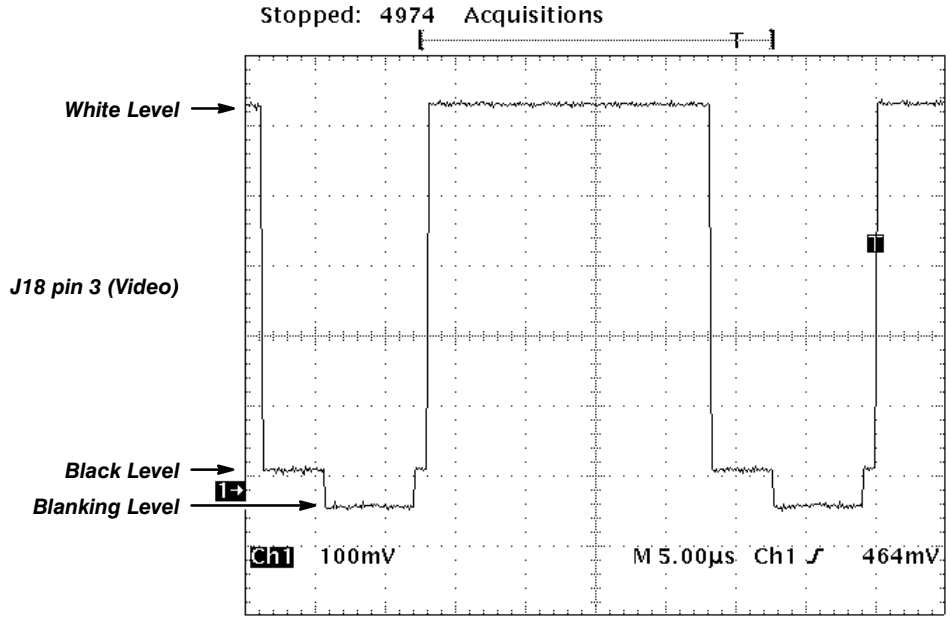


Figure 6-29: A Video Signal with White, Black, and Blanking Levels

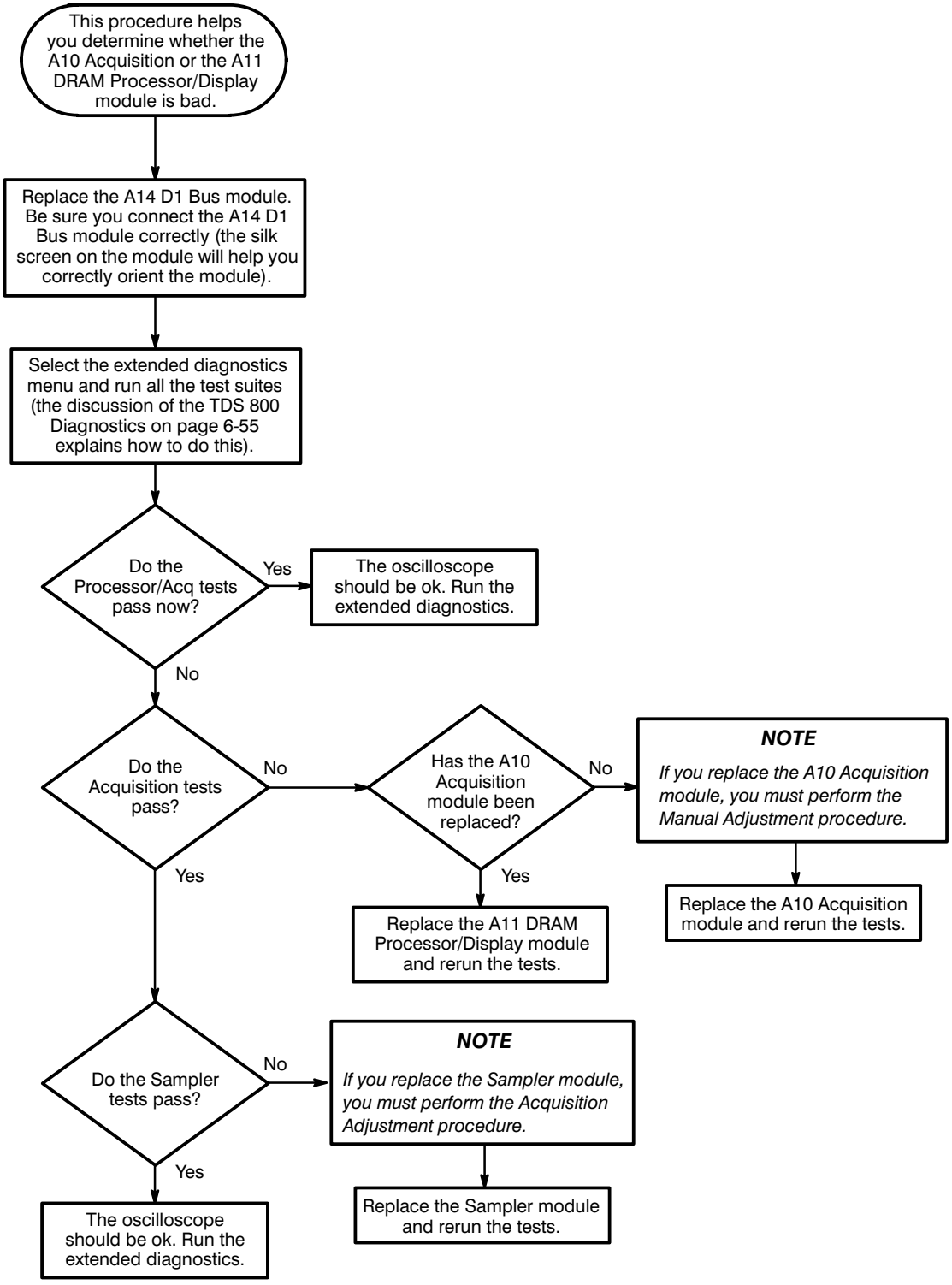


Figure 6-30: Processor/Acquisition Troubleshooting Procedure

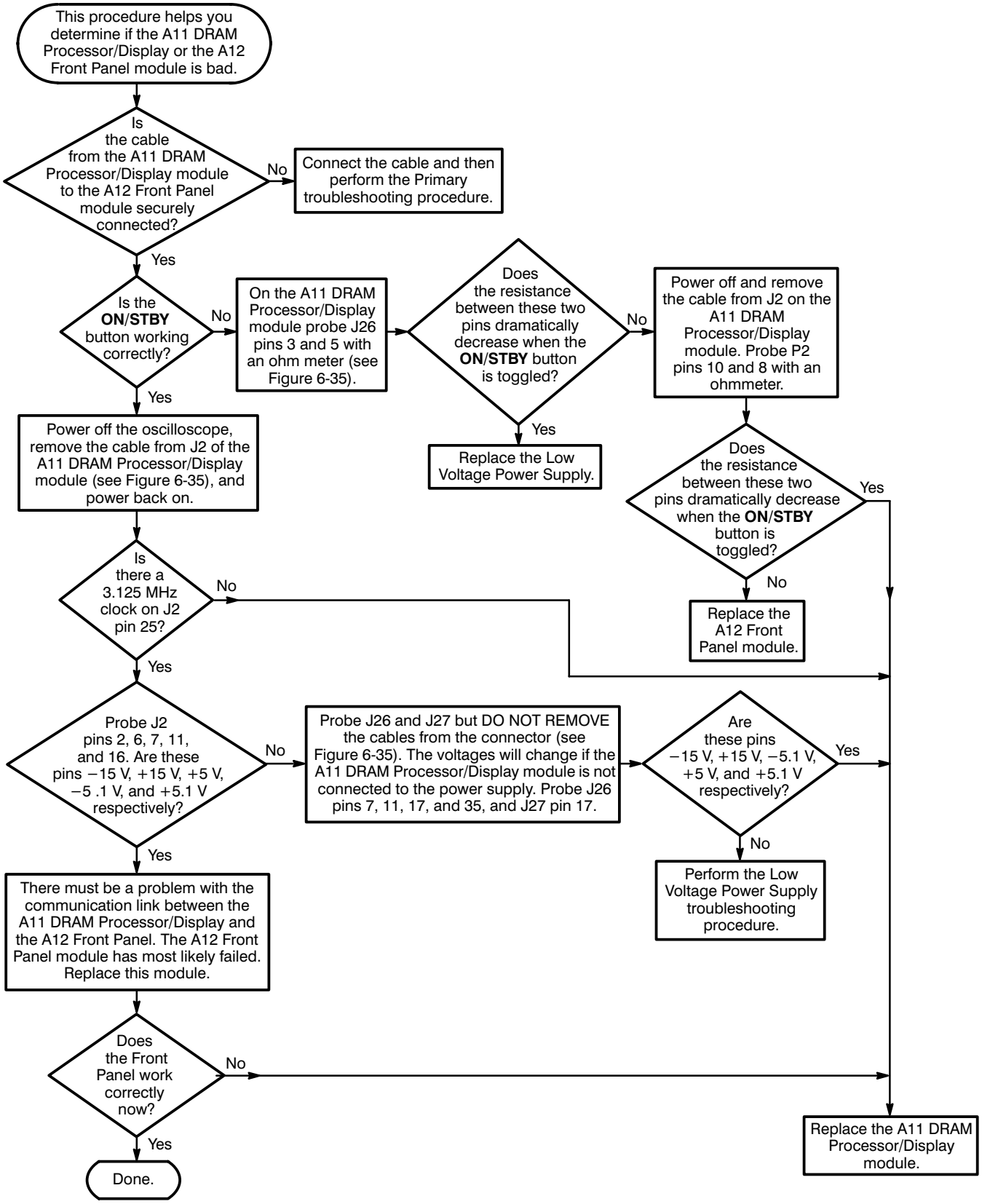


Figure 6-31: Processor/Front Panel Troubleshooting Procedure

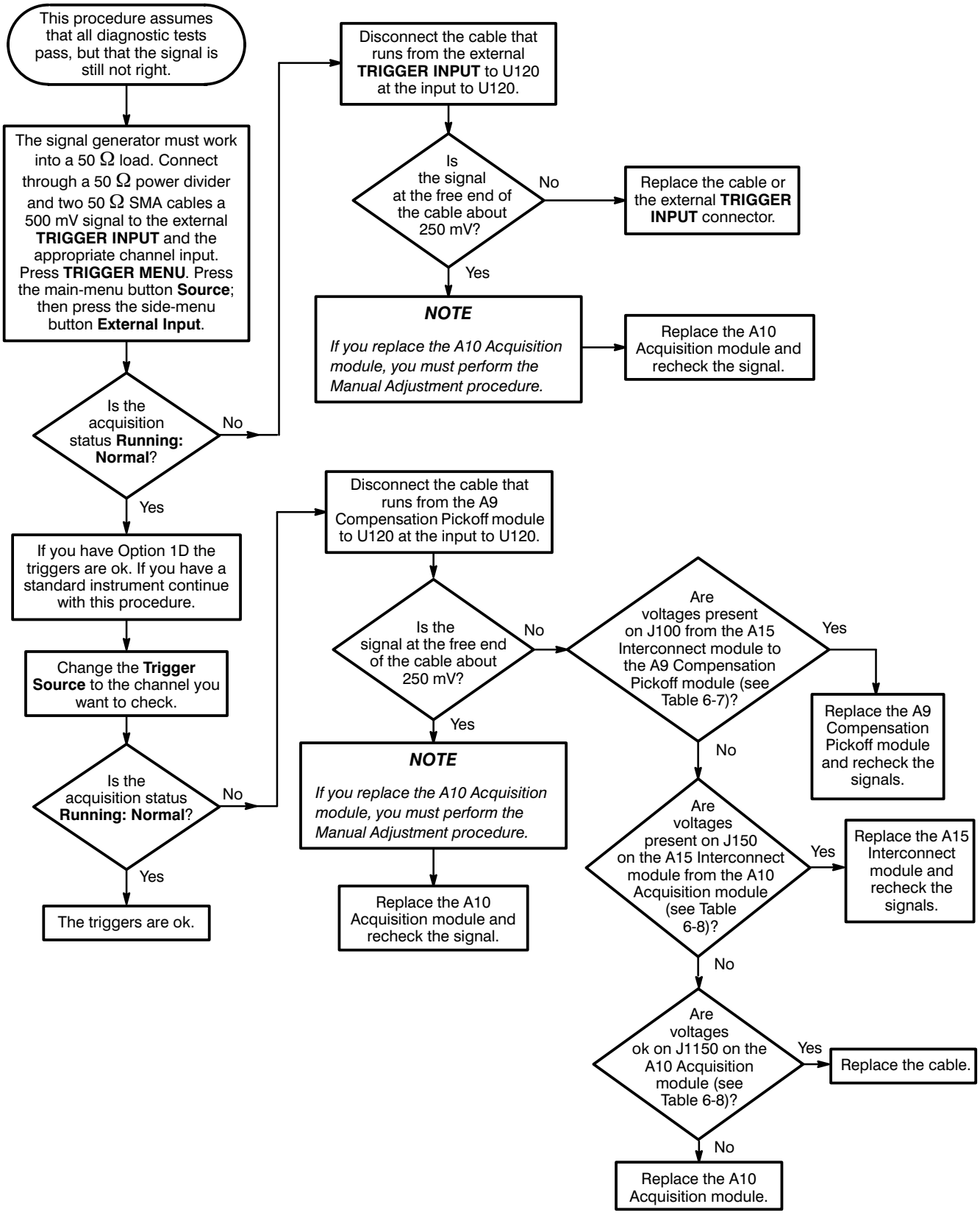


Figure 6-32: Trigger Troubleshooting Procedure

Table 6-7: A15 Interconnect to A9 Compensation Pickoff Power Connector J100

Pin	Voltage	Title
1	−0.8 to +0.8 V	TRIG_LEV
2	0 V	AGND
3	−5 V	−5VPO
4	TTL Level	FPKOFF_EN
5	TTL Level	FPKOFF_SEL_1
6	+5 V	+5VPO

Table 6-8: A15 Interconnect Module Power Connectors J150 and J1150

Pin	Voltage	Title
1	0 V	AGND
2	+5 V	
3	+15 V	
4	−5.1 V	
5	−15 V	
6	0 V	AGND
7	TTL Levels	PKOFF_EN
8	TTL Levels	PKOFF_SEL_1
9	0 V	AGND
10		TRIG LEVEL

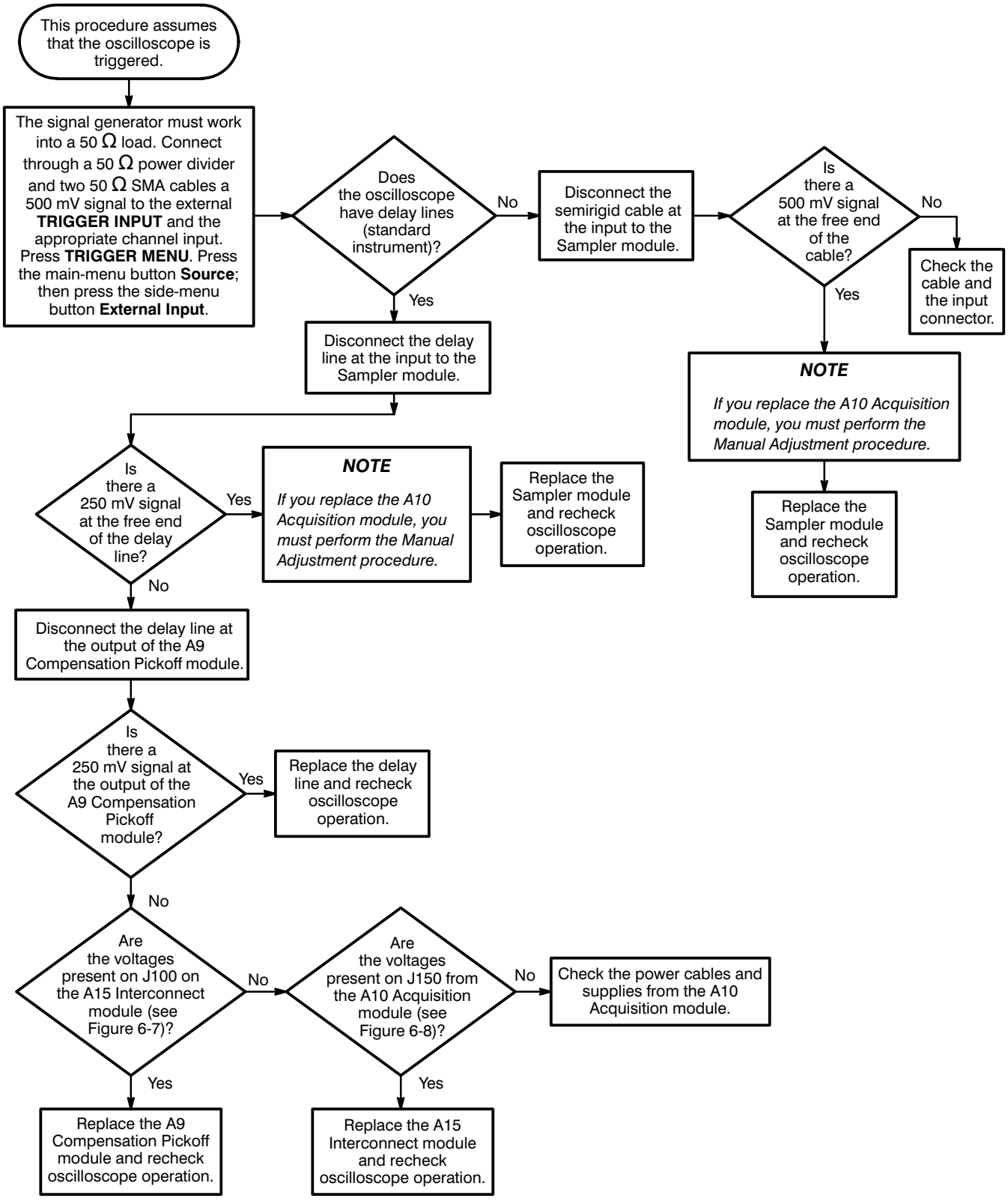


Figure 6-33: Signal Path Troubleshooting Procedure

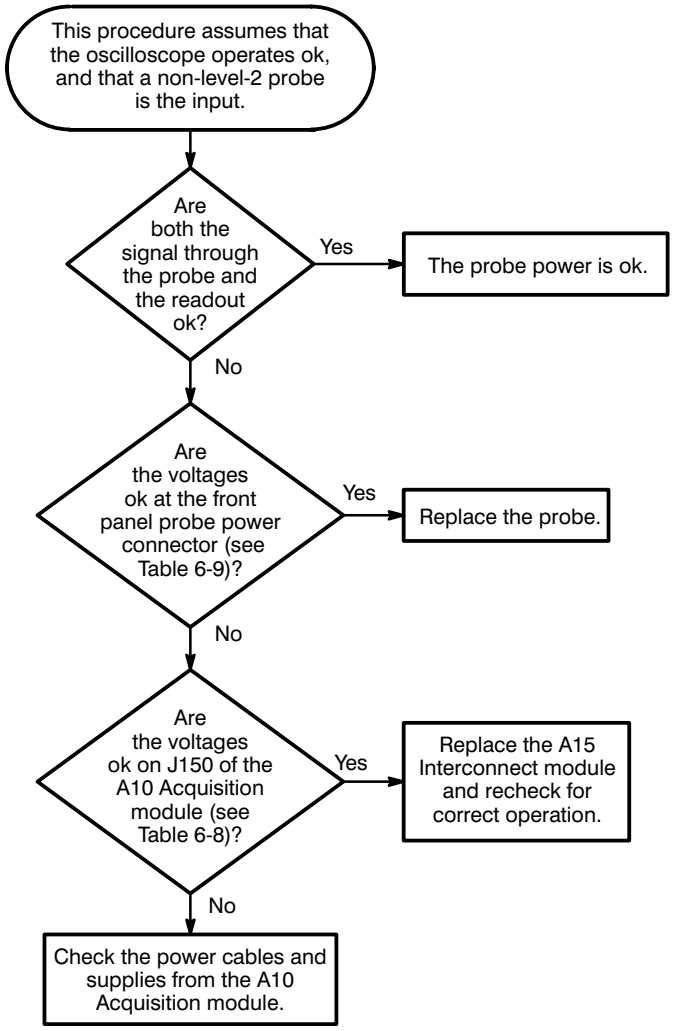


Figure 6-34: Probe Power Troubleshooting Procedure

Table 6-9: Probe Power Voltages

Pin	Voltage	Title
1		DATA
2	−5 V	
3	−15 V	
5	0 V	AGND
7	+15 V	
8	+5 V	
9		CLK
11		OFFSET

CAUTION

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

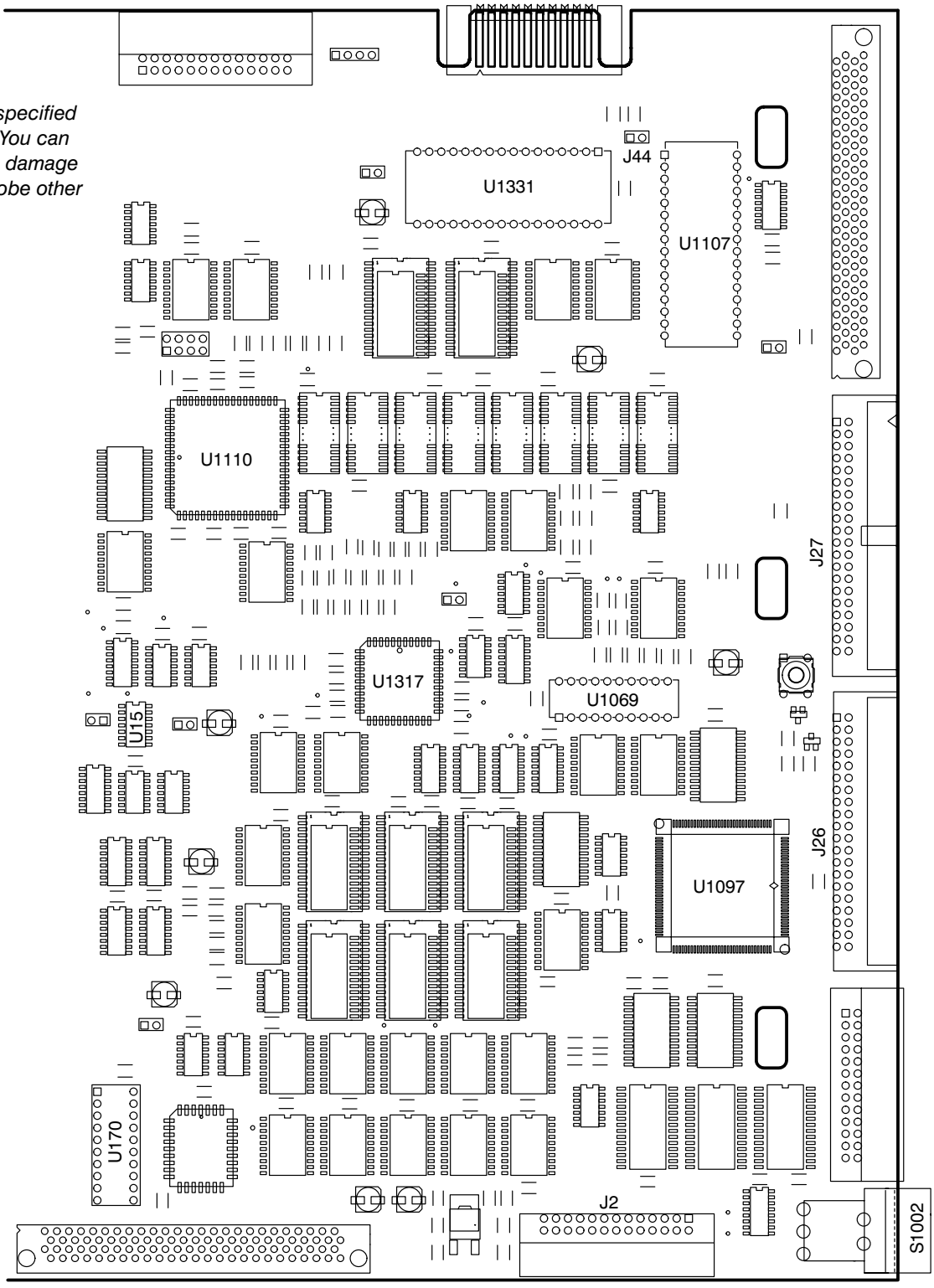


Figure 6-35: A11 DRAM Processor/Display Module (View of Right Side)

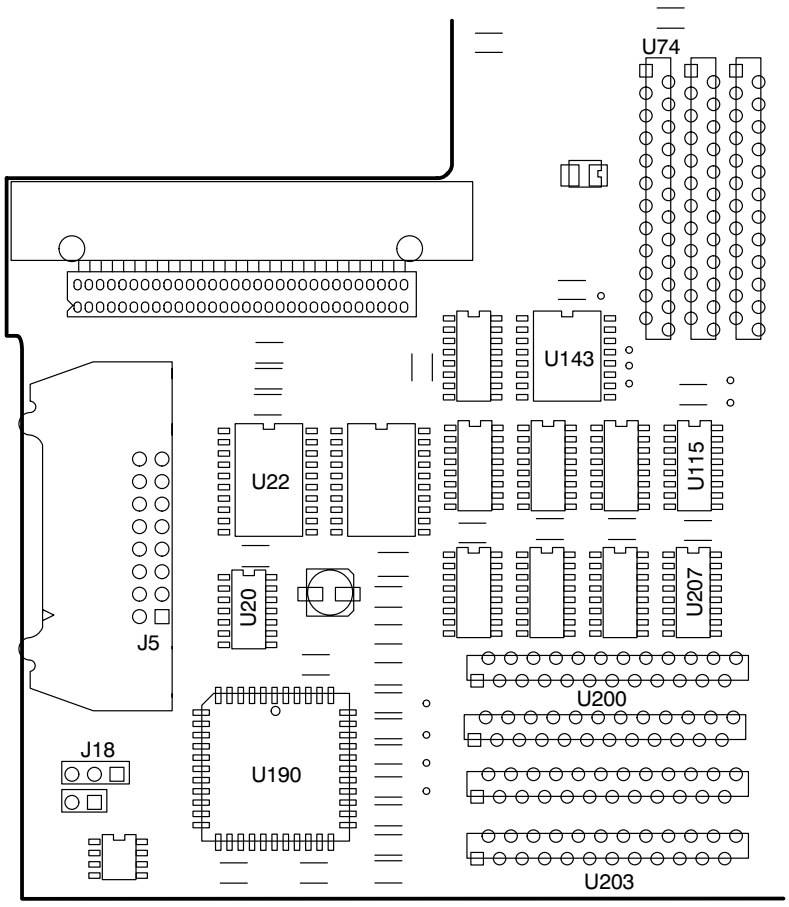


Figure 6-36: A11 DRAM Processor/Display Module (View of Lower Left Corner)

r

Options and Accessories

This section describes the various options as well as the standard and optional accessories that are available for TDS 800 Digitizing Oscilloscopes.

Options

Options available for the digitizing oscilloscope are described below.

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, listed in Table 7-1, with the oscilloscope 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: Module Level Service Manual

When you order Option B1, Tektronix ships a module level service manual with the oscilloscope.

Warranty-Plus Service Options

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

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

Option 1D: Delete Delay Lines and Trigger Pickoff

With its delay lines removed, the TDS 820 features a higher bandwidth and slightly reduced noise. However, it cannot display any pretrigger information, nor can either input channel be used as the trigger source.

Option 2D: Delete 2 P6207 Probes

With this option, Tektronix removes the two standard P6207 probes.

Option 1K: Oscilloscope Cart

When you order Option 1K, Tektronix ships a K218 Oscilloscope Cart with the oscilloscope.

Option 1P: HC100 4-Pen Plotter

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

Option 1R: Rackmounted Digitizing Oscilloscope

Tektronix ships the digitizing oscilloscope, 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 (016−1136−00) for field conversions.

Instructions for rackmounting the digitizing oscilloscope are shipped with the Option 1R.

Option 13: RS-232/Centronics Hardcopy Interface

With this option, Tektronix ships the oscilloscope equipped with a RS-232 and a Centronics interface that can be used to obtain hardcopies of the oscilloscope screen.

Option 2F: Advanced DSP Math

With this option, the oscilloscope can compute and display three advanced math waveforms: integral of a waveform, differential of a waveform, and an FFT (Fast Fourier Transform) of a waveform.

Option 1S: SIU 800 Static Isolation Unit

With this option, Tektronix ships two SIU 800 Static Isolation Units. The SIU 800 protects the sampler from damage due to static discharge from circuit boards and cables.

Option 95: Calibration Data Report

This option includes a calibration data report for the instrument.

Option 96: Certificate of Calibration

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

Table 7-2 lists the standard accessories that are included with the digitizing oscilloscope:

Table 7-2: Standard Accessories

Accessory	Part Number
User Manual	070−8512−XX
Programmer Manual	070−8513−XX
Performance Verification	070−8696−XX
Reference	070−8511−XX
Front cover	200−3696−XX
U.S. power cord	161−0230−01
Two 12-inch 50-Ω male-to-male SMA cables	174−1364−XX
Sixty-inch 50-Ω male-to-male SMA cable	174−1428−XX
Antistatic grounding wrist strap	006−3415−XX
SMA T connector	015−1016−XX
SMA female-to-female adapter	015−1012−XX
Two SMA short circuit terminations (male)	015−1020−XX
Two SMA (male)-to-BNC (female) adapters	015−0554−XX
Two High Impedance Active Probes	P6207

Optional Accessories

You can also order the optional accessories listed in Table 7-3:

Table 7-4: Optional Accessories

Accessory	Part Number
TDS 820 Service Manual	070−8514−XX
Oscilloscope camera	C9
Oscilloscope camera adapter	016−1145−XX
Soft-Sided carrying case	016−0909−XX
Transit case	016−1135−XX
SMA kit	020−1693−XX
GPIB cable (1 meter)	012−0991−01
GPIB cable (2 meter)	012−0991−00
Security cable	012−1388−XX

Accessory Probes

Optional accessory probes that you can use with your digitizing oscilloscope are described in the *User Manual*.

Accessory Software

Table 7-5 lists the optional Tektronix software products recommended for use with your digitizing oscilloscope:

Table 7-5: Accessory Software

Software	Part Number
Wavewriter: AWG and waveform creation	S3FT400
LabWindows	LWDOS

Warranty Information

Check for the full warranty statements for this product, the probes, and the products listed above on the back of each product manual's title page.

Replaceable 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 Section 10, *Replaceable Parts List.* Refer to that section for part numbers when using this manual.

Diagrams

This contains the block diagram and the interconnection diagram for this oscilloscope.1

Symbols

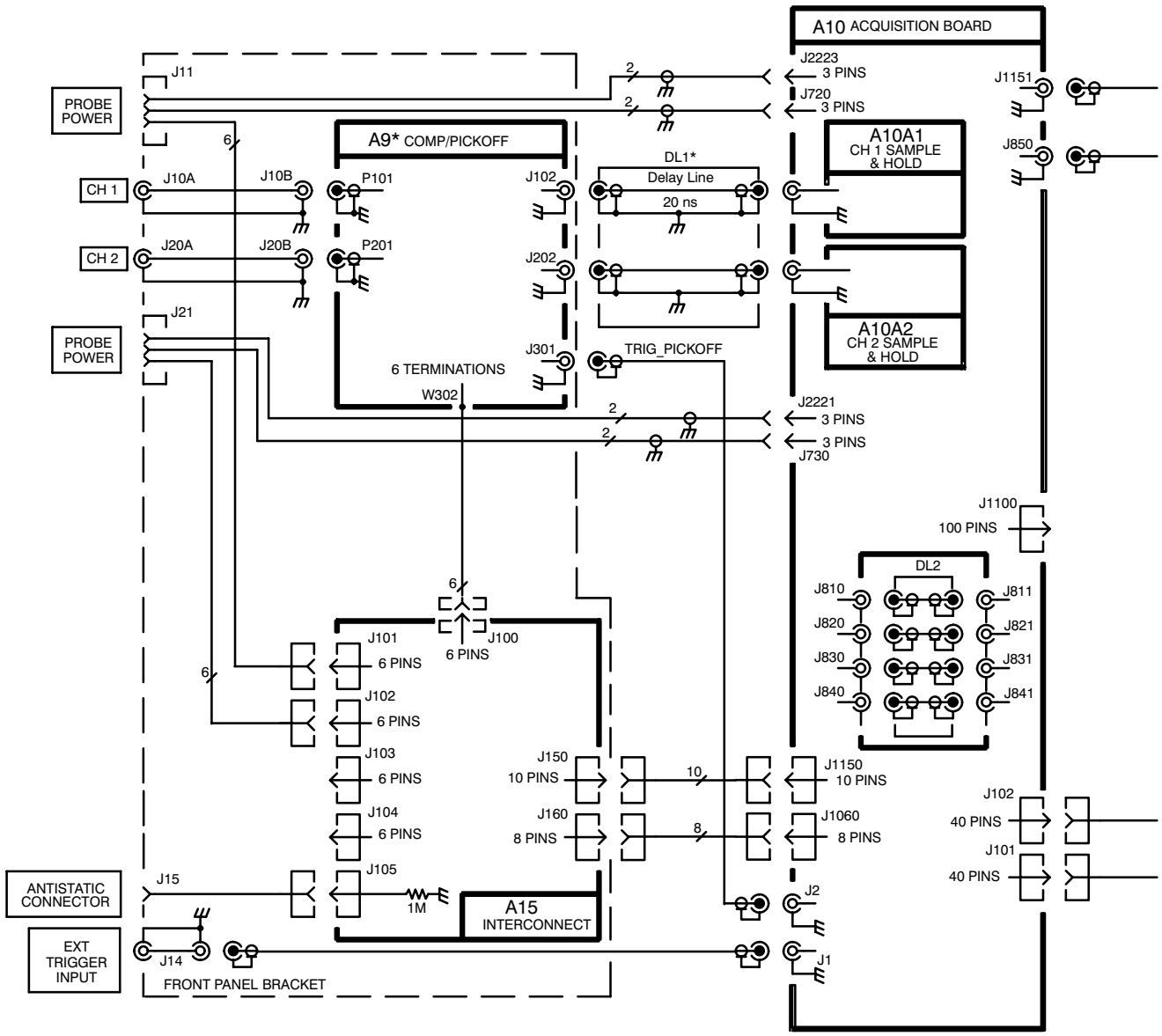
Graphic symbols and class designation letters are based on ANSI Standard Y32.2−1975. Abbreviations are based on ANSI Y1.1−1972.

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



NOTE: * FOR OPTION 1D THE A9 & DL1 ASSEMBLIES ARE NOT USED. CONNECT J10 & J20 DIRECTLY TO A10A1 & A10A2.

Figure 9-1: TDS 800 Interconnections

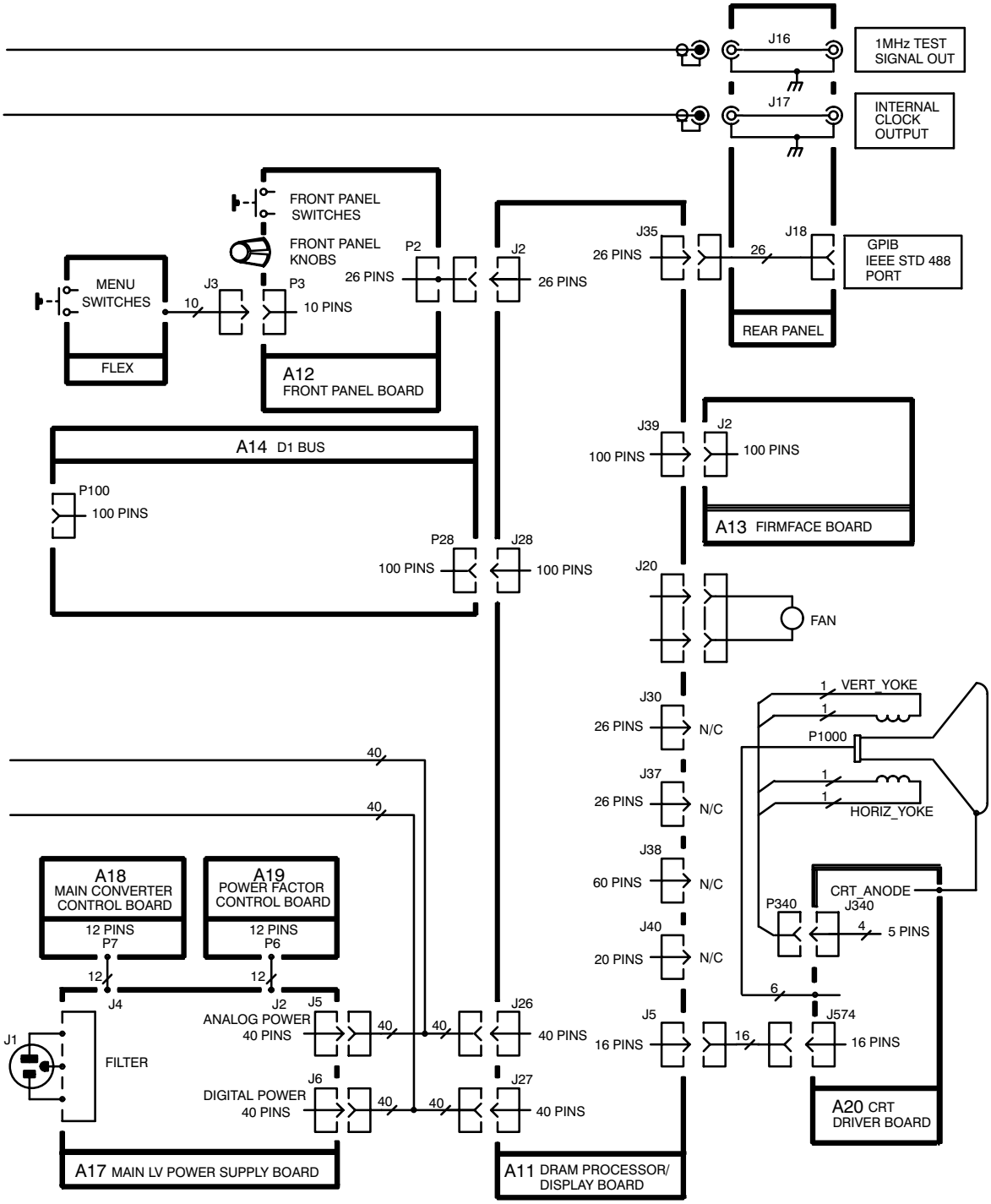


Figure 9-1: TDS 800 Interconnections (Cont.)

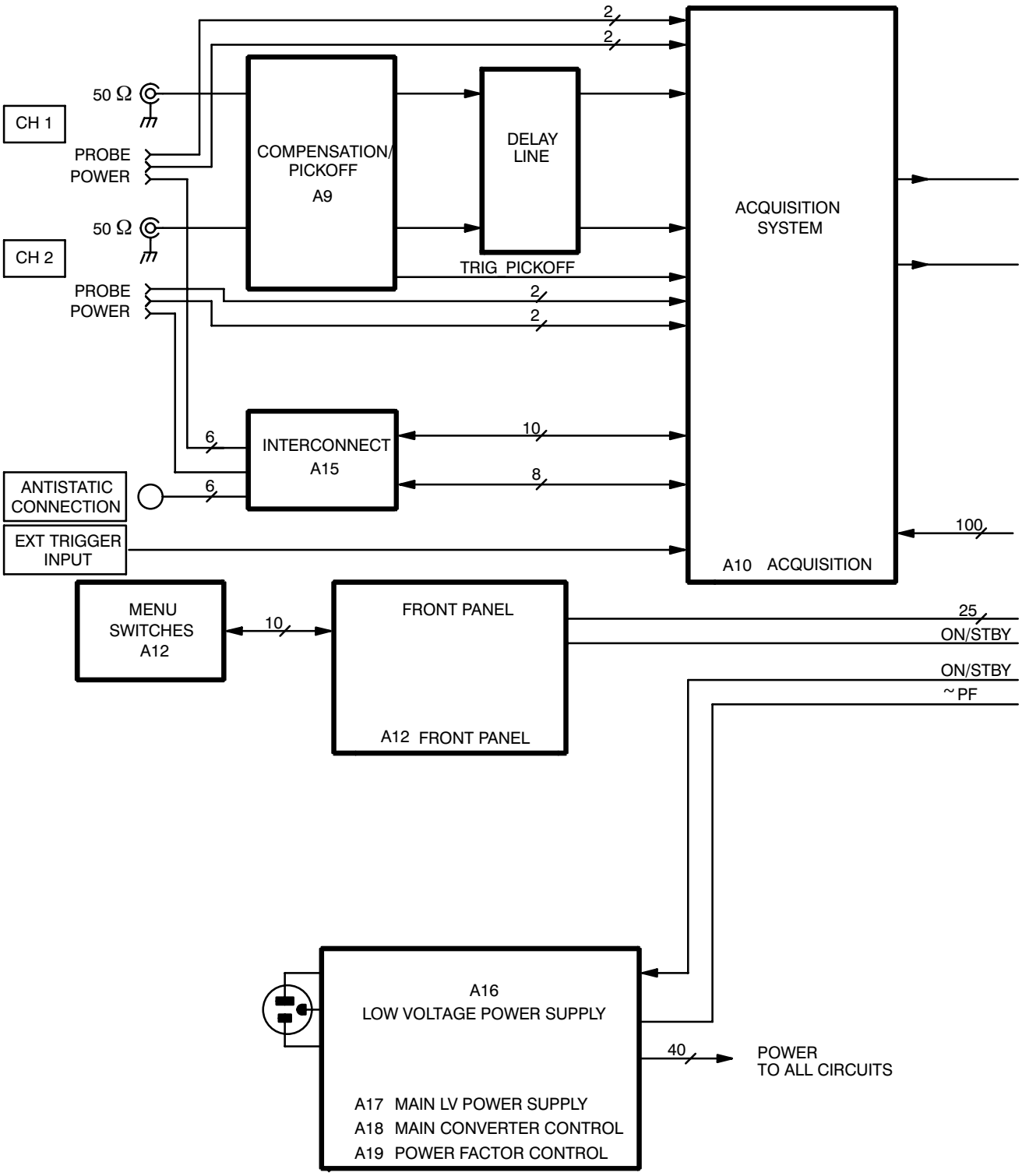


Figure 9-2: TDS 800 Block Diagram

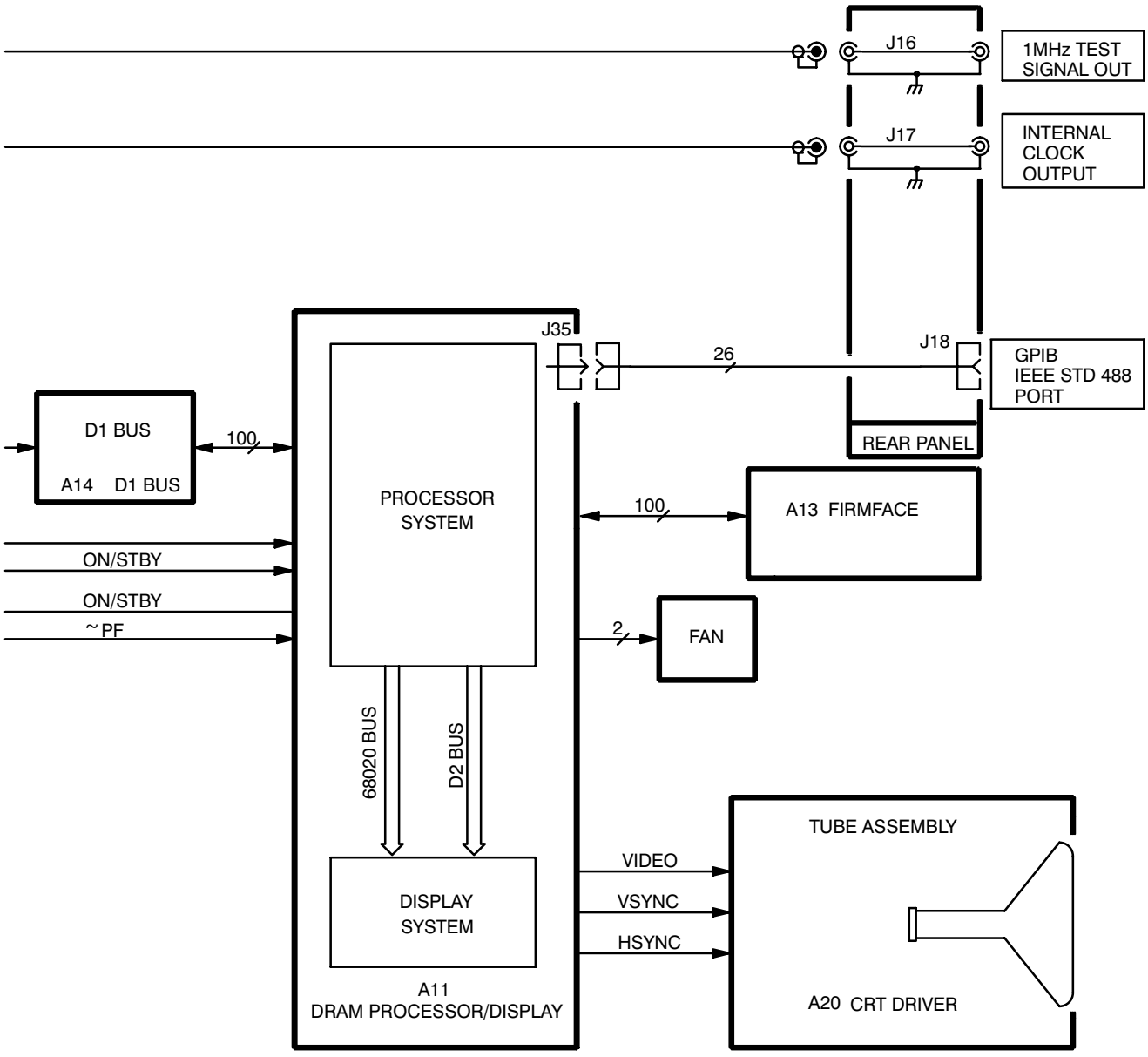


Figure 9-2: TDS 800 Block Diagram (Cont.)

Replaceable Parts List

This section contains a list of the modules that are replaceable for the TDS 800. Use this list to identify and order replacement modules.

Module Ordering Information

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

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

Module Replacement

The TDS 800 is serviced by module replacement, so 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 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 incomplete. For further Item Name identification, U.S. Federal Cataloging Handbook H6-1 can be used where possible.

Indentation System

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

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

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
TK0435	LEWIS SCREW CO	4300 S RACINE AVE	CHICAGO IL 60609–3320
TK0488	CURRAN COIL SPRING INC	635 NW 16TH	PORTLAND OR 97209–2206
TK0588	UNIVERSAL PRECISION PRODUCTS	1775 NW 216TH	HILLSBORO OR 97123
TK0623	GENERAL TOOL AND SUPPLY CO (DIST)	407 NW 17TH	PORTLAND OR 97209–2214
TK1163	POLYCAST INC	9898 SW TIGARD ST	TIGARD OR 97223
TK1465	BEAVERTON PARTS MFG CO	1800 NW 216TH AVE	HILLSBORO OR 97124–6629
TK1617	CRAFT FACTORY PLASTICS	17145 SW ALEXANDER	ALOHA OR 97007
TK1899	MINNESOTA MINING AND MFG CO	5400 RT B PO BOX 1228	COLUMBIA MO 65205
TK1918	SHIN–ETSU POLYMER AMERICA INC	1181 NORTH 4TH ST	SAN JOSE CA 95112
TK2162	DERBY MFG	24350 STATE ROAD 23 SOUTH	SOUTH BEND IN 46614–9696
TK2354	UNITRACK INDUSTRIES INC	1372 ENTERPRISE PO BOX 1927	WEST CHESTER PA 19380
TK2430	ZYTEC CORPORATION	1425 EAST BRIDGE ST	REDWOOD FALLS MN 56283
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
TK2478	GRIMES COMPANY	115 S AROVISTA CIRCLE	BREA CA 92631
0GZV8	HUBER AND SUHNER INC	500 WEST CUMMINGS PARK	WOBURN MA 01801
0JR05	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER WA 98661–2999
0J9P9	GEROME MFG CO INC	PO BOX 737	NEWBERG OR 97132
0KB01	STAUFFER SUPPLY	810 SE SHERMAN	PORTLAND OR 97214
0KB05	NORTH STAR NAMEPLATE	1281–S NE 25TH	HILLSBORO OR 97124
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
02660	AMPHENOL CORP INDUSTRIAL TECHNOLOGY DIVISION (ITD)	720 SHERMAN AVENUE PO BOX 4340	HAMDEN CT 06514
11536	OPTICAL COATING LABORATORY INC	2789 NORTHPOINT PKWY	SANTA ROSA CA 95407–7350
24931	SPECIALTY CONNECTOR CO INC	2100 EARLYWOOD DR PO BOX 547	FRANKLIN IN 46131
26805	M/A–COM OMNI SPECTRA INC MICROWAVE CONNECTOR DIV SUB OF M/A–COM INC	140 4TH AVE	WALTHAM MA 02154–7507
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
52814	TECH–ETCH INC	45 ALDRIN RD	PLYMOUTH MA 02360
53387	MINNESOTA MINING MFG CO	PO BOX 2963	AUSTIN TX 78769–2963
70903	COOPER BELDEN ELECTRONICS WIRE AND CABLE SUB OF COOPER INDUSTRIES INC		
75915	LITTELFUSE INC SUB TRACOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016–3049
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077–0001
9W826	EZ FORM CABLE CORPORATION	315 PECK ST BLDG #24	NEW HAVEN CT 06513

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
10−1−1	650−2922−XX			1	CABINET ASSY:SCOPE CAB/ATTACHING PARTS	80009	6502922XX
−2	437−0399−XX			1	CABINET,SCOPE:	80009	4370399XX
−3	348−1109−XX			2	GASKET,SHIELD:45.0 L	80009	3481109XX
−4	200−3695−XX			1	REAR COVER ASSY:W/FEET AND LABELS	80009	2003695XX
−5	343−1213−XX			1	CLAMP,PWR CORD:POLYMIDE (STANDARD ACCESSORY)	TK1163	ORDER BY DESC
−6	161−0230−XX			1	CABLE ASSY,PWR,:3,18 AWG,92 L,SVT,TAN (STANDARD ACCESSORY)	TK2432	ORDER BY DESC
−7	200−2264−XX			1	CAP,FUSEHOLDER:3AG FUSES (AMERICAN)	S3629	FEK 031 1666
	200−2265−XX			1	CAP,FUSEHOLDER:5 X 20MM FUSES (EUROPEAN)	S3629	FEK 031.1663
−8	159−0013−XX			1	FUSE,CARTRIDGE:3AG,6A,250V,FAST BLOW (AMERICAN)	75915	312006
	159−0210−XX			1	FUSE,CARTRIDGE:DIN 5 X 20MM,5AMP,250V (EUROPEAN)	S3629	TYPE FST 034−31
−9	367−0247−XX			1	HANDLE,CARRYING:11.54 L,W/CLIP	80009	3670247XX
−10	200−2191−XX			2	CAP,RETAINER:PLASTIC	0JR05	ORDER BY DESC
−11	348−1110−XX			4	FOOT,CABINET:	80009	3481110XX
−12	348−1254−XX			4	PAD,FOOT:TEK BLACK,SANTOPRENE	80009	3481254XX
−13	348−0875−XX			1	FLIPSTAND,CAB:	TK0488	ORDER BY DESC
−14	200−3696−XX			1	COVER,FRONT:PLASTIC (STANDARD ACCESSORY)	80009	2003696XX
−15	101−0142−XX			1	TRIM,DECORATIVE:FRONT	TK1163	ORDER BY DESC
−16	334−8309−XX			1	MARKER,IDENT:MKD TDS820,6GHZ,2 CHANNEL	0KB05	3348309XX
	334−8381−XX			1	MARKER,IDENT:MKD TDS820,8GHZ,2 CHANNEL (OPTION 1D ONLY)	0KB05	338381XX
−17	050−2855−XX			1	SWITCH,ELAST:SILCON RUBBER,BEZEL	TK1918	ORDER BY DESC
−18	211−0730−XX			8	SCR,ASSEM WSHR:6−32 X 0.375,PNH,STL CD PL	0KB01	ORDER BY DESC
−19	650−2298−XX			1	REPLACABLE ASSY:FRAME DISPLAY;W/FLEX	80009	6502298XX
−20	378−0366−XX			1	FILTER,LT,CRT:6.75X5.50,DARK GRAY	11536	ORDER BY DESC
−21	386−6211−XX			1	RETAINER,FILTER:LIGHT FILTER RETAINER	TK1163	ORDER BY DESC
−22	650−2764−XX			1	OVERLAY ASSY:386−6145−XX,333−3994−XX	80009	6502764XX
−23	614−0892−XX			1	FRONT PNL ASSY:TDS820	80009	6140892XX
−24	671−1701−XX			1	CIRCUIT BD ASSY:FIRMFACE	80009	6711701XX
−25	348−1160−XX			2	SHIELD,ELEC:SST,W/CHEVRONS,0.4 PITCH,8.0 L	52814	ORDER BY DESC
−26	348−1159−XX			2	SHIELD,ELEC:SST,W/CHEVRONS,0.4 PITCH,5.0 L	52814	ORDER BY DESC
−27	377−0579−XX			6	INSERT,KNOB:PLASTIC	TK1163	ORDER BY DESC
−28	366−2170−XX			1	KNOB:DIMPLED GPK,1.7 DIA	TK1163	ORDER BY DESC
−29	386−6281−XX			1	SUBPANEL,FRONT:PLASTIC,TDS820	80009	3866281XX
−30	333−3985−XX			1	PANEL,FRONT:LOWER,6GHZ +/−6V,ALUMINUM	80009	3333985XX
	334−8405−XX			1	MARKER,IDENT:INPUT PANEL,FT LOWER 8GHZ (OPTION 1D ONLY)	0KB05	3348405XX
−31	366−2114−XX			2	KNOB:LARGE,DETENTED	TK1163	ORDER BY DESC
−32	366−2111−XX			3	KNOB:SMALL,FLUTED	TK1163	ORDER BY DESC

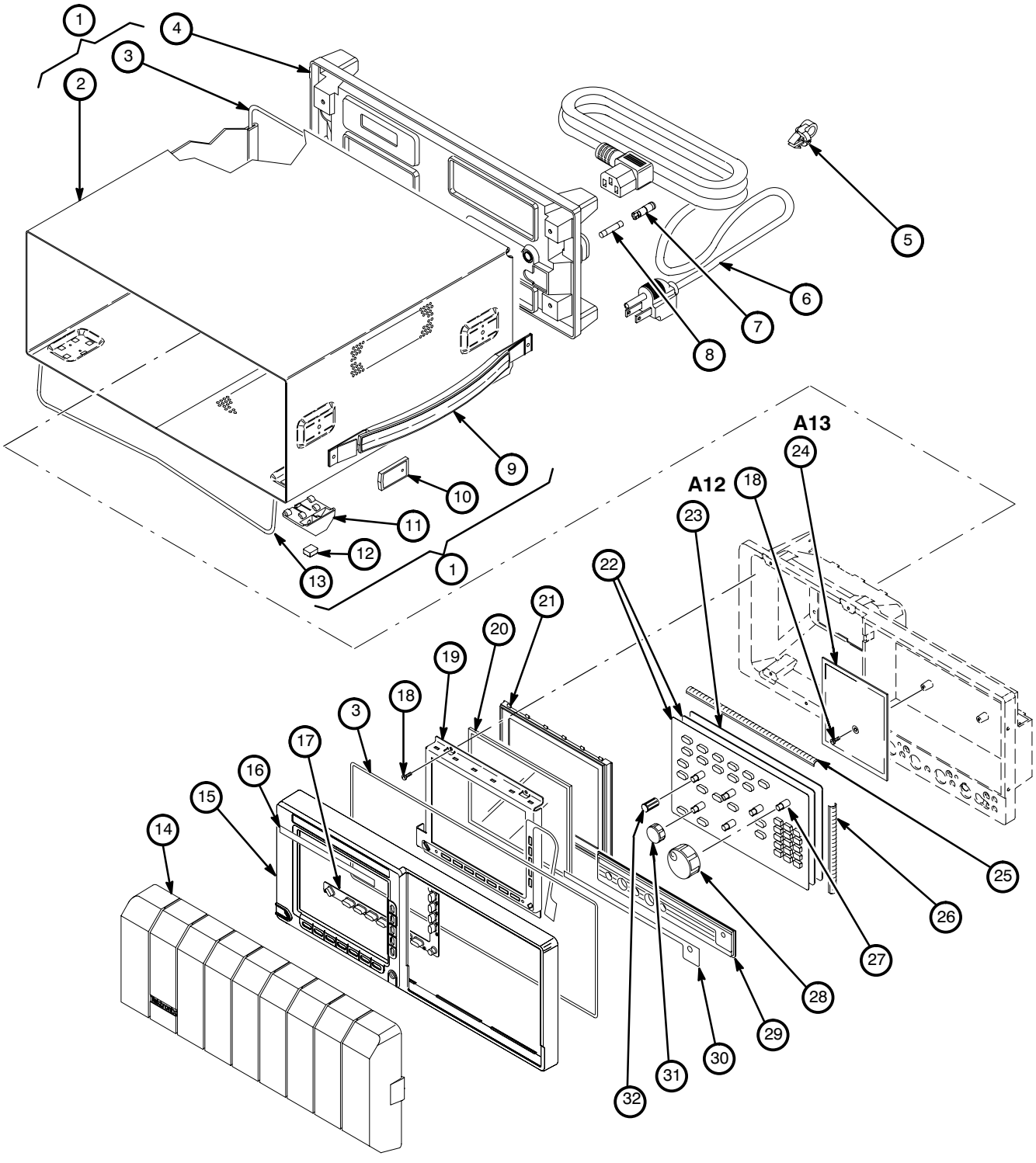


Figure 10-1: External and Front Panel Modules

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
10−2−1	212−0189−XX			2	SCREW,MACHINE:8−32 X 0.500,PAN HEAD	0KB01	ORDER BY DESC
−2	119−5044−XX			1	FAN,TUBEAXIAL:48 VDC,22W,3350RPM,235 CFM	80009	1193413XX
−3	671−2002−XX			1	CIRCUIT BD ASSY:PROCESSOR DISPLAY	80009	6712002XX
−4	441−1902−XX			1	CHASSIS,SCOPE:REAR	0J9P9	ORDER BY DESC
−5	129−1085−XX			2	SPACER,POST:0.25 L,4−40,BRS,0.25 HEX	TK0588	1291085XX
−6	103−0269−XX			2	ADAPTER,CONN:SMA TO PELTOLA,FEMALE	24931	39JR198−1
−7	210−0465−XX			1	NUT,PLAIN,HEX:0.25−32 X 0.375,BRS CD PL	0KB01	ORDER BY DESC
−8	334−8300−XX			1	MARKER,IDENT:MKD BNC,TDS820	80009	3348300XX
−9	407−3825−XX			2	BRACKET,CKT BD:PLASTIC,REAR	TK1163	ORDER BY DESC
−10	386−5872−XX			1	PLATE,REAR:ALUMINUM,STD	0J9P9	ORDER BY DESC
−11	348−1300−XX			2	SHLD,GSKT,ELEK:3.165L,CLIP ON	30817	0098−0564−09−03
−12	211−0730−XX			12	SCR,ASSEM WSHR:6−32 X 0.375,PNH,STL CD PL	0KB01	ORDER BY DESC
−13	671−1568−XX			1	CIRCUIT BD ASSY:D1 BUS	80009	6711568XX
−14	671−2563−XX			1	CIRCUIT BD ASSY:ACQ CONTROL,2 CHANNEL	80009	6712563XX
−15	119−4283−XX			2	MODULE ASSY:SAMPLER	80009	1194283XX
−16	211−0260−XX			8	SCR,ASSEM WSHR:2−56 X 0.687,PNH,STL,POZ	TK0435	ORDER BY DESC
−17	343−1466−XX			1	CLP,HT SINK:0.063 ALUMINUM	TK1465	ORDER BY DESC
−18	211−0382−XX			2	SCREW,MACHINE:4−40X0.500,PAN HEAD,CD PL	TK0435	ORDER BY DESC
−19	174−2638−XX			2	CABLE ASSY,RF:50 OHM SEMI RIG COAX,6.275L (OPTION 1D ONLY)	80009	1742638XX
−20	119−4286−XX			1	DELAY LINE,ELEC:20NS,+/− 0.1NS,DUAL CABLE	9W826	300153
−21	119−4303−XX			1	MODULE ASSEMBLY:COMPENSATION BOX	80009	1194303XX
−22	200−4345−XX			1	COVER,DLY LINE:DELAY LINE COMPENSATOR	80009	2004345XX
−23	131−0850−XX			3	CONN,RF JACK:SMA,FEEDTHRU;DUAL FERRLE	26805	2084−0000−02
−24	671−2405−XX			1	CIRCUIT BD ASSY:INTERCONNECT	80009	6712405XX
−25	174−2764−XX			2	CA ASSY,SP,BR:MIXED,RIBBON,DESCRETE	80009	1742764XX
−26	136−0140−XX			1	JACK,TIP:BANANA,CHARCOAL GRAY	TK1617	1360140XX
−27	407−4179−XX			1	BRACKET,CONN:ALUMINUM	0J9P9	4074179XX
−28	210−0270−XX			2	TERMINAL,LUG:0.438 ID,LOCKING,BRS CD PL	80009	2100270XX
−29	210−0895−XX			1	WASHER,SHLDR:0.255 ID X 0.375 OD X 0.105,NYL	TK1617	ORDER BY DESC
−30	210−0465−XX			1	NUT,PLAIN,HEX:0.25−32 X 0.375,BRS CD PL	0KB01	ORDER BY DESC
−31	343−0088−XX			1	CLAMP,CABLE:0.062 DIA,PLASTIC	80009	3430088XX
−32	441−1901−XX			1	CHASSIS,SCOPE:TOP	0J9P9	ORDER BY DESC
−33	407−3878−XX			6	BRACKET,CKT BD:PLASTIC	TK1163	ORDER BY DESC
−34	407−3877−XX			2	BRACKET,CKT BD:PLASTIC	TK1163	ORDER BY DESC

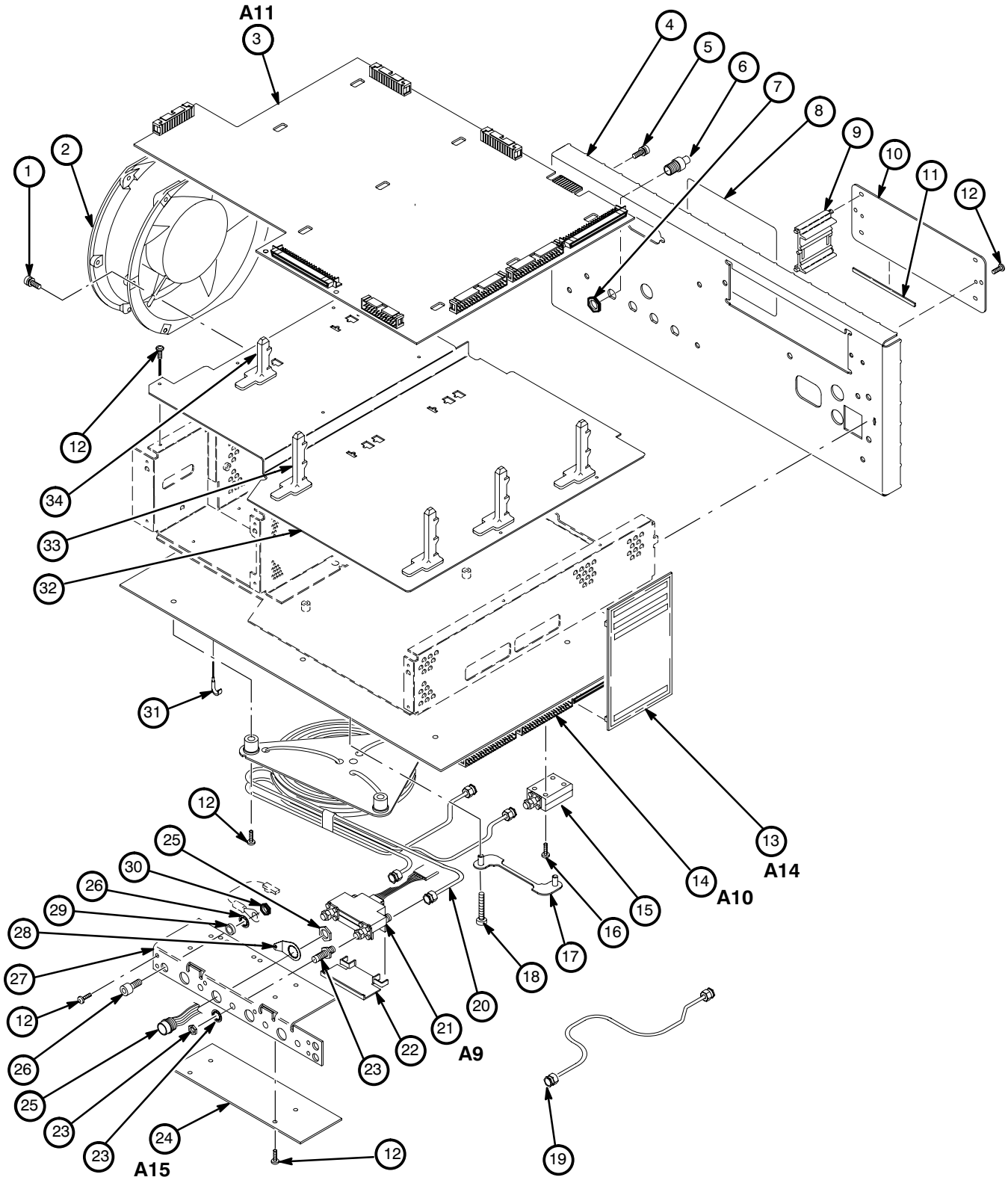


Figure 10-2: Outer-Chassis Modules

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
10−3−1	640−0071−01			1	DISPLAY,MONOCHR:7 INCH	80009	640007101
−2	348−1300−XX			1	SHLD,GSKT,ELEK:3.165L,CLIP ON	30817	0098−0564−09−03
−3	620−0063−XX			1	POWER SUPPLY:SWITCHING,300W,MULT OUT	80009	6200063XX
−4	441−2017−XX			1	CHASSIS,SCOPE:W/SHIELD,ALUMINUM	80009	4412017XX
−5	386−6282−XX			1	PANEL,FRONT:ALUMINUM,CASTING	80009	3866282XX

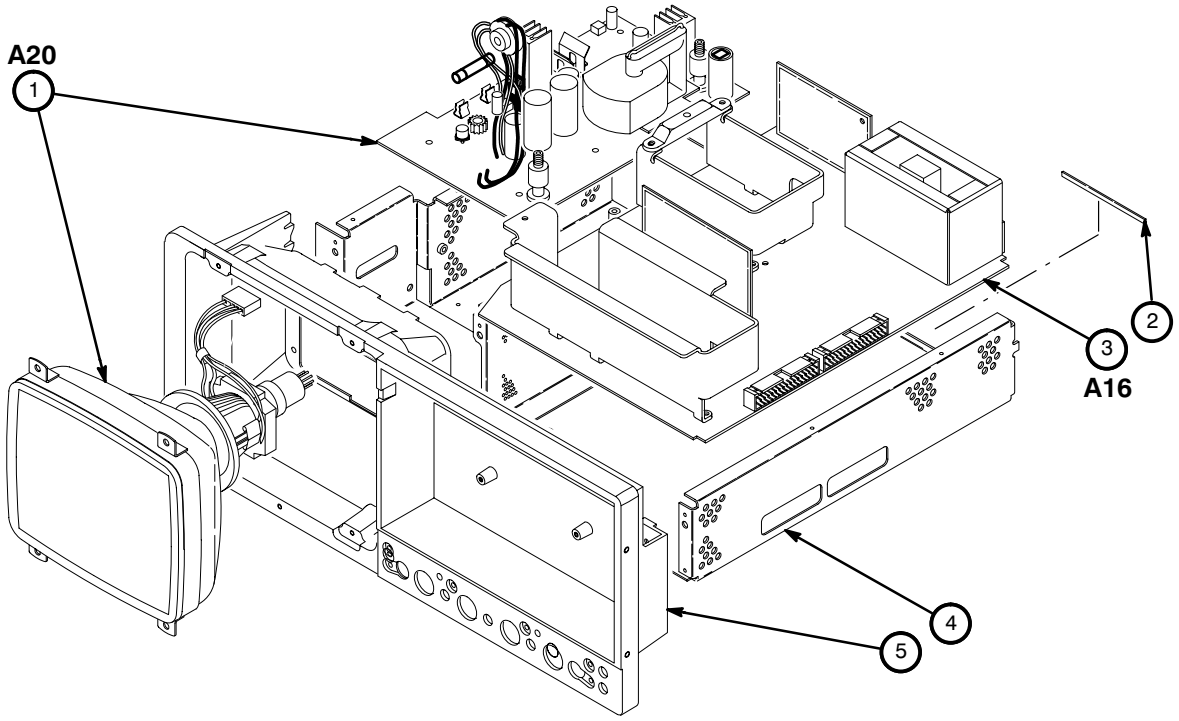


Figure 10-3: Inner-Chassis Modules

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
10−4−1	174−1525−XX			1		CA ASSY,SP,ELEC:2 X 8−13,28 AWG	TK2469	ORDER BY DESC
−2	174−2349−XX			1		CABLE ASSY:7.0 L,2,2 COND,RIBBON,LDI,1X2	TK2354	ORDER BY DESC
−3	174−1524−XX			1		CA ASSY,SP,ELEC:26/24 PIN,GPIB	TK2469	ORDER BY DESC
−4	346−0266−XX			1		STRAP,CABLE:PLASTIC	0KB05	3460266XX
−5	174−1519−XX			2		CA ASSY,SP,ELEC:2 X 20,0.1 X 0.1,28 AWG	TK1899	ORDER BY DESC
−6	174−1728−XX			1		CA ASSY,SP,ELEC:26 COND,6.0 L	53387	ORDER BY DESC

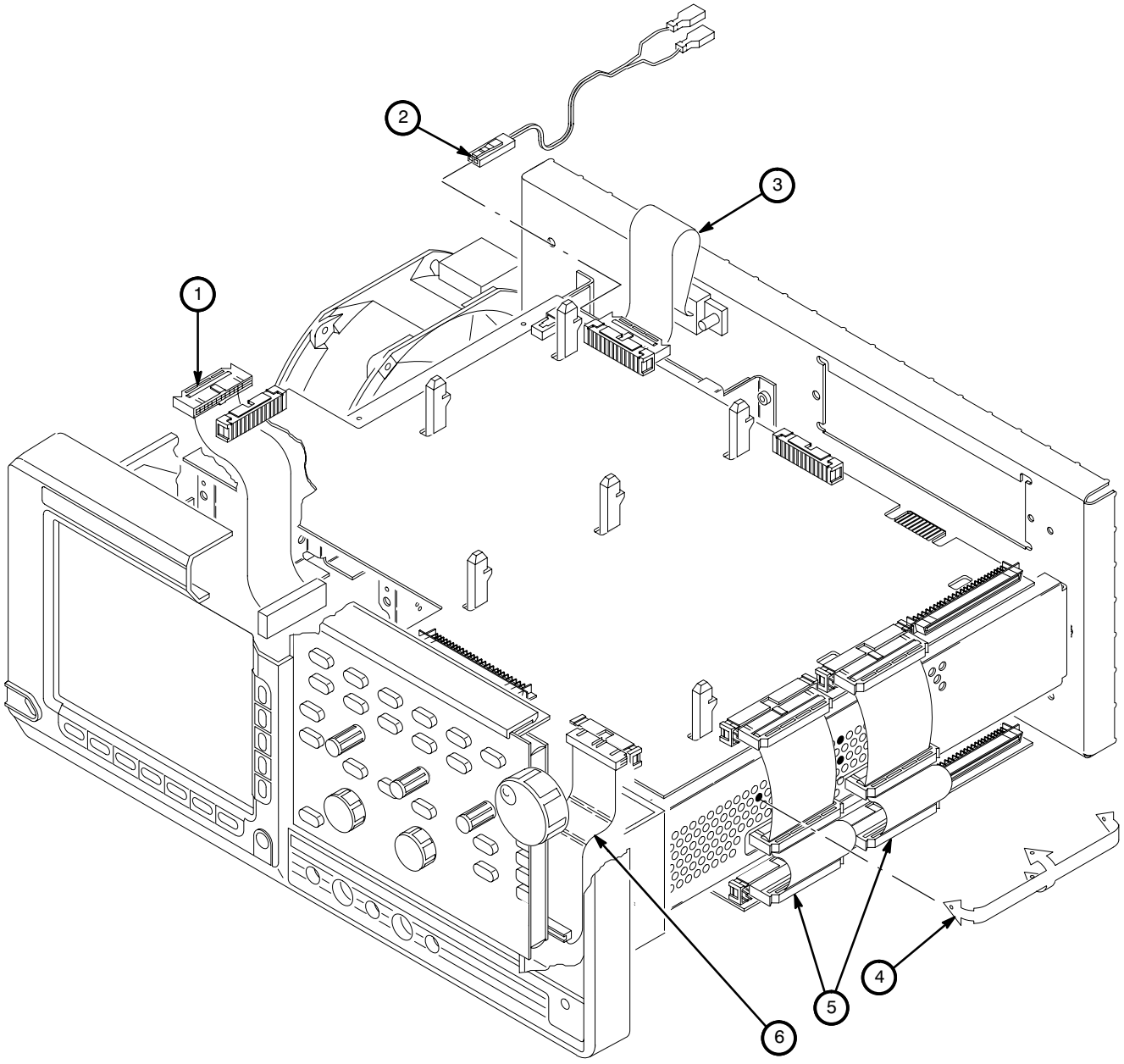


Figure 10-4: Cables (Top View)

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
10−5−1	174−2636−XX			1		CABLE ASSY,RF:50 OHM COAX,4.0 L,SMA MALE	TK2469	ORDER BY DESC
−2	174−2637−XX			2		CABLE ASSY,RF:50 OHM COAX,8.0 L,SMA MALE	80009	1742637XX
−3	−−−−−−−−			2		CA ASSY,SP,BR:MIXED,RIBBON,DESCRETE (P/O 174−2764−XX, SEE FIGURE 2)		
−4	174−2729−XX			2		CABLE ASSY,RF:50 OHM COAX,5.5 L W/PETOLA	TK2469	ORDER BY DESC
−5	119−4314−XX			1		DELAY LINE,ELEC:COAX,FLEXIBLE	TK2469	ORDER BY DESC
−6	175−8029−XX			1		CABLE ASSY,RF:50 OHM COAX,12.0 L,9−2	80009	1758029XX
−7	174−1769−XX			1		CA ASSY,SP:RIBBON.;CRIMP/STRIP,6,28,2.5L	80009	1741769XX
−8	174−2726−XX			1		CA ASSY,SP,ELEC:10,28 AWG,4.0 L,RIBBON	80009	1742726XX
−9	174−2727−XX			1		CA ASSY,SP,ELEC:8,28 AWG,16.0 L,RIBBON,1X8	80009	1742727XX
−10	174−2667−XX			1		CABLE ASSY,RF:50 OHM COAX,13.5 L	TK2469	ORDER BY DESC

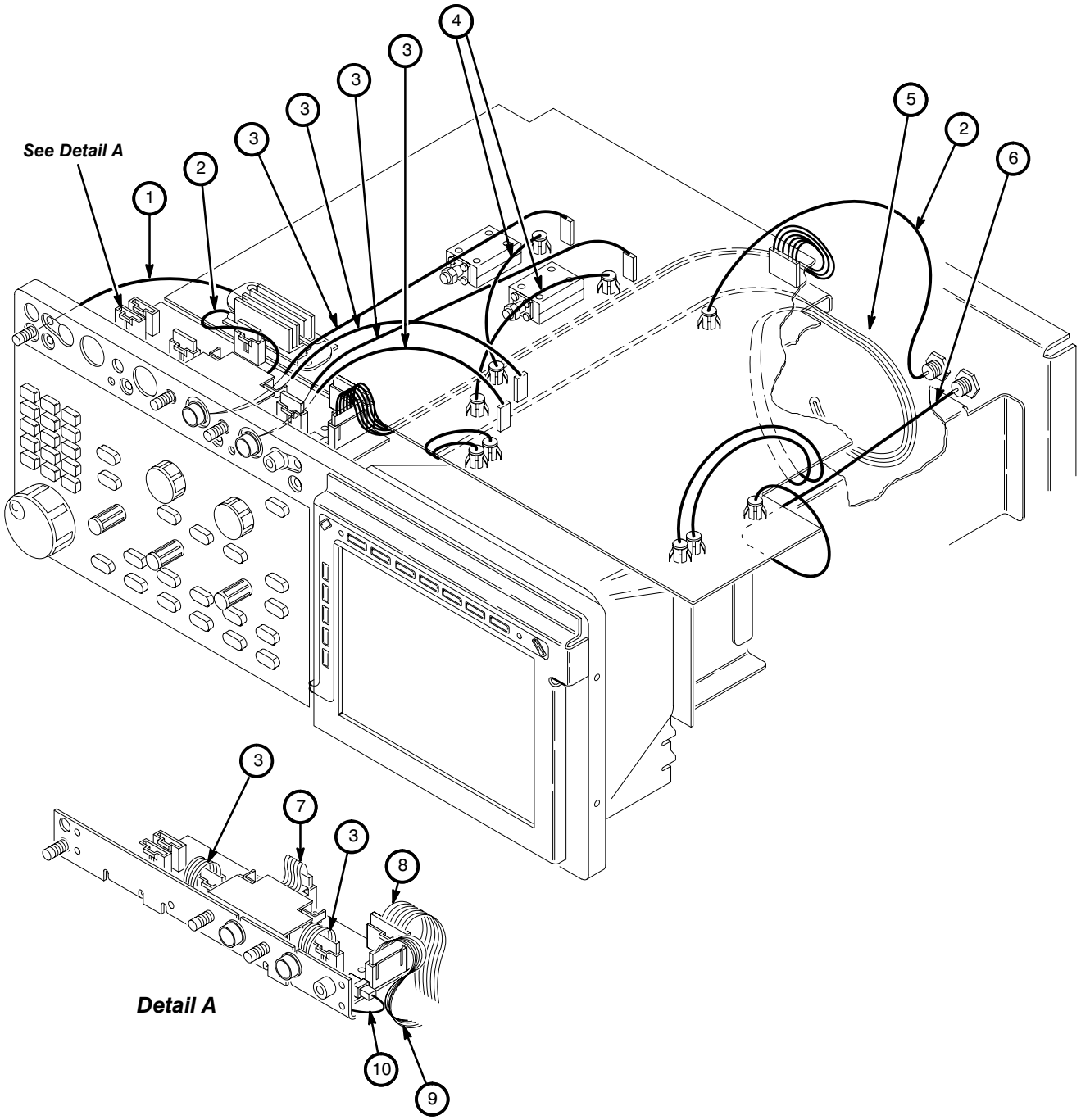


Figure 10-5: Cables (Bottom View)

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
						STANDARD ACCESSORIES		
	P6207			2		PROBE,ACTIVE:4GHZ,0.3PF,10X,SMA	80009	P6207
	006−3415−XX			1		STRAP,WRIST:3M TYPE 2214,ADJUSTABLE,6 FT	TK0623	400 1829
	015−0554−XX			1		ADPTR,SMA,ELEC:FEMALE BNC TO MALE SMA	80009	0150554XX
	015−1012−XX			1		ADAPTER,CONN:SMA,FEMALE,0.500 L	02660	901−9217
	015−1016−XX			1		ADAPTER,CONN:SMA MALE TO 2 SMA FEMALES	80009	0151016XX
	015−1020−XX			1		TERM,COAXIAL:SHORT CIRCUIT,SMA	0GZV8	64SMA−50−0−1
	070−8511−XX			1		MANUAL,TECH:QUICK REFERENCE TDS820	80009	0708511XX
	070−8512−XX			1		MANUAL,TECH:TUTORIAL/USER TDS820	80009	0708512XX
	070−8513−XX			1		MANUAL,TECH:PROGRAMMER TDS820	80009	0708513XX
	070−8696−XX			1		MANUAL,TECH:PERFORMANCE VERIFICATION	80009	0708696XX
	−−−−−−−−			1		CABLE ASSY,PWR:3,18AWG,115V,74.0 L (STANDARD, SEE FIGURE 10−1−6)		
	161−0104−05			1		CABLE ASSY,PWR,:3,18 AWG,240V,98.0 L (OPTION A3−AUSTRALIAN)	S3109	SAA/3−OD3CCFC3X
	161−0104−06			1		CABLE ASSY,PWR,:3 X 0.75MM SQ,220V,98.0 L (OPTION A1−EUROPEAN)	S3109	VIIGSOPO−HO5VVF
	161−0104−07			1		CABLE ASSY,PWR,:3,1.0MM SQ,240 VOLT,2.5 M (OPTION A2−UNITED KINGDOM)	S3109	ORDER BY DESC
	161−0104−08			1		CABLE ASSY,PWR,:3,18 AWG,98 L (OPTION A4−NORTH AMERICAN)	S3109	ORDER BY DESC
	161−0167−00			1		CABLE ASSY,PWR,:3.0 X 0.75,6A,240V,2.5M (OPTION A5−SWITZERLAND)	S3109	ORDER BY DESC
	174−1364−XX			1		CABLE ASSY,RF:12.0L,0−N	TK2469	ORDER BY DESC
	174−1428−XX			1		CABLE ASSY,RF:50 OHM COAX,60.0 LW/BLACK	TK2469	ORDER BY DESC
	−−−−−−−−			1		COVER,FRONT:PLASTIC (SEE FIGURE 10−1−14)		
	−−−−−−−−			1		CLAMP,PWR CORD:POLYMIDE (SEE FIGURE 10−1−5)		

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
						OPTIONAL ACCESSORIES		
	012−0991−00			1		CABLE,COMPOSITE:IDC,GPIB.2 METER,24 COND	00779	553577−3
	012−0991−01			1		CABLE,GPIB:LOW EMI, 1 METER	00779	553577−2
	012−1388−XX			1		CABLE,ASSEMBLY:OSC SECURITY CABLE,6 FT	TK2478	TSC−20
	016−0909−XX			1		CASE,CARRYING:SOFTSIDED FOR 3002C,25 PIN	TK2162	0587
	016−1135−XX			1		CASE,CARRYING:26 X 22 X 15,HARD TRANSFER	34416	2622RW−7T−7B
	016−1236−XX			1		MOUNTING KIT:RACKMOUNT KIT (OPTION 1R ONLY)	80009	0161136XX
	016−1145−XX			1		HOOD ASSEMBLY:TDS SERIES	80009	0161145XX
	020−1693−XX			1		COMPONENT KIT:SMA KIT	80009	0201693XX
	063−1262−XX			1		SOFTWARE PKG:FIRMWARE V2,(1) 3.5,(1)5.25	80009	0631262XX
	070−8514−XX			1		MANUAL,TECH:SERVICE,TDS820/840	80009	0708514XX
	070−8567−XX			1		MANUAL,TECH:RS−232/CENTRONICS (OPTION 13 ONLY)	80009	0708567XX
	C9			1		CAMERA SCOPE:	80009	C9
	HC100			1		PLOTTER 4 PIN:GPIB/CENTRONICS INPUT CONN (OPTION 1P ONLY)	80009	HC100
	K218			1		CART: (OPTION 1K ONLY)	80009	K218
	SIU800			1		STATIC ISOLATOR (OPTION IS ONLY)	80009	SIU800