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Service Manual

Tektronix

TDS 520
Digitizing Oscilloscope

070-8312-01

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

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

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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

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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 520 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 520 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 the Digitizing Oscilloscope

The TDS 520 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 520.

Without the protective ground connection, all parts of the TDS 520 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 520 without the panels or covers.

Do Not Operate in Explosive Atmospheres

The TDS 520 provides no explosion protection from static discharges or arcing components. Do not operate the TDS 520 in an atmosphere of explosive gasses.

Electric Overload

Never apply a voltage to a connector on the TDS 520 that is outside the range specified for that connector.

Product Description

This section begins with a general description of the traits of the TDS 520 Digitizing Oscilloscope. Three subsections follow, one for each of three classes of traits: *nominal traits, warranted characteristics,* and *typical characteristics*.

General

The Tektronix TDS 520 Digitizing Oscilloscope is a portable, four-channel instrument suitable for use in a variety of test and measurement applications and systems. It supplies two full-featured channels, plus two auxiliary channels with fewer vertical scale factors. Key features include:

- Two full-featured input channels, each with 8-bit vertical resolution and a selectable record length of 500 to15,000 samples. A 50,000-sample record length is available with the 1M option.
- Two auxiliary input channels, similar to the full-featured channels but with only three vertical scale settings: 100 mV, 1 V, and 10 V.
- Any two of the four input channels can acquire and display waveforms simultaneously.
- A maximum digitizing rate of 500 Megasamples/second with an analog bandwidth of 500 MHz.
- Extensive triggering capabilities: such as edge, logic, and glitch.
- Full programmability and printer/plotter output.
- Advanced functions like continuously-updated measurements and local pass/fail decision making.
- Specialized display modes, such as waveform averaging and variable persistence.
- A unique graphical user interface (GUI), an on-board help mode, and a logical front-panel layout which combine to deliver a new standard in usability.

User Interface

This oscilloscope uses a combination of front-panel buttons, knobs, and on-screen menus to control its many functions. The front-panel controls are grouped according to function: vertical, horizontal, trigger, and special. Any function which is likely to get adjusted often, such as vertical positioning or the time base setting, is set directly by its own front-panel knob. Functions which are changed less often, such as vertical coupling and horizontal mode, are set indirectly using selected menus.

Menus

Pressing one (sometimes two) front-panel button(s), such as vertical menu, displays a *main* menu of related functions, such as coupling, bandwidth, etc., at the bottom of the screen. Pressing a main-menu button, such as coupling, displays a *side* menu of settings for that function, such as AC, DC, or GND (ground) coupling, at the right side of the screen. Pressing a side-menu button selects a setting such as DC.

Indicators

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

General Purpose Knob

The general purpose knob can be assigned to adjust a selected parameter function and can quickly change parameters by toggling the **SHIFT** button. Use the same method as for *selecting* a function, except the final side-menu selection assigns the general purpose knob to *adjust* some function, such as the position of measurement cursors on screen, or the setting for a channels fine gain.

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 full, 100 MHz, and 20 MHz bandwidth. Such icons allow you to more readily determine status or the available settings.

Signal Acquisition System

The signal acquisition system provides four vertical channels: two full-featured vertical channels (CH 1 and CH 2) with calibrated vertical scale factors from 1 mV to 10 V per division, plus two auxiliary channels (AUX 1 and AUX 2) with three calibrated vertical scale factors of 100 mV, 1 V, and 10 V per division. Any two of the four channels can be acquired simultaneously.

Each of the four channels can be displayed, vertically positioned, and offset; CH 1 and CH 2 can also have their bandwidth limited (100 MHz or 20 MHz) and their vertical coupling specified. Fine gain can also be adjusted for CH 1 and CH 2.

Besides the four channels, up to three math waveforms and four reference waveforms are available for display. (A math waveform results when dual waveform operations, such as add, are specified 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 vs Divisions per Record

Record Length[1, 2]	Divisions per Record (50 Samples/Division)
50000	1000 divs
15000	300 divs
5000	100 divs
2500	50 divs
1000	20 divs
500	10 divs

[1]The 50,000 samples in 1,000 division record is only available with Option 1M.

[2]The maximum record length of 15,000 samples (50,000 samples with Option 1M) is selectable with all acquisition modes except Hi Res. In Hi Res, the maximum record length is 5,000 samples (15,000 samples with Option 1M).

Both the delayed display and the intensified zone on the main intensified display can be delayed by time with respect to the main trigger. Both can be set to display immediately after the delay (delayed runs after main mode); the delayed display can also be set to display at the first valid trigger after the delay (delayed triggerable mode).

The delayed display (or the intensified zone) can also be delayed by a selected number of events. In this case, the events source is the delayed trigger source. For any events signal, the delayed-trigger system conditions the signal by determining the source, coupling, etc., of that signal.

Trigger System

The triggering system is comprised of three types of signals for triggering the signal-acquisition system.

- **Edge** (main- and delayed-trigger systems): This familiar type of triggering is fully configurable for source, slope, coupling, mode (auto or normal), and holdoff.
- **Logic** (main-trigger system): This type of triggering can be based on pattern (asynchronous) or state (synchronous). In either case, logic triggering is configurable for sources, for boolean operators to apply to those sources, for logic pattern or state on which to trigger, for mode (auto or normal), and for holdoff. Time-qualified logic triggering can also be specified.

- **Pulse** (main-trigger system): Pulse triggering is configurable for triggering on runt or glitch pulses, or on pulse widths or periods inside or outside limits that you specify. It is also configurable for source, polarity, mode, and holdoff.

You can choose where the trigger point is located within the acquired waveform record by selecting the amount of pretrigger data displayed. Presets of 10%, 50%, and 90% of pretrigger data can be selected in the horizontal menu, or the general purpose knob can be assigned to set pretrigger data to any value within the limits of trigger position resolution.

Acquisition Control

You can specify the mode and manner in which signals are acquired and processed, depending on your measurement requirements:

- You can select equivalent-time sampling on repetitive signals or interpolation of points sampled on non-repetitive signals. Both can increase the apparent sample rate on the waveform when maximum real-time rates are reached.
- Peak-detect, high-resolution, sample, envelope, and average modes can be used to acquire signals.
- The acquisition can be set to stop after a single acquisition (or sequence of acquisitions if acquiring in average or envelope modes).

On-Board User Assistance

Using the help and autoset features help you set up this oscilloscope to make your measurements.

Help

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

Autoset

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

Measurement Assistance

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

Cursor

Three types of cursors are provided for making parametric measurements on the displayed waveforms. Horizontal bar cursors (H Bar) measure vertical parameters (typically volts). Vertical bar cursors (V Bar) measure horizontal parameters (typically time or frequency) and now extend to the top and bottom of the screen. Paired cursors measure both amplitude and time simultaneously. These are delta measurements; that is, measurements based on the difference between two cursors.

Both H Bar and V Bar cursors can also be used to make absolute measurements; that is measurements relative to a defined level or event. For the H Bars, either cursor can be selected to read out its voltage with respect to any channels ground reference level. For the V Bars, it's time with respect to the trigger point (event) of the acquisition and the cursors can control the portion of the waveform on which automatic measurements are made.

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. Any four out of the more than 20 parameters available can be displayed to the screen. The displayed parameters are extracted continuously and the results updated on-screen as the Digitizing Oscilloscope continues to acquire waveforms. A single display of most of the automatic measurements can be obtained.

Digital Signal Processing (DSP)

An important component of the multiprocessor architecture of this Digitizing Oscilloscope is Tektronix's 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

Acquired waveforms may be saved 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 via 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 user can make hardcopies in a variety of popular output formats, such as TIFF, PCX, BMP, and EPS mono or color. The hardcopies obtained are based on what is displayed on-screen at the time hardcopy is invoked. The hardcopies can be stamped with date and time and spooled to a queue for printing at a later time.

Display

The TDS 520 Digitizing Oscilloscope offers 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

Zoom

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 tables that list the electrical and mechanical *nominal traits* that describe the TDS 520 Digitizing Oscilloscope.

Nominal traits are described using simple statements of fact such as "Two, both identical" 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	
Bandwidth Selections	20 MHz, 100 MHz, and FULL (500 MHz)	
Digitizers, Number of	Two, both identical	
Digitized Bits, Number of	8 bits[1]	
Input Channels, Number of	Two full-featured (CH 1 and CH 2), plus two limited, auxiliary inputs (AUX 1 and AUX 2)	
Input Coupling[2]	DC, AC, or GND	
Input Impedance Selections	1 MΩ or 50 Ω	
Ranges, Offset, CH 1 and CH 2	**Volts/Div Setting**	**Offset Range**
	1 mV/div–99.5 mV/div	±1 V
	100 mV/div–995 mV/div	±10 V
	1 V/div–10 V/div	±100 V
Ranges, Offset, AUX 1 and AUX 2	**Volts/Div Setting**	**Offset Range**
	100 mV/div	±0.5 V
	1 V/div	±5.0 V
	10 V/div	±50 V
Range, Position	±5 divisions	
Range, Sensitivity, CH 1 and CH 2	1 mV/div to 10 V/div[3]	
Range, Sensitivity, AUX 1 and AUX 2	100 mV/div, 1 V/div, and 10 V/div[4]	

[1]Displayed vertically with 25 digitization levels (DLs) per division and 10.24 divisions dynamic range with zoom off. A DL is the smallest voltage level change that can be resolved by the 8-bit A-D Converter, with the input scaled to the volts/division setting of the channel used. Expressed as a voltage, a DL is equal to 1/25 of a division times the volts/division setting.

[2]The input characteristics (*Input Coupling, Input Impedance Selections, etc.*) apply to both full-featured and auxiliary inputs except where otherwise specified.

[3]The sensitivity ranges from 1 mV/div to 10 V/div in a 1–2–5 sequence of coarse settings. Between a pair of adjacent coarse settings, the sensitivity can be finely adjusted. The resolution of such a fine adjustment is 1% of the more sensitive of the pair. For example, between 50 mV/div and 100 mV/div, the volts/division can be set with 0.5 mV resolution.

[4]There is no fine adjustment between the three sensitivity selections for AUX 1 and AUX 2.

Table 1-3: Nominal Traits—Time Base System

Name	Description		
Range, Sample-Rate[1,3]	**Input Channel**	**Number of Channels On**	**Sample-Rate Range**
	CH 1 or CH 2	1	5 Samples/s–500 MSamples/s
	CH 1 or CH 2	2	5 Samples/s–250 MSamples/s
	AUX 1 or AUX 2	Doesn't matter	5 Samples/s–250 MSamples/s
Range, Equivalent Time or Interpolated Waveform Rate[2,3]	500 MSamples/s to 100 GSamples/s (2 ns/Sample to 1 ps/Sample)		
Range, Seconds/Division	500 ps/div to 10 s/div		
Range, Time Base Delay Time	16 ns to 250 seconds		
Record Length[4]	500 samples, 1000 samples, 2500 samples, 5000 samples, 15000 samples. A record length of 50000 samples is available with Option 1M.		

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

[2]The range of waveform rates for equivalent time or interpolated waveform records.

[3]The Waveform Rate (WR) is the equivalent sample rate of a waveform record. For a waveform record acquired by real-time sampling of a single acquisition, the waveform rate is the same as the real-time sample rate; for a waveform created by interpolation of real-time samples from a single acquisition or by equivalent-time sampling of multiple acquisitions, the waveform rate is faster than the real time sample rate. For all three cases, the waveform rate is 1/(Waveform Interval) for the waveform record, where the waveform interval (WI) is the time between the samples in the waveform record.

[4]The maximum record length of 15,000 samples (50,000 samples with Option 1M) is selectable with all acquisition modes except Hi Res. In Hi Res, the maximum record length is 5,000 samples (15,000 samples with Option 1M).

Table 1-4: Nominal Traits—Triggering System

Name	Description	
Range, Delayed Trigger Time Delay	16 ns to 250 seconds	
Range, Events Delay	2 to 10,000,000	
Range (Time) for Pulse-Glitch or Pulse-Width Triggering	2 ns to 1 s	
Ranges, Trigger Level or Threshold	**Source**	**Range**
	Any Channel	±12 divisions from center of screen
	Line	±300 V

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	Single Graticule: 401 × 501 pixels/8 × 10 divisions, where divisions are 1 cm by 1 cm
Waveform Display Grey Scale	Sixteen levels in infinite-persistence and variable persistence display styles

Table 1-6: Nominal Traits—Interfaces, Outputs, and Power Fuse

Name	Description
Interface, GPIB	GPIB interface complies with IEEE Std 488.1-1987 and IEEE Std 488.2-1987
Interface, RS-232 (Option 13 only)	RS-232 interface complies with EIA/TIA 574
Interface, Centronics (Option 13 only)	Centronics interface complies with Centronics interface standard C332-44 Feb 1977, REV A
Logic Polarity for Main- and Delayed-Trigger Outputs	Negative TRUE. High to low transition indicates the trigger occurred.
Fuse Rating	Either of two fuses[1] may be used: a .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	Standard Digitizing Oscilloscope 12.3 kg (27 lbs), with front cover. 20.0 kg (44 lbs), when packaged for domestic shipment. Rackmount Digitizing Oscilloscope 12.3 kg (27 lbs) plus weight of rackmount parts, for the rackmounted Digitizing Oscilloscope (Option 1R). 20.5 kg (45 lbs), when the rackmounted Digitizing Oscilloscope is packaged for domestic shipment. Rackmount conversion kit 2.3 kg (5 lbs), parts only; 3.6 kg (8 lbs), parts plus package for domestic shipping.
Overall Dimensions	Standard Digitizing Oscilloscope Height: 193 mm (7.6 in), without the accessories pouch installed. Width: 445 mm (17.5 in), with handle. Depth: 434 mm (17.1 in), with front cover installed. Rackmount Digitizing Oscilloscope 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 electrical and environmental *warranted characteristics* that describe the TDS 520 Digitizing Oscilloscope. Included are characteristics.

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

NOTE

In these tables, those warranted characteristics that are checked in the procedure Performance Verification, *found in Section 4, 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 scope has been adjusted at an ambient temperature between +20° C and +30° C, has had a warm-up period of at least 20 minutes, and is operating at an ambient temperature between 0° C and +50° C (unless otherwise noted).

Table 1-8: Warranted Characteristics—Signal Acquisition System

Name	Description	
Accuracy, DC Gain	±1%	
Accuracy, DC Voltage Measurement, Averaged[3]	**Measurement Type**	**DC Accuracy**
	Average of ≥16 waveforms	±(1.0% × |(reading − Net Offset[1])| + Offset Accuracy + 0.06 div)
	Delta volts between any two averages of ≥16 waveforms[2]	±(1.0% × |reading| + 0.1 div + 0.3 mV)

[1]Net Offset = Offset − (Position x Volts/Div). 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]The samples must be acquired under the same setup and ambient conditions.

[3]To ensure the most accurate measurements possible, run an SPC calibration first. When using the oscilloscope at a Volts/Div setting ≤5 mV/div, an SPC calibration should be run once per week to ensure that instrument performance levels meet specifications.

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

Name	Description	
Accuracy, Offset (CH 1 and CH 2)	**Volts/Div Setting**	**Offset Accuracy**
	1 mV/div – 99.5 mV/div	± (0.2% × |Net Offset[1]| + 1.5 mV + 0.1 div)
	100 mV/div – 995 mV/div	± (0.35% × |Net Offset[1]| + 15 mV + 0.1 div)
	1 V/div – 10 V/div	± (0.35% × |Net Offset[1]| + 150 mV + 0.1 div)
Accuracy, Offset (AUX 1 and AUX 2)	± (1% of Net Offset[1] + 0.1 div)	
Analog Bandwidth, DC-50 Ω Coupled or DC-1 M Ω Coupled	**Volts/Div**	**Bandwidth[4]**
	5 mV/div – 10 V/div	DC – 500 MHz
	2 mV/div – 4.98 mV/div	DC – 350 MHz
	1 mV/div – 1.99 mV/div	DC – 250 MHz
Cross Talk (Channel Isolation)	≥100:1 at 100 MHz and ≥30:1 at the rated bandwidth (see above) for any two channels having equal volts/division settings	
Delay Between Channels, Full Bandwidth, Equivalent Time	≤250 ps for any two channels with equal volts/division and coupling settings	
Input Impedance, DC-1 MΩ Coupled	1 MΩ ± 0.5% in parallel with 10 pF ±2 pF	
Input Impedance, DC-50 Ω Coupled	50 Ω ± 1% with VSWR ≤1.3:1 from DC – 500 MHz	
Input Voltage, Maximum, DC-1 MΩ, AC-1 MΩ, or GND Coupled	±400 V (DC + peak AC); derate at 20 dB/decade above 1 MHz	
Input Voltage, Maximum, DC-50 Ω or AC-50 Ω Coupled	5 V_{RMS}, with peaks ≤ ±30 V	
Lower Frequency Limit, AC Coupled	≤10 Hz when AC–1 MΩ Coupled; ≤200 kHz when AC-50 Ω Coupled[5]	

[1]Net Offset = Offset – (Position x Volts/Div). 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.

[4]The limits given are for the ambient temperature range of 0° C to +30° C. Reduce the upper bandwidth frequencies by 2.5 MHz for each ° C above +30° C.

[5]The AC Coupled Lower Frequency Limits are reduced by a factor of 10 when 10X, passive probes are used.

Table 1-9: Warranted Characteristics—Time Base System

Name	Description
Accuracy, Long Term Sample Rate and Delay Time	±25 ppm over any ≥1 ms interval
Accuracy, Delta Time Measurement	For single-shot acquisitions using sample or high-resolution acquisition modes and acquired in CH 1 or CH 2:

Channels On/Bandwidth Selected	**Measurement Accuracy[1,2]**
1 channel/100 MHz	± (1 WI + 25 ppm of |Reading| + 500 ps)
2 channels/20 MHz	± (1 WI + 25 ppm of |Reading| + 1.3 ns)

For repetitive acquisitions using average acquisition mode with ≥8 averages:

Channels On/Bandwidth Selected	**Measurement Accuracy[1,2]**
1 to 2 Channels/Full Bandwidth	± (1 WI + 25 ppm of |Reading| + 200 ps)

[1]For input signals ≥5 divisions in amplitude and a slew rate of ≥2.0 divisions/ns at the delta time measurement points. Signal must have been acquired at a volts/division setting ≥5 mV/division.

[2]The WI (waveform interval) is the time between the samples in the waveform record. Also, see the footnotes for *Sample Rate Range* and *Equivalent Time or Interpolated Waveform Rates* in Table 1-3 on page 1-8.

Table 1-10: Warranted Characteristics—Triggering System

Name	Description		
Accuracy (Time) for Pulse-Glitch or Pulse-Width Triggering	**Time Range**	**Accuracy**	
	2 ns to 1 µs	±(20% of setting + 0.5 ns)	
	1.02 µs to 1 s	±(100 ns + .0025% of setting)	
Accuracy, Trigger Level or Threshold, DC Coupled	**Trigger Source**	**Accuracy**[2]	
	Any Channel	±(2% of (Setting − Net Offset[1]) + 0.3 div × volts/div setting + Offset Accuracy)	
Sensitivity, Edge-Type Trigger, DC Coupled[3]	**Trigger Source**	**Sensitivity**	
	CH 1 and CH 2	0.35 division from DC to 50 MHz, increasing to 1 division at 500 MHz	
	AUX 1 and AUX 2	0.55 division from DC to 50 MHz, increasing to 1.5 divisions at 500 MHz.	
Width, Minimum Pulse and Rearm, for Pulse Triggering	**Pulse Class**	**Minimum Pulse Width**	**Minimum Rearm Width**
	Glitch	2 ns	2 ns + 5% of Glitch Width Setting
	Runt	2.5 ns	2.5 ns
	Width	2 ns	2 ns + 5% of Width Upper Limit Setting

[1]Net Offset = Offset − (Position × Volts/Div). 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]The Accuracy limits are for signals having rise and fall times ≥20 ns.

[3]The minimum sensitivity for obtaining a stable trigger. A stable trigger results in a uniform, regular display triggered on the selected slope. The trigger point must not switch between opposite slopes on the waveform, and the display must not "roll" across the screen on successive acquisitions. The TRIG'D LED stays constantly lighted when the SEC/DIV setting is 2 ms or faster but may flash when the SEC/DIV setting is 10 ms or slower.

Table 1-11: Warranted Characteristics—Interfaces, Output Ports and Power Requirements

Name	Description	
Output Voltage and Frequency, Probe Compensator	**Characteristic**	**Limits**
	Voltage	
	TDS 520 (B021799 and below); TDS 540 (B022999 and below):	0.5 V (base-top) ±5% into a 1 MΩ load; 0.25 V (base-top) ±7.5% into a 50 Ω load
	TDS 520 (B021800 and above); TDS 540 (B023300 and above):	0.5 V (base-top) ±1% into a 50 Ω load to ground
	Frequency	1 kHz ±5%
Source Voltage	90 to 250 VAC_{RMS}, continuous range	

Table 1-11: Warranted Characteristics—Interfaces, Output Ports and Power Requirements

Name	Description
Source Frequency	47 Hz to 63 Hz
Power Consumption	≤300 W (450 VA)

Table 1-12: Warranted Characteristics—Environmental, Safety, 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%, +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; 3.05 g rms, from 5 to 500 Hz, 10 minutes each axis, non-operating
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
User-Misuse Simulation	Electrostatic Discharge Susceptibility: Up to 8 kV with no change to settings or impairment of normal operation; up to 15 kV with no damage that prevents recovery of normal operation

Typical Characteristics

The tables in this subsection list the *typical characteristics* that describe the TDS 520 Digitizing Oscilloscope.

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

Table 1-13: Typical Characteristics—Signal Acquisition System

Name	Description	
Accuracy, DC Voltage Measurement, Not Averaged	**Measurement Type**	**DC Accuracy**
	Any Sample	±(1.0% × (|reading − Net Offset[1]|) + Offset Accuracy + 0.13 div + 0.6 mV)
	Delta Volts between any two samples[2]	±(1.0% × |reading| + 0.26 div + 1.2 mV)
Frequency Limit, Upper, 100 MHz Bandwidth Limited (CH 1, CH 2 only)	100 MHz	
Frequency Limit, Upper, 20 MHz Bandwidth Limited (CH 1, CH 2 only)	20 MHz	
Calculated Rise Time[3]	**Volts/Div Setting**	**Rise Time**
	5 mV/div–10 V/div	800 ps
	2 mV/div–4.98 mV/div	1.2 ns
	1 mV/div–1.99 mV/div	1.6 ns

[1]Net Offset = Offset − (Position × Volts/Div). 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]The samples must be acquired under the same setup and ambient conditions.

[3]The numbers given are valid 0° C to +30° C and will increase as the temperature increases due to the degradation in bandwidth. Rise time is calculated from the bandwidth. It is defined by the following formula:

$$Rise\ Time\ (ns) = \frac{400}{BW\ (MHz)}$$

Note that if you measure rise time, you must take into account the rise time of the test equipment (signal source, etc.) that you use to provide the test signal. That is, the measured rise time (RT_m) is determined by the instrument rise time (RT_i) and the rise time of the test signal source (RTgen) according to the following formula:

$$RT_m^{\ 2} = RT_i^{\ 2} + RT_{gen}^{\ 2}$$

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

Name	Description				
Nonlinearity	<1 DL, differential; ≤1 DL, integral, independently based				
Step Response Settling Errors (CH 1, CH 2 only)	**Volts/Div Setting**	**Step Amplitude**	**Settling Error (%)[4]**		
			20 ns	**100 ns**	**20 ms**
	1 mV/div–99.5 mV/div	≤2 V	≤0.5	≤0.2	≤0.1
	100 mV/div–995 mV/div	≤20 V	≤1.0	≤0.5	≤0.2
	1 V/div–10 V/div	≤200 V	≤1.0	≤0.5	≤0.2

[4]The values given are the maximum absolute difference between the value at the end of a specified time interval after the mid-level crossing of the step, and the value one second after the mid-level crossing of the step, expressed as a percentage of the step amplitude.

Table 1-14: Typical Characteristics—Time Base System

Name	Description
Aperture Uncertainty	≤(50 ps + 0.03 ppm × Record Duration)$_{rms}$, for real-time or interpolated records having duration ≤1 minute; ≤(50 ps + 0.06 × WI[1])$_{RMS}$, for equivalent time records

[1]The WI (waveform interval) is the time between the samples in the waveform record. Also, see the footnotes for *Sample Rate Range* and *Equivalent Time or Interpolated Waveform Rates* in Table 1-3 on page 1-8.

Table 1-15: Typical Characteristics—Triggering System

Name	Description	
Input, Auxiliary Trigger	The input resistance is ≥1.5 kΩ; the maximum safe input voltage is ±20 V (DC + peak AC).	
Error, Trigger Position, Edge Triggering	**Acquire Mode**	**Trigger-Position Error[1,2]**
	Sample, Hi-Res, Average	±(1 WI + 1 ns)
	Peak Detect, Envelope	±(2 WI + 1 ns)
Holdoff, Variable, Main Trigger	Minimum: For any horizontal scale setting, the *minimum* holdoff is 10 times that setting, but is never less than 1 µs or longer than 5 s. Maximum: For any horizontal scale setting, the *maximum* holdoff is at least 2 times the minimum holdoff for that setting, but is never more than 10 times the minimum holdoff for that setting.	

[1]The trigger position errors are typically less than the values given here. These values are for triggering signals having a slew rate at the trigger point of ±0.5 division/ns.

[2]The waveform interval (WI) is the time between the samples in the waveform record. Also, see the footnote for the characteristics *Sample Rate Range* and *Equivalent Time or Interpolated Waveform Rates* in Table 1-3 on page 1-8.

Table 1-15: Typical Characteristics—Triggering System (Cont.)

Name	Description	
Width, Minimum Pulse and Rearm, for Logic Triggering or Events Delay[3]	5 ns	
Lowest Frequency for Successful Operation of "Set Level to 50%" Function	30 Hz	
Sensitivity, Edge Trigger, Not DC Coupled[4]	**Trigger Coupling**	**Typical Signal Level for Stable Triggering**
	AC	Same as DC-coupled limits[5] for frequencies above 60 Hz. Attenuates signals below 60 Hz.
	Noise Reject	Three and one half times the DC-coupled limits.[5]
	High Frequency Reject	One and one half times the DC-coupled limits[5] for frequencies above 30 kHz. Attenuates signals below 30 kHz.
	Low Frequency Reject	One and one half times the DC-coupled limits[5] for frequencies above 80 kHz. Attenuates signals below 80 kHz.
Sensitivities, Logic-Type Trigger/Events Delay, DC Coupled[6]	1.0 division, from DC to 100 MHz with a minimum slew rate of 25 div/µs at the trigger level or the threshold crossing.	
Sensitivities, Pulse-Type Runt Trigger[6]	1.0 division, from DC to 200 MHz with a minimum slew rate of 25 div/µs at the trigger level or the threshold crossing.	
Sensitivities, Pulse-Type Trigger Width and Glitch[6]	1.0 division with a minimum slew rate of 25 div/µs at the trigger level or the threshold crossing. For <5 nsec pulse width or rearm time, 2 divisions are required.	
Sensitivity, Derating Aux Channel Trigger	All trigger sensitivity specifications are derated by 50% for AUX 1 and AUX 2 inputs.	

[3]The minimum pulse width and rearm width required for logic-type triggering or events delaying to occur.

[4]The minimum sensitivity for obtaining a stable trigger. A stable trigger results in a uniform, regular display triggered on the selected slope. The trigger point must not switch between opposite slopes on the waveform, and the display must not "roll" across the screen on successive acquisitions. The TRIG'D LED stays constantly lighted when the SEC/DIV setting is 2 ms or faster but may flash when the SEC/DIV setting is 10 ms or slower.

[5]See the characteristic *Sensitivity, Edge-Type Trigger, DC Coupled* in Table 1-10, which begins on page 1-14.

[6]The minimum signal levels required for stable logic or pulse triggering of an acquisition or for stable counting of a DC-coupled events delay signal. Also, see the footnote for *Sensitivity, Edge-Type Trigger, DC Coupled* in this table. (Stable counting of events is counting that misses no events.)

Table 1-16: Typical Characteristics—Data Handling

Name	Description
Time, Data-Retention, 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]Data is maintained by small lithium-thionyl-chloride batteries internal to the memory ICs. 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 the TDS 520 Digitizing Oscilloscope, as well as general information critical to safe and effective servicing of this oscilloscope.

Before Servicing

This manual is for servicing the TDS 520 Digitizing Oscilloscope. 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 the TDS 520 Digitizing Oscilloscope. (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, *Replaceable Parts.* 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 the TDS 520 Digitizing Oscilloscope and tables of the characteristics and descriptions that apply to it.
- *Operating Information* — is this section. It 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 your TDS 520 Digitizing Oscilloscope. Tektronix technicians are appraised of the latest information on improvements to the product as well as the latest new options to the product.

Warranty Repair Service

Tektronix warrants this product for three years from date of purchase, excluding probes for which the warranty is one year. (The 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 your TDS 520 Digitizing Oscilloscope to fit your requirements.

Option 9C — When you order your TDS 520 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 of the TDS 520 Digitizing Oscilloscope. 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

The TDS 520 Digitizing Oscilloscope comes with the following manuals:

TDS 520 and TDS 540 User Manual contains a tutorial to quickly show you how to operate the TDS 520 Digitizing Oscilloscope and an in depth discussion of how to more completely use its features. Applications are also discussed.

TDS 520 and TDS 540 Reference Manual contains a brief overview of oscilloscope operation.

TDS Family 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 the TDS 520 Digitizing Oscilloscope to a power source.

WARNING

AC POWER SOURCE AND CONNECTION. The TDS 520 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 520 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 TDS 520 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 *Table 2-2: Power-Cord and 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

Operating Voltage

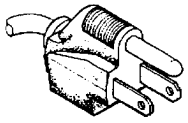
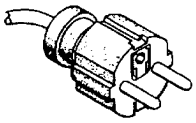
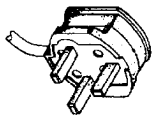
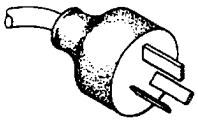
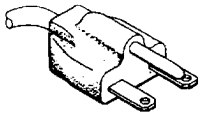
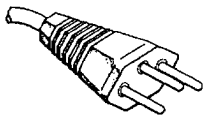
This oscilloscope operates with any line voltage from 90–250 VAC_{RMS} with any line frequency from 47–63 Hz. There are two fuses, either of which may be used throughout the line voltage and frequency ranges. (The two fuses are not totally interchangeable as each requires a different fuse cap.)

Memory Backup Power

Memory modules with on-board batteries allow the TDS 520 Digitizing Oscilloscope 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 on may indicate that the memory modules need to be replaced.

Table 2-2: Power Cord and Plug Identification

Plug Configuration	Usage (Max Rating)	Reference Standards & Certification	Option #
	North America 125 V/6 A	ANSI C73.11[1] NEMA 5-15-P[2] IEC 83[3] UL[10] CSA[11]	Standard
	Europe 220 V/16 A	IEC 83[3] CEE (7), II, IV, VII[4] VDE[8] SEMKO[9]	A1
	United Kingdom 240 V/13 A	IEC 83[3] BSI 1363[5]	A2
	Australia 240 V/10 A	AS C112[6] ETSA[12]	A3
	North America 240 V/15 A	ANSI C73.20[1] NEMA 6-15-P[2] IEC 83[3] UL[10] CSA[11]	A4
	Switzerland 220 V/10 A	SEV[7]	A5

1ANSI — American National Standards Institute
2NEMA — National Electrical Manufacturers' Association
3IEC — International Electrotechnical Commission
4CEE — International Commission on Rules for the Approval of Electrical Equipment
5BSI — British Standards Institute
6AS — Standards Association of Australia
7SEV — Schweizerischer Elektrotechnischer Verein
8VDE — Verband Deutscher Elektrotechniker
9SEMKO — Swedish Institute for Testing and Approval of Electrical Equipment
10UL — Underwriters Laboratories
11CSA — Canadian Standards Association
12ETSA — Electricity Trust of South Australia

Operating Environment

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

Operating Temperature

The TDS 520 Digitizing Oscilloscope can be operated where the ambient air temperature is between 0° and +50° C and can be stored in ambient temperatures from −40° 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 TDS 520 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 ¾ 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 Digitizing Oscilloscopes 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 On

Upon power on, 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 Off

CAUTION

DO NOT power off 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 off the instrument when doing operations that affect the data types listed in Table 2-3. Wait for the instrument to finish the operation when doing adjustments, saving waveforms, or saving setups.

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

Table 2-3: Effects of Corrupted Data

Corrupted Data Type	Results
Adjustment Constants:	
■ Signal Path Compensation	A signal path compensation is required.
■ Voltage Reference	A voltage reference adjustment is required (Section 5).
■ Frequency Response	A frequency response adjustment is required (Section 5).
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 and with an inside dimension at least six inches greater than the instrument dimensions.

If the instrument is being shipped to a Tektronix Service Center, enclose the following information: the owners 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 2-2 (on page 2-9 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

This subsection contains general operating instructions for theTDS 520 Digitizing Oscilloscope. The complete operators instructions are found in the *User Manual*.

Additional instructions are integrated into the service procedures found in later sections of this manual. For instance, the procedures found in Section 4 *Performance Verification* contain instructions for making the front-panel settings required to check each instrument characteristic included there. Also, the general instructions for operating this Digitizing Oscilloscopes 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.

Screen Layout

The screen layout is illustrated in Figure 2-1 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

Before doing service, read the following operating instructions. These instructions are at the level appropriate for servicing this Digitizing Oscilloscope.

How to Power On

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, the internal power supplies and much of the other circuitry of this Digitizing Oscilloscope are energized regardless of the setting of the* **ON/STBY** *switch.*

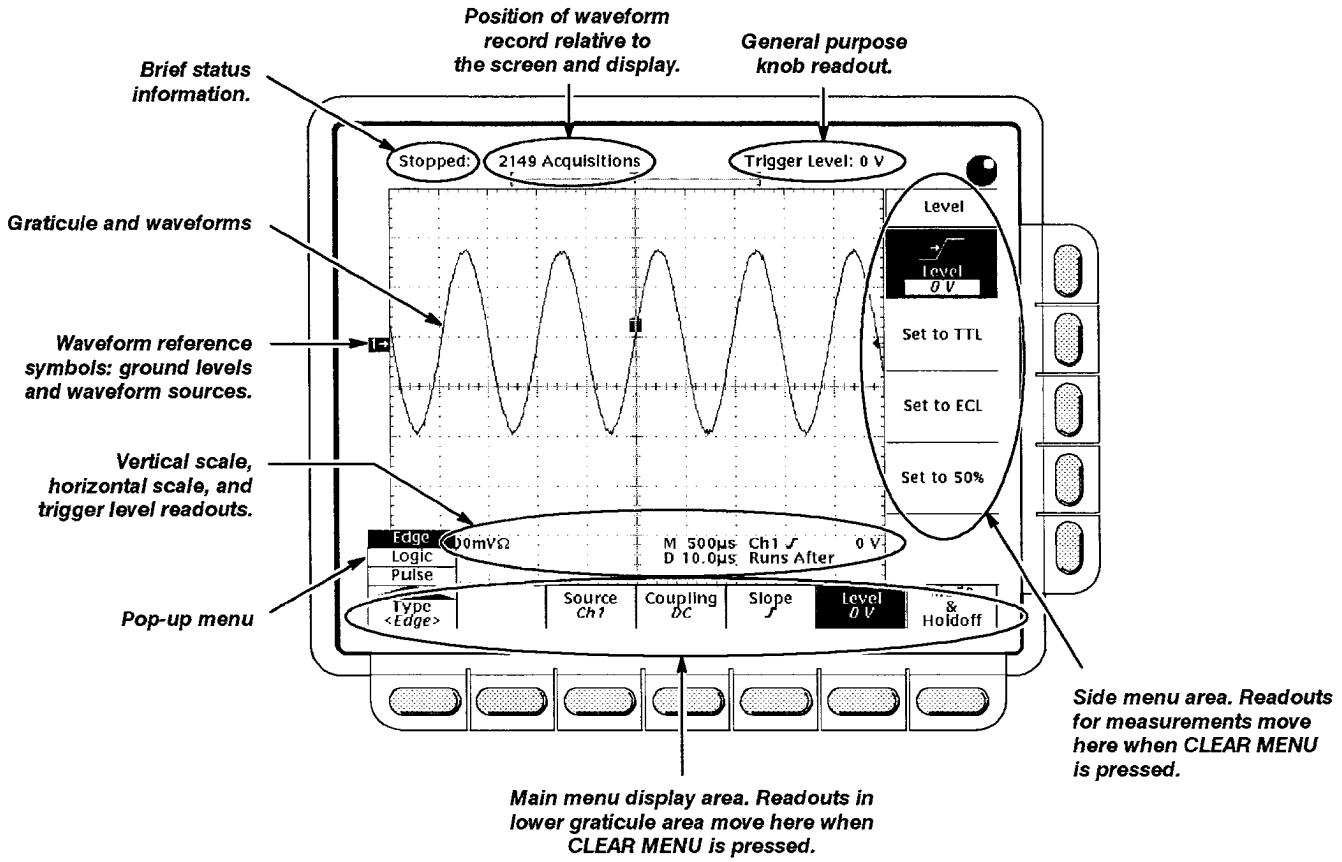


Figure 2-1: Map of Display Functions

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.

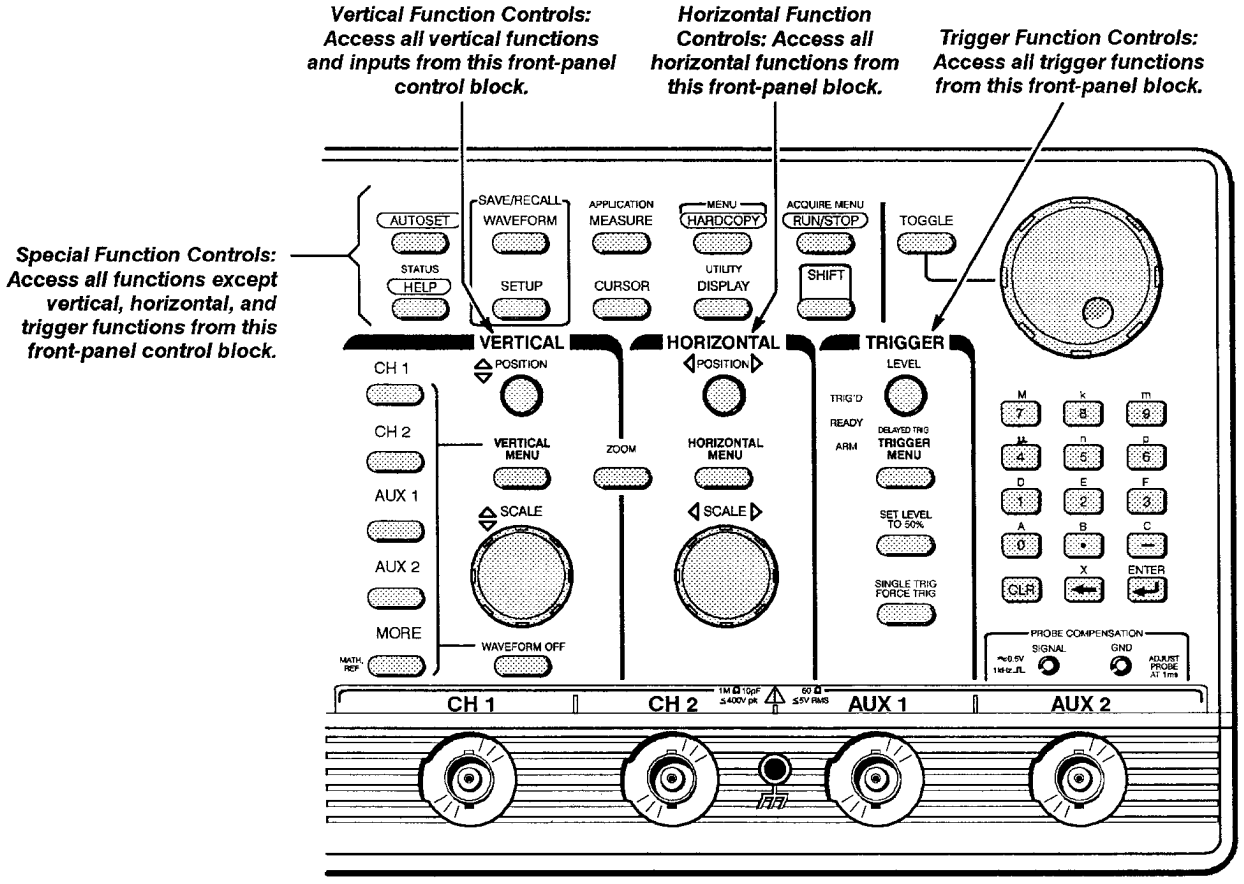
How to Use the Status Menu

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.

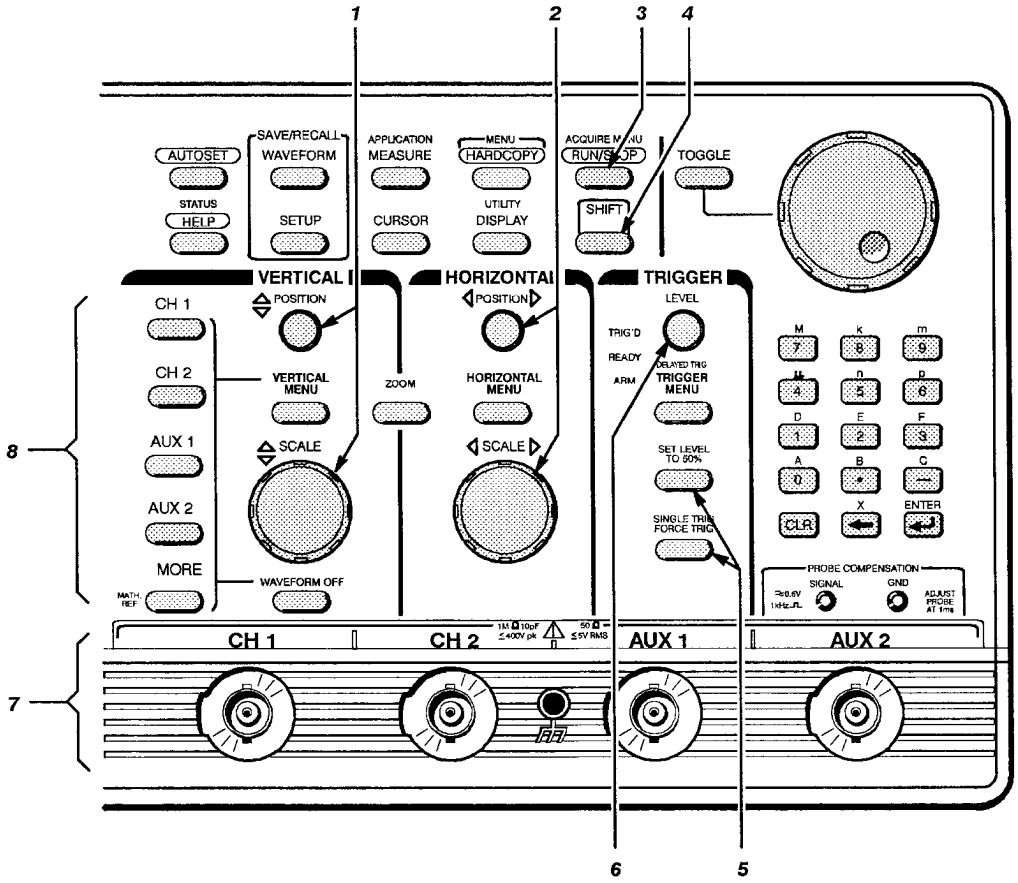
How to Set Functions

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.

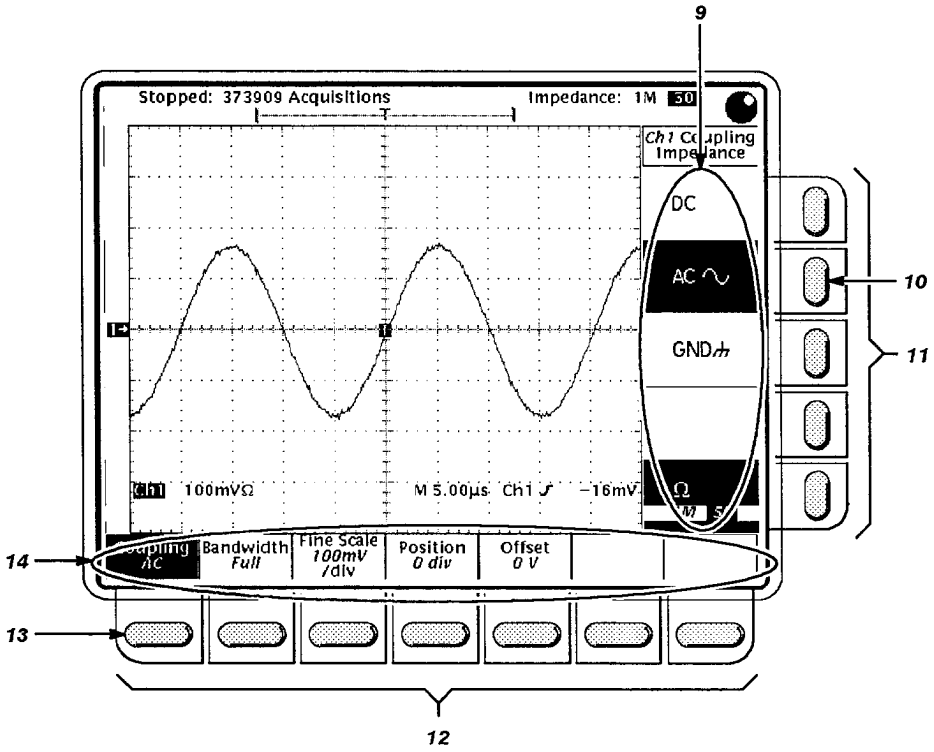
d. Stop and start acquiring waveforms (3). Example: Push **RUN/STOP** if not acquiring.

e. Adjust trigger level (6) to trigger the waveform(s) selected or use these buttons (5) to either set a trigger level at the mid-amplitude level of the selected waveform or to force a single trigger. 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***.

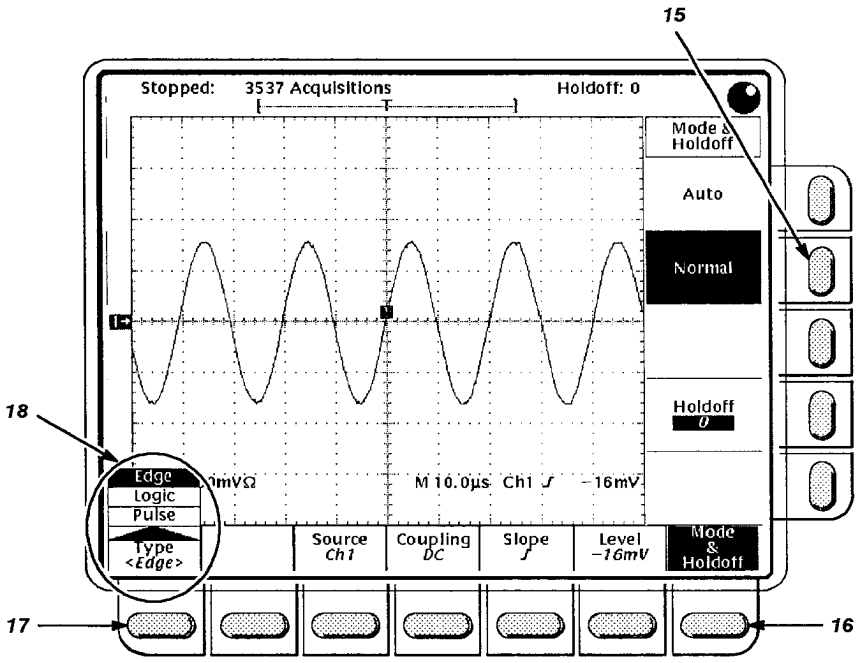
   d. Select a function from the main menu using the main menu buttons (12). A side menu for selecting among that the available settings for that function appears. Example: Push **Coupling** (13).

   e. Select the setting for the function from the side menu (9) using the side menu buttons (11). Example: Push **AC** (10).

How to Set Complex Functions

A few functions require more than just two levels (main and side) of menus to completely specify their settings. In such cases, either the main menu, 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:



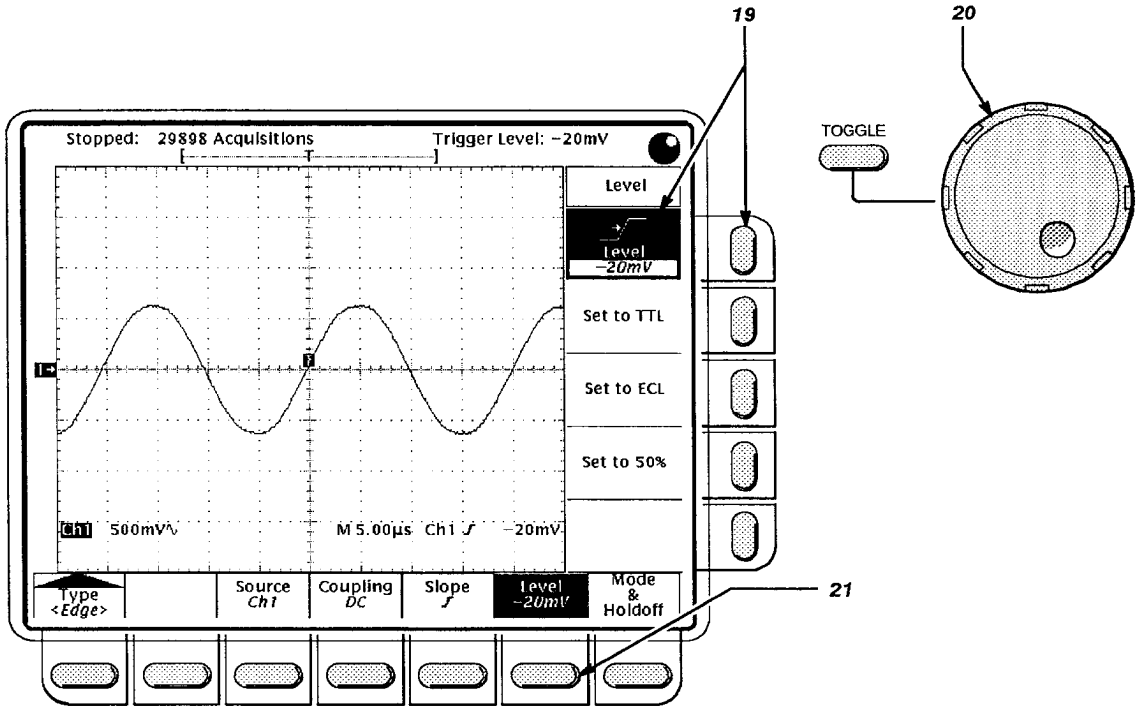
a. For some selections, pushing a main-menu button pops up a menu (18) of subfunctions. Example: Push **Type** (17).

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

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

c. Complete the setting of the desired mode by selecting from the main menu and the side menu that results. Example: Push **Mode & Holdoff** (16), and then push **Normal** (15).

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 **TRIGGER MENU**.)



a. Pushing some main menu buttons displays a side menu with labels containing readouts that can be varied. Example: Push **Level** (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 **Level** (19).

c. Use the general purpose knob (20) to adjust the trigger level to the setting desired. Example: Turn the knob to **−20 mV**.

More About the General Purpose Knob — As you've 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
- Delay time
- Number of events
- Trigger position
- 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 icon-label settings that show up in side-menu labels. Once assigned, the general purpose knob can change parameters by toggling the **SHIFT** button.
- The general purpose knob has a readout area at the upper right corner of the screen. (See Figure 2-1.) 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 doesn't control any function. (An exception is the cursor function. If cursors are turned on, removing the menu leaves the knob assigned to control the cursors until reassigned by selecting another menu and function that uses the knob.)
- 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, intensified or non-intensified samples, 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. Instructions for setting up communication over the GPIB are found in Section 5, *Adjustment Procedures*.

Circuit Description

This section describes the electrical operation of the TDS 520 Digitizing Oscilloscope 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 TDS 520 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 Section 9 *Diagrams,* Figure 9-2.

General

The Tektronix TDS 520 Digitizing Oscilloscope is a portable, four-channel instrument suitable for use in a variety of test and measurement applications and systems. It has two full-featured channels, plus two auxiliary channels.

Input Signal Path

A signal enters the oscilloscope through a probe connected to a BNC on the A15 Attenuator board.

Attenuators — Circuitry in the attenuator selects the input coupling, termination, and the attenuation factor. The processor system, by way of the acquisition system, controls the attenuators. For example, if 50 Ω input termination is selected and the input is overloaded, the processor system switches the input to the 1 MΩ position.

Probe Coding Interface — Probe coding interface signals pass through the A15 Attenuator to the acquisition system, where they are sensed and controlled.

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 instrument. 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.

Voltage Controlled Oscillator (VCO)

Master clocks for the acquisition system are generated by a voltage controlled oscillator on the A21 VCO Board and circuitry on the A10 Acquisition board. The circuitry makes up a phased locked loop. The master clock is divided down by the A10 Acquisition circuitry under control of the processor system.

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) assembly. 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 ports. Any changes in their settings are reported to the processor system. The Front-Panel Processor also turns the LEDs on and off and generates the bell signal.

Front-panel menu switches are also read by the Front-Panel Processor. The processor sends any changes in menu selections to the processor system. The **ON/STBY** switch is one of the menu switches. However, it is not read by the Front-Panel Processor, but passes through the A12 Front Panel board and the A11 DRAM Processor/Display board to the low voltage power supply.

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

Rear Panel

The **GPIB** connector provides access to stored waveforms, and allows external control of the oscilloscope.

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 off.

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

General Instructions

These procedures verify both the TDS 520 and the TDS 540 Digitizing Oscilloscopes.

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 4-4.

  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 4-6.

  Advantages: These procedures require minimal additional time to perform, require no additional equipment other than a standard-accessory probe, 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 4-13, 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 4-13.)

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:

- 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 **Coupling**", 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.

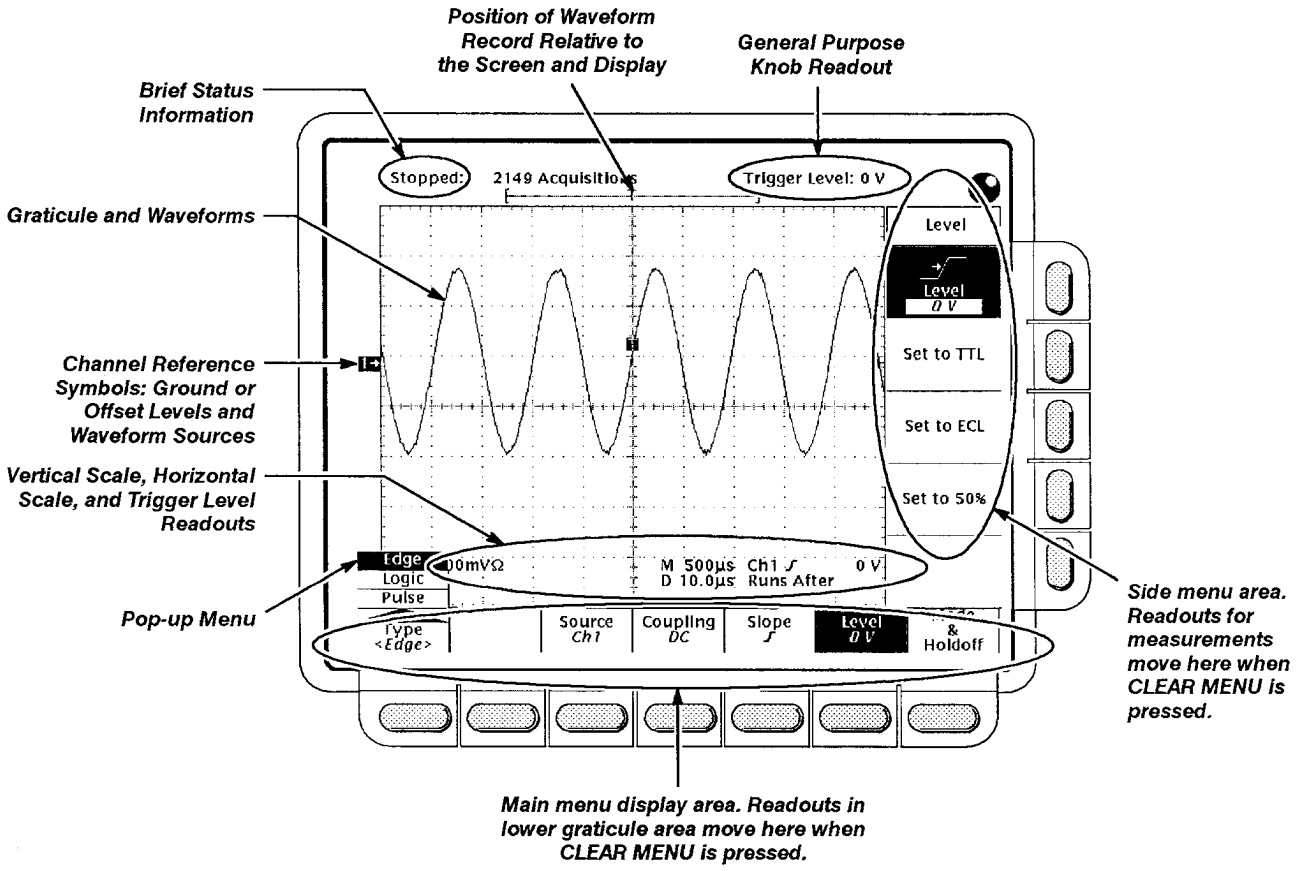


Figure 4-1: Map of Display Functions

- 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 **Coupling**", or "verify that the status message is ***Pass***.

- 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 instrument"* by doing "Press save/recall **SETUP**. Now, press the main-menu button...".

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

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 on 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. *Run the System Diagnostics:* Press the main-menu button **Execute**; then press the side-menu button **OK Confirm Run Test**.
   c. *Wait:* The internal diagnostics do an exhaustive verification of proper oscilloscope function. This verification will take up to two minutes. While it progresses, a "clock" icon (shown at left) is displayed on-screen. When finished, the resulting status will appear on the screen.
   d. *Confirm no failures are found:* Verify that no failures are found and reported on-screen.
   e. *Confirm the three adjustment sections have passed status:*
      - Press **SHIFT**; then press **UTILITY**.
      - Press the main menu button **System** until **Cal** is highlighted in the pop-up menu.
      - Verify that the word ***Pass*** appears in the main menu under the following menu labels: **Voltage Reference**, **Frequency Response**, and **Pulse Trigger**. (See Figure 4-2.)

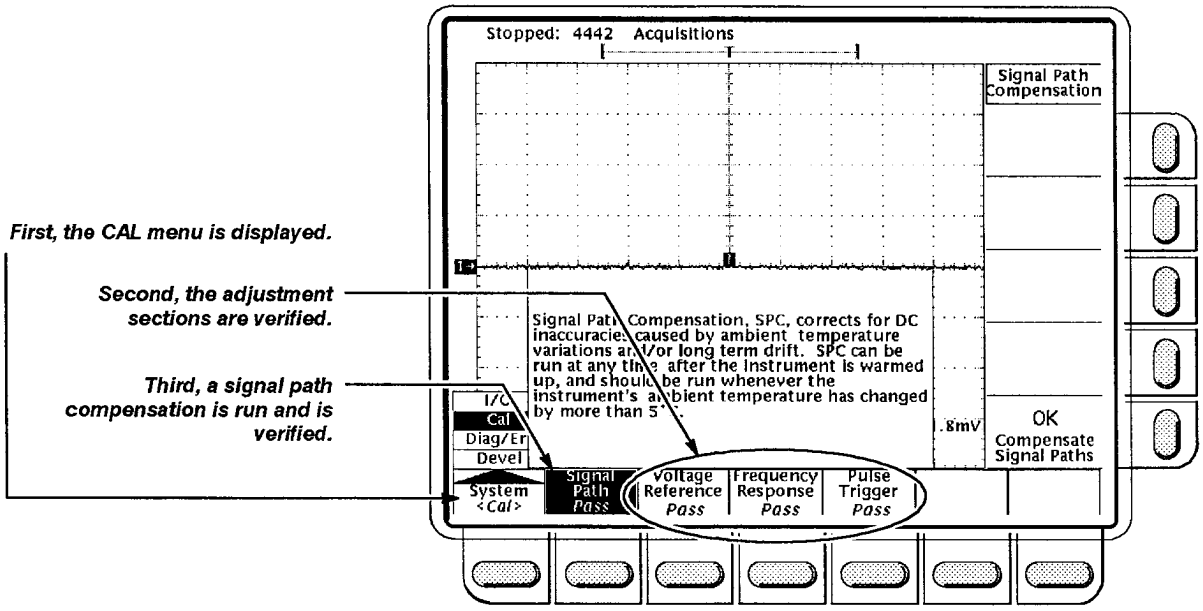


Figure 4-2: Verifying Adjustments and Signal-Path Compensation

f. *Run the signal-path compensation:* Press the main-menu button **Signal Path**; then press the side-menu button **OK Compensate Signal Paths**.

g. *Wait:* Signal-path compensation runs in about one to two minutes. 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 **Signal Path** 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 probes.

STOP

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 4-13.

STOP

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: One P6139A probe.

Prerequisites: None.

Procedure:

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

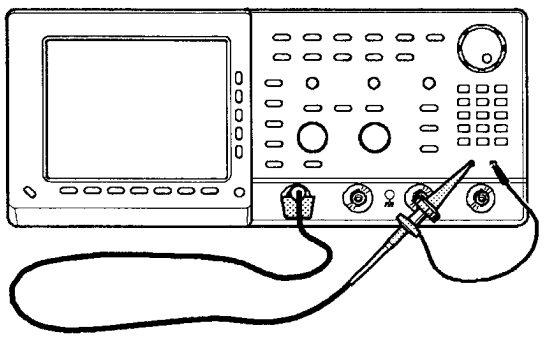


Figure 4-3: Universal Test Hookup for Functional Tests

a. *Hook up the signal source:* Install the probe on **CH 1**. Connect the probe tip to **PROBE COMPENSATION SIGNAL** on the front panel; connect the probe ground to **PROBE COMPENSATION GND**.

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 CH 1 and CH 2 operate:* Do the following substeps — test CH 1 first, *skipping substep a since CH 1 is already selected from step 1.*

a. *Select CH 2:*

- Press **WAVEFORM OFF** to remove CH 1 from display.
- Press the front-panel button CH 2.
- Move the probe to CH 2.

b. *Set up the selected channel:*

- Press **AUTOSET** to obtain a viewable, triggered display in the selected channel.
- Set the horizontal **SCALE** to 200 µs. 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 200 mV, and a square-wave probe-compensation signal about 2.5 divisions 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 200 mV returns the amplitude to about 2.5 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 five hardware 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.



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



- **Peak Detect** mode displays an actively acquiring waveform on-screen with the noise present in Sample mode "peak detected".



- **Hi Res** mode displays an actively acquiring waveform on-screen with the noise that was present in Sample mode reduced.



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



- **Average** mode displays an actively acquiring waveform on-screen with the noise reduced like in Hi Res mode.

e. *Test both channels:* Repeat substeps a through d to verify CH 2.

3. *Verify auxiliary inputs operate:*

a. *Select an auxiliary channel (AUX1 or AUX 2):*

- 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 probe to the channel you selected.

b. *Set up the selected channel:* Press **AUTOSET** to obtain a viewable, triggered display in the selected channel.

The display obtained may not trigger stably because autoset cannot provide more than about ½ division of probe compensation signal amplitude in an auxiliary channel equipped with a 10X probe. This amount is less than the minimum trigger sensitivity for auxiliary channel trigger sources; therefore triggering is not required.

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 1 V, and a square-wave probe-compensation signal about ½ division 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 to 10 V decreases the amplitude of the waveform on-screen. (The amplitude will drop to near zero when doing this substep.)
- Returning the knob to 1 V returns the amplitude to about ½ division.

d. *Verify that the channel acquires in all acquisition modes:* Disconnect the probe ground lead from the probe-compensation terminal. Do step 3, substep e to verify the five acquire modes.

e. *Test both channels:* Repeat substeps a through d to verify AUX 2.

5. *Remove the test hookup:* Disconnect the probe from the channel input and the probe-compensation terminals.

Verify the Time Base

Equipment Required: One P6139A probe.

Prerequisites: None.

Procedure:

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

   a. *Hook up the signal source:* Install the probe on **CH 1**. Connect the probe tip to **PROBE COMPENSATION SIGNAL** on the front panel; connect the probe ground to **PROBE COMPENSATION GND**. (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 µs.
      - Press **CLEAR MENU** to remove the menus from the screen.

2. *Verify that the time base operates:* Confirm the following statements.

   a. One period of the square-wave probe-compensation signal is about five horizontal divisions on-screen for the 200 µs 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 µs 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 probe from the channel input and the probe-compensation terminals.

Verify the Main and Delayed Trigger Systems

Equipment Required: One P6139A probe.

Prerequisites: None.

Procedure:

1. *Install the test hookup and preset the oscilloscope controls:*
   a. *Hook up the signal source:* Install the probe on **CH 1**. Connect the probe tip to **PROBE COMPENSATION SIGNAL** on the front panel; connect the probe ground to **PROBE COMPENSATION GND**. (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 **AUTOSET** to obtain a viewable, triggered display.
      - Set the horizontal **SCALE** for the **M** (main) time base to 200 µs.
      - Press **TRIGGER MENU**.
      - Press the main-menu button **Mode & Holdoff**.
      - Press the side-menu button **Normal**.
      - Press **CLEAR MENU** to remove the menus from the screen.
2. *Verify that the main trigger system operates:* Confirm that the following statements are true.
   - The trigger level readout for the main 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 *un*triggered.)
   - Pressing **SET LEVEL TO 50%** triggers the signal that you just left untriggered. (Leave the signal triggered.)
3. *Verify that the delayed trigger system operates:*
   a. *Select the delayed time base:*
      - Press **HORIZONTAL MENU**.
      - Press the main-menu button **Time Base**.
      - Press the side-menu button **Delayed Triggerable**; then press the side-menu button **Delayed Only**.
      - Set the horizontal **SCALE** for the **D** (delayed) time base to 200 µs.

b. *Select the delayed trigger level menu:*

- Press **SHIFT**; then press **DELAYED TRIG**.
- Press the main-menu button **Level**; then press the side-menu button **Level**.

c. *Confirm that the following statements are true*:

- The trigger-level readout for the delayed trigger system changes with the general purpose knob.
- The general purpose knob can trigger and untrigger the square-wave probe-compensation signal as you rotate it. (Leave the signal *un*triggered.)
- Pressing the side-menu button **Set to 50%** triggers the probe-compensation signal that you just left untriggered. (Leave the signal triggered.)

d. *Verify the delayed trigger counter:*

- Press the main-menu button **Delay by *Time***.
- Use the keypad to enter a delay time of 1 second (press **1** then press **ENTER**).
- Verify that the trigger **READY** indicator on the front panel flashes about once every second as the waveform is updated on-screen.

4. *Remove the test hookup:* Disconnect the standard-accessory probe from the channel input and the probe-compensation terminals.

Performance Tests

This subsection contains a collection of procedures for checking that the TDS 520 Digitizing Oscilloscope performs as warranted.

The procedures are arranged in four logical groupings: *Signal Acquisition System Checks, Time Base System Checks, Triggering System Checks*, and *Output Ports 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 4-4, and those under *Functional Tests,* found on page 4-6.
- A signal-path compensation must have been done within the recommended calibration interval 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	Attenuator, 5X	Ratio: 5X; impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011-0060-02	Signal Attenuation
3	Terminator, 50 Ω	Impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011-0049-01	Signal Termination for Channel Delay Test
4	Cable, Precision Coaxial (two required)	50 Ω, 36 in, male to male BNC connectors	Tektronix part number 012-0482-00	Signal Interconnection
5	Connector, Dual-Banana (two required)	Female BNC to dual banana	Tektronix part number 103-0090-00	Various Accuracy Tests
6	Connector, BNC "T"	Male BNC to dual female BNC	Tektronix part number 103-0030-00	Checking Trigger Sensitivity
7	Coupler, Dual-Input	Female BNC to dual male BNC	Tektronix part number 067-0525-02	Checking Delay Between Channels
8	Generator, DC Calibration	Variable amplitude to ±110 V; accuracy to 0.1%	Data Precision 8200, with 1 kV option installed	Checking DC Offset, Gain, and Measurement Accuracy
9	Generator, Calibration	500 mV square wave calibrator amplitude; accuracy to 0.25%	PG 506A[1]	Use to check CH 3 Output accuracy (TDS 540 Only).
10	Generator, Leveled Sine Wave, Medium-Frequency	200 kHz to 250 MHz; Variable amplitude from 5 mV to 5.5 V_{p-p} into 50 Ω	TEKTRONIX SG 503 Leveled Sine Wave Generator[1]	Checking Trigger Sensitivity at low frequencies
11	Generator, Leveled Sine Wave, High-Frequency	250 MHz to 500 MHz; Variable amplitude from 500 mV to 4 V_{p-p} into 50 Ω; 6 MHz reference	TEKTRONIX SG 504 Leveled Sine Wave Generator[1] with its Leveling Head	Checking Analog Bandwidth and Trigger Sensitivity at high frequencies
12	Generator, Time Mark	Variable marker frequency from 10 ms to 10 ns; accuracy within 2 ppm	TEKTRONIX TG 501 Time Mark Generator[1]	Checking Sample-Rate and Delay-time Accuracy
13	Probe, 10X, included with this instrument	A P6139A probe	Tektronix number P6139A	Signal Interconnection
14	Adapter, BNC female to Clip Leads	BNC female to Clip Leads	Tektronix part number 013-0076-00	Signal Coupling for Probe Compensator Output Check[2]

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

[2]**Required for model TDS 520 with serial numbers B021800 and above only.**

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 Offset (Zero Setting)

Equipment Required: None.

Prerequisites: The oscilloscope must meet the prerequisites listed on page 4-13.

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**.
      - Press **CLEAR MENU** to remove the menus from the screen.
   b. *Modify the default settings:*
      - Set the horizontal **SCALE** to 1 ms.
      - Press **SHIFT**; then **ACQUIRE MENU**.
      - Press the main-menu button **Mode**; then press the side-menu button **Hi Res**.
      - Press **DISPLAY**.
      - Press the main-menu button **Graticule**; then press the side-menu button **Frame**.
      - Press **CURSOR**.
      - Press the main-menu button **Function**; then press the side-menu button **H Bars**.
      - Press **CLEAR MENU**.
2. *Confirm input channels are within limits for offset accuracy at zero offset:* 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: DC Offset Accuracy (Zero Setting)

Vertical Scale Setting		Vertical Position and Offset Setting[1]	Offset Accuracy Limits	
CH 1 – CH 2	AUX 1 & AUX 2		CH 1 – CH 2	AUX 1 & AUX 2
1 mV	100 mV	0	±1.6 mV	±10 mV
100 mV	1 V	0	±25 mV	±100 mV
1 V	10 V	0	±250 mV	±1.0 V

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

b. *Set the vertical scale:* Set the vertical **SCALE** to one of the settings listed in Table 4-2 that is not yet checked. (Start with the first setting listed.)

c. *Display the test signal:* The baseline DC test level was initialized for all channels in step 1 and is displayed as you select each channel and its vertical scale. 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. *Measure the test signal:* Rotate the general purpose knob to superimpose the active cursor over the baseline DC test level. (Ignore the other cursor.)

e. Read the measurement results at the absolute (@:) cursor readout, not the delta (Δ:) readout on screen (see Figure 4-4).

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

- CHECK that the measurement results are within the limits listed for the current vertical scale setting.
- Repeat substeps b through f until all vertical scale settings settings listed in Table 4-2 are checked for the channel under test.

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

3. *Disconnect the hookup:* No hookup was required.

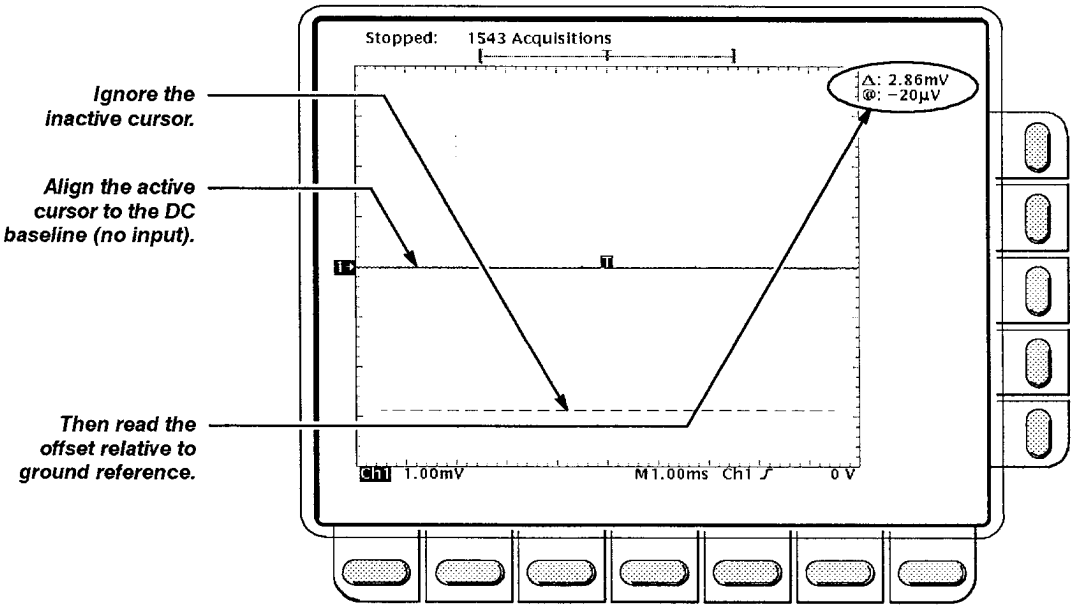


Figure 4-4: Measurement of DC Offset Accuracy at Zero Setting

Check DC Gain and Voltage Measurement Accuracy

WARNING

Performance of this procedure requires input voltages up to 130 VDC. 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.

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

Prerequisites: The oscilloscope must meet the prerequisites listed on page 4-13.

Procedure:

1. *Install the test hookup and preset the instrument controls (see Figure 4-5):*

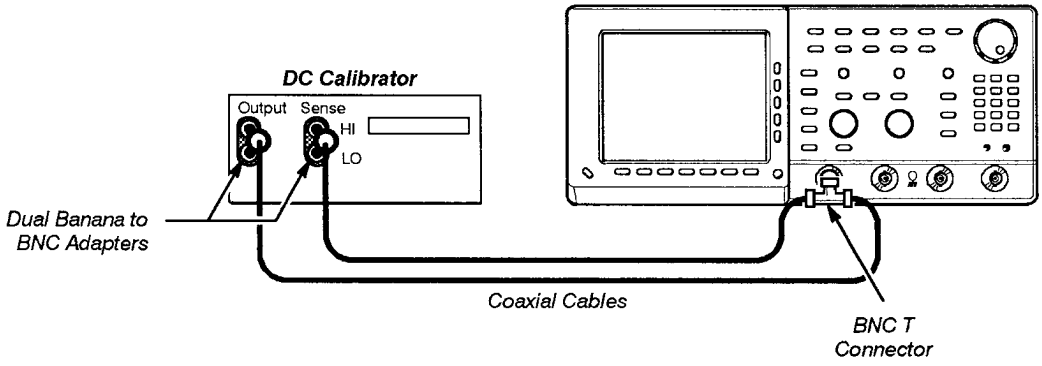


Figure 4-5: Initial Test Hookup

a. *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. Now connect the BNC T connector to **CH 1**.

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 default settings:*

- Press **SHIFT**; then **ACQUIRE MENU**.
- Press the main-menu button **Mode**; then press the side-menu button **Average 16**.
- Press **CURSOR**.
- Press the main-menu button **Function**; then press the side-menu button **H Bars**.
- Press **DISPLAY**.
- Press the main-menu button **Graticule**; then press the side-menu button **Frame**.

2. *Confirm input channels are within limits for DC delta voltage accuracy:* Do the following substeps — test CH 1 first, *skipping substep a since CH 1 is already selected from step 1.*

   a. *Select an unchecked channel:*

      - *Set the generator output to 0 V.*
      - Press **WAVEFORM OFF** to remove the channel just confirmed from the display.
      - Press the front-panel button that corresponds to the next channel you are to confirm.
      - Move the test hook up to the channel you select.

   b. *Display the test signal:*

      - Press **VERTICAL MENU**. Press the main-menu button **Position**.
      - Use the keypad to set vertical position to −2.5 divisions (press **−2.5**, then **ENTER**, on the keypad).

   c. *Measure the test signal:*

      - Press **CURSOR**. Use the general purpose knob to precisely align the active cursor to the DC baseline level on screen.
      - Set the generator output to 500 mV.
      - Press **TOGGLE**. Use the general purpose knob to precisely align the alternate cursor to the 500 mV DC test level on screen.
      - Press **CLEAR MENU**. Read the measurement results from the delta (Δ:) readout, not the absolute (@:) readout. See Figure 4-6 on page 4-20.

   d. *Check against limits:* CHECK that the Δ: readout on screen is within 485 mV to 515 mV.

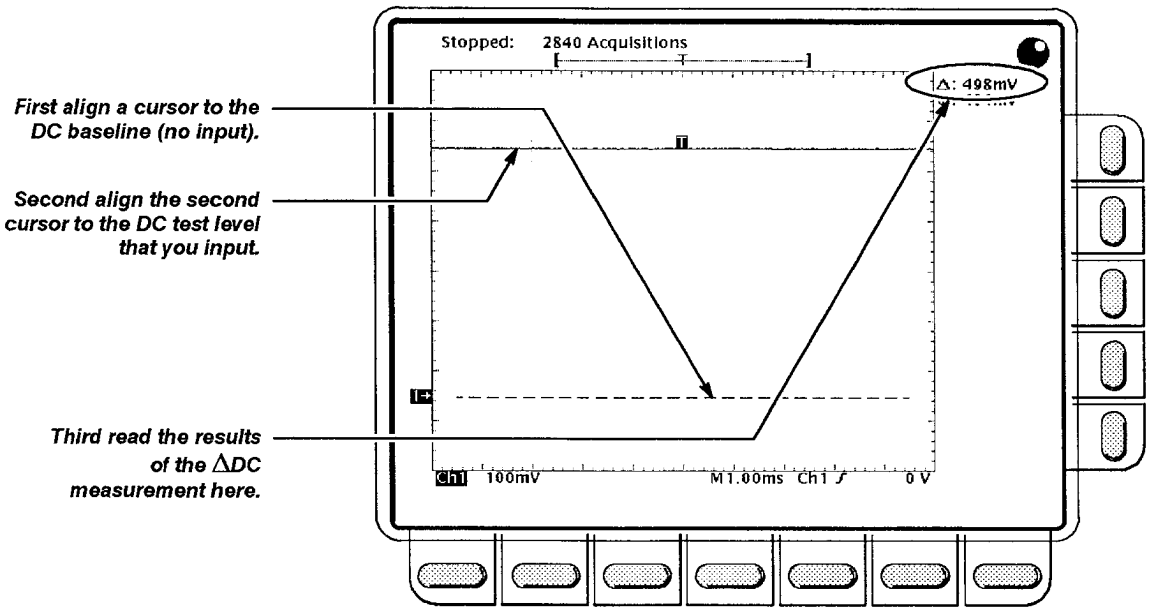


Figure 4-6: Measurement of the DC Accuracy for Delta Measurements

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

3. *Reestablish the initial test hookup setup:*

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

      - Set the output of a DC calibration generator to 0 volts.
      - Move the BNC T connector back to **CH 1**.

   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 default settings:*

      - 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**.

4. *Confirm input channels are within limits for DC accuracy at maximum offset and position:* Do the following substeps — test CH 1 first, *skipping substep a since CH 1 is already selected from step 3.*

   a. *Select an unchecked channel:*

- Press **WAVEFORM OFF** to remove the channel just confirmed from the display.
- Press the front-panel button that corresponds to the channel you are to confirm.
- *Set the generator output to 0 V.*
- Move the test hookup to the channel you select.

b. *Turn on the measurement Mean for the channel:*

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

c. *Set its vertical scale:* Set the vertical **SCALE** to one of the settings listed in the table matching the channel under test that is not yet checked. (Start with the first setting listed.)

Table 4-3: DC Accuracy: CH 1–CH 2

Scale Setting	Position Setting (Divs)	Offset Setting	Generator Setting	Accuracy Limits
5 mV	−5	+1 V	+1.040 V	+1.0355 V to +1.0445 V
	+5	−1 V	−1.040 V	−1.0355 V to −1.0445 V
200 mV	−5	+10 V	+11.6 V	+11.525 V to +11.675 V
	+5	−10 V	−11.6 V	−11.525 V to −11.675 V
1 V	−5	+100 V	+108 V	+107.450 V to +108.550 V
	+5	−100 V	−108 V	−107.450 V to −108.550 V

Table 4-4: DC Accuracy: AUX 1–AUX 2

Scale Setting	Position Setting (Divs)	Offset Setting	Generator Setting	Accuracy Limits
100 mV	−5	+0.5 V	+1.3 V	+1.271 V to +1.329 V
	+5	−0.5 V	−1.3 V	−1.271 V to −1.329 V
1 V	−5	+5 V	+13 V	+12.710 V to +13.290 V
	+5	−5 V	−13 V	−12.710 V to −13.290 V
10 V	−5	+50 V	+130 V	+127.10 V to +132.90 V

Table 4-4: DC Accuracy: AUX 1–AUX 2 (Cont.)

Scale Setting	Position Setting (Divs)	Offset Setting	Generator Setting	Accuracy Limits
	+5	−50 V	−130 V	−127.10 V to −132.90 V

d. *Display the test signal:*

- Press **VERTICAL MENU**. Press the main-menu button **Position**.
- Use the keypad to set vertical position to −5 divisions (press **−5**, then **ENTER**, on the keypad). The baseline level will move off screen.
- Press the main-menu button **Offset**.
- Use the keypad to set vertical offset to the positive-polarity setting listed in the table for the current vertical scale setting. The baseline level will remain off screen.
- Set the generator to the level and polarity indicated in the table for the vertical scale, position, and offset settings you have made. The DC test level should appear on screen. (If it doesn't return, the DC accuracy check is failed for the current vertical scale setting of the current channel.)

e. *Measure the test signal:* Press **CLEAR MENU**. Read the measurement results at the **Mean** measurement readout. See Figure 4-7.

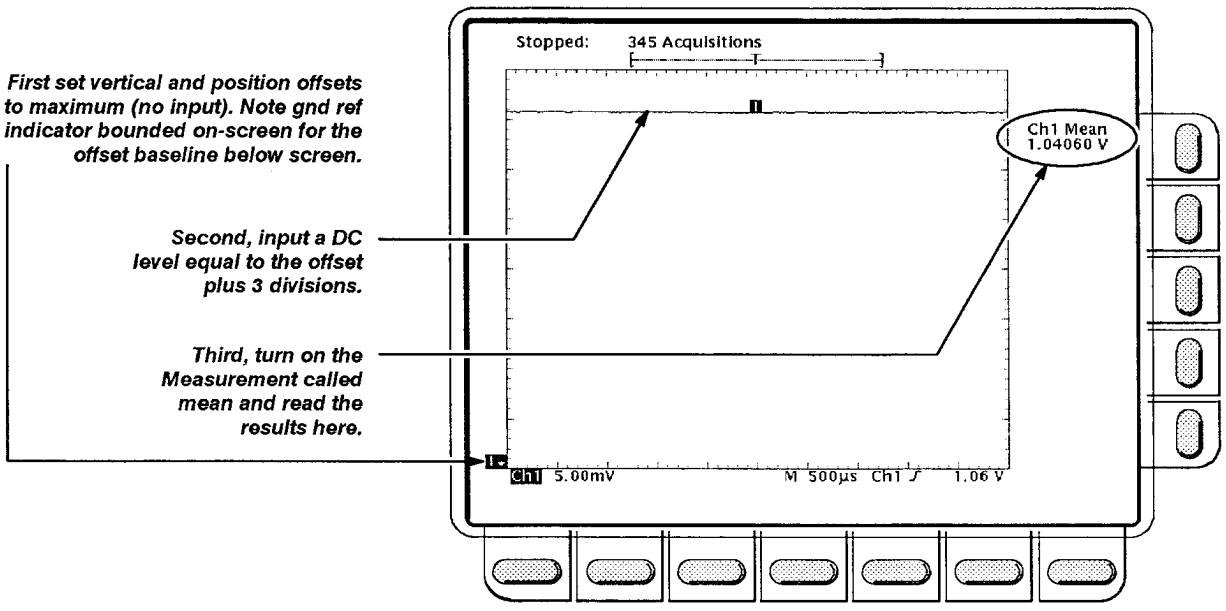


Figure 4-7: Measurement of DC Accuracy at Maximum Offset and Position

f. *Check against limits:*

- CHECK that the readout for the measurement **Mean** readout on screen is within the limits listed for the current vertical scale and position/offset/generator settings.
- Repeat step d, reversing the polarity of the position, offset, and generator settings as is listed in the table.
- CHECK that the **Mean** measurement readout on screen is within the limits listed for the current vertical scale setting and position/offset/generator settings.
- Repeat substeps c through f until all vertical scale settings settings listed in both tables are checked for the channel under test. (Use the table that matches the input under test — CH or AUX.)

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

5. *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.

Check Analog Bandwidth

Equipment Required: One high-frequency leveled sine wave generator and its leveling head (Item 11), plus two10X attenuators (Item 1).

Prerequisites: *See page 4-13.*

Procedure:

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

   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:*

   - Set the horizontal **SCALE** to 50 ns. Now press **SHIFT**; then **ACQUIRE MENU**.
   - Press the main-menu button **Mode**; then press the side-menu button **Average 16**.
   - Press **TRIGGER MENU**.
   - Press the main-menu button **Coupling**; then press the side-menu button **Noise Rej**.
   - Press **Measure**. Now press the main-menu button **High–Low Setup**; then press the side-menu button **Min–Max**.

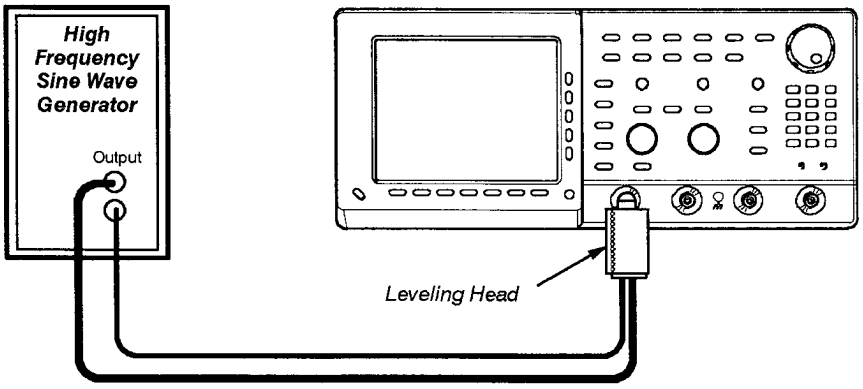


Figure 4-8: Initial Test Hookup

   c. *Hook up the test-signal source:* Connect, through its leveling head, the sine wave output of a high-frequency leveled sine wave generator to **CH 1**. Set the output of the generator to a reference frequency of 6 MHz.

2. *Confirm the input channels are within limits for analog bandwidth:* Do the following substeps — test CH 1 first, *skipping substeps a and b 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 leveling head to the channel you select.

   b. *Match the trigger source to the channel selected:*

      - Press **TRIGGER MENU**.
      - Press the main-menu button **Source**.
      - Press the side-menu button that corresponds to the channel selected.

   c. *Set its input impedance:*

      - Press **VERTICAL MENU**; then press the main-menu button **Coupling**.
      - Press the side-menu button Ω to toggle it to the 50 Ω setting.

   d. *Set the vertical scale:* Set the vertical **SCALE** to one of the settings listed in Table 4-5 not yet checked. (Start with the 100 mV setting.)

Table 4-5: Analog Bandwidth

Vertical Scale[1]	Attenuators (10X)	Reference Amplitude (at 6 MHz)	Horizontal Scale	Test Frequency	Limits
100 mV	none	600 mV (6 divisions)	1 ns	500 MHz	≥424 mV
1 V	none	5 V (5 divisions)	1 ns	500 MHz	≥3.535 V
500 mV	none	3 V (6 divisions)	1 ns	500 MHz	≥2.121 V
200 mV	none	1.2 V (6 divisions)	1 ns	500 MHz	≥848 mV
50 mV	1	300 mV (6 divisions)	1 ns	500 MHz	≥212 mV
20 mV	1	120 mV (6 divisions)	1 ns	500 MHz	≥84 mV
10 mV	1	60 mV (6 divisions)	1 ns	500 MHz	≥42 mV
5 mV	2	30 mV (6 divisions)	1 ns	500 MHz	≥21 mV
2 mV	2	12 mV (6 divisions)	2 ns	350 MHz	≥8.48 mV
1 mV	2	6 mV (6 divisions)	2 ns	250 MHz	≥4.24 mV

[1]**Only the 100 mV, 1 V, and 10 V vertical scale settings are available for the AUX 1 and AUX 2 input channels. Ignore all other settings listed when checking those channels.**

e. *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 **Pk-Pk** appears in the side menu (its icon is shown at the left). Press the side-menu button **Pk-Pk**.
- Press **CLEAR MENU**.
- Set the generator output so the CHx Pk-Pk readout equals the reference amplitude in Table 4-5 that corresponds to the vertical scale set in substep d.
- Press the front-panel button **SET LEVEL TO 50%** as necessary to trigger a stable display.

f. *Measure the test signal:*

- Increase the frequency of the generator output to the test frequency in Table 4-5 that corresponds to the vertical scale set in substep d.
- Set the horizontal **SCALE** to 1 ns. Press **SET LEVEL TO 50%** as necessary.
- Read the results at the CHx Pk-Pk readout, which will automatically measure the amplitude of the test signal.

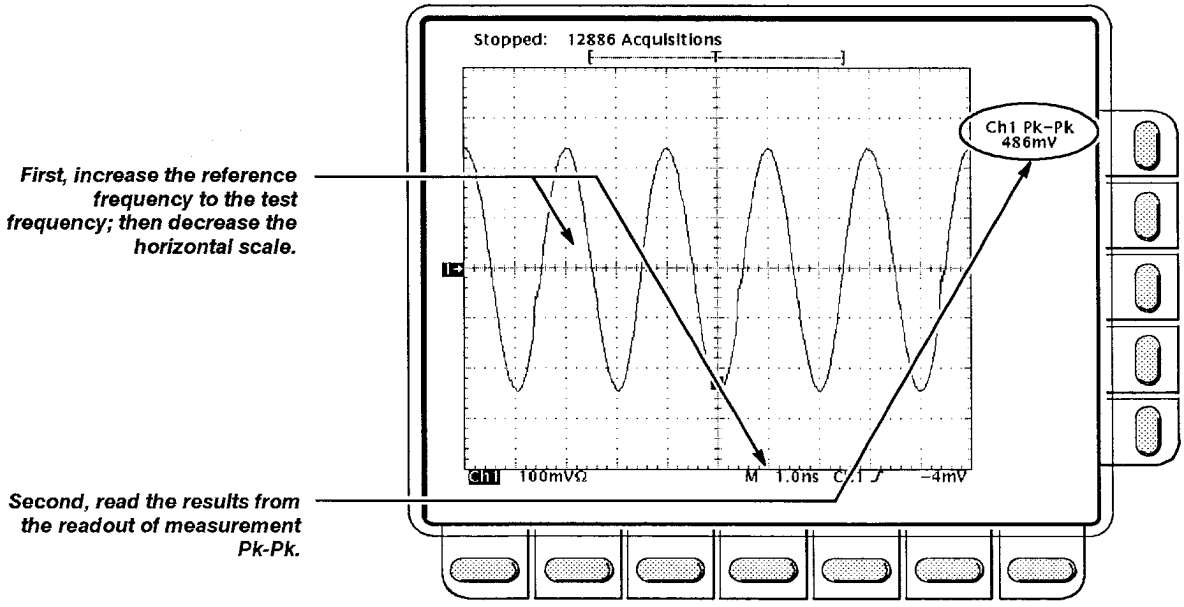


Figure 4-9: Measurement of Analog Bandwidth

g. *Check against limits:*

- CHECK that the **Pk-Pk** readout on screen is within the limits listed in Table 4-5 for the current vertical scale setting.
- When finished checking, set the horizontal **SCALE** back to the 50 ns setting.



Checking each channel's bandwidth at all vertical scale settings is time consuming and unnecessary. You may skip checking the remaining vertical scale settings in Table 4-5 (that is, skip the following substep, h) if this digitizing oscilloscope has performed as follows:

- Passed the 100 mV vertical scale setting just checked in this procedure.
- Passed the *Verify Internal Adjustment, Self Compensation, and Diagnostics* procedure found under *Self Tests,* on page 4-4.

NOTE

Passing the signal path compensation confirms the signal path for all vertical scale settings for all channels. Passing the internal diagnostics ensures that the factory-set adjustment constants that control the bandwidth for each vertical scale setting have not changed.

h. *Check remaining vertical scale settings against limits (optional):*

- If desired, finish checking the remaining vertical scale settings for the channel under test by repeating substeps d through g for each of the remaining scale settings settings listed in Table 4-5 for the channel under test.
- When doing substep e, skip the subparts that turn on the CHx Pk-Pk measurement until you check a new channel.
- Install/remove 10X attenuators between the generator leveling head and the channel input as is needed to obtain the six division reference signals listed in the table.

i. *Test all channels:* Repeat substeps a through g for all four channels.

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

Check Delay Between Channels

Equipment Required: One medium-frequency leveled sine-wave generator (Item 10), one precision coaxial cable (Item 4), one 50 Ω terminator (Item 3), and a dual-input-coupler (Item 7).

Prerequisites: *See page 4-13.*

Procedure:

STOP

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

1. *Install the test hookup and preset the instrument controls:*
   a. *Initialize the front panel;*
      - Press save/recall **SETUP.**
      - Press the main-menu button **Recall Factory Setup**.
      - Press the side-menu button **OK Confirm Factory Init.**
   b. *Modify the initialized front-panel control settings:*
      - Do *not* adjust the vertical position of any channel during this procedure.
      - Set the horizontal **SCALE** to 500 ps.
      - Press **SHIFT**; then press **ACQUIRE MENU.**
      - Press the main-menu button **Mode**, and then press the side-menu button **Average 16**.

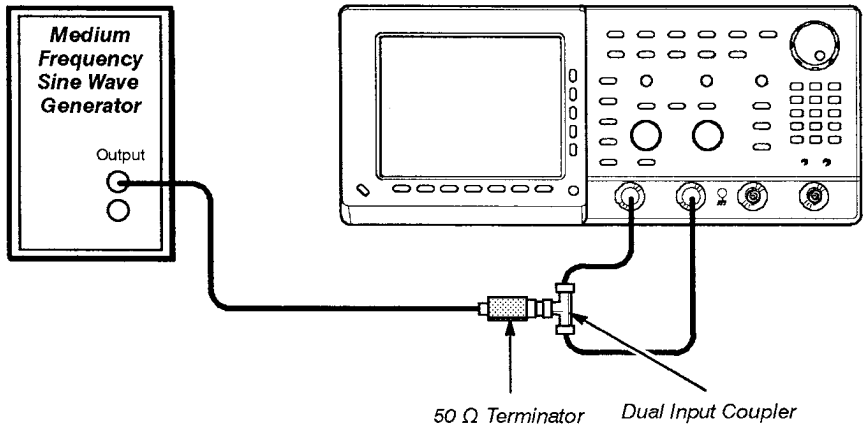


Figure 4-10: Initial Test Hookup

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

- Connect, through a 50 Ω precision coaxial cable, followed by a 50 Ω termination, the sine wave output of a medium-frequency sine wave generator to a dual-input coupler.
- Connect the coupler to both **CH 1** and **CH 2**.

2. *Confirm CH 1 through CH 2 are within limits for channel delay:*

a. *Set up the generator:* Set the generator frequency to 250 MHz and the amplitude for about five divisions in CH 1.

b. *Display all test signals:* Press **CH 2**.

Hint: as you are adjusting the generator amplitude, push **SET LEVEL TO 50%** frequently to speed up the updating of the waveform amplitude on screen.

c. *Measure the test signal:*

- Locate the point on the rising edge of the left-most waveform where it crosses the center horizontal graticule line. This is the *time reference point* for this waveform. Note the corresponding *time reference point* for right-most waveform. See Figure 4-11.
- Press **CURSOR**; then press the side-menu button **V Bars**.
- Press **CLEAR MENU**.
- Rotate the General Purpose knob to align one cursor to the *time reference point* of the left-most waveform edge and the other cursor to the *time reference point* of the right-most waveform edge. (Press **TOGGLE** to switch between the two cursors.) See Figure 4-11.

- Read the measurement results at the Δ: cursor readout, not the @: readout on screen.

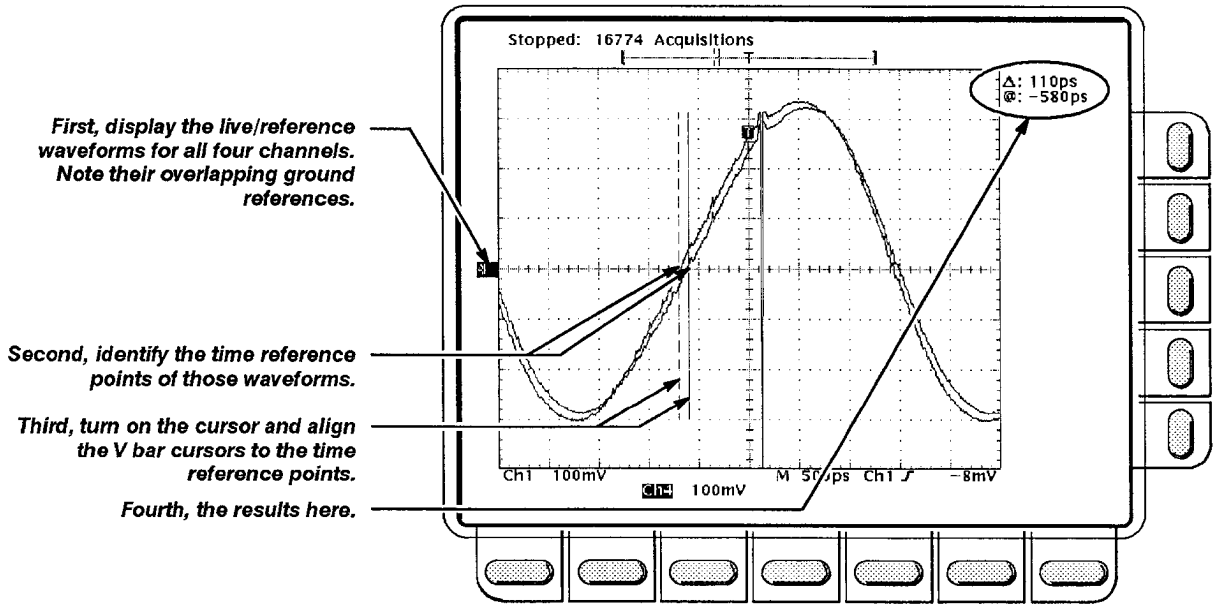


Figure 4-11: Measurement of Channel Delay

d. *Check against limits:* CHECK that the cursor readout on screen is ≤250 ps.

3. *Disconnect the hookup:* Disconnect the cable from the generator output at the input connectors of the channels.

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

Equipment Required: One time-marker generator (Item 12) and one precision coaxial cable (Item 4).

Prerequisites: *See page 4-13.*

Procedure:

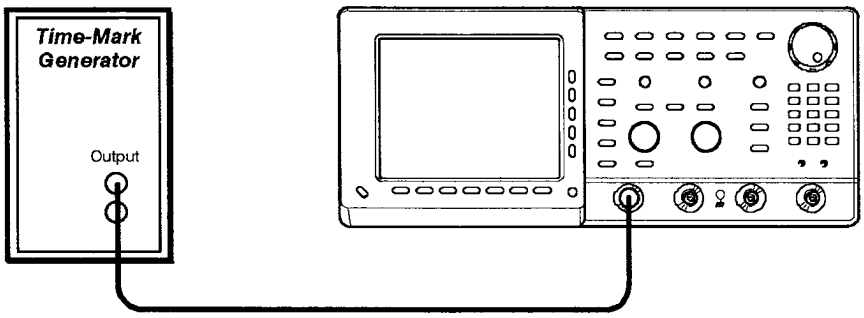


Figure 4-12: Initial Test Hookup

1. *Install the test hookup and preset the instrument controls:*
   a. *Hook up the test-signal source*: Connect, through a 50 Ω precision coaxial cable, the time-mark output of a time-marker generator to **CH 1**. Set the output of the generator for 10 ms markers.
   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 500 mV.
      - Press **VERTICAL MENU**; then press the main-menu button **Coupling**. Press the side-menu button Ω to **50 Ω**.
      - Press **SET LEVEL TO 50%**.
      - Use the vertical **POSITION** knob to center the test signal on screen.
      - Set the horizontal **SCALE** of the Main time base to 1 ms.

- Press **TRIGGER MENU**; then press the main-menu button **Mode & Holdoff**. Now press the side-menu button **Normal**.
- Press **SET LEVEL TO 50%**.
- Press horizontal **MENU**. Press the main-menu button **Record Length**; then press the side-menu button **1000 points in 20 divs**.
- Press the main-menu button **Trigger Position**. Press the side-menu button **Pretrigger**; then set pretrigger to 20%: press **20**, then **ENTER**, on the keypad.

2. *Confirm Main and Delayed time bases are within limits for accuracies:*

   a. *Display the test signal:*

   - Adjust the horizontal **POSITION** so the trigger **T** is aligned to the center vertical graticule line.
   - Press the main-menu button **Time Base**.
   - Press the side-menu buttons **Delayed Only** and **Delayed Runs After Main**.

   b. *Measure the test signal*:

   - Set the horizontal **SCALE** of the **D** (delayed) time base to 100 ns.
   - Use the keypad to set delayed time to 10 ms. (Press **10**, then **SHIFT**, then **m** followed by **ENTER**.)

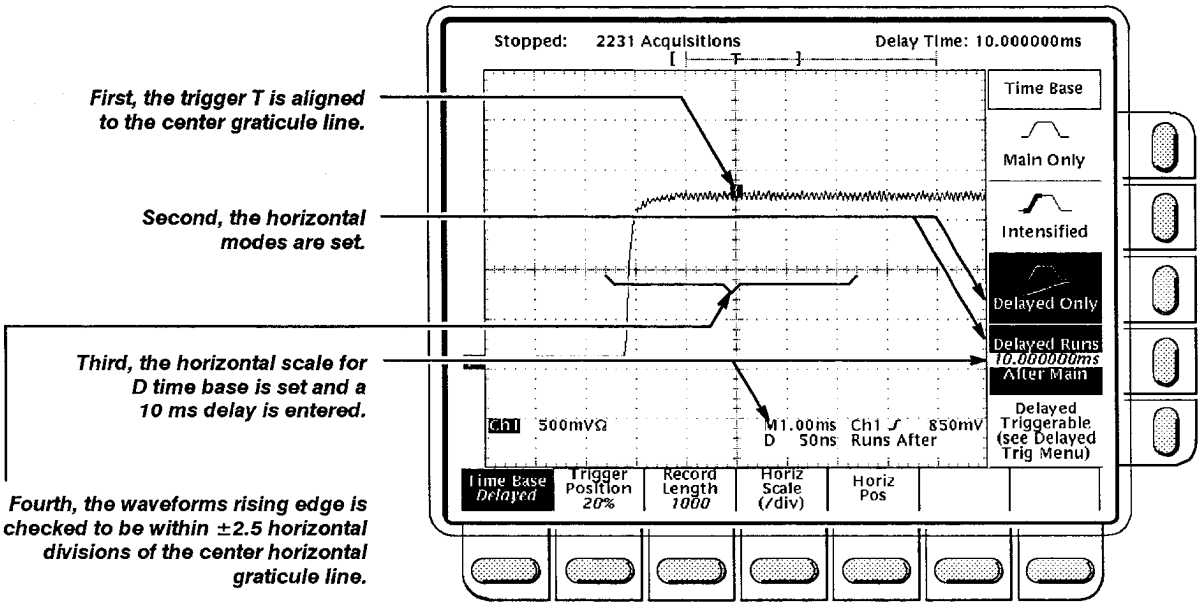


Figure 4-13: Measurement of Accuracy — Long-Term and Delay-Time

c. *Check long-term sample rate and delay time accuracies against limits:* CHECK that the rising edge of the marker crosses the center horizontal graticule line at a point within ±2.5 divisions of center graticule.

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

- Press the side-menu button **Main Only**. Set horizontal **SCALE** to 2 ns.
- Set the output of the generator for 20 ns markers.
- Press **SET LEVEL TO 50%**.
- Press **SHIFT**; then **ACQUIRE MENU**. Now press the main-menu button **Mode**; then press the side-menu button **Average**.
- Enter **8**, for eight averages, on the keypad.
- 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 Ch1**.
- Press the side-menu button **–more–**, until **PERIOD** appears in the side menu. Press **PERIOD**.
- Press **CLEAR MENU**.
- CHECK that the readout for **CH 1 Per** is within 19.760 ns to 20.240 ns.

3. *Disconnect the hookup:* Disconnect the cable from the generator output at the input connector of **CH 1**.

Trigger System Checks

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

Check Accuracy (Time) for Pulse-Glitch or Pulse-Width Triggering

Equipment Required: One medium-frequency leveled sine wave generator (Item 10), one 10X attenuator (Item 1), and one precision coaxial cable (Item 4).

Prerequisites: *See page 4-13.*

Procedure:

1. *Install the test hookup and preset the instrument controls:*
   a. *Initialize the instrument:*
      - Press save/recall **SETUP.**
      - Press the main-menu button **Recall Factory Setup.**
      - Press the side-menu button **OK Confirm Factory Init.**
   b. *Modify the default setup:*
      - Press vertical **MENU.**
      - Press the main-menu button **Coupling**; then press the side-menu button Ω to select 50 Ω coupling.
      - Set the horizontal **SCALE** to 10 ns.

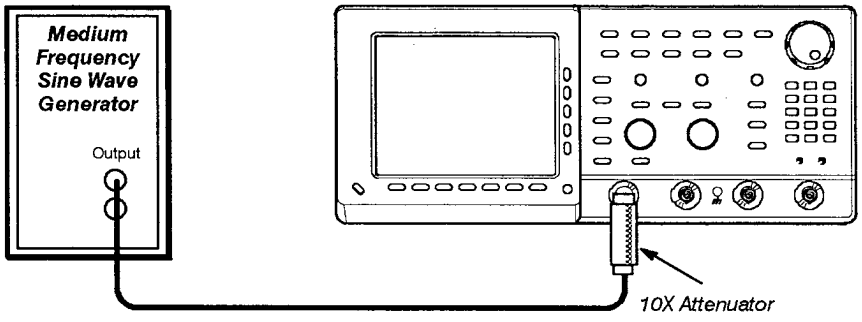


Figure 4-14: Initial Test Hookup

   c. *Hook up the test-signal source:* Connect, through a 50 Ω precision coaxial cable, followed by a 10X attenuator, the output of a medium-frequency leveled sine wave generator (Item 10) to CH 1.

2. *Confirm the trigger system is within time-accuracy limits for pulse-glitch or pulse-width triggering (Horizontal Scale ≤1 µs):*

   a. *Display the test signal:* Set the output of the sine wave generator for a 100 MHz, five-division sine wave on screen. Press **SET LEVEL TO 50%**.

   b. *Set the trigger mode:* Press **TRIGGER MENU**. Now press the main-menu button **Mode & Holdoff**; then the side-menu button **Normal**.

   c. *Set upper and lower limits that ensures triggering:*

      - Press the main-menu button **Type**; then repeatedly press the same button until **Pulse** is highlighted in the menu that pops up.
      - Press the main-menu button **Class**; then repeatedly press the same button until **Width** is highlighted in the menu that pops up.
      - Press the main-menu button **Trig When**; then press the side-menu button **Within Limits.**
      - Press the side-menu button **Upper Limit**. Use the keyboard to set the upper limit to 10 ns: press **10**; then **SHIFT**; then **n**; then **ENTER**.
      - Press the side-menu button **Lower Limit**. Use the keypad to set the lower limit to 2 ns.

   d. *Check against limits:*

      - Press **SET LEVEL TO 50%**.
      - While doing the following subparts, monitor the display (it will stop acquiring) and the front-panel light **TRIG** (it will extinguish) to determine when triggering is lost.
      - Use the general purpose knob to *increase* the **Lower Limit** readout until triggering is lost.
      - CHECK that the **Lower Limit** readout is within 2.5 ns to 7.5 ns, inclusive.
      - Use the keypad to return the **Lower Limit** to 2 ns and reestablish triggering.
      - Press the side-menu button **Upper Limit**; then use the general purpose knob to slowly *decrease* the the **Upper Limit** readout until triggering is lost.
      - CHECK that the **Upper Limit** readout is within 2.5 ns to 7.5 ns, inclusive.

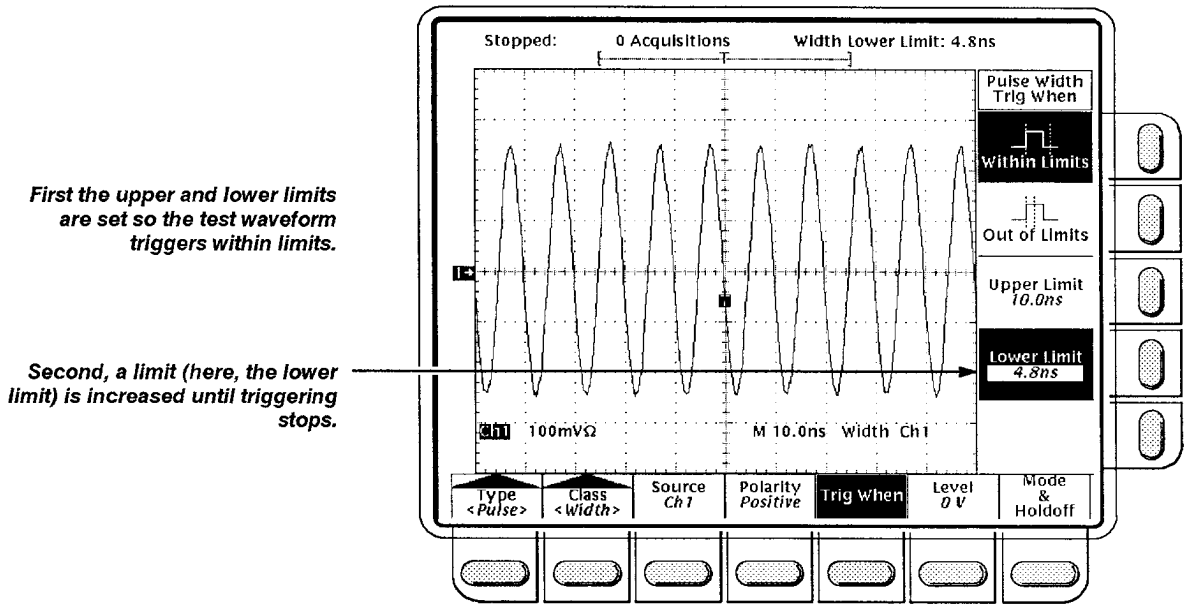


Figure 4-15: Measurement of Time Accuracy for Pulse and Glitch Triggering

3. *Confirm the trigger system is within time-accuracy limits for pulse-glitch or pulse-width triggering (horizontal scale >1 µs):*

   a. *Set upper and lower limits that ensures triggering at 250 kHz:*

      - Press the side-menu button **Upper Limit**. Use the keyboard to set the upper limit to 4 µs.
      - Press the side-menu button **Lower Limit**. Use the keypad to set the lower limit to 500 ns.

   b. *Display the test signal:*

      - Set the horizontal **SCALE** to 5 µs.
      - Set the output of the sine-wave generator for a 250 kHz, five-division sine wave on screen. Set the vertical **SCALE** to 20 mV (the waveform will overdrive the display).
      - Press **SET LEVEL TO 50%**.

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

      - Use the general purpose knob to *increase* **Lower Limit** readout until triggering is lost.
      - CHECK that the **Lower Limit** readout is within 1 µs to 3 µs, inclusive.
      - Use the keypad to return the **Lower Limit** to 500 ns and reestablish triggering.

- Press the side-menu button **Upper Limit**; then use the general purpose knob to slowly *decrease* the the **Upper Limit** readout until triggering is lost.
- CHECK that the **Upper Limit** readout is within 1 µs to 3 µs, inclusive.

4. *Disconnect the hookup:* Disconnect the cable from the generator output at the input connector of **CH 1**.

Check Accuracy, Trigger-level or Threshold, DC Coupled

Equipment Required: One DC calibration generator (Item 8), one BNC T connector (Item 6), and two precision coaxial cables (Item 4).

Prerequisites: The oscilloscope must meet the prerequisites listed on page 4-13.

Procedure:

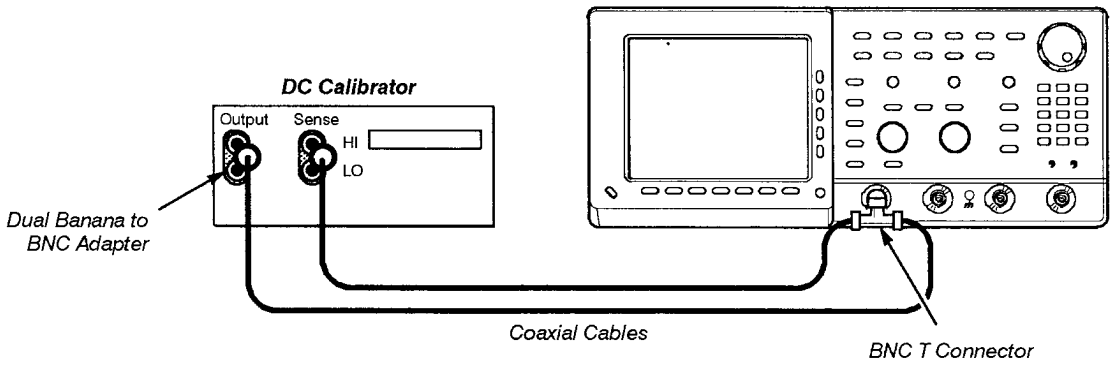


Figure 4-16: Initial Test Hookup

1. *Install the test hookup and preset the instrument controls:*
   a. *Hook up the test-signal source:*
      - Set the output of a 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 other side of the BNC T connector. Now connect the BNC T connector to **CH 1**.

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. *Select Delayed Triggerable:*

- Press **HORIZONTAL MENU**.
- Press the main-menu button **Time Base**.
- Press the side-menu button **Delayed Triggerable**.

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

a. *Display the test signal:*

- Press **VERTICAL MENU**. Press the main-menu button **Position**.
- Use the keypad to set vertical position to −3 divisions (press **−3**, then **ENTER**, on the keypad.) The baseline level will move down three divisions.
- Press the main-menu button **Offset**.
- Use the keypad to set vertical offset to +10 volts. The baseline level will move off-screen.
- Set the standard output of a DC calibration generator to +10 volts. The DC test level will appear on screen.

b. *Measure the test signal:*

- Press **SET LEVEL TO 50%**.
- Press **TRIGGER MENU**.
- Read the measurement results from the readout below the label **Level** in the menu; not the trigger readout in the graticule area.

c. *Check against limits:*

- CHECK that the **Level** readout in the main menu is within 9.940 V to 10.060 V, inclusive.



- Press **TRIGGER MENU**. Press the main-menu button **Slope**; then press the side-menu button for negative slope. (See icon at left.) Repeat substep b.
- CHECK that the **Level** readout in the main menu is within 9.940 V to 10.060 V, inclusive.

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

a. *Select the Delayed time base:*

- Press **HORIZONTAL MENU**.

- Press the main-menu button **Time Base**.
- Press the side-menu buttons **Delayed Only** and **Delayed Triggerable**.
- Set **D** (delayed) horizontal **SCALE** to 500 µs.

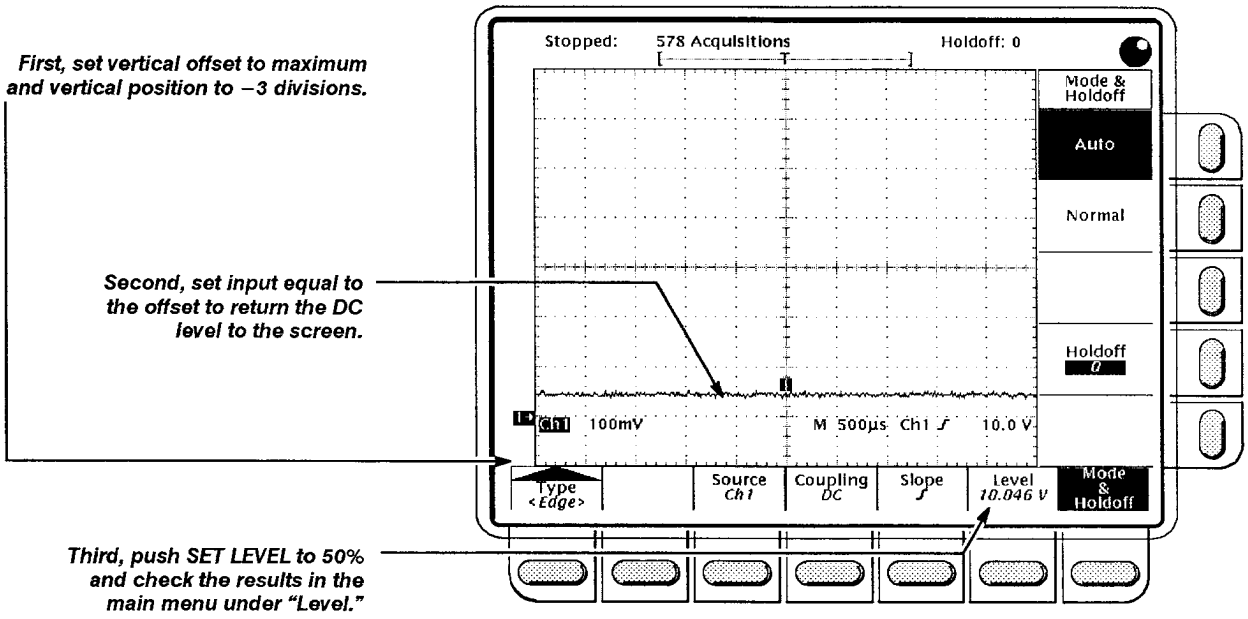


Figure 4-17: Measurement of Trigger-level Accuracy

b. *Select the Delayed trigger system:*

- Press **SHIFT**; then press the front-panel button **DELAYED TRIG**.
- Press the main-menu button **Level**.

c. *Measure the test signal:* Press the *side-menu button* **SET TO 50%**. The **TRIG'D** indicator should be lit. Read the measurement results in the side menu below the label **Level**.

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

- CHECK that the **Level** readout in the side menu is within 9.940 V to 10.060 V, inclusive.
- Press the main-menu button **Slope**; then press the side-menu button for negative slope. (See icon at left.) Press the main-menu button **Level**. Repeat substep c.
- CHECK that the **Level** readout in the side menu is within 9.940 V to 10.060 V, inclusive.

4. *Disconnect the hookup:*
   a. *First set the output of the DC calibration generator to 0 volts.*
   b. Then disconnect the cable from the generator output at the input connector of **CH 1**.

Sensitivity, Edge Trigger, DC Coupled

Equipment Required: One medium-frequency leveled sine wave generator (Item 10), one high-frequency leveled sine wave generator (Item 11), one precision 50 Ω coaxial cable (Item 4), and one 10X attenuator (Item 1). When checking the TDS 520 Digitizing Oscilloscope, a BNC T connector (Item 6), a 5X attenuator (Item 2), and a second precision 50 Ω coaxial cable (Item 4) are also required.

Prerequisites: *See page 4-13.*

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**.
   b. *Modify the initialized front-panel control settings:*
      - Set the horizontal **SCALE** for the **M** (main) time base to 20 ns.
      - Press **HORIZONTAL MENU**; then press the main-menu button **Time Base**.
      - Press the side-menu button **Delayed Only**; then the side-menu button **Delayed Triggerable**.
      - Set the horizontal **SCALE** for the **D** (delayed) time base to 20 ns; then press the side-menu button **Main Only**.

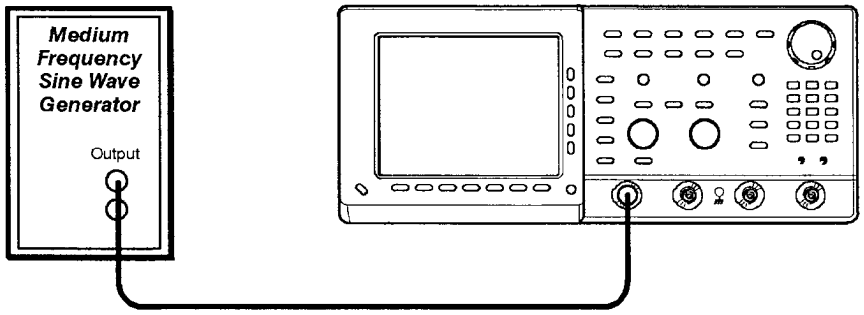


Figure 4-18: Initial Test Hookup

- Press **TRIGGER MENU**; then press the main-menu button **Mode & Holdoff**. Now press the side-menu button **Normal**.
- Press **VERTICAL MENU**; then press the main-menu button **Coupling**. Now press the side-menu button Ω select the 50 Ω setting.
- Press **SHIFT**; then press **ACQUIRE MENU**. Now press the main-menu button **Mode**; then the side-menu button **Average 16**.

c. *Hook up the test-signal source*: Connect, through a 50 Ω precision coaxial cable, the signal output of a medium-frequency sine wave generator to **CH 1**.

2. *Confirm Main and Delayed trigger systems are within sensitivity limits (50 MHz):*

a. *Display the test signal:*

- Set the generator frequency to 50 MHz.
- 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 Ch1**.
- 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 **CLEAR MENU**.
- Set the test signal amplitude for about three divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 350 mV. (Readout may fluctuate around 350 mV.)
- Disconnect the 50 Ω precision coaxial cable at **CH 1** and reconnect it to **CH 1** through a 10X attenuator.

b. *Check for 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. It will flash for slower settings.
- Press **TRIGGER MENU**; then press the main-menu button **Slope**.

- Press **SET LEVEL TO 50%.** 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.)
- Leave the Main trigger system triggered on the positive slope of the waveform before continuing to the next step. (The Main trigger system must be triggered to check the delayed trigger system in the next step.)

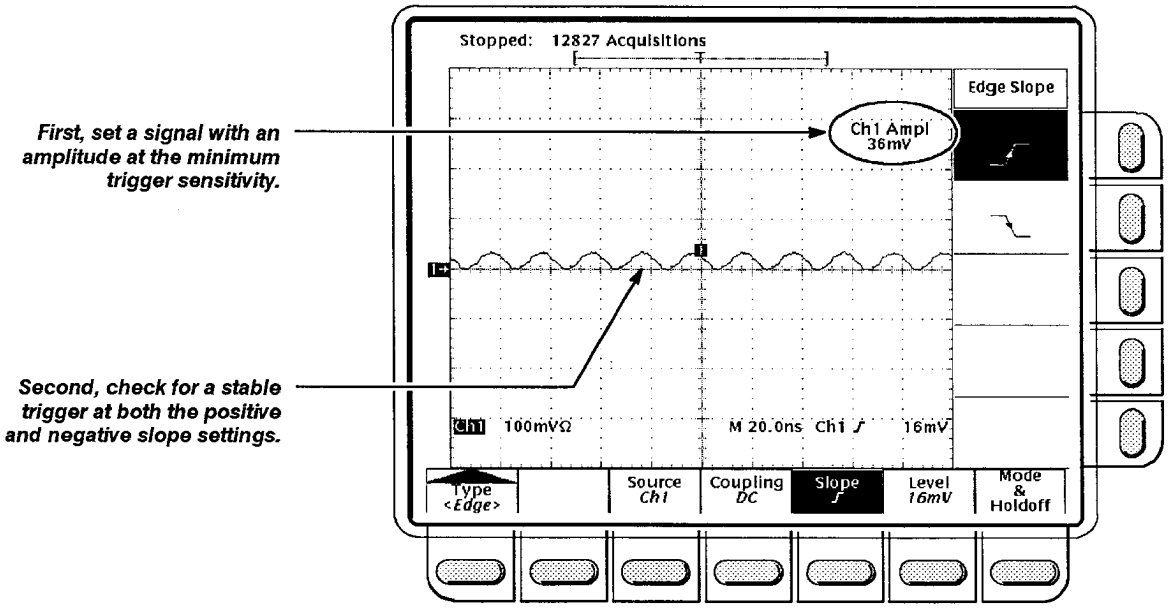


Figure 4-19: Measurement of Trigger Sensitivity

c. *Check delayed trigger system for stable triggering at limits:* Do the following subparts in the order listed.

- Press **HORIZONTAL MENU**; then press the main-menu button **Time Base**. Now press the side-menu button **Delayed Only**.
- Press **SHIFT**; then press **DELAYED TRIG**. Press the main-menu button **Level**.
- Press the *side-menu* button **SET TO 50%.** CHECK that a stable trigger is obtained for the test waveform for both the positive and negative slopes of the waveform. (Use the General Purpose knob to stabilize the trigger if required.) Press the main-menu button **Slope**; then use the side menu to switch between trigger slopes.
- Leave the delayed trigger system triggered on the positive slope of the waveform before continuing to the next step. Also, return to the main time base: Press **HORIZONTAL MENU**; then press

the main-menu button **Time Base**. Now press the side-menu button **Main Only**.

3. *Confirm that the Main and Delayed trigger systems are within sensitivity limits (500 MHz):*

   a. *Hook up the test-signal source:* Disconnect the hookup installed in step 1. Connect, through its leveling head, the signal output of a high-frequency leveled sine-wave generator to **CH 1**.

   b. *Set the Main and Delayed Horizontal Scales:*

      - Set the horizontal **SCALE** to 500 ps for the **M** (Main) time base.
      - Press **HORIZONTAL MENU**. Now press the main-menu button **Time base**.
      - Press the side-menu button **Delayed Only**.
      - Set the horizontal **SCALE** to 500 ps for the **D** (Delayed) time base. Press the side-menu button **Main Only**.

   c. *Display the test signal:*

      - Set the generator frequency to 500 MHz.
      - Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 500 mV. (Readout may fluctuate around 500 mV.)
      - Disconnect the leveling head at **CH 1** and reconnect it to **CH 1** through a 5X attenuator.

   d. Repeat step 2, substeps b and c only, since only the 500 MHz frequency is to be checked here.

4. *Confirm that the Main and Delayed trigger systems couple trigger signals from all channels:* Doing the procedure *Check Analog Bandwidth,* which begins on page 4-24, checks coupling. If you have not done that procedure, do so after finishing this procedure. See the following note.

NOTE

Steps 1 through 3 confirmed trigger sensitivity for the Main and Delayed triggering systems using the CH 1 input. Doing the procedure Check Analog Bandwidth *ensures that trigger signals are coupled from all four channels.*

When checking delayed triggering sensitivity at 500 MHz, the waveform record may have some missing interpolated record points. The waveform is still stably triggered. (See definition of a stable trigger earlier in this procedure.)

5. *Disconnect the hookup:* Disconnect the cable from the generator output at the input connector of the channel last tested.

Output Signal Checks

The procedure that follows checks the characteristics of the probe compensation signal that are listed as checked under *Warranted Characteristics* in Section 1, *Specification.*

Check Probe Compensator Outputs

Oscilloscopes with serial numbers B021799 and below: One standard-accessory 10X probe (Item 13).

Oscilloscopes with serial numbers B021800 and above: One female BNC to clip adapter (item 14), two dual-banana connectors (Item 5), one BNC T connector (Item 6), two 50 Ω precision cables (Item 4), and one DC calibration generator (Item 8).

Prerequisites: See page 4-13. Also, this Digitizing Oscilloscope must have passed *Check Accuracy — Long-Term Sample Rate, Delay time, Time Measurement* on page 4-31 and *Check Accuracy for DC Gain and Voltage Measurements* on page 4-17.

Procedure:

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

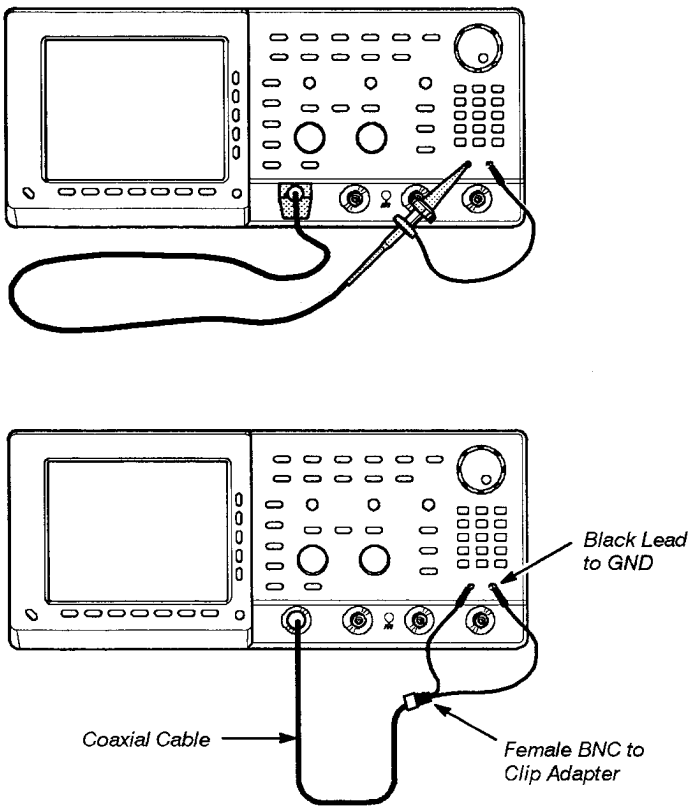


Figure 4-20: Initial Test Hookup

a. *Hook up test-signal:*

- Check your instrument serial number and note for use in the following subparts.
- For serial numbers B021799 and below, connect **CH 1** to **PROBE COMPENSATION SIGNAL** and to **PROBE COMPENSATION GND** through a probe as is shown in the top hookup illustration of Figure 4-20.
- For serial numbers B021800 and above, connect **CH 1** to **PROBE COMPENSATION SIGNAL** and to **PROBE COMPENSATION GND** through a precision coaxial cable and a BNC to clip adapter as is shown in the bottom hookup illustration of Figure 4-20.

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 100 mV as required.
- Set the horizontal **SCALE** to 200 µs.
- Press **SHIFT**; then press **ACQUIRE MENU**.
- Press the main-menu button **Mode**; then press the side-menu button **Average**..
- Select **128** averages.

2. *Confirm that the Probe Compensator signal is within limits for frequency:*

a. *Measure the frequency of the probe compensation signal:*

- Press **MEASURE**; then press the main-menu button **Select Measurement for Ch1**.



- Repeatedly press the side-menu button **–more–** until **Frequency** appears in the side menu (its icon is shown at the left). Press the side-menu button **Frequency**.
- Press **CLEAR MENU** to remove the menus from the display. See Figure 4-21.

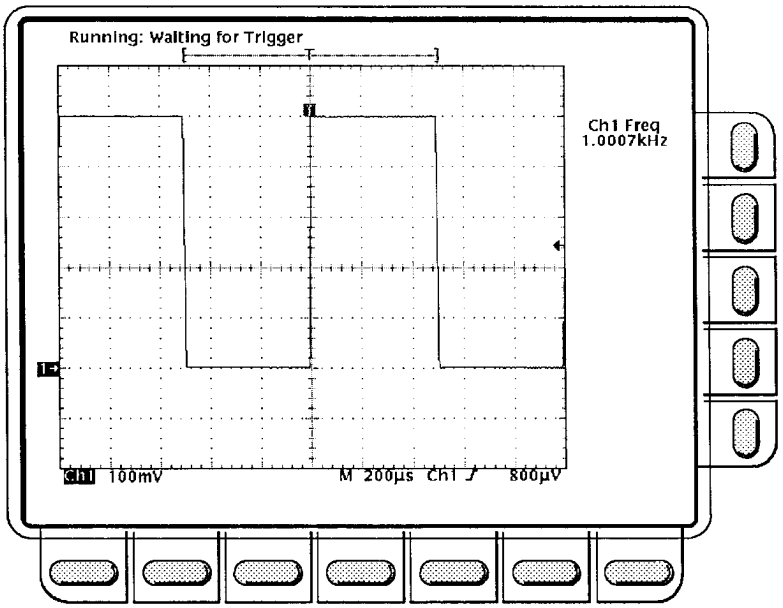


Figure 4-21: Measurement of Probe Compensator Frequency

b. *Check against limits:* CHECK that the **CH 1 Freq** readout is within 950 Hz to 1.050 kHz, inclusive, and that the readout for **Ch1 Ampl** is within 475 mV to 525 mV, inclusive.

c. *Check against limits:* CHECK that the **CH 1 Freq** readout is within 950 Hz to 1.050 kHz, inclusive.

STOP

Check the serial number of the oscilloscope you are testing. Then do the following to confirm that the Probe Compensator signal amplitude is within limits:

- If your oscilloscope serial number is B021799 or below, do step 3. Do *not* do step 4.
- If your oscilloscope serial number is B021800 or above, do step 4. Do *not* do step 3.

3. *Confirm that the Probe Compensator signal is within limits for amplitude:*

a. *Measure the amplitude of the probe compensation signal:* Repeatedly 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**.

b. *Check against limits:* CHECK that the readout for **Ch 1 Ampl** is within 475 mV to 525 mV, inclusive.

c. Skip to end of procedure (step 5.)

4. *Confirm that the Probe Compensator signal is within limits for amplitude:*

   a. *Save the probe compensation signal in reference memory:*

      - Press **SAVE/RECALL WAVEFORM**; then press the main-menu button **Save Waveform Ch 1**.
      - Press the side-menu button **Ref 1** to save the probe compensation signal in reference 1.
      - Disconnect the cable from **CH 1** and the clips from the probe compensation terminals.
      - Press **MORE**; then press the main-menu button **Ref 1** to displayed the stored signal.
      - Press **CH 1**.

   b. *Hook up the dc standard 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. Now connect the BNC T connector to **CH 1**.

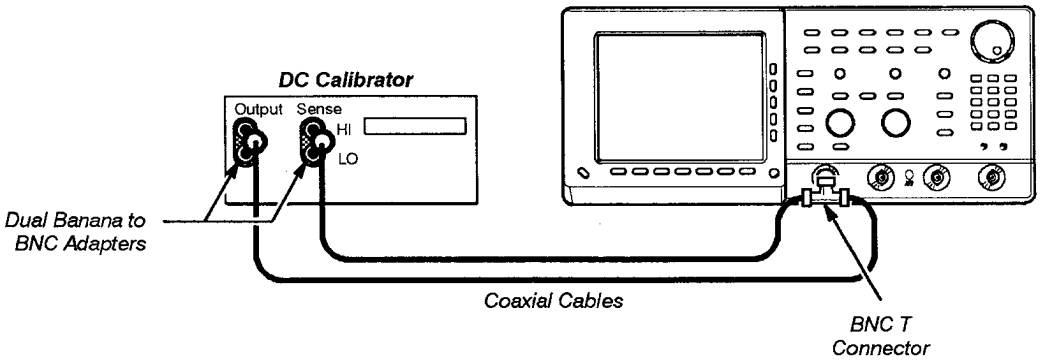


Figure 4-22: Subsequent Test Hookup

   c. *Measure amplitude of the probe compensation signal:*

      - Press **SHIFT**; then press **ACQUIRE MENU**. Then use the keypad to set **AVERAGE** to **16** in the side menu.
      - Adjust the output of DC calibration generator until it precisely overlaps the top (upper) level of the stored probe compensation signal. (This value will be near 500 mV.)
      - Record the setting of the DC generator.

- Adjust the output of DC calibration generator until it precisely overlaps the base (lower) level of the stored probe compensation signal. (This value will be near zero volts.)
- Record the setting of the DC generator.

d. Press **CLEAR MENU** to remove the menus from the display. See Figure 4-23.

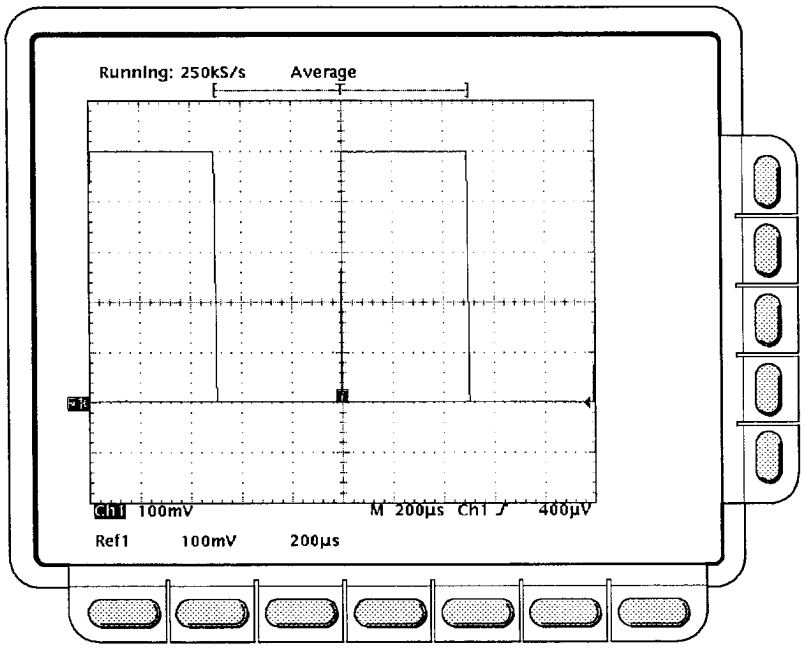


Figure 4-23: Measurement of Probe Compensator Amplitude

e. *Check against limits:*

- Subtract the value just obtained (base level) from that obtained previously (top level).
- CHECK that the difference obtained is within 495 mV to 505 mV, inclusive.

5. *Disconnect the hookup:* Disconnect the cable from **CH 1**.

Adjustment Procedures

This section contains information needed to adjust your TDS 520 Digitizing Oscilloscope to bring it to conformance with the *Warranted Characteristics* as listed in Section 1 of this manual, *Specification*.

The *Adjustment Procedures* are divided into seven subsections as follows:

- General Information gives basic start-up information.
- Equipment Requirements and Options provides information about computer system, peripheral, and test equipment needed to perform the adjustment procedures.
- Adjustments contains general information about using *TDS 520 Adjustment Software* and adjustment dependencies.
- Equipment Required is a list of equipment needed to perform the adjustments.
- Adjustment Instructions provides procedures for installing and using the *TDS 520 Adjustment Software* (included with this manual). Read the material found in this section before using the adjustment software.
- Probe Adjustment is a procedure for manually adjusting the P6139A probe.
- Display Assembly Adjustment is procedure for manually adjusting the display assembly.

General Information

This procedure is to be performed only 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. Performance errors may occur if adjustments are done before the operating temperature has stabilized.

Access

Do not remove the cabinet except when adjusting the display assembly. The internal adjustment constants of the oscilloscope are enabled or disabled through two small holes in the chassis.

Equipment Requirements and Options

The following computer system, peripherals, and test equipment are required to adjust this oscilloscope:

Computer System and Peripheral Requirements

- An IBM® PC™ or a strict compatible is required
- Eight MHz clock speed or faster.
- DOS 3.2 or higher.
- 640K Resident RAM with 550K Available RAM.
- A hard drive.
- A high-density floppy drive: 3.5 inch (1.44 M) or 5.25 inch (1.2 M).
- A GPIB board — National Instruments® GPIB-PCII, GPIB-PCIIA or GPIB-PCII/IIA. (A PC–GPIB Package that includes the PCII/IIA is available—Tektronix part number 118-8688-00).
- Suitable keyboard and monitor.

Optional Peripherals

Installation of a math coprocessor integrated circuit (IC) in your system is not required, but is strongly recommended to decrease the time required to adjust the oscilloscope.

Test Equipment

The equipment list starting on page 5-5, lists all test equipment required to adjust this oscilloscope.

Adjustments

The following topics describe what you must do to adjust the oscilloscope and what is done by the software. Individual adjustment performance and adjustment dependencies are also discussed.

Performing the Adjustments

These procedures are 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.

As a general rule, these adjustments should be done every 2000 hours of operation or once a year if used infrequently.

You will not be required to manually adjust any circuits when using the adjustment software. The software adjusts the circuits using external standards you provide in response to prompts on the computer screen. Your function is to provide those test signals and to prompt the computer to continue.

Since the probe and display-assembly adjustments require manual adjustment of circuit components, they are not part of the adjustment software. Written procedures for these adjustments begin on page 5-10.

Complete Adjustment

A *complete adjustment*, is defined as the performance of all adjustments on the *TDS 520 Adjustment Software,* in sequence, plus the *Probe Adjustment* (see page 5-10).

Individual Adjustments

The adjustment software contains three classes of adjustments. Each class contains one (or more) individual calibration test(s) and may also include a Signal Path Compensation (SPC). The three classes of adjustments are as follows:

- Voltage Reference Adjustment.
- Frequency Response Adjustment
- Pulse Trigger Adjustment

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

Signal Path Compensation

This internal routine is not an adjustment. It is a temperature compensation routine that compensates for the current operating temperature to optimize oscilloscope performance.

Partial Adjustment

The adjustment software will allow you to make individual adjustments, however this is not recommended 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
Attenuator 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 Assembly 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. For example, the Voltage Reference Adjustment must be passed before any other adjustments can be successfully completed. The following table lists the adjustments and their dependencies.

Table 5-2: Adjustments and Dependencies

Adjustment	Prior Completion Requirements
Voltage Reference Adjustment	None
Frequency Response Adjustment	Voltage Reference
Pulse Trigger Adjustment	Voltage Reference
Probe Adjustment	Voltage Reference and Frequency Response
Display Assembly Adjustment	None

Equipment Required

The following test equipment is required to adjust the TDS 520 Digitizing Oscilloscope.

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

Item Number and Description		Minimum Requirements	Example	Purpose
1	Adapter, BNC-Female-to-BNC-Female	Tektronix 013-0028-00	Tektronix 013-0028-00	Probe Adjustment
2	Adapter, Probe Tip to BNC, 50 Ω termination	Tektronix 013-0227-00	Tektronix 013-0227-00	Probe Adjustment
3	Adjustment Tool	Less than 1/8 inch diameter and over 2 inches long	Tektronix 003-0675-00	Software-based Adjustments (used as a probe) and Manual Adjustments
4	Attenuator, 10X (Two required)	Ratio: 10X; impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011-0059-02	Software-based Adjustments
5	Attenuator, 2X	Ratio: 2X; impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011-0069-02	Software-based Adjustments
6	Cable GPIB	IEEE Std 488.1-1987/ IEEE Std 488.2-1987	Tektronix part number 002-0991-01	Software-based Adjustments
7	Coupler, Dual Input		Tektronix part number 067-0525-02	Software-based Adjustments
8	Cable, Precision Coaxial	50 Ω, 36 in, male to male BNC connectors	Tektronix part number 012-0482-00	Software-based Adjustments
9	Connector, Dual-Banana	Female BNC to dual banana	Tektronix part number 103-0090-00	Software-based Adjustments
10	Generator, Calibration	High Amplitude pulse with variable amplitude of 60 V to 100 V.	TEKTRONIX PG 506A Calibration Generator[1]	Probe Adjustment
11	Generator, DC Calibration	Variable amplitude to ±10 V; accuracy to 0.05%	Data Precision 8200	Software-based Adjustments
12	Generator, Leveled Sine Wave, Medium-Frequency	200 kHz to 250 MHz; Variable amplitude from 5 mV to 4 V p-p into 50 Ω; flatness ≤3 %; harmonic content: 2nd harmonic down −30 dB from fundamental; all others down −40 dB	TEKTRONIX SG 503[1] or SG5030[2] Leveled Sine Wave Generator	Software-based Adjustments

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

Item Number and Description	Minimum Requirements	Example	Purpose
13 Generator, Leveled Sine Wave, High-Frequency	250 MHz to 500 MHz; Variable amplitude from 5 mV to 4 V p-p into 50 Ω; 6 MHz reference; harmonic content: 2nd harmonic down −30 dB from fundamental; all others down −40 dB	TEKTRONIX SG 504[1] Leveled Sine Wave Generator with its leveling head or a TEKTRONIX SG 5030[2] Programmable Leveled Sine Wave Generator with its leveling head	Software Based Adjustments
14 Magnifier, 6X	Standard Tool		Brightness and Focus Adjustment
15 Photometer	0.1 to 200 Footlamberts	TEKTRONIX J16 Photometer with J6503 Luminance Probe	Contrast Adjustment
16 Probe, P6139A 10 X	A P6139A Probe	TEKTRONIX P6139A	Probe Adjustment
17 Pulser, Tunnel Diode	TEKTRONIX 067-0681-01	TEKTRONIX 067-0681-01	Probe Adjustment

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

[2]**Requires a TM5000 Series Power Module Mainframe.**

Adjustment Instructions

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

Hardware Installation

1. *Install the proper GPIB card (see* Computer System Requirements *on page 5-2):* Use the manual accompanying your GPIB card to install and configure that card.
2. *Configure the GPIB card:*
   a. This software is designed to be compatible with cards configured for PCII and PCIIA operation. Table 5-4 on page 5-7 lists the default card settings.
   b. If these settings conflict with your hardware setup, see your GPIB card manual for alternate settings.

Table 5-4: GPIB Board Configuration[1]

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

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

a. If you have more than one GPIB card installed, this adjustment software assumes the first card (referenced 0). See your GPIB card manual for information on how to determine which card is your "0" card.

Software Installation



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

1. *Create a working disk:* Using the proper DOS commands, copy the *TDS 520 Adjustment Software* disk to a working disk.
2. *Install the software to hard disk:*
   a. Install your working disk in a floppy drive then type *install.* You will be asked to specify the hard disk on which to install the adjustment software. You will also be prompted to specify several GPIB-card configuration parameters.
   b. The adjustment software will be installed in a directory called *520.ADJ* on your hard drive.
3. *Store your installation disk:* Remove your installation disk and store it in a secure place.

Software-based Adjustments

Equipment Required: All items that are listed for "Software-based Adjustments" under "Purpose" in Table 5-3 on page 5-5.

1. *Hook up the oscilloscope:*
   a. Connect the GPIB cable (Item 6) to the GPIB port at the computer rear panel. (When multiple GPIB cards are installed, connect to the GPIB0 card.)
   b. Connect the GPIB cable to the GPIB port at the oscilloscope rear panel.
   c. Power on the oscilloscope.
2. *Set up the oscilloscope:*
   a. Press **SHIFT**; then press **UTILITY**.
   b. Repeatedly press the main-menu button **System** until **I/O** is highlighted in the pop-up menu.
   c. Press the side-menu button **TALK/LISTEN**.
   d. Use the keypad to set any address between 0 and 29.
3. *Enable the adjustment constants to be written:* The protection switch that enables or disables the writing of new adjustment constants to non-volatile RAM (NVRAM) is accessed through one of two small holes in the oscilloscope chassis (see Figure 5-1).

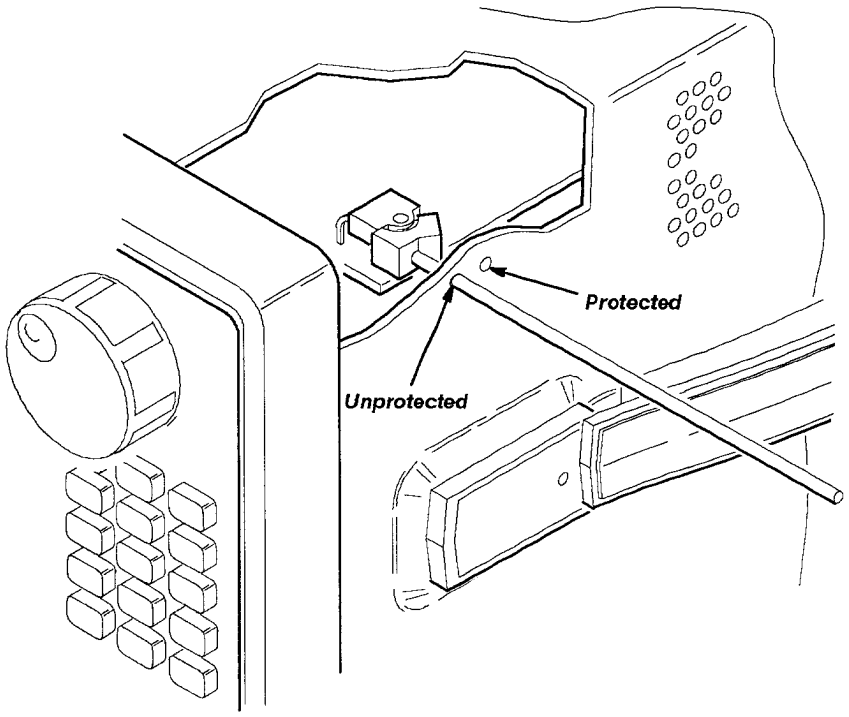


Figure 5-1: Accessing the Protection Switch

   a. Locate the two small access holes on the right side of the oscilloscope cabinet near the front.

b. Insert the adjustment tool (Item 3) in the hole nearest the front of the oscilloscope about ½ inch to engage the rocker switch.

c. Use the inserted adjustment tool to push the switch to its unprotected (enabled) position.

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

5. *Start the adjustment software:*

   a. Change the drive to the hard drive.

   b. Change directories to *520.ADJ*.

   c. Type *ADJ520.*

   d. Follow the instructions as prompted on your computer screen.

6. *When adjustment has been completed:*

CAUTION

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

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

   b. Insert the adjustment tool (Item 3) in the hole nearest the *rear* of the oscilloscope about ½ inch to engage the rocker switch.

   c. Using the inserted adjustment tool, push the switch to its protected (disabled) position.

   d. To do a complete adjustment as defined on page 5-3, you must also do the *Probe Adjustment* procedure starting on page 5-10.

Probe Adjustment

Probe adjustment is divided into three parts: *Compensate the Probe, Measure the Probe Bandwidth*, and *Adjust the Probe — High Frequency Response.* If probe bandwidth is within required limits, you will be instructed to *not* do the high frequency response adjustment.

Compensate the Probe

Equipment Required: One P6139A probe (Item 16) and one adjustment tool (Item 3).

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

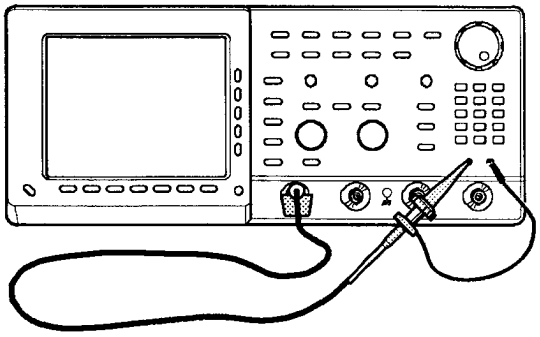


Figure 5-2: Hookup for Probe Compensation

a. *Hook up test-signal source:* Install the standard-accessory probe to **CH 1**. Connect the probe tip to **PROBE COMPENSATION SIGNAL** on the front panel; connect the probe ground to **PROBE COMPENSATION GND**.

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:*

- Press **AUTOSET**. Set the horizontal **SCALE** to 200 µs.
- Press **SHIFT**. Then press **ACQUIRE MENU**.
- Press the main-menu button **Mode**. Then press the side-menu button **Hi Res**.

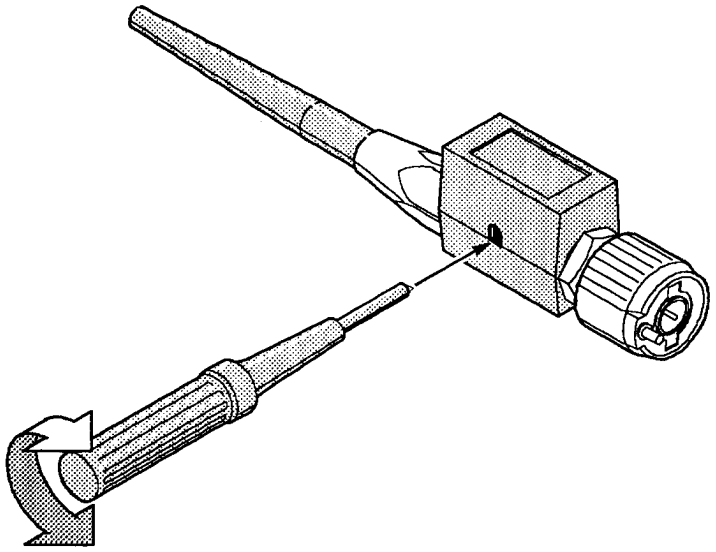


Figure 5-3: Performing Probe Compensation

2. *Compensate the Probe:*

   a. Locate the probe compensation hole in the side of the probe body (see Figure 5-3).

   b. Using the adjustment tool, adjust the probe for best square wave compensation (flat as possible across its across its top).

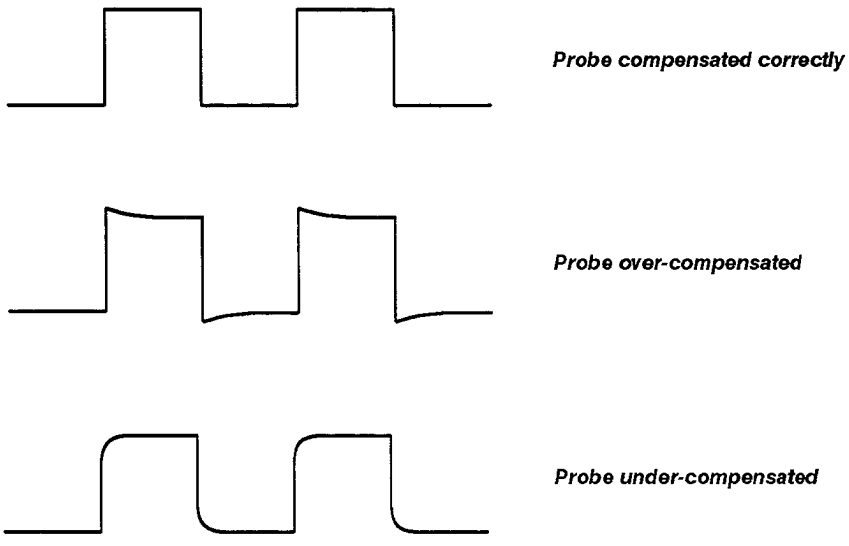


Figure 5-4: Proper and Improper Probe Compensation

3. *Disconnect the hookup:* Disconnect the probe from the probe compensator terminals; leave probe installed on CH 1 and leave the oscilloscope control setup as is for doing the next part of probe adjustment.

Measure Probe Bandwidth

Equipment Required: One high-frequency sine wave generator with its leveling head (Item 13), one BNC-female-to-female BNC adapter (Item 1), one BNC-to-probe tip adapter (Item 2), and one P6139A 10X probe (Item 16).

1. *Expose the probe tip, install the test hookup, and preset the oscilloscope controls:*

   a. *Expose the Inner Probe Tip:* Follow the instructions in Figure 5-5.

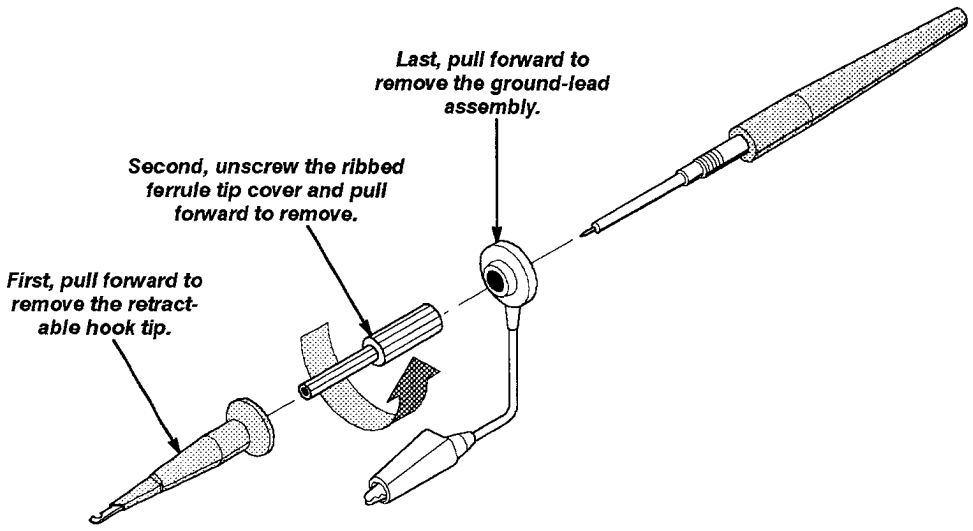


Figure 5-5: Exposing the Inner Probe Tip

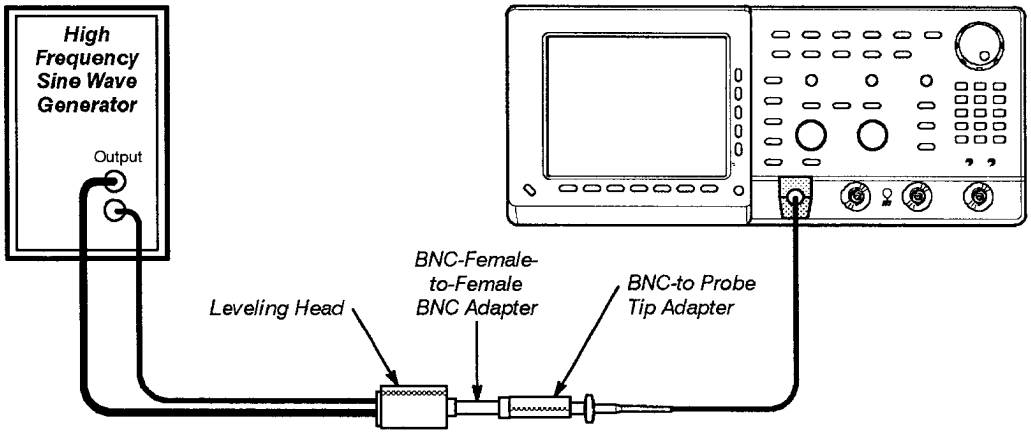


Figure 5-6: Initial Test Hookup

b. *Hook up test-signal source:*

- Connect the output of a high-frequency sine wave generator, through its leveling head, to a female-to-female adapter (see Figure 5-6).
- Connect the female-to-female adapter to a BNC-to-probe tip adapter.
- Plug the probe tip from the probe on CH 1 into the BNC-to-probe tip adapter.

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 50 mV.
- Set the horizontal **SCALE** to 100 ns.
- Press **SHIFT**. Then press **ACQUIRE MENU**.
- Press the main-menu button **Mode**. Then press the side-menu button **Hi Res**.
- Press **MEASURE**.
- Press the main-menu button **Hi-Low Setup**. Then press the side-menu button **Min-Max**.

- Press the main-menu button **Select Measurement for Ch1**.
- Repeatedly press the side-menu button **–more–** until **Pk-Pk** appears in the side menu. Press the side-menu button **Pk-Pk**.
- Press **CLEAR MENU**.

2. *Confirm that the Probe Compensator signal is within limits for bandwidth:*
   a. *Display and measure the test signal:*
      - Monitor the **CH 1 Pk-Pk** readout while you set the output of the generator for a 3.0 V (6 division), 6 MHz reference signal.
      - Set the horizontal **SCALE** to 1 ns and set the frequency of the generator to 500 MHz.
      - Read the measurement results at the CH 1 Pk-Pk readout on screen.
   b. *Check against limits:* CHECK that the **CH 1 Pk-Pk** readout is greater than or equal to 2.1 V.
3. *Disconnect the hookup:*
   a. Unplug the probe from BNC-to-probe tip adapter.
   b. If substep 2b was passed, the probe adjustment is finished. Reverse the instructions in Figure 5-5, on page 5-12, to reinstall the retractable hook probe tip.
   c. If substep 2b was *not* passed, leave the probe tip exposed. Remove the probe from CH 1 and go on to the next procedure *Adjust the Probe — High Frequency Response*.

Adjust the Probe—High Frequency Response

Do not perform this procedure until you have first completed the procedures *Compensate the Probe* and *Measure Probe Bandwidth* on pages 5-10 and 5-12, respectively.

Do not perform this procedure if you have successfully completed *Measure Probe Bandwidth* (probe adjustment is complete).

Equipment Required: One calibration generator (Item 10), one 50 Ω precision cable (Item 8), one tunnel diode pulser (Item 17), one female-to-female adapter (Item 1), one BNC to probe adapter (Item 2), one P6139 10X probe (Item 16), one 10X attenuator (Item 4), and one small standard screwdriver.

1. *Install the test hookup and preset the oscilloscope controls:*
   a. *Access Inner Probe Tip and Adjustment Ports:*
      - The probe tip should be exposed from the procedure *Measure Probe Bandwidth.* If not, follow the instructions in Figure 5-5 on page 5-12 to expose the probe tip.

- Follow the instructions in Figure 5-7 to remove the probe body covers.

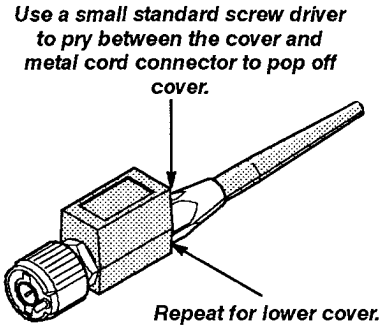


Figure 5-7: Exposing the Probe Body

b. *Hook up the test signal source:*

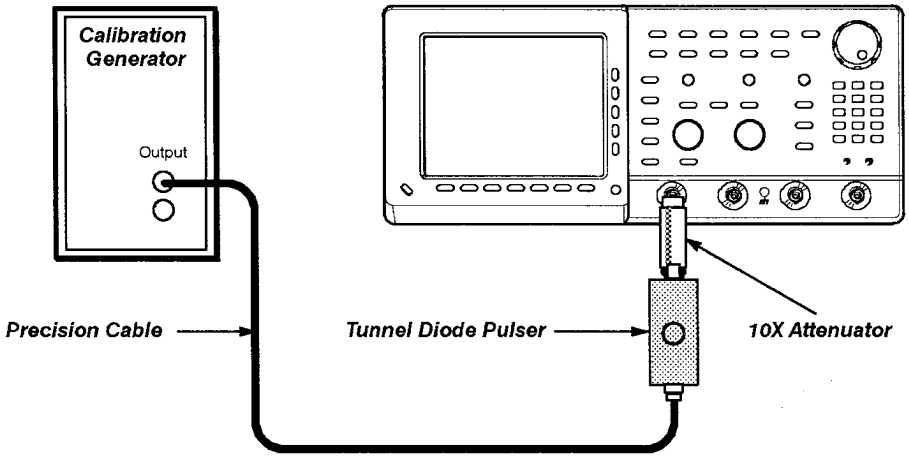


Figure 5-8: Initial Test Hookup

- Connect the high-amplitude output of the calibration generator, through a 50 Ω precision cable to the input of a tunnel diode pulser (see Figure 5-8).
- Connect the output of the tunnel diode pulser through a 10X attenuator to CH 1.
- Set the triggering level of the tunnel diode pulser to minimum.

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 vertical **SCALE** to 5 mV.
- Press **VERTICAL MENU**. Then press the main-menu button **Coupling**. Press the side-menu button Ω to toggle to 50 Ω coupling.
- Press **SHIFT**. Then press **ACQUIRE MENU**.
- Press the main-menu button **Mode**. Then press the side-menu button **Hi Res**.
- Press **CLEAR MENU**.

2. *Adjust the Probe:*

a. *Display and store the reference signal:*

- Set the high-amplitude output of the generator between 60 to 100 V *at the input to the tunnel diode pulser.*
- Advance the triggering level of the tunnel diode pulser until a five to six division square wave appears on screen.
- Push **SET LEVEL TO 50%** as required to trigger the signal.
- Advance the horizontal **SCALE** to 5 ns.
- Press **HORIZONTAL MENU**.
- Press the main-menu button **Trigger Position**; and press the side-menu button **10%**.
- Push **SHIFT**; then press **SAVE WAVEFORM**.
- Press the main-menu button **Save Waveform**. Then press the side-menu button **To Ref 1**.
- Press **MORE**. Then push the main-menu button **Ref 1**.

b. *Display the test signal:*

- Disconnect the tunnel diode pulser at CH 1 and remove the 10X attenuator.
- Connect the output of the tunnel diode pulser through a BNC-female-to-BNC-female adapter to a BNC-to-probe tip adapter.
- Install the probe on CH 1.
- Plug the probe tip from the probe into the BNC-to-probe tip adapter.
- Press the main-menu button **Coupling**. Then press the side-menu button Ω to toggle to 1 MΩ coupling.
- Press **HORIZONTAL MENU**.
- Press the main-menu button **Trigger Position**; and press the side-menu button **50%**.

c. *Make the adjustments:*

- Locate the various adjustments in Figure 5-9.

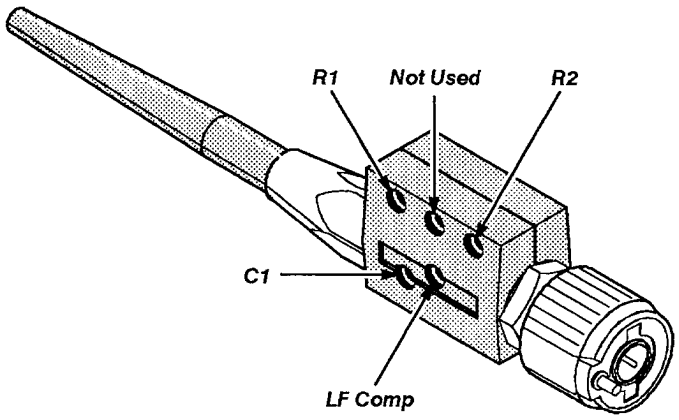


Figure 5-9: Locations of Probe Adjustments

- Manually adjust the front-corner response of the probe to best match the response of the Ref 1 waveform. Note that it is more important to match the response during the first 5 ns than during the entire first 20 ns the adjustments affect.
- See Figure 5-10 to see what areas on the front corner that the various adjustments affect.

d. *Recheck Probe Bandwidth:*

- Redo the procedure *Adjust Probe — High Frequency Response* to check if the probe now meets its bandwidth requirement.
- If bandwidth is met, adjustment is complete. Skip to step 3.
- If bandwidth is *not* met, redo this procedure, increasing front corner overshoot slightly relative to the stored waveform.
- Repeat this step (d) until bandwidth is met.

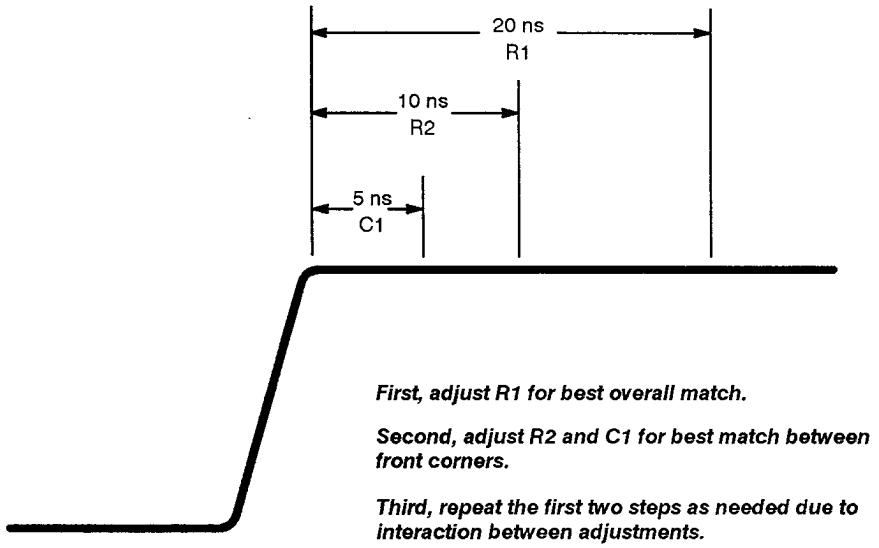


Figure 5-10: Adjustments vs Front-Corner Response

3. *Disconnect the hookup:* Unplug the probe from the BNC-to-probe tip adapter. Reverse the instructions in Figure 5-5, page 5-12, to reinstall the retractable probe tip.

Display Assembly 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.

Brightness and Contrast Adjustment

Equipment Required: One 6X magnifier (Item 14) and one J16 Photometer with a J6503 Luminance Probe (Item 15).

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 instrument 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 5-11) just disappear, while the lines in the 10% luminance patch are just visible, when both are viewed through the magnifier.

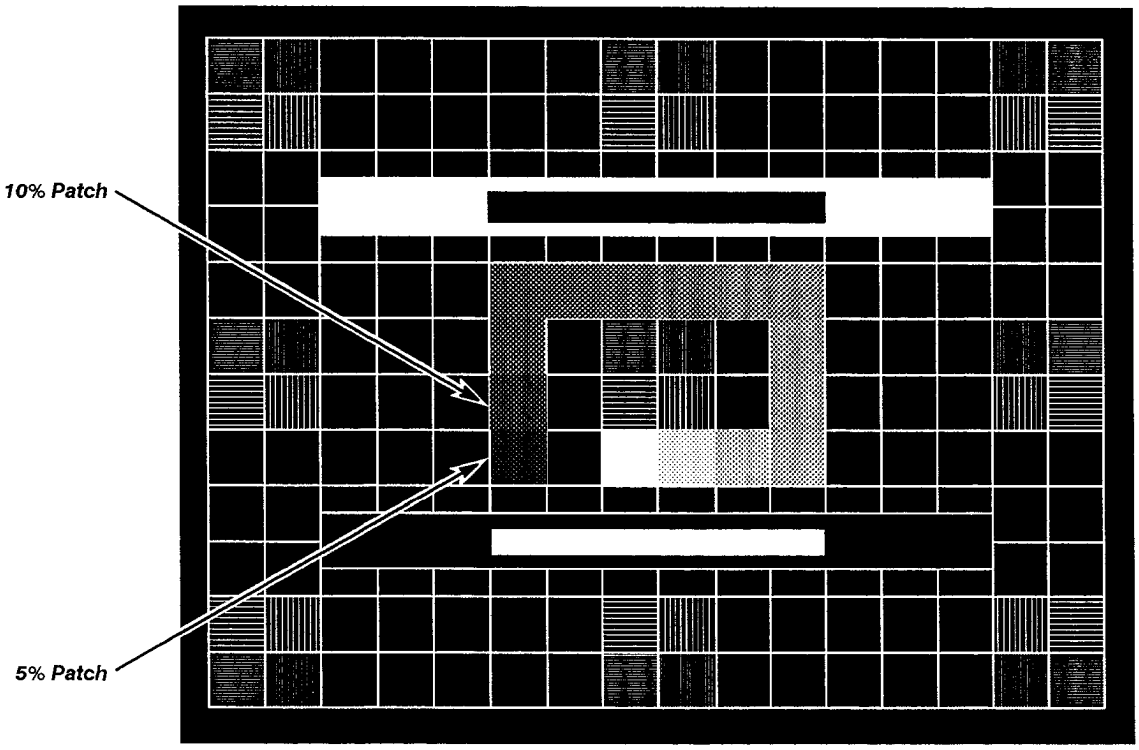


Figure 5-11: Five and Ten Percent Luminance Patches

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 instrument 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 the 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 the TDS 520 Digitizing Oscilloscope. 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, *Replaceable Parts,* lists all field replaceable modules by part number.

Preventing Electrostatic Discharge (ESD)

CAUTION

Electrostatic 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. Remove anything capable of generating or holding a static charge from the work station surface.
5. When possible handle circuit boards by the edges.
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, the TDS 520 Digitizing Oscilloscope. 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's front cover protects the front panel and display from dust and damage. Install it when storing or transporting the oscilloscope.

Inspection and Cleaning Procedures

Inspect and clean the oscilloscope as often as operating conditions require. The collection of dirt on components inside can cause them to overheating 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. Repair defects that could cause personal injury or lead to further damage to the oscilloscope immediately.

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-pressure, deionized air (approximately 9 psi).
2. Remove any remaining dust with a lint free cloth dampened in isopropyl alcohol (75% solution) and rinse with a warm deionized water. (A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards.)
3. If steps 1 and 2 do not remove all the dust or dirt, the oscilloscope may be spray washed using a solution of 75% isopropyl alcohol by doing steps 4 through 8.
4. Gain access to the parts to be cleaned by removing easily accessible shields and panels (see "Removal and Installation Procedures").
5. Spray wash dirty parts with the isopropyl alcohol and wait 60 seconds for the majority of the alcohol to evaporate.
6. Use hot (120° F to 140° F) deionized water to thoroughly rinse them.
7. Dry all parts with low-pressure, deionized air.
8. Dry all components and assemblies in an oven or drying compartment using low-temperature (125° F to 150° F) circulating air.

Lubrication

There is no periodic lubrication required for this oscilloscope.

Removal and Installation Procedures

This subsection contains procedures for removal and installation of all modules. A module is any electrical or mechanical module, assembly, or part listed in Section 10, *Replaceable Parts*. Specifically, the following subsections are included:

- 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* on page 6-5.)
- Three module locator diagrams for finding all the modules in this oscilloscope.

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 this oscilloscopes components, read Before Servicing and Supplying Operating Power *in Section 2, and* Preventing Electrostatic Discharge *on page 6-2.*

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, *Replaceable Parts* lists all modules.

General Instructions



READ THESE GENERAL INSTRUCTIONS BEFORE REMOVING A MODULE.

First read the following *Summary of Procedures* 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 6-48.

If you are removing a module for service, begin by doing *Access Procedure* on page 6-16. This procedure describes how to remove the module to be serviced while removing the minimum number of additional modules.

Summary of Procedures

The following procedures are described in the order in which they appear in this subsection. You can also look up the procedure for removal and reinstallation of any module in the *Table of Contents* of this manual.

- The *Access Procedure* on page 6-15 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 6-16 are procedures for removing modules which do not require internal access to the oscilloscope.
- *Procedures for Outer-Chassis Modules* on page 6-30 are procedures for removing modules which require access internal to the instrument but external to the chassis.
- *Procedures for Inner-Chassis Modules* on page 6-41 are procedures for removing modules which require access internal to the instrument and internal to the chassis.
- *Disassembly for Cleaning* on page 6-35 is a procedure that describes how to remove all modules for cleaning. Instructions for cleaning are found in *Inspection and Cleaning* on page 6-5.

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	003-0301-00
2	T-15 Torx tip	Torx®-driver bit for T-15 size screw heads	003-0966-00
3	T-20 Torx tip	Torx®-driver bit for T-20 size screw heads	003-0866-00
4	T-20 Torx tip	Special Tool: Narrow Torx®-driver bit for T-20 size screw heads (Fan removal only)	003-1457-01
5	Flat-bladed screwdriver	Screwdriver for removing standard-headed screws	
6	Needle-Nose Pliers	Standard tool	
7	Nutdriver, ¼ inch	Standard tool	
8	Retaining Ring Pliers	Standard tool; 1⅛ inch minimum throw	
9	Angle-Tip Tweezers	Standard tool	
10	Pliers	Standard tool	

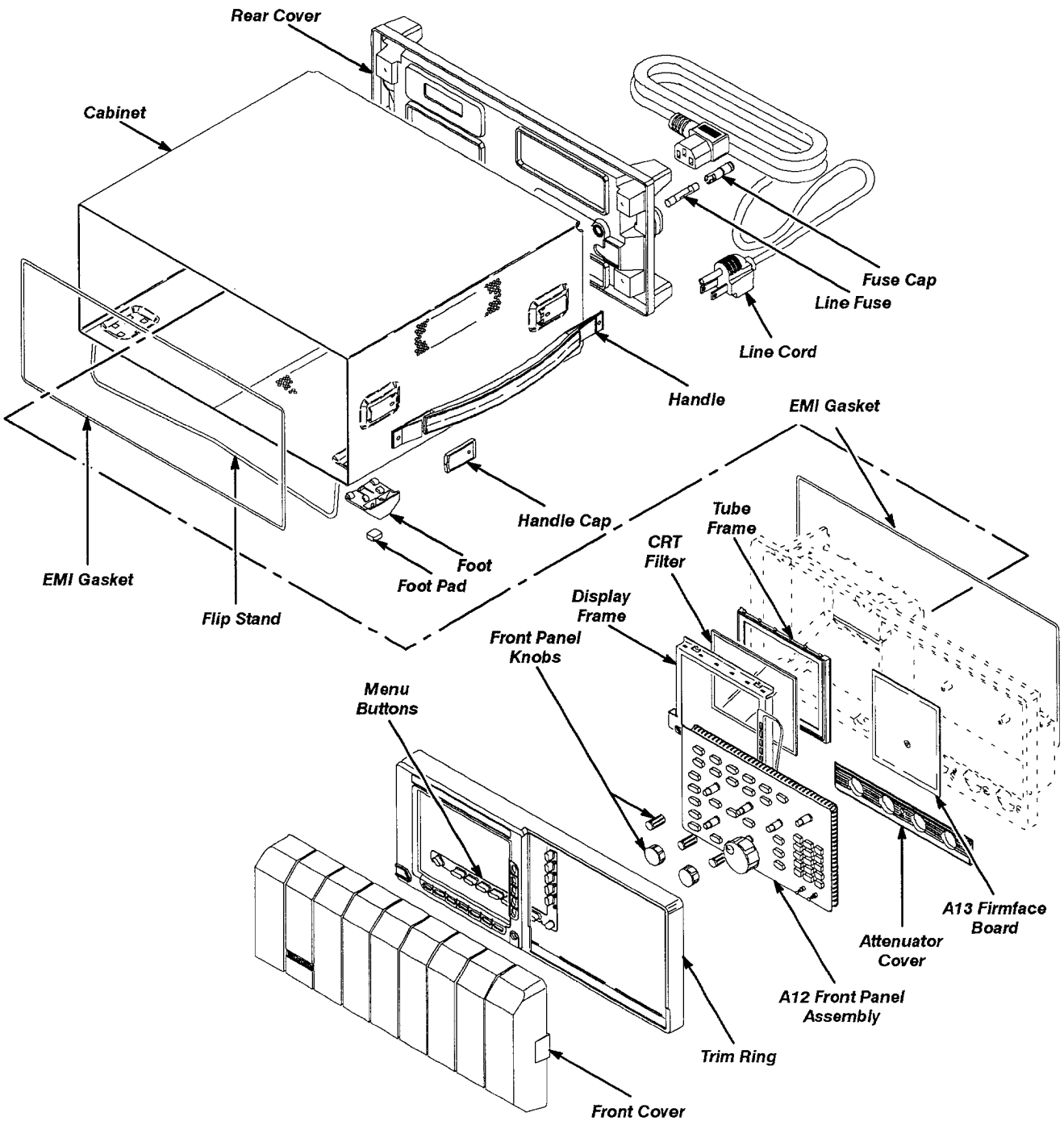


Figure 6-1: External Modules

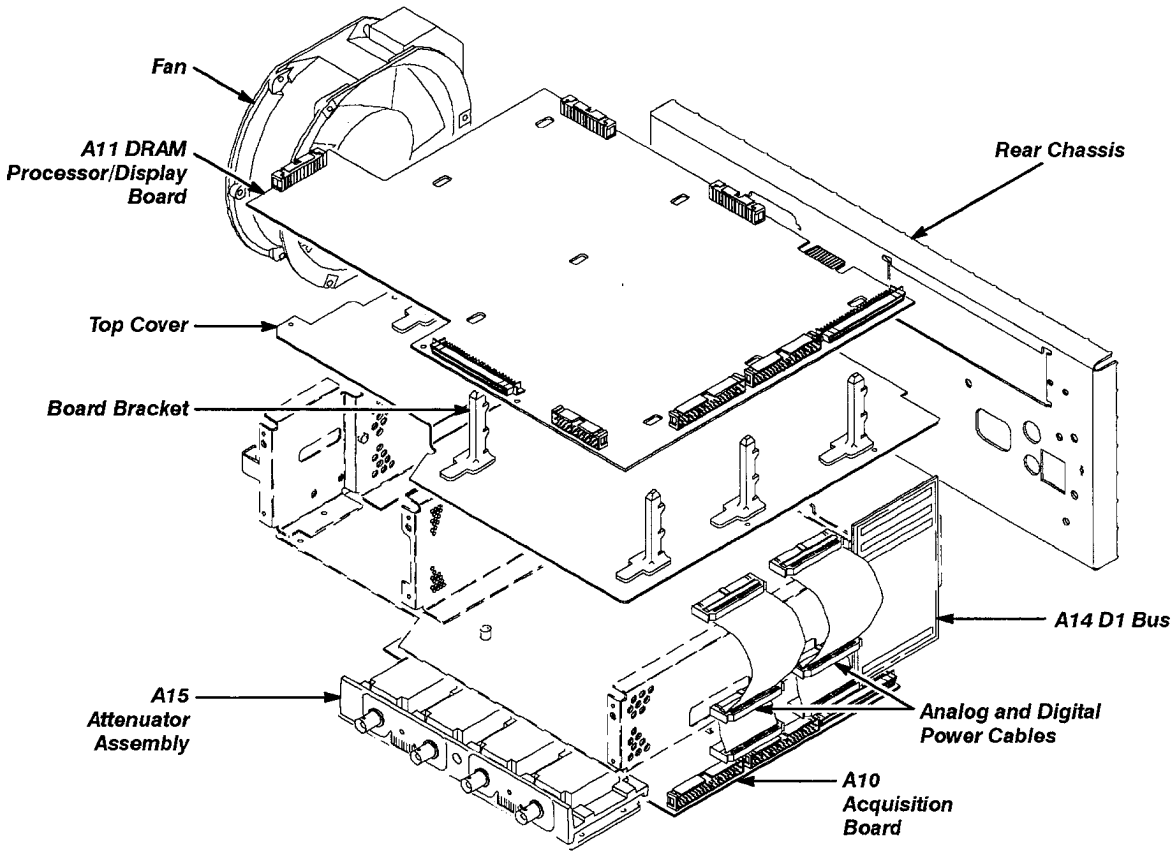


Figure 6-2: Outer-Chassis Modules

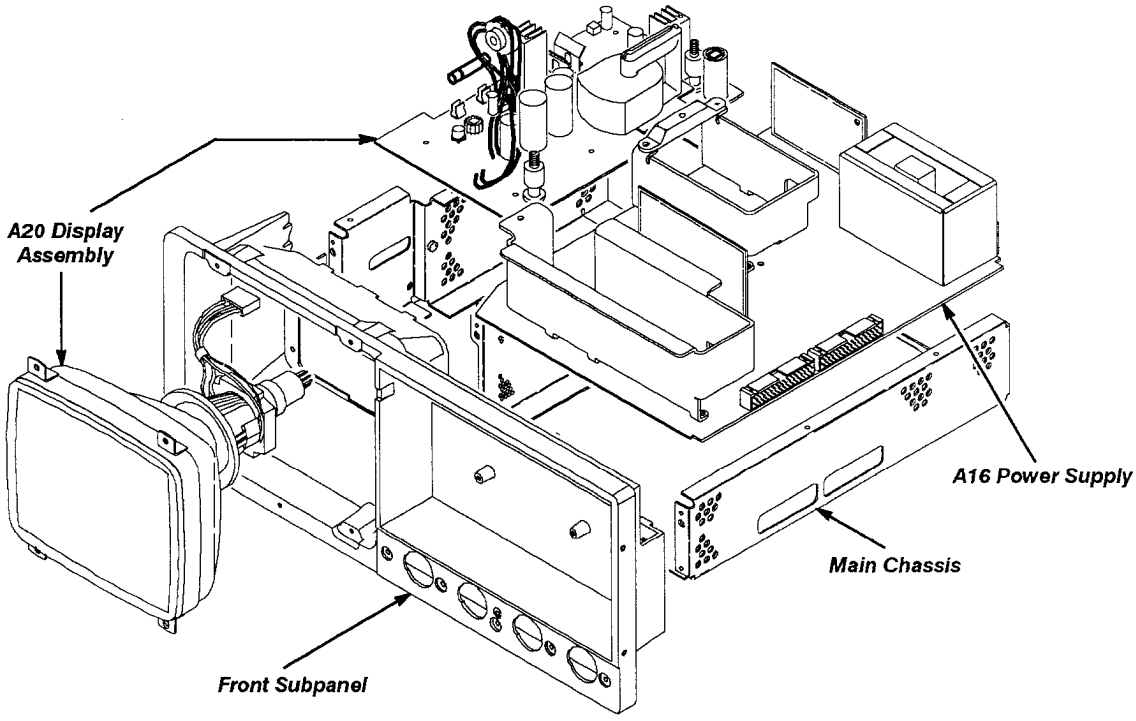


Figure 6-3: Inner-Chassis Modules

Access Procedure

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

1. *Locate module to be removed:*
   a. Find the module to be removed in the module locator diagrams, Figures 6-1 through 6-3.
   b. Once the module is found, note from the title of the figure whether the module is an external, outer-chassis mounted, or inner-chassis mounted part.
2. *If the module is externally mounted, no internal access is required; remove the module:* Find and do the procedure whose title matches the name of the module to be removed under *Procedures for External Modules* (page 6-16).
3. *If the module is an outer- or inner-chassis module, access the inside of the instrument:*
   a. First do the procedure *Line Fuse and Line Cord*; then do the procedure *Rear Cover and Cabinet.* Both are found under *Procedures for External Modules* immediately following this procedure.
   b. After completing those procedures, return to this procedure and continue with step 4.
4. *If the module is an outer-chassis module, remove it:*
   a. If removing the attenuator or display-frame assembly, first do the procedure *Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel,* found under *Procedures for External Modules* (page 6-16).
   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 6-30.
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 Attenuator Panel,* found under *Procedures for External Modules.* Also remove the display-frame assembly found under *Procedures for External Modules,* on page 6-16.
   b. Also, if removing the front subpanel, do *A12 Front-Panel Assembly and A13 Firmface Board* and *A15 Attenuator Assembly,* 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 6-30.
   d. Find and do the procedure whose title matches the name of the module to be removed under *Procedures for Inner-Chassis Modules*, page 6-41.

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

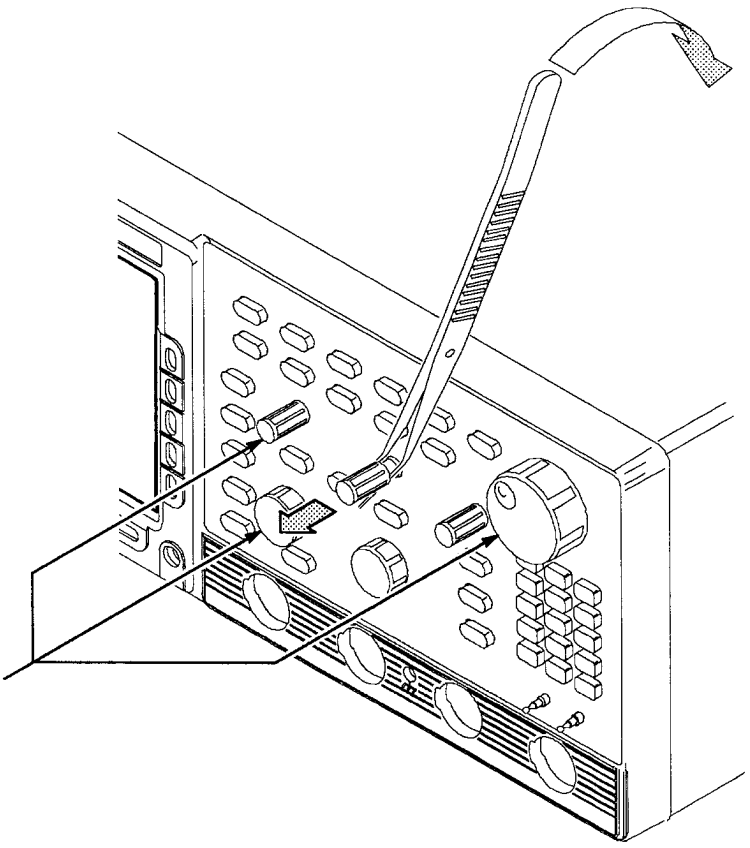
Do the *Access Procedure* (page 6-15) before doing any procedure in this collection.

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 Attenuator 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 9). 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.
4. *Reinstallation:* To reinstall the knob, align it to the shaft and push it in until it snaps.



When reinstalling the knobs, note there are three sizes. Be sure to reinstall the proper size knob in the proper location.

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.

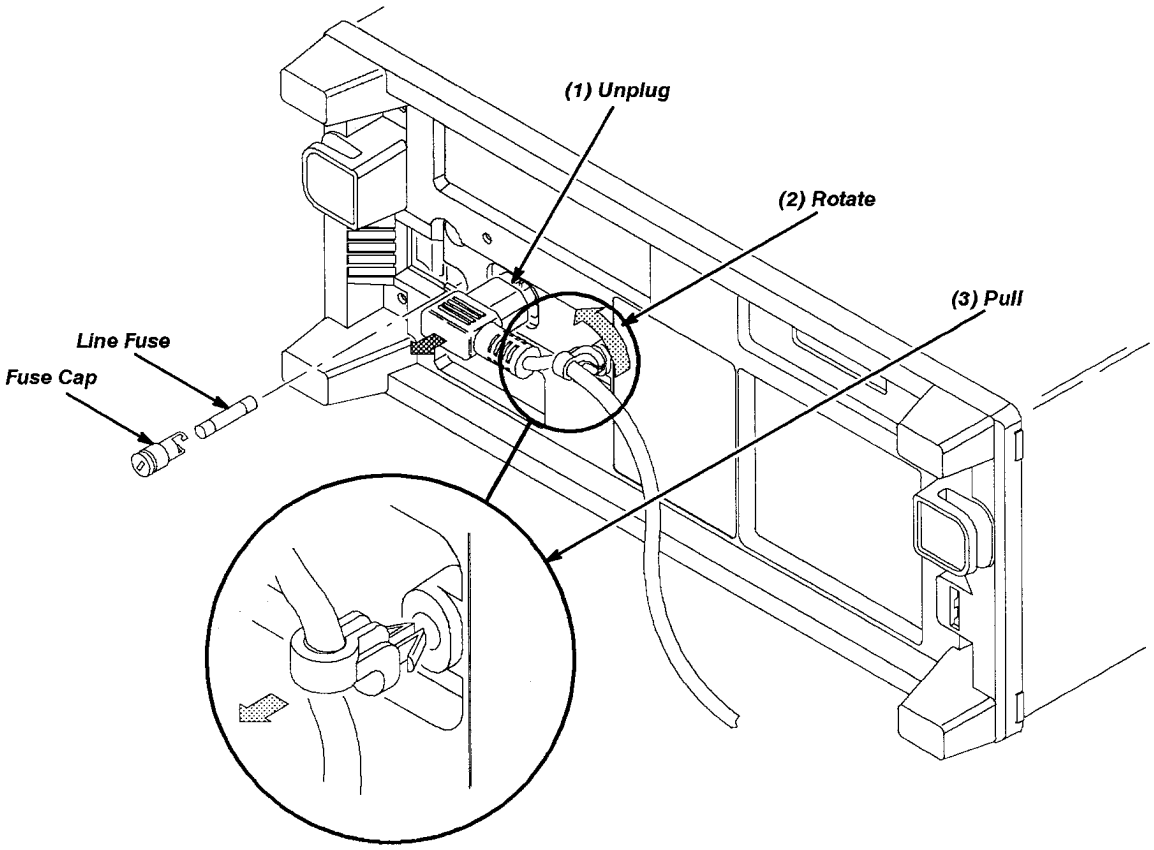


Figure 6-5: Line Fuse and Line Cord Removal

EMI Gaskets

See *Rear Cover and Cabinet* procedure on page 6-19.

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 oscilloscopes 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 oscilloscopes 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 6).
   b. Locate the modules to be removed in the locator diagram *External Modules*, Figure 6-1.
7. *Remove the EMI gaskets:*
   a. Look for the point where the ends of the gasket touch in the channel at the rear edge of the cabinet.
   b. Use the 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 and 4 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 cabinet aligns with the groove containing the EMI shield on the front casting.
   d. Be sure that the ridge around the rear chassis slides into the groove containing a second EMI cable on the rear of the cabinet.
   e. When reinstalling the four screws at the rear panel, tighten them to 16 inch-lbs torque.
   f. See the procedure *Line Fuse and Line Cord* to reinstall the line cord. This completes the oscilloscope reassembly.

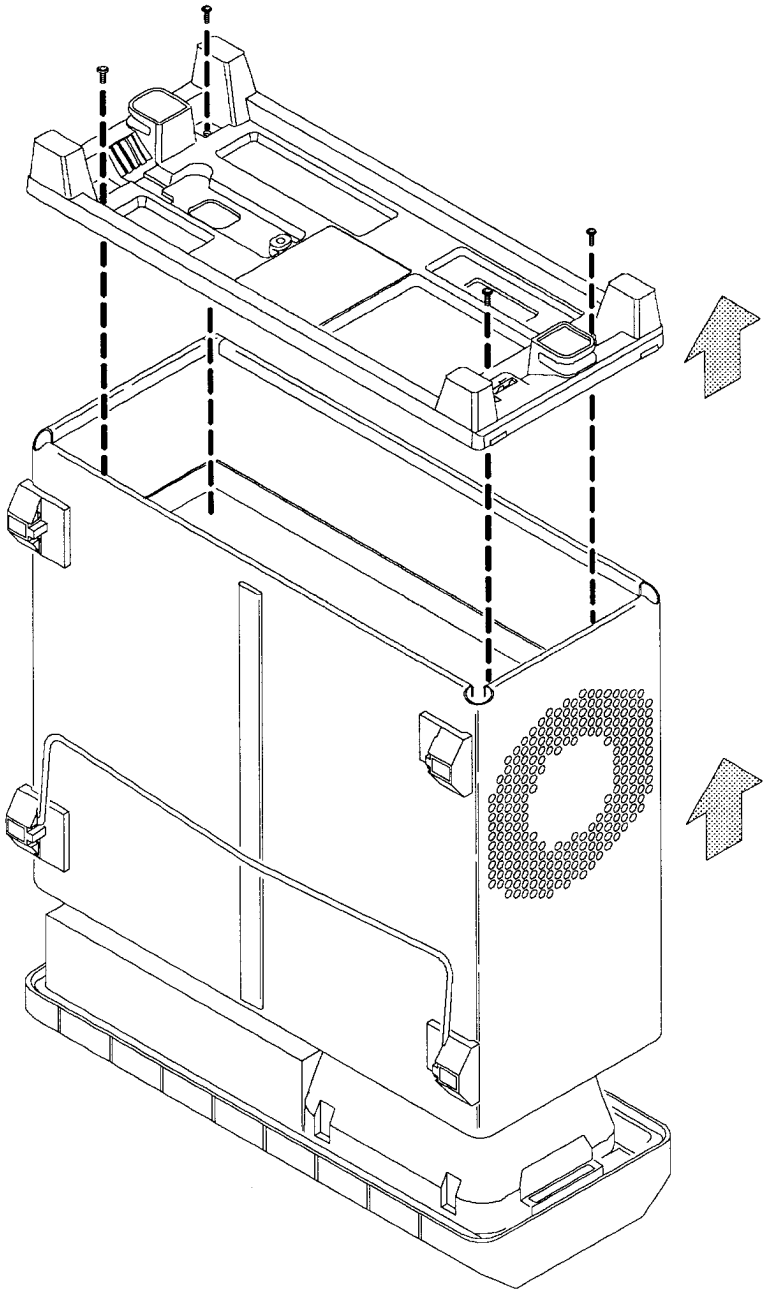


Figure 6-6: Rear Cover and Cabinet Removal

Front Cover, Trim Ring, Menu Buttons, and Attenuator 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.)

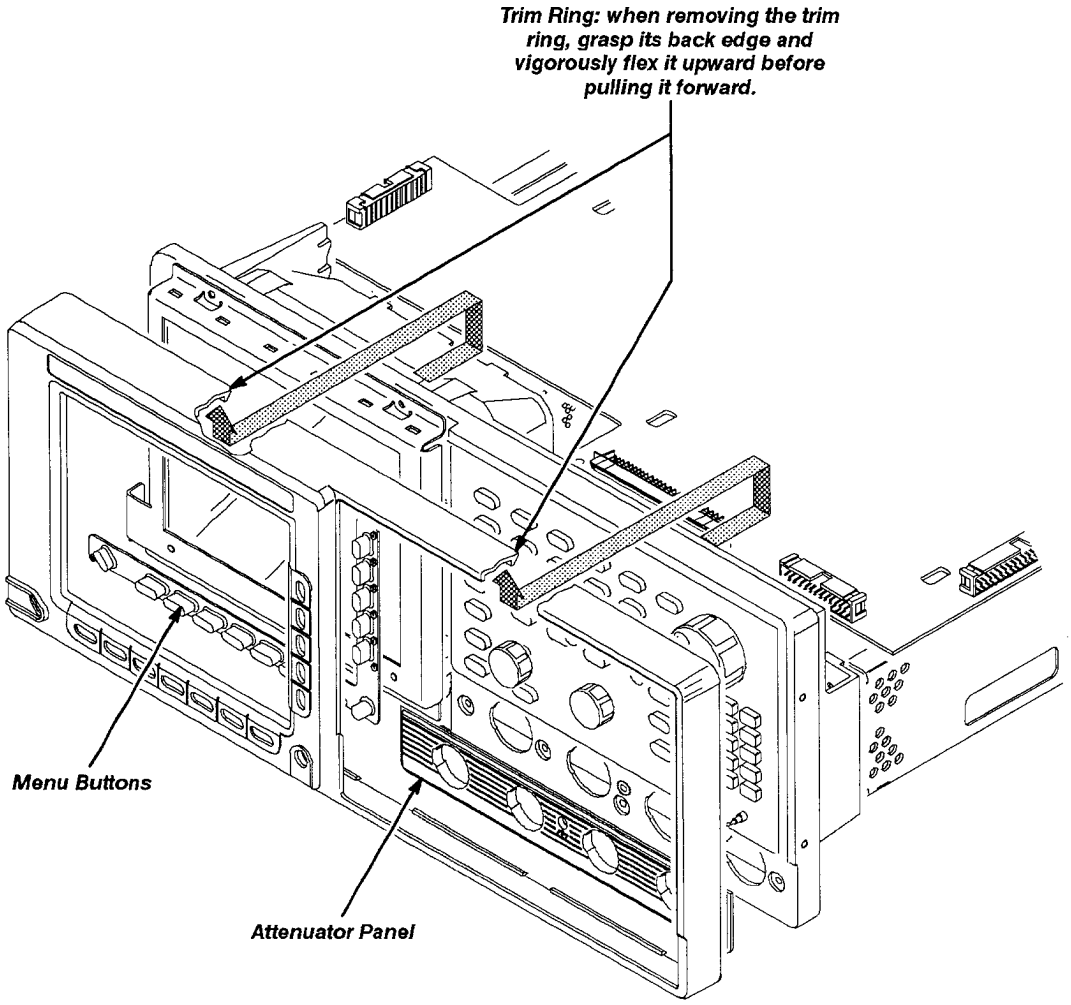


Figure 6-7: Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel Removal (Front Cover not Shown)

STOP

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

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

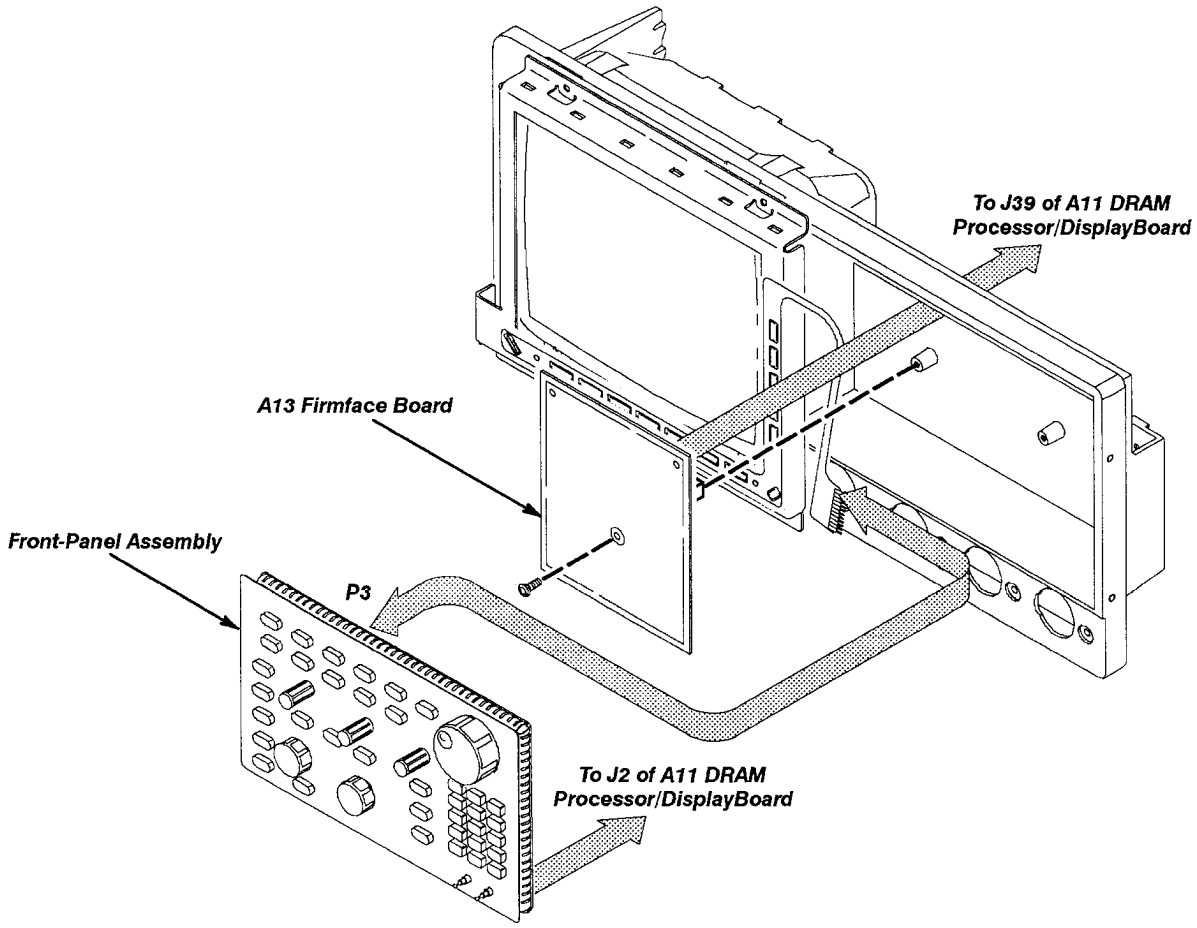


Figure 6-8: A12 Front-Panel Assembly and A13 Firmface Board Removal

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 6-16.

   b. Remove the eight screws mounting the front-panel board to the front panel.

   c. Now hand disassemble the front-panel-assembly components using Figure 6-9 as a guide. Reverse procedure to reassemble, using the same Figure 6-9 as a guide.

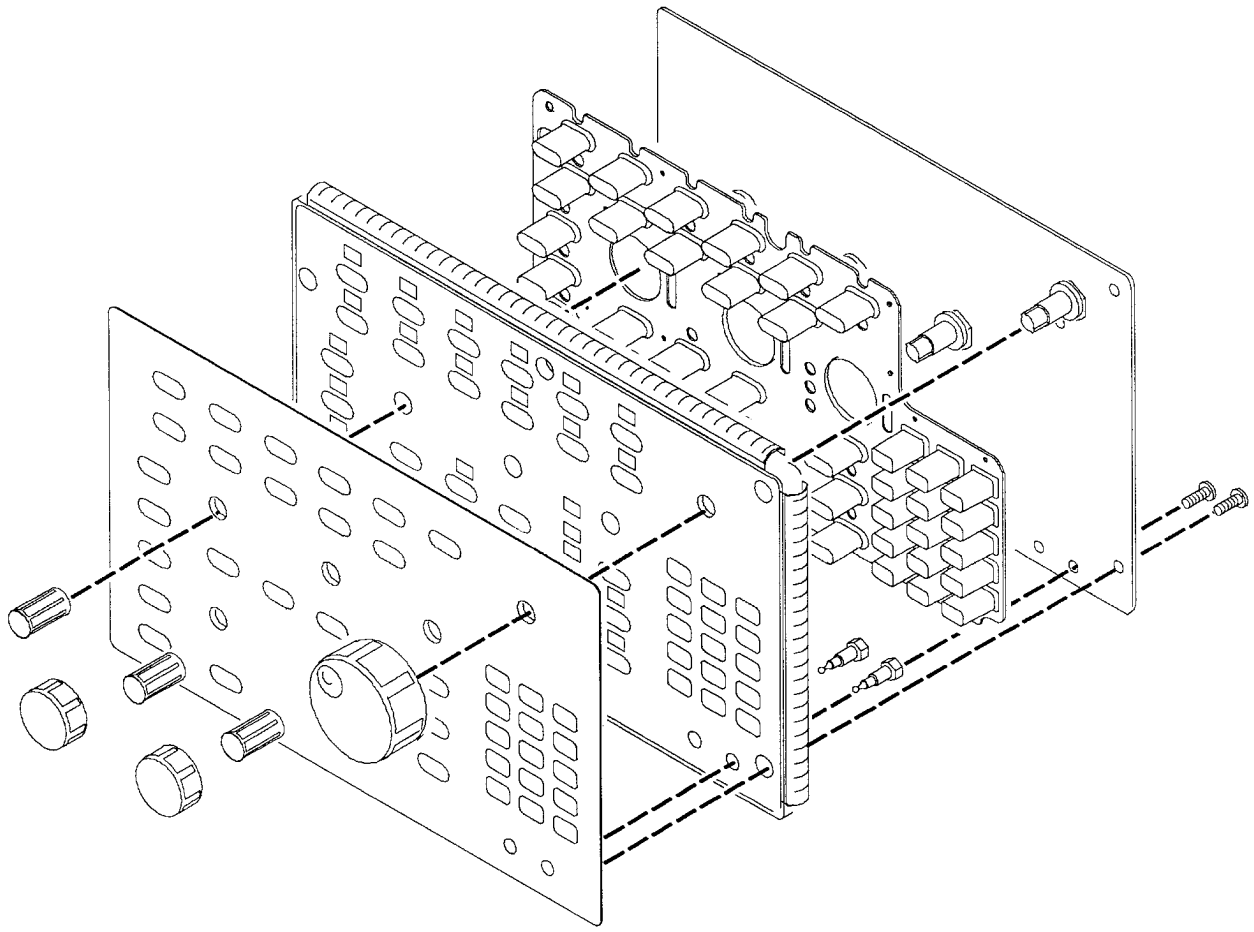


Figure 6-9: Disassembly of Front-Panel Assembly

5. *Remove the firmface board:* Remove the three screws that secure 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 6-25.)

6. *Reinstallation:* If the front-panel assembly was further disassembled in step 4, then reverse substeps 4a–4c to reassemble, using Figure 6-8 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 Attenuator Panel* (page 6-22).

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 *Outer-Chassis Modules*, Figure 6-2, page 6-13.

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 Attenuator Panel* (page 6-22) 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 Attenuator Panel* (page 6-22) 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 6). 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 6) 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 8) into the opening created in the handle cap when you removed the handle.
   b. While using the pliers to expand the handle cap outward, grasp it and snap it off.
   c. Repeat procedure to remove the remaining cap as needed; push the cap(s) back on to reinstall.
5. *Remove the flip stand:* Grasp the flip stand by both sides near where it joins each flip stand foot. Now compress the flip stand until the flip stand ends clear the flip stand feet to complete the removal.
6. *Remove the flip stand foot (or feet):*
   a. Do *Rear Cover and Cabinet* (page 6-19) 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 6-19) to reinstall the rear cover and cabinet. Do in reverse order steps 3 and 5, reversing each step, to reinstall the flip stand, then the handle caps (if removed), then the handle.

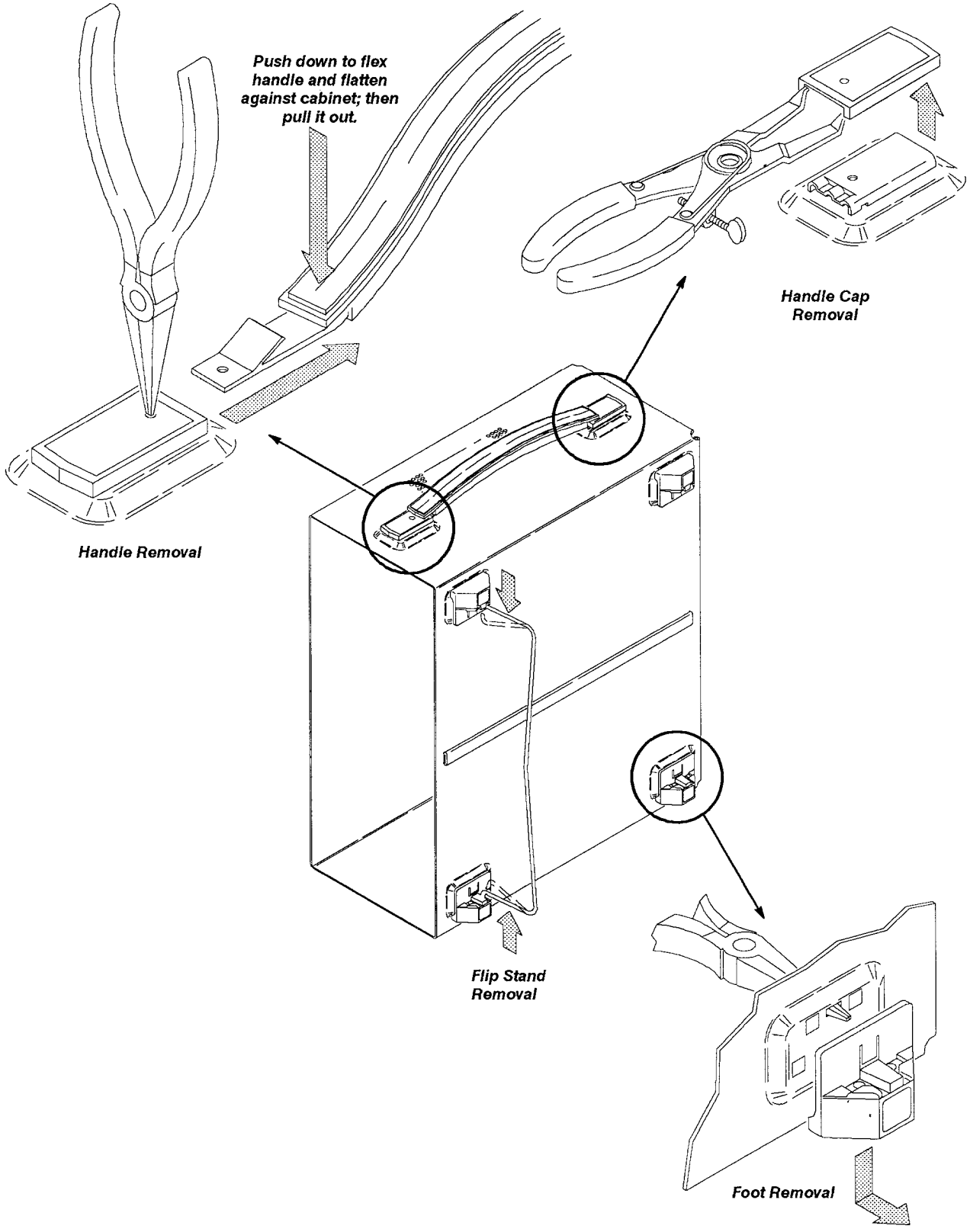


Figure 6-10: Cabinet Modules Removal

Procedures for Outer-Chassis Modules

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

- *A15 Attenuator Assembly*
- *Fan*
- *A14 D1 Bus and Analog-Power and Digital-Power Cables*
- *A11 Processor/Display Board*
- *Top Cover and Board Brackets*
- *GPIB Cable*
- *A10 Acquisition Board*
- *Rear Chassis*

A15 Attenuator Assembly

1. *Assemble equipment and locate modules to be removed:*
   a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2).
   b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.
2. *Orient the oscilloscope:* Set the oscilloscope so its top is down on the work surface and its front is facing you.
3. *Remove the Attenuator Assembly:*
   a. Unplug each of the four interconnect cables that connect the attenuators to the Acquisition board from its jack on the Acquisition board. See Figure 6-31.
   b. Unplug the ribbon interconnect cable that plugs in from the attenuator at J1153. See Figure 6-31.
   c. Now, remove the four screws the heads of which you exposed when you removed the attenuator panel.
   d. Complete the removal by lifting the attenuator assembly out of the front subpanel. Reverse the procedure to reinstall. Be careful to plug each cable into its correct jack — Figure 6-31 shows the correct orientation.
4. *Reinstallation:* Do in reverse order substeps 3a–3d, reversing the removal instructions in each substep to reinstall the assembly. Then see the following procedures, in the order listed, to complete reassembly of the oscilloscope.
   - *Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel* (page 6-16)
   - *Rear Cover and Cabinet* (page 6-19)

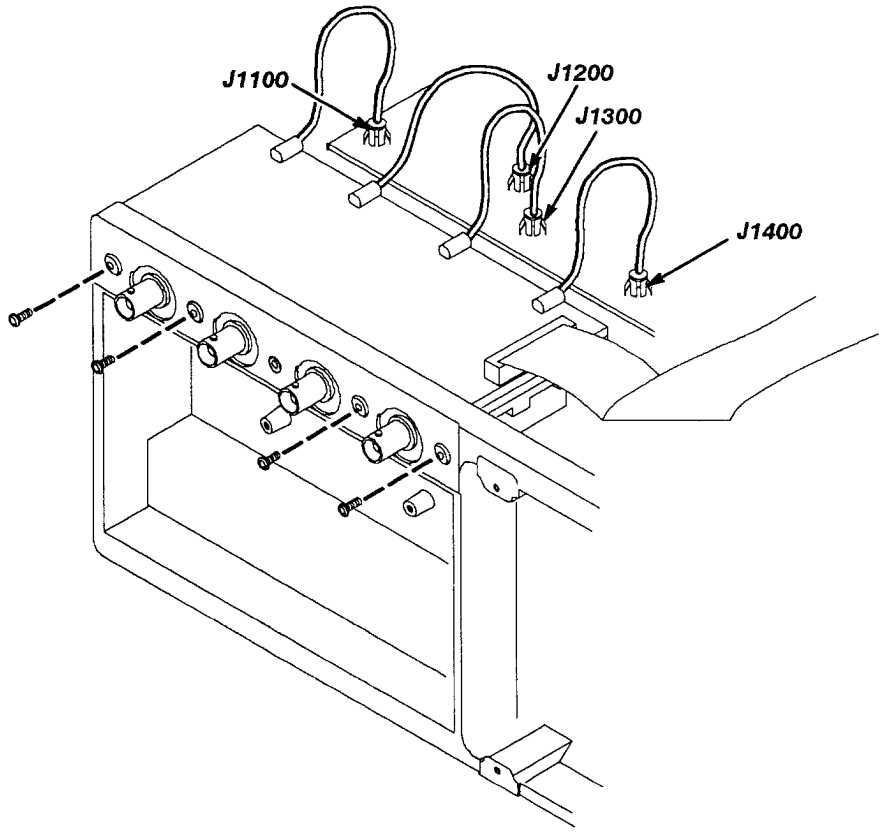


Figure 6-11: Attenuator Interconnect Cable Routing and Jack Locations

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 6-13.
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 6-19) 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 handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2). Find the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.
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; J100 is on the acquisition board.) Reverse these removal instructions to reinstall.
4. *Remove the analog-power and digital-power interconnect cables:*
   a. Unplug the analog-power cable at J26 on the display processor board, at J5 on the low-voltage power supply, and at J700 on the acquisition board.
   b. Unplug the digital-power cable at J27 on the display processor board, at J6 on the low-voltage power supply, and at J101 on the acquisition board.

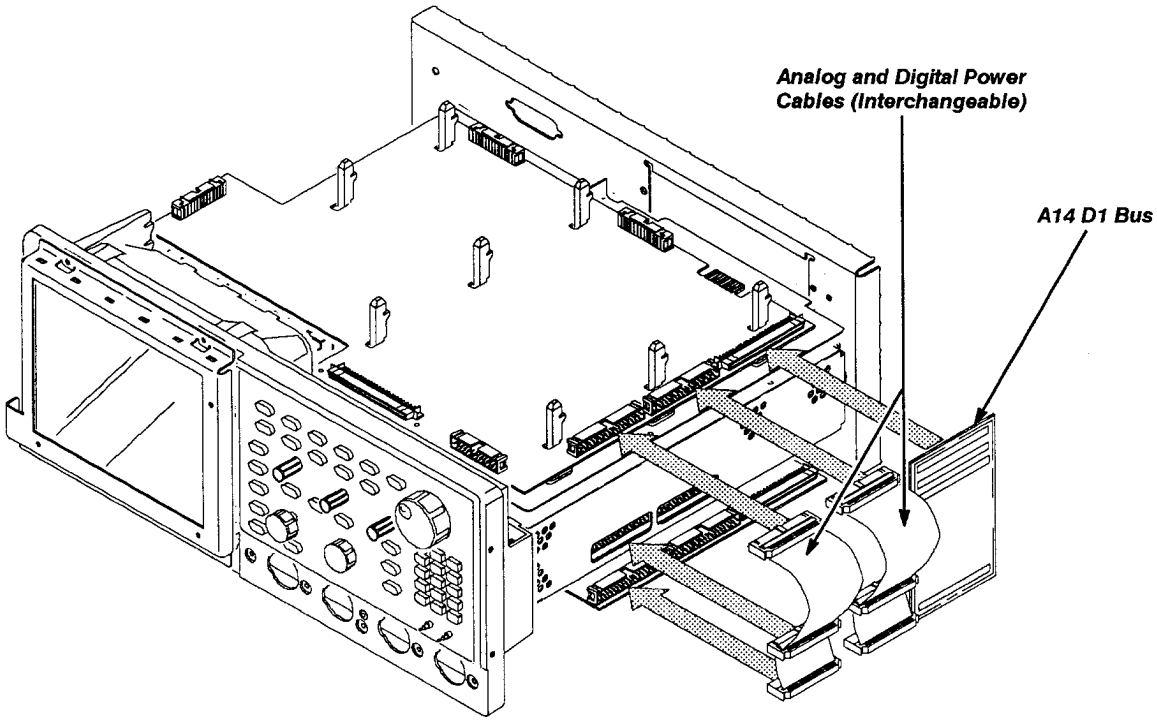


Figure 6-12: A14 D1 Bus and Analog-Power and Digital-Power Cables Removal

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 Attenuator Panel* (page 6-22)
   - *Rear Cover and Cabinet* (page 6-19)

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 6-13.

   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 from the GPIB connector on the rear cover at J35 of the processor/display board. Disconnect the bus cable at J5.

   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 substep 4c.)

   b. See the procedures *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-32) and *Rear Cover and Cabinet* (page 6-19) to complete reassembly of the oscilloscope.

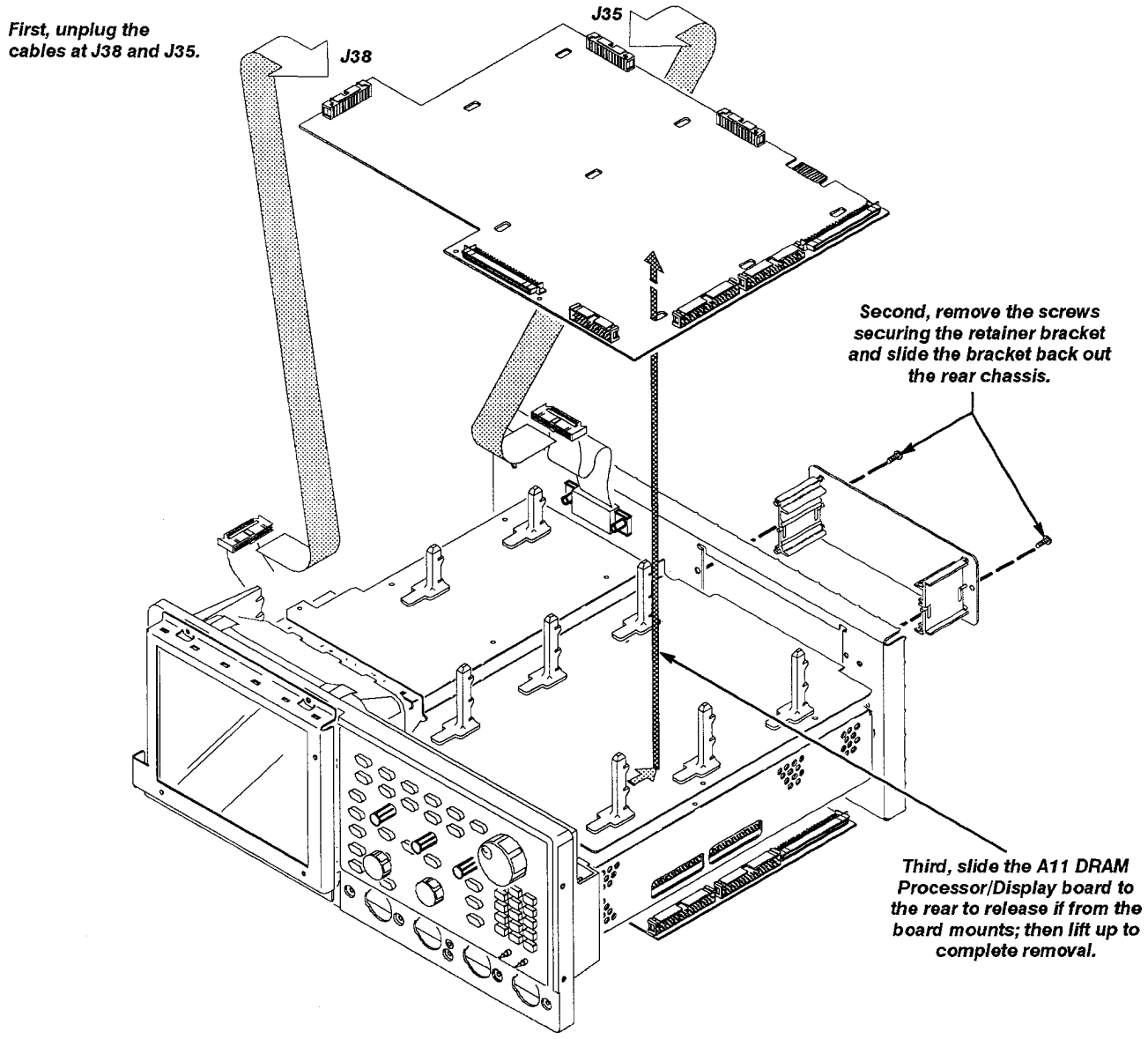


Figure 6-13: A11 Processor/Display Removal

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*, a flat-bladed screwdriver (Item 5).

   b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.

   c. Do the procedures *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-32) and *A11 Processor/Display Board* (page 6-34) 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 12 screws securing the top cover to the main chassis, then slide it back until its front edge clears the retainers in the front subpanel. Lift the top cover away to complete removal.
4. *Remove the board mount(s):* From the top side of the top cover, use the flat-bladed screwdriver to pry up the retainer lug until it clears the slot in the front cover. While holding the lug clear of the slot, push the mount towards the rear until it releases. (When reinstalling, be sure to align the lug properly and be sure it snaps into its slot.)

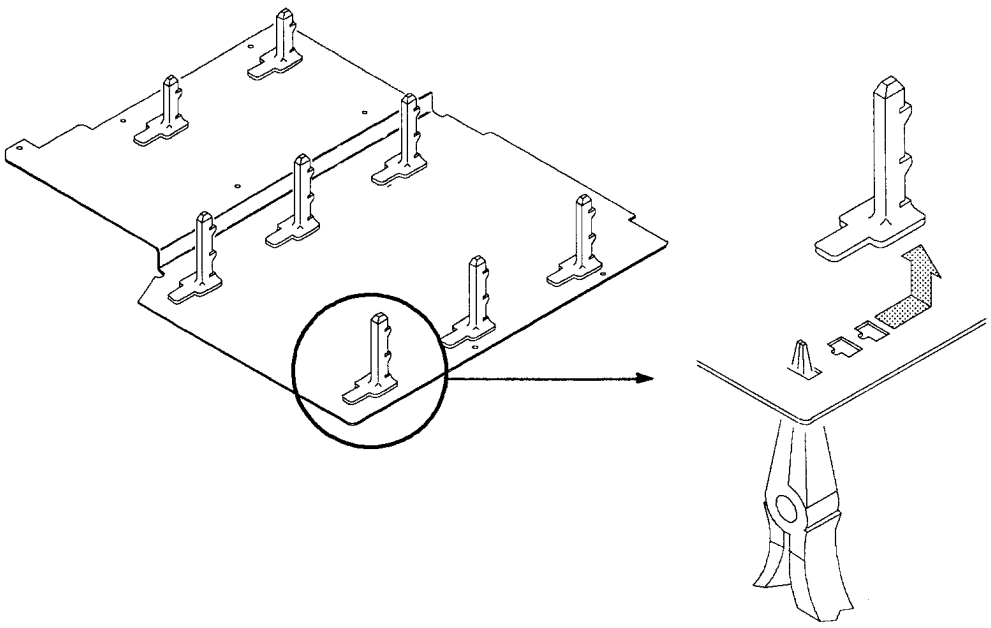


Figure 6-14: Board Bracket Removal

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 6-34)
      - *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-32)
      - *Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel* (page 6-22)
      - *Rear Cover and Cabinet* (page 6-19)

GPIB Cable

1. *Assemble equipment and locate modules to be removed:* Have handy a ¼ inch nut driver (Item 7).
2. *Remove the cable(s):*
   a. Unplug the GPIB cable from its jack (J35) of the processor/display board.
   b. Working from the rear panel and using the ¼ 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 out of the rear chassis.
3. *Reinstallation:* Reverse substep in step 2 to reinstall the GPIB cable.

A10 Acquisition Board

1. *Assemble equipment and locate modules to be removed:*
   a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2).
   b. Locate the modules to be removed, including those listed under *Additional Modules Removed* in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.
   c. Do the procedure *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-32) 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 Acquisition Board:* Use Figure 6-15 as a guide.
   a. Unplug each of the four interconnect cables that connect the attenuators to the acquisition board from its jack on the Acquisition board.
   b. Unplug the ribbon interconnect cable that plugs in from the attenuator at J1153.
   c. Remove the two screws used to secure the noise reduction shield to the rear chassis.
   d. Remove the six screws that mount the acquisition board to the main chassis and lift the board away from the main chassis to complete removal.

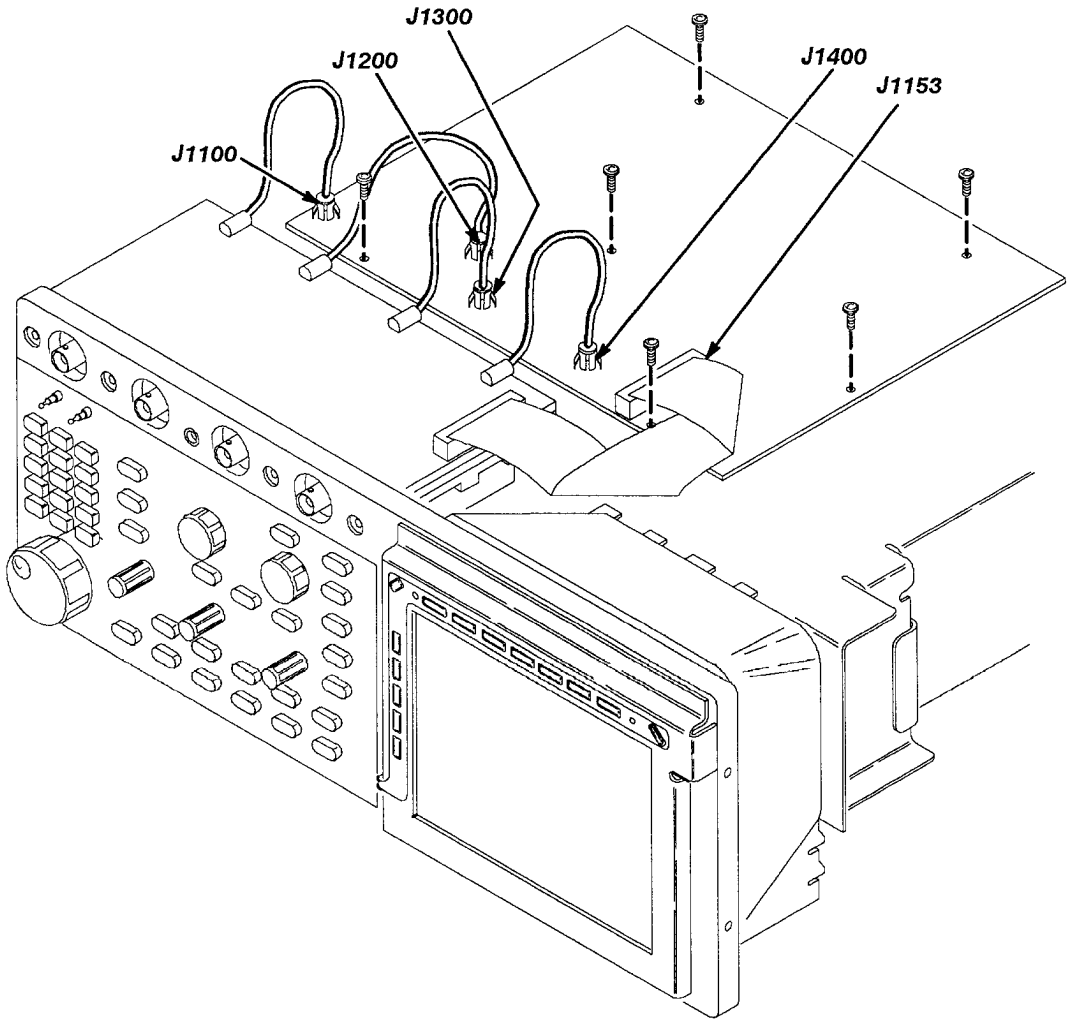


Figure 6-15: A10 Acquisition Board Removal

4. *Reinstallation:* Do, in reverse order, substeps 3a–d reversing each step to reinstall the *acquisition board*. 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 6-32).
   - *Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel* (page 6-22).
   - *Rear Cover and Cabinet* (page 6-19).

Rear Chassis

1. *Assemble equipment and locate modules to be removed:*
   a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2) and a T-20 Torx® tip (Items 1 and 2).

b. Locate the modules to be removed, including those listed under *Additional Modules Removed* in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.

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 6-16 as a guide when doing the following substeps:

   a. Unplug the GPIB interconnect cable at J32 of the processor/display board.

   b. Remove the 6 screws securing the rear chassis to the main chassis and the two screws securing it to the low-voltage power-supply shield.

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 6-32)
   - *Rear Cover and Cabinet* (page 6-19)

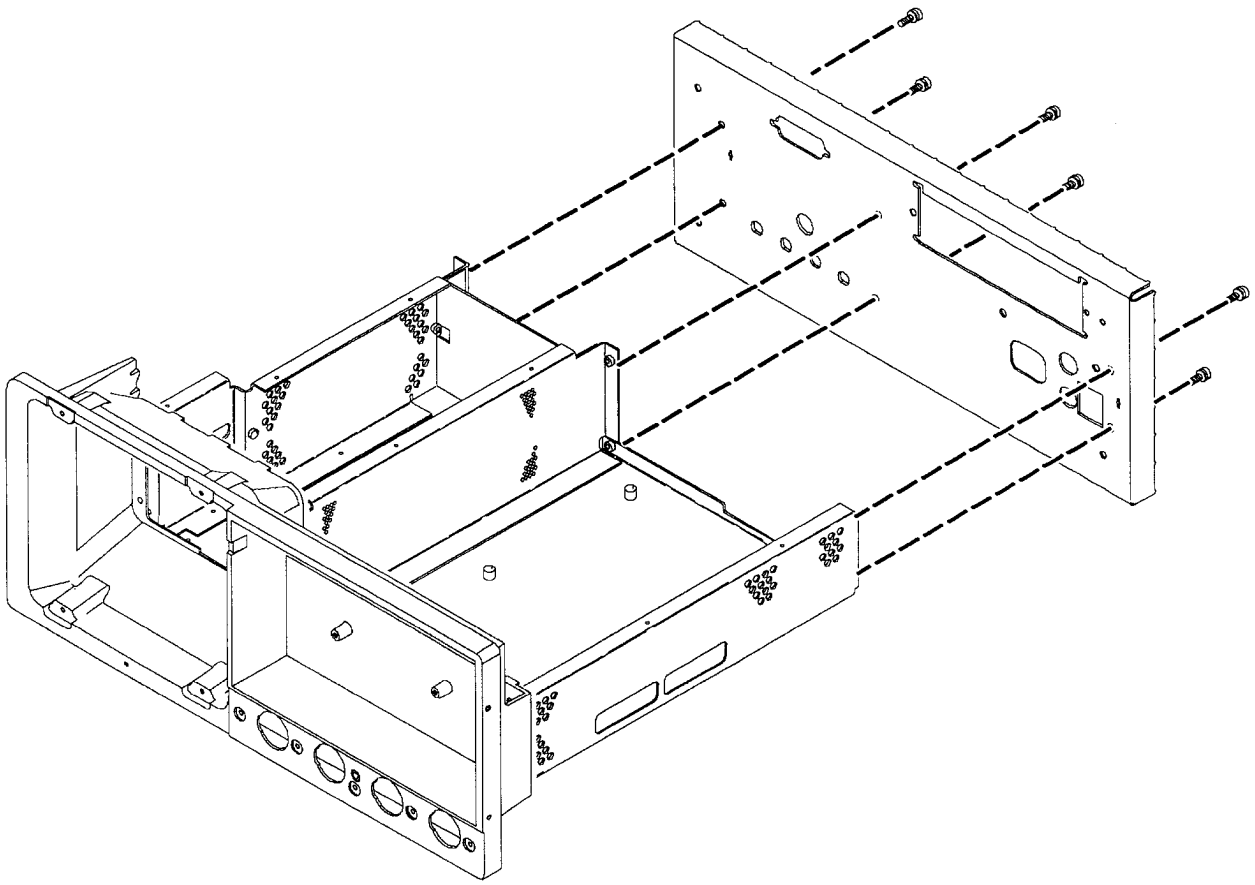


Figure 6-16: Rear Chassis Removal

Procedures for Inner-Chassis Modules

You should have done the *Access Procedure* (page 6-15) before doing any procedure in this collection. The procedures found here, listed in order presented, follow.

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 6-2, 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 6-17.
   b. Now, working from the top of the oscilloscope, remove the seven screws indicated in Figure 3-6 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 6-35)
   - *A11 Processor/Display Board* (page 6-34)
   - *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-32)
   - *Rear Cover and Cabinet* (page 6-19)

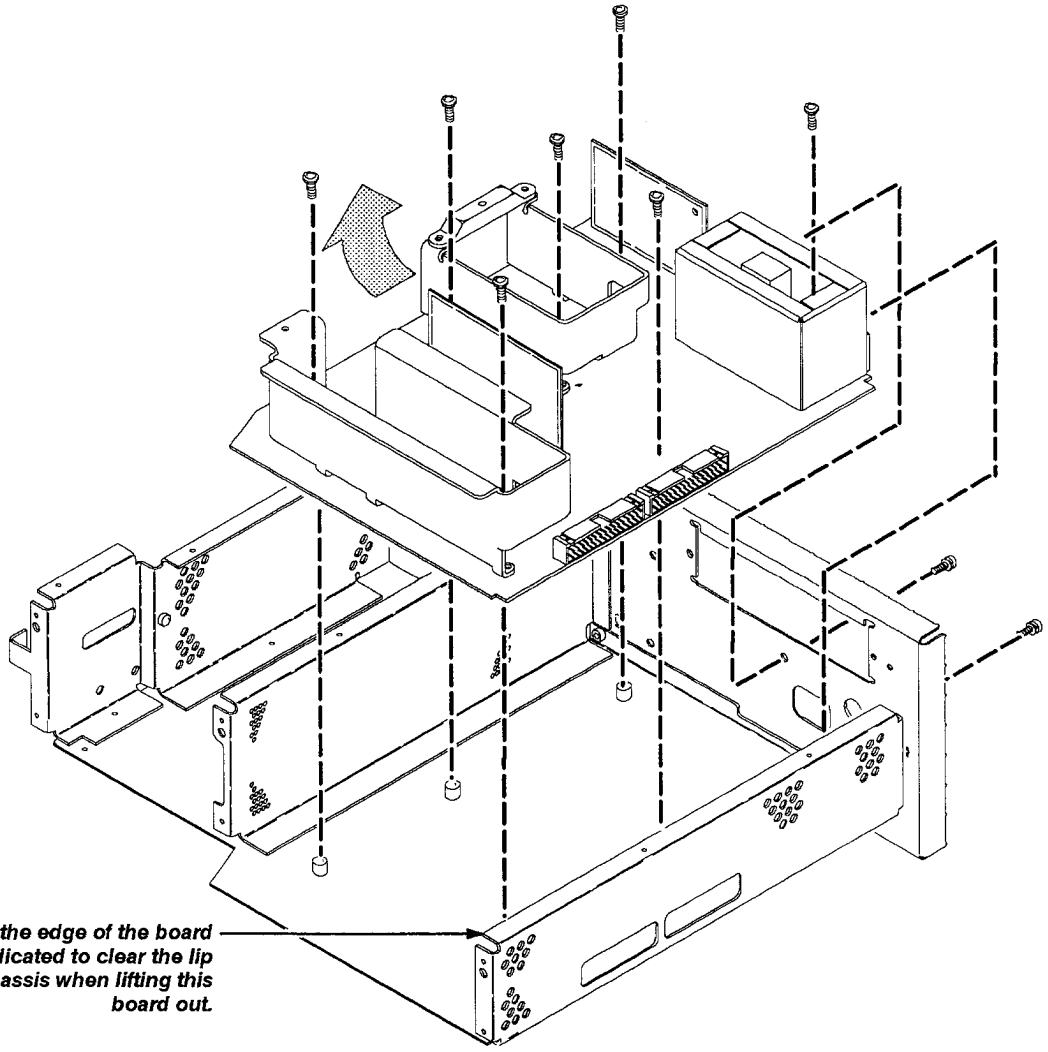


Figure 6-17: A16 Low Voltage Power Supply Removal

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 6-2, 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. 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 outline in the warning above. Reference Figure 6-18 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 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.

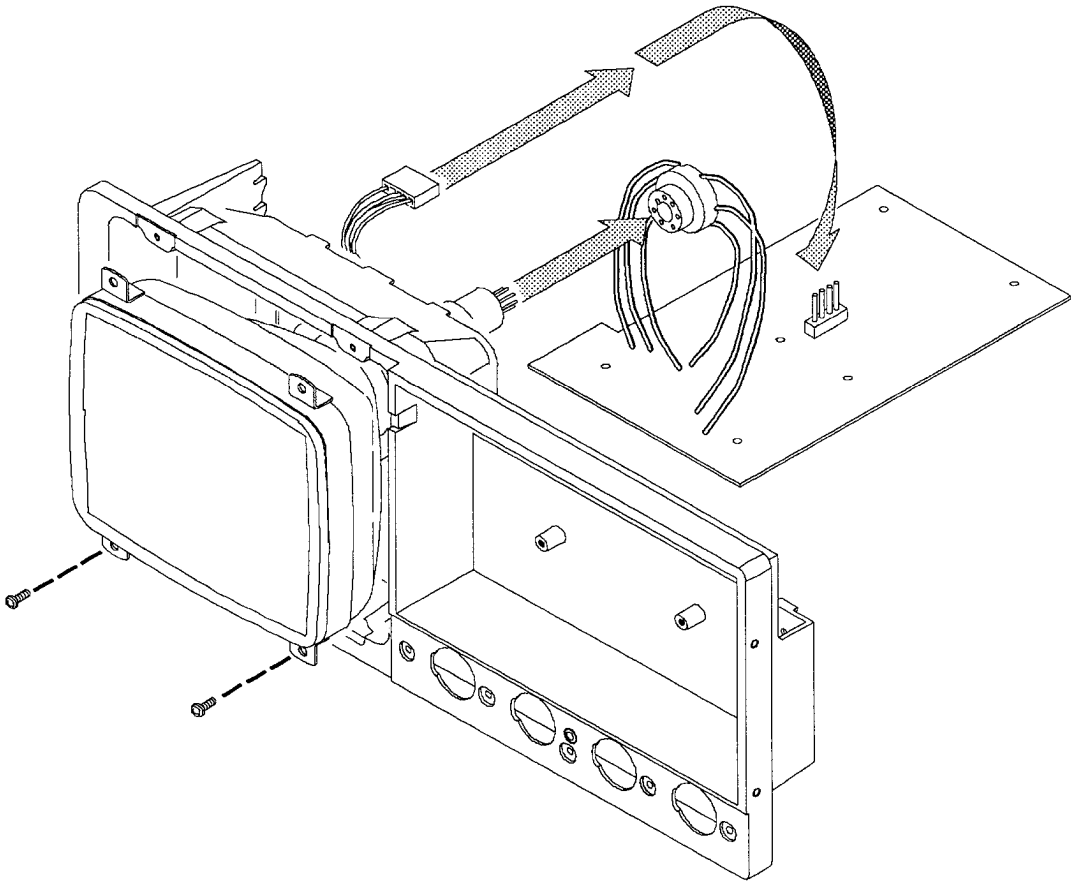


Figure 6-18: Display Assembly Removal

5. *Remove the Display-Supply board:* Use Figure 6-19 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 oscilloscopes main chassis.

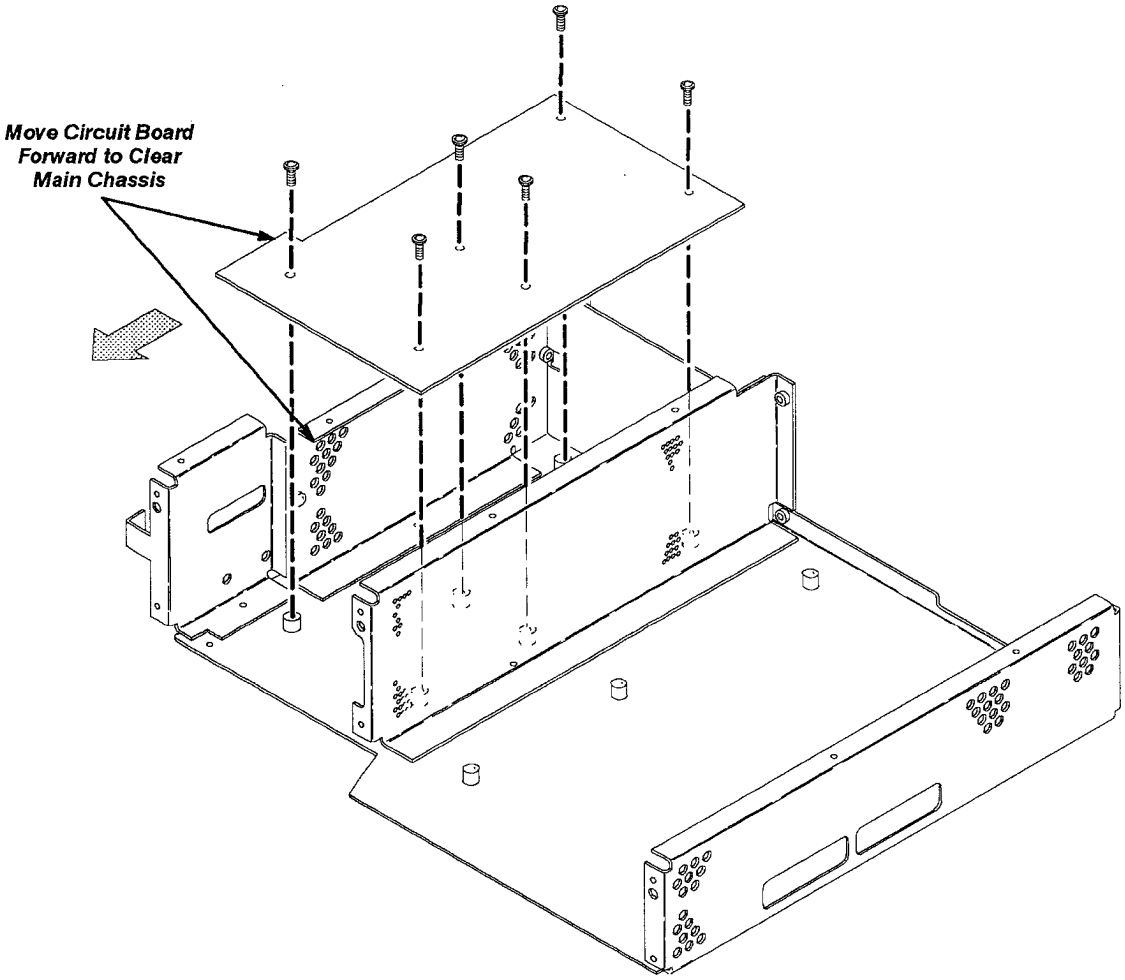


Figure 6-19: Display-Driver Board Removal

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. Do the following procedures, in order, to complete reassembly of the oscilloscope:

      - *Top Cover and Board Brackets* (top cover only) on page 6-35
      - *A11 Processor/Display Board* (page 6-34)
      - *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-32)
      - *Display-Frame Assembly*

- *Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel* (page 6-22)
- *Rear Cover and Cabinet* (page 6-19) (completes reassembly)

Front Subpanel

1. *Assemble equipment and locate modules to be removed:*
   a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2).
   b. Do the procedure *A20 Display Assembly and Supply Fuse* (page 6-42). Do not remove the display-driver board.
   c. Locate the modules to be removed in the locator diagram *Inner-Chassis Modules*, Figure 6-2, page 6-13.
2. *Orient the 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 6-20 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 magnified view, Figure 6-20.) Then reinstall the six screws removed in step 3.
   b. See the procedure *A20 Display Assembly and Supply Fuse* (page 6-42) 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 6-35)
      - *A11 Processor/Display Board* (page 6-34)
      - *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-32)
      - *Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel* (page 6-22)
      - *Rear Cover and Cabinet* (page 6-19)

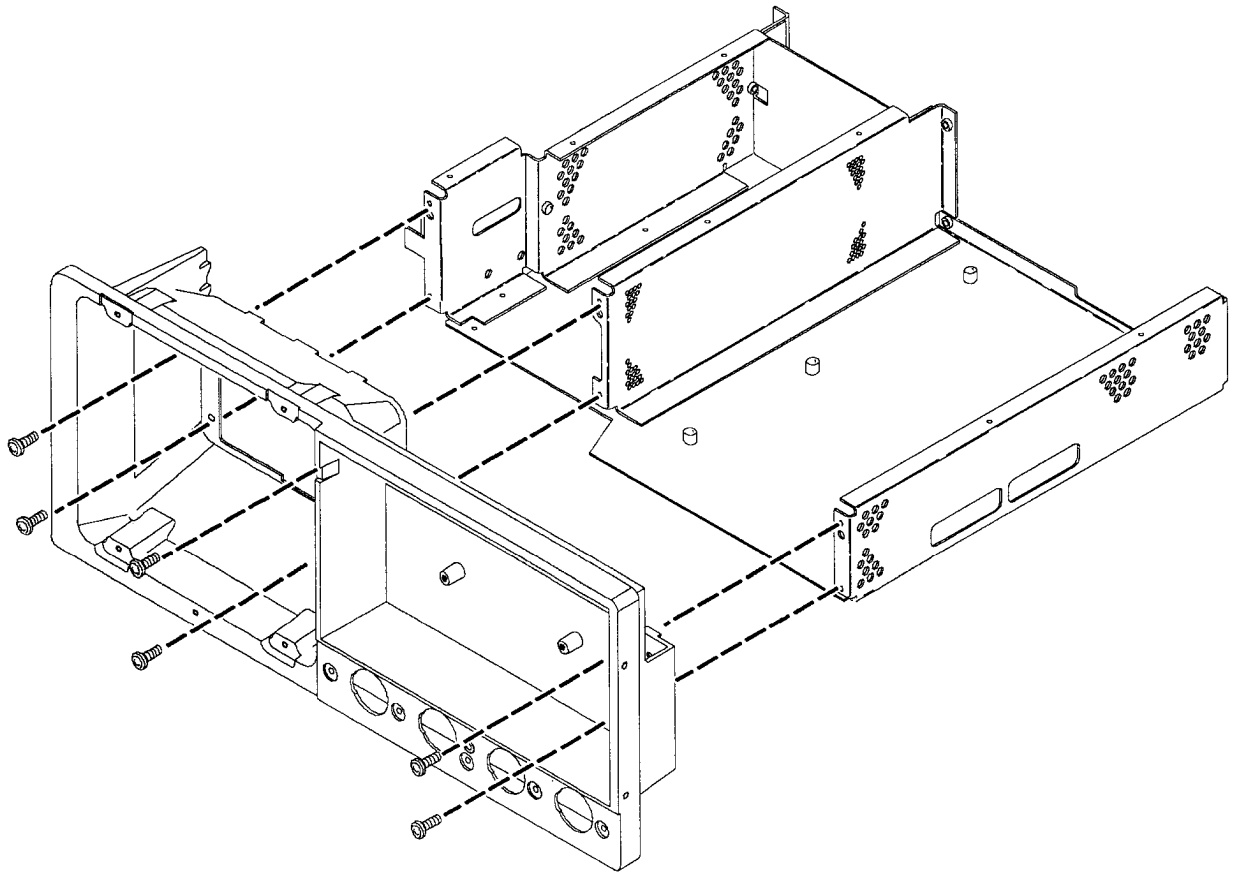


Figure 6-20: Front Subpanel Removal

Main Chassis

Additional Modules Removed: All.

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

Disassembly for Cleaning

This procedure is for disassembly of the TDS 520 Digitizing Oscilloscope into its individual modules so they can be cleaned. For the cleaning instructions, see *Inspection and Cleaning*, which begins this section.

1. *Assemble equipment and locate modules to be removed:*
   a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2), a T-20 Torx® tip (Item 3), a flat-bladed screwdriver (Item 6-11), and a pair of angle-tip tweezers (Item 6-11).
   b. Familiarize yourself with the modules illustrated in Figure 3-1.
2. *Remove external modules:* Do in order the following procedures. They are found under *Procedures for External Modules* which starts on page 6-16.
   a. *Line Fuse and Line Cord* (page 6-17)
   b. *Rear Cover and Cabinet* (page 6-19)
   c. *Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel* (page 6-22)
   d. *Front Subpanel* (page 6-46) 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 6-30.
   a. *Fan* (page 6-31)
   b. *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-32)
   c. *A11 Processor/Display Board* (page 6-34)
   d. *Top Cover and Board Brackets* (page 6-35)
   e. *A15 Attenuator Assembly*
   f. *A10 Acquisition Board* (page 6-37)
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 6-41.
   a. *A16 Low Voltage Power Supply* (page 6-41)
   b. *A20 Display Assembly and Supply Fuse* (page 6-42)
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 6-20 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 6-16 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 an 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 6-41.

- *A20 Display Assembly and Supply Fuse* (page 6-42)
- *A16 Low Voltage Power Supply* (page 6-41)

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 6-30.

- *A15 Attenuator Assembly* (page 6-30)
- *Top Cover and Board Brackets* (page 6-35)
- *A11 Processor/Display Board* (page 6-34)
- *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-32)
- *Fan* (page 6-32)
- *A10 Acquisition Board* (page 6-37)

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 6-16.

- *Front Subpanel* (page 6-46)
- *Display-Frame Assembly* (page 6-42)

- *Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel* (page 6-22)
- *Rear Cover and Cabinet* (page 6-19)
- *Line Fuse and Line Cord* (page 6-17)

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* in this section.

TDS 520 Diagnostics

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

Both levels of internal diagnostics report any bad modules and/or interfaces. If 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 on, the oscilloscope automatically executes the short set. The extended set is optional and is executed by using the following procedure:

Prerequisites: Power on 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. *Run the System Diagnostics:* Press the main-menu button **Execute**; then press the side-menu button **OK Confirm Run Test**.
3. *Wait:* The internal diagnostics do an exhaustive verification of proper 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 520 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 6-21 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.

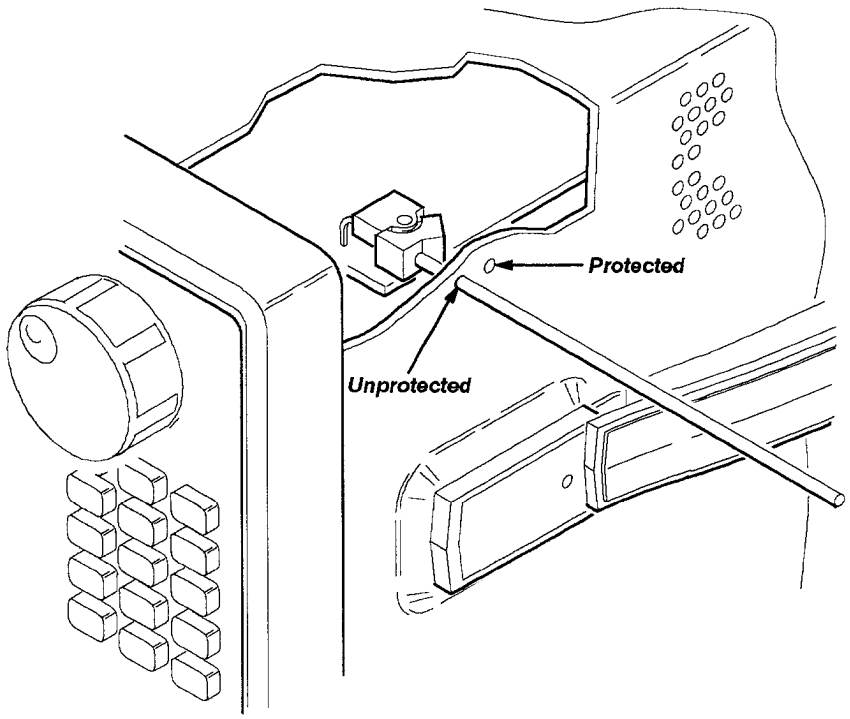
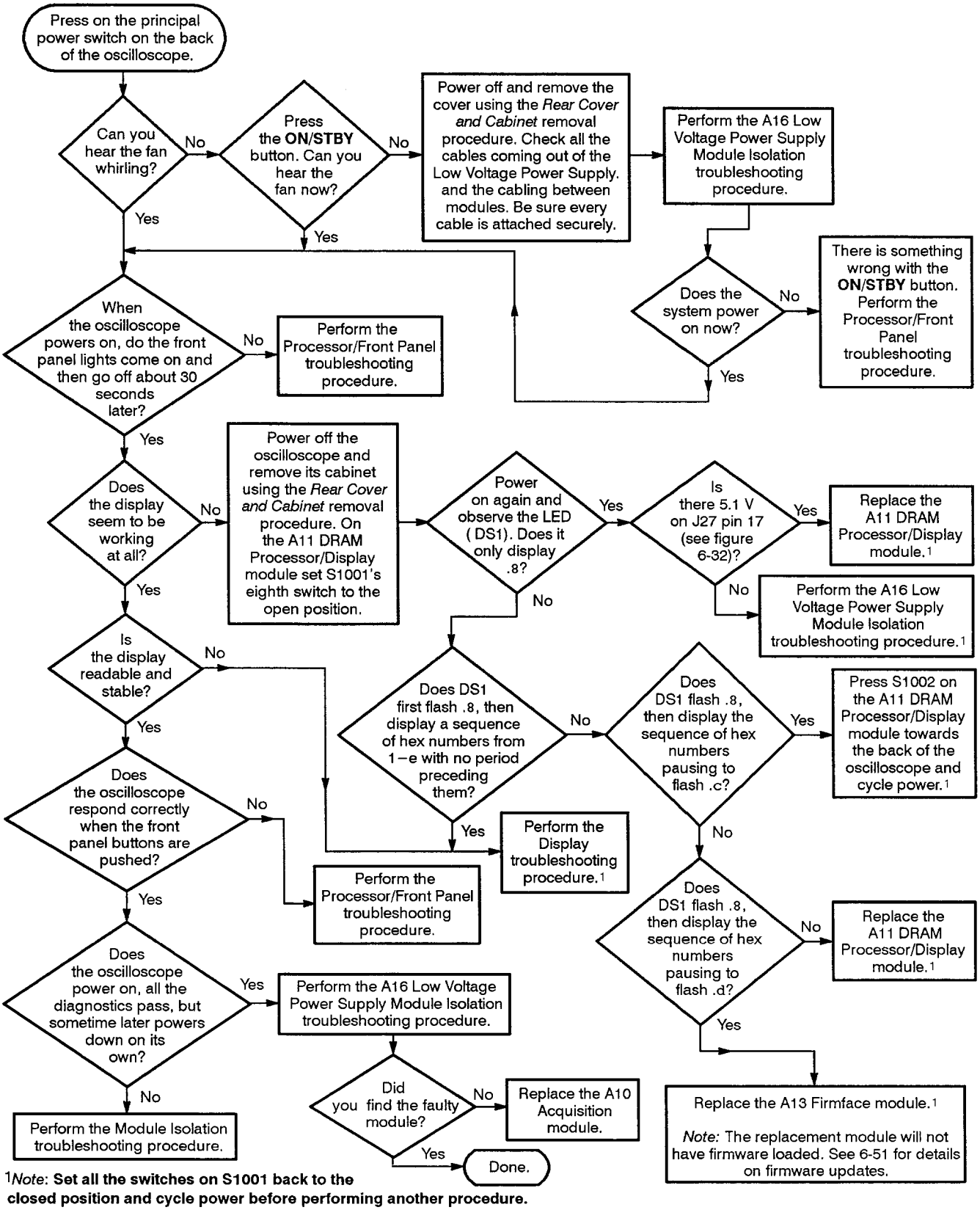


Figure 6-21: Accessing the Protection Switch



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

Figure 6-22: Primary Troubleshooting Procedure

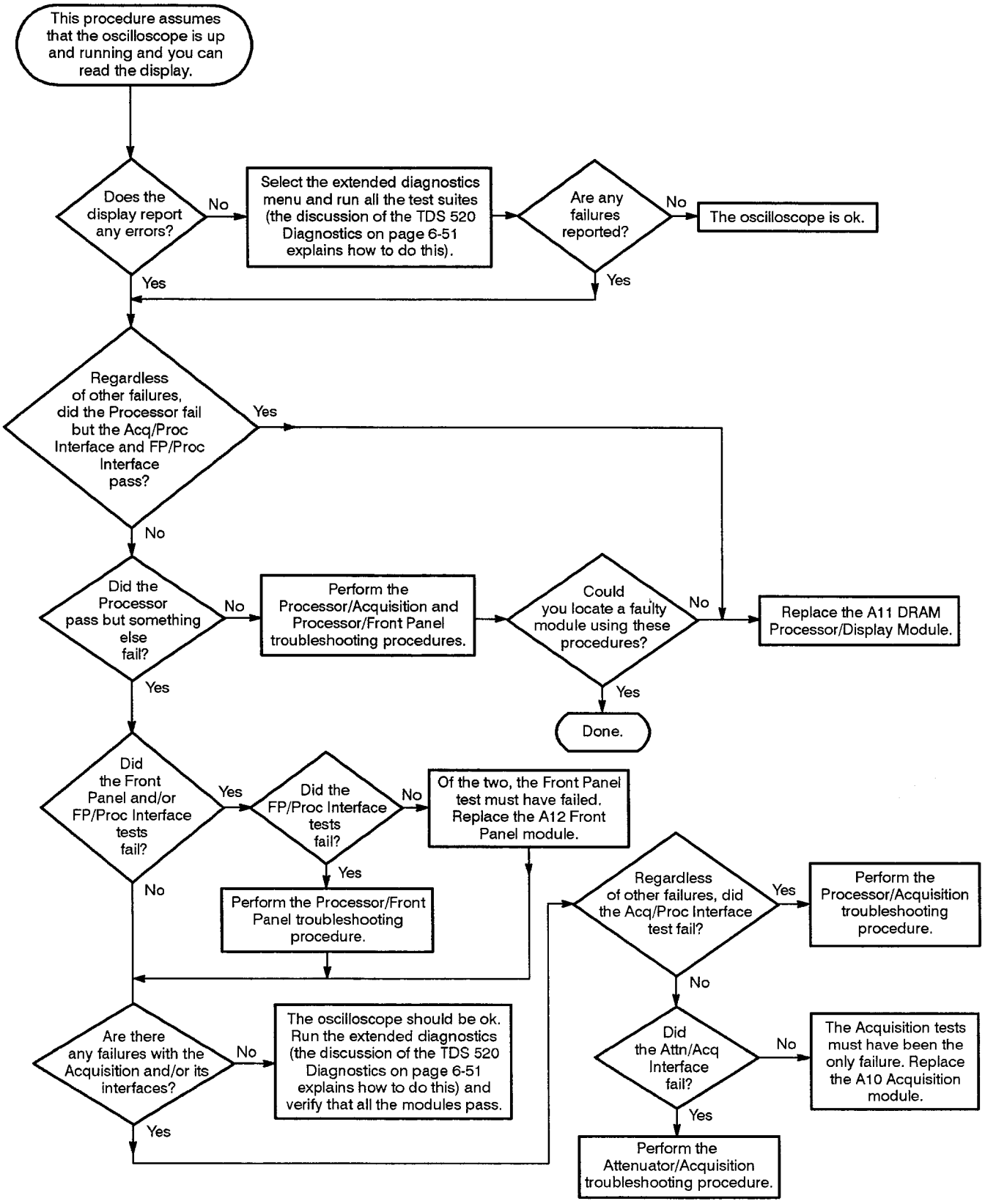


Figure 6-23: Module Isolation Troubleshooting Procedure

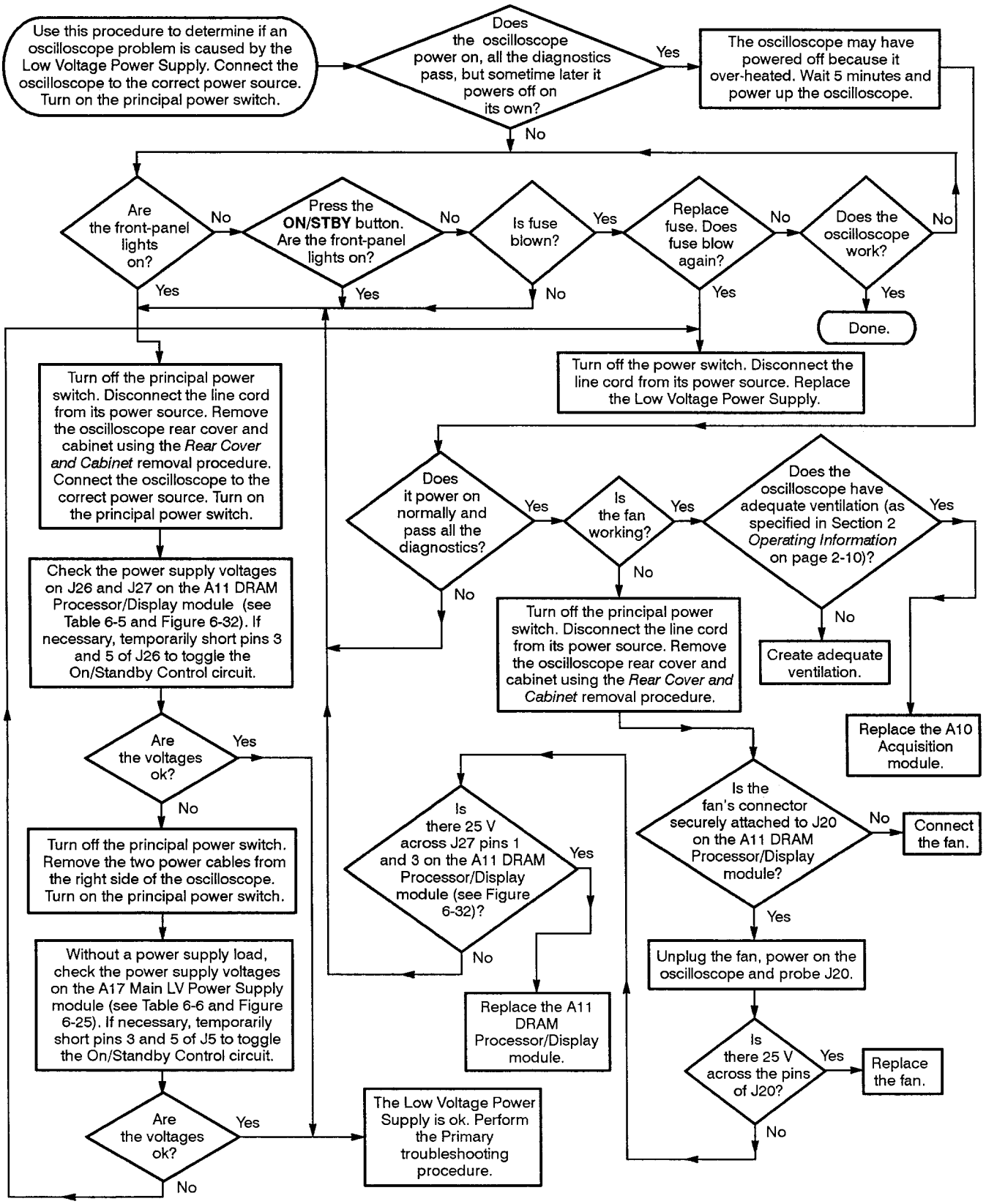


Figure 6-24: A16 Low Voltage Power Supply Module Isolation Troubleshooting Procedure

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

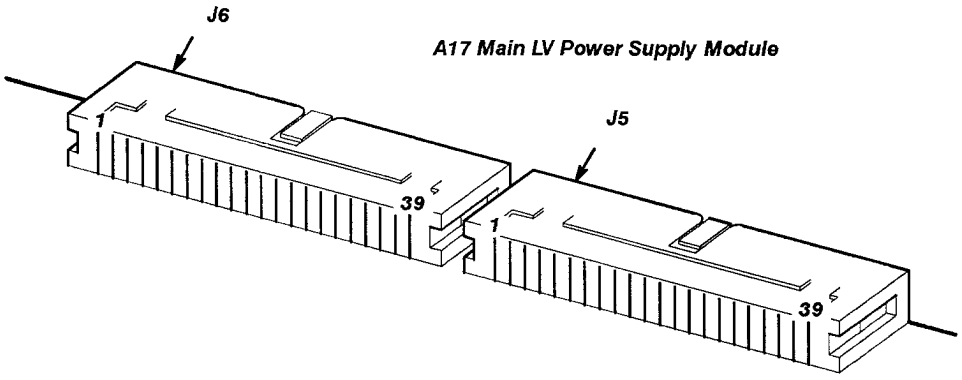


Figure 6-25: Power Supply Voltage Measurement Locations

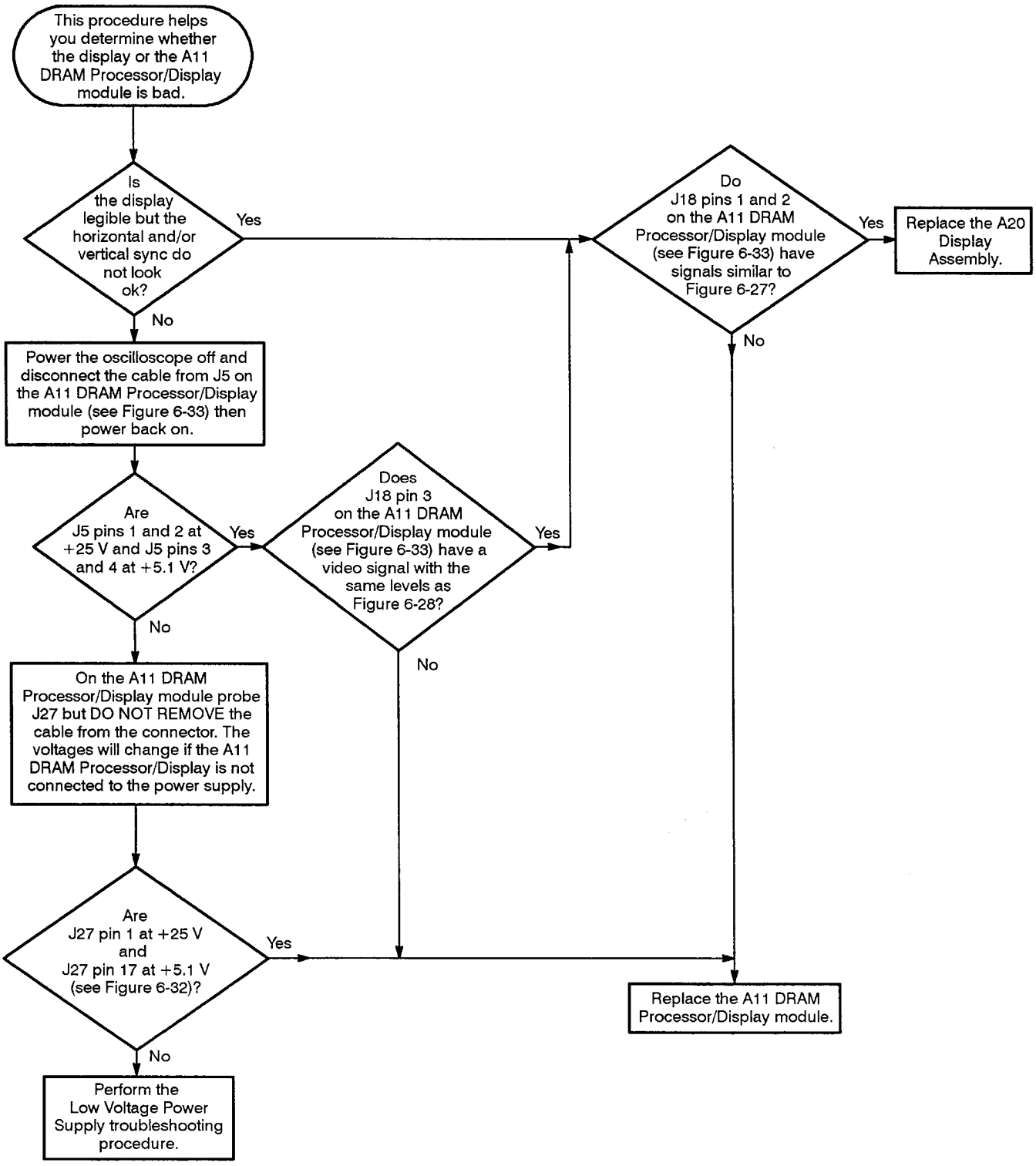


Figure 6-26: Display Troubleshooting Procedure

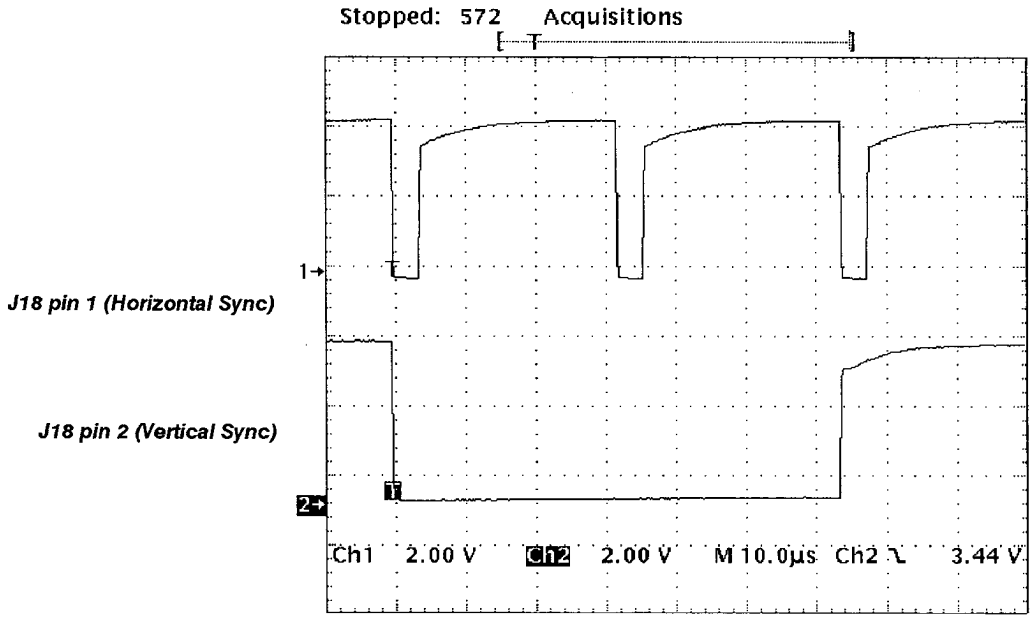


Figure 6-27: Horizontal and Vertical Sync Signals

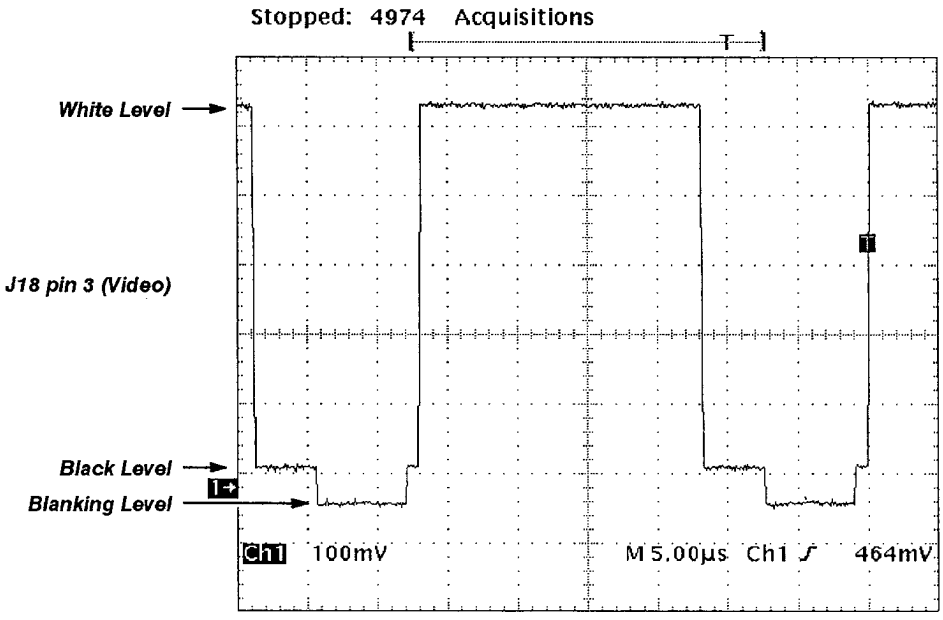


Figure 6-28: A Video Signal with White, Black, and Blanking Levels

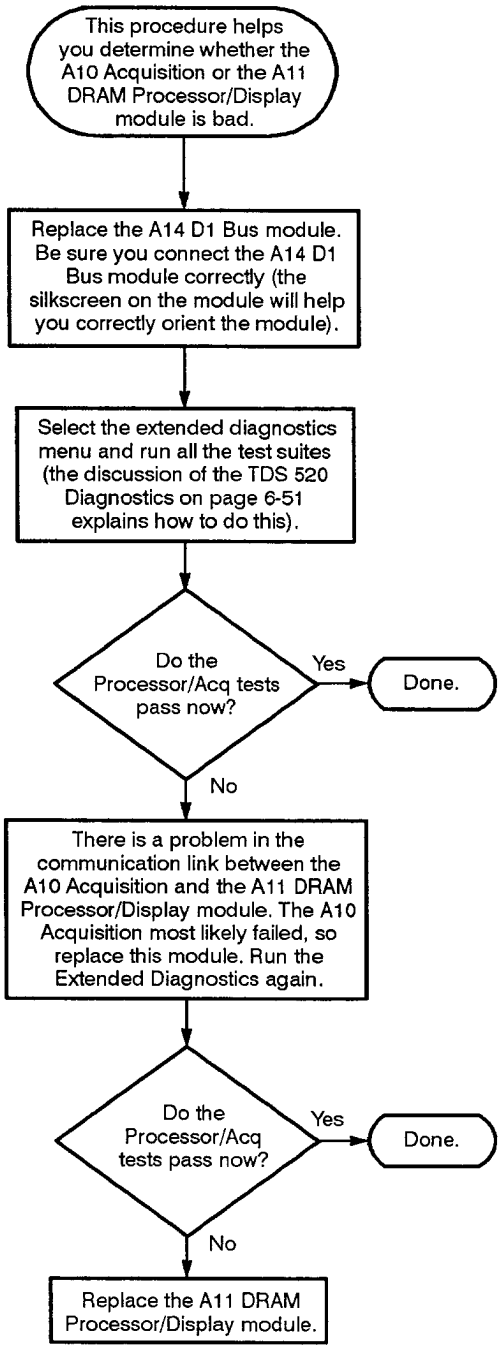


Figure 6-29: Processor/Acquisition Troubleshooting Procedure

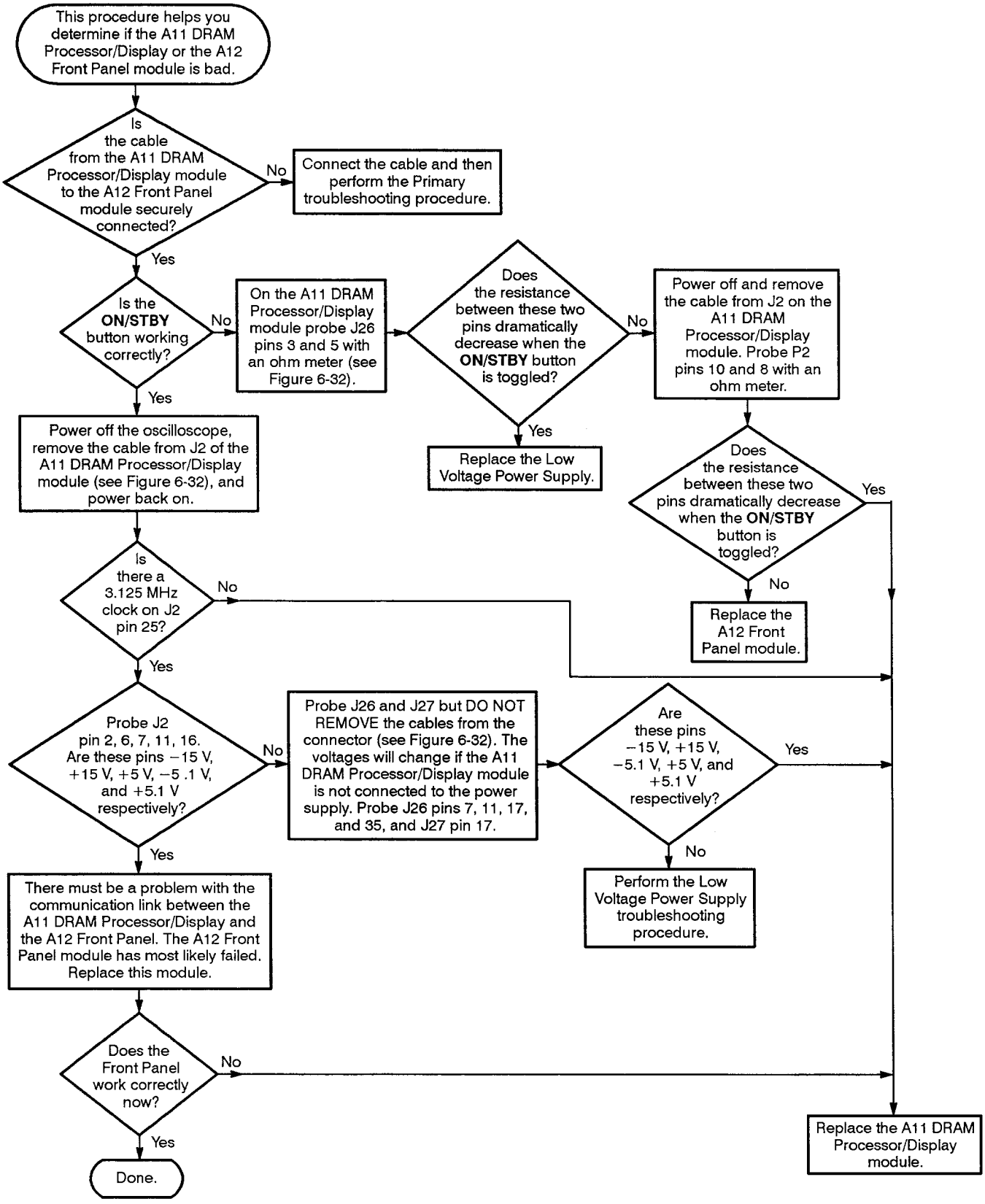


Figure 6-30: Processor/Front Panel Troubleshooting Procedure

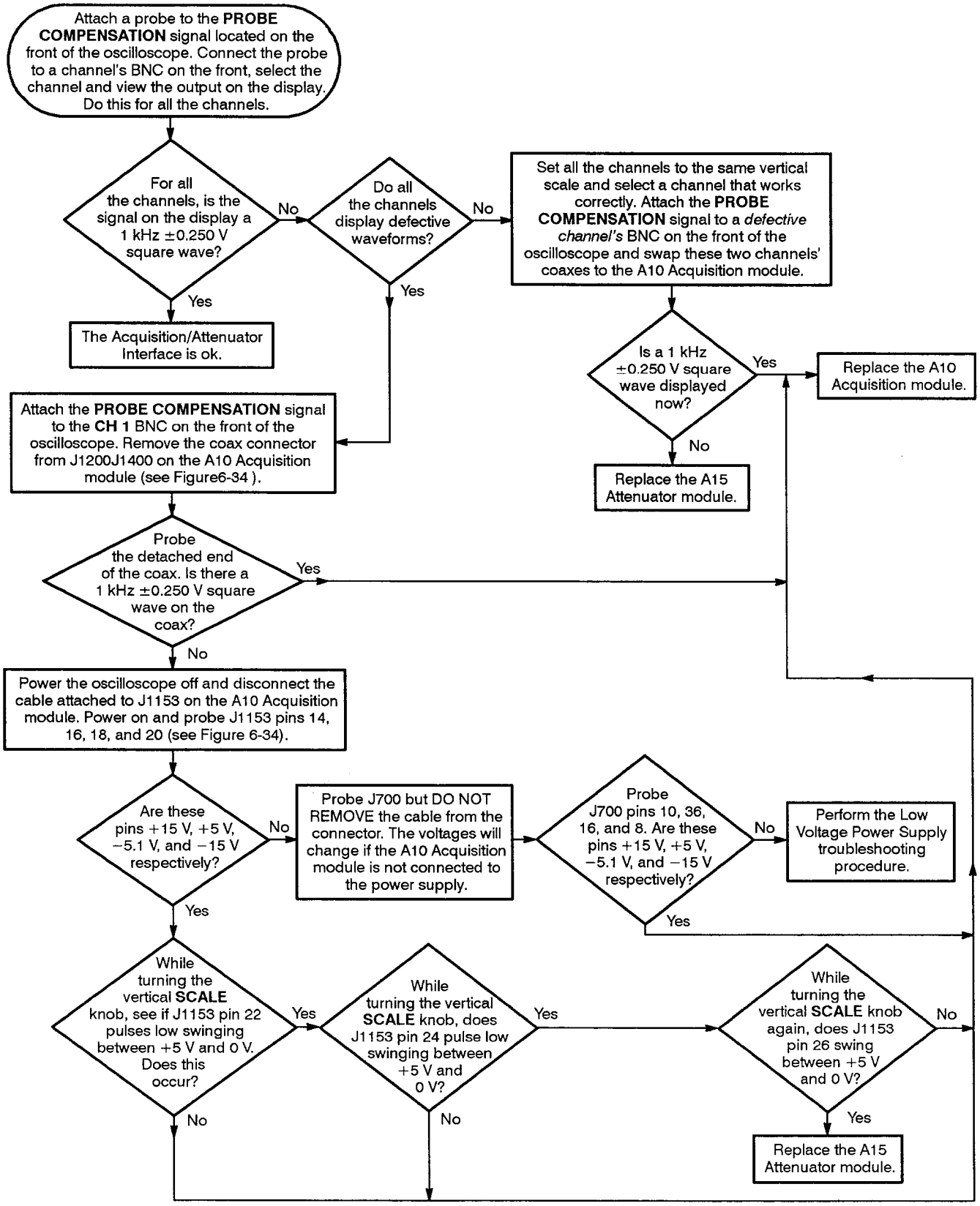


Figure 6-31: Attenuator/Acquisition Troubleshooting Procedure

CAUTION *Probe only those points specified in the procedures. You can cause catastrophic damage if you attempt to probe other points.*

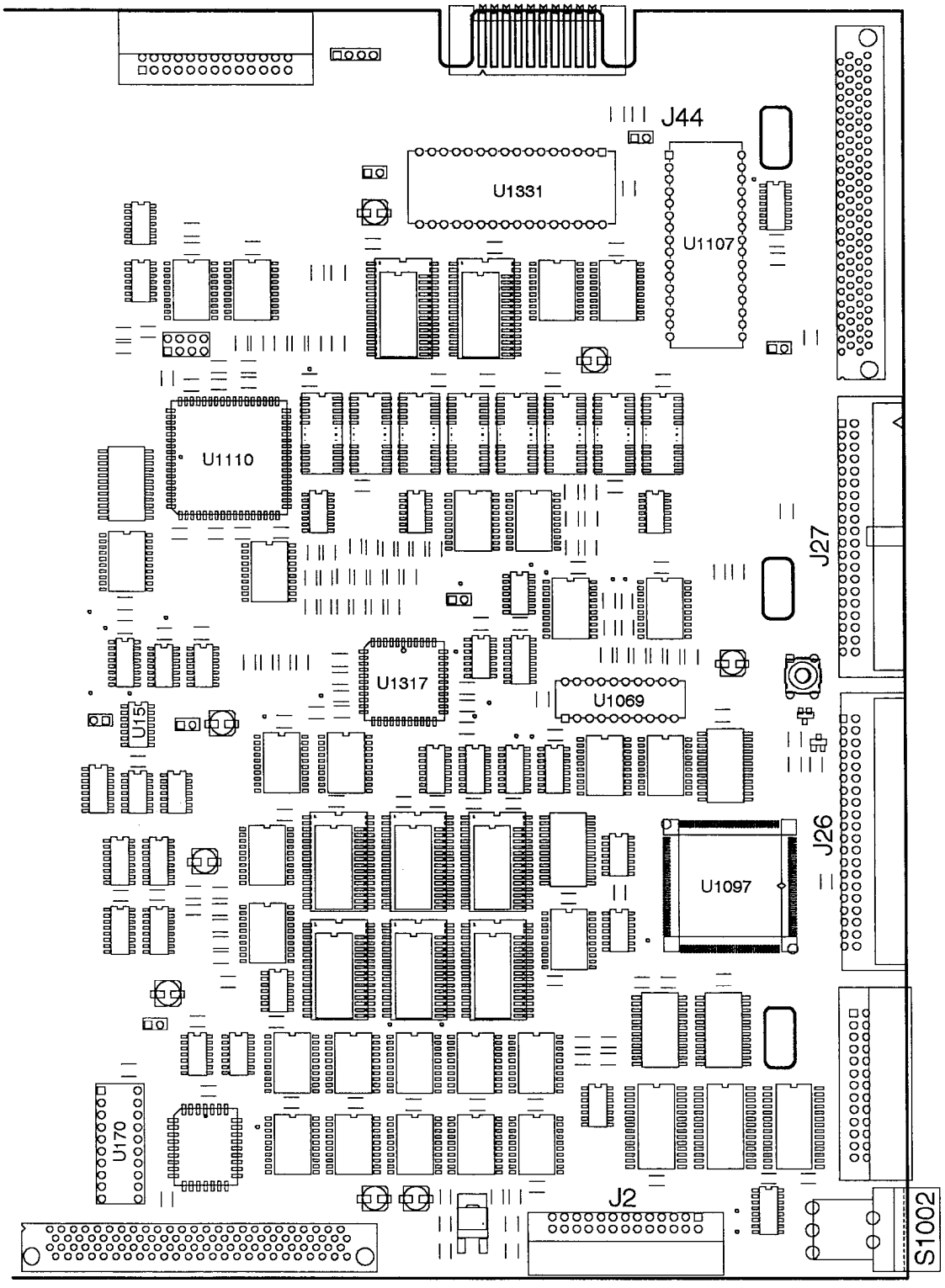


Figure 6-32: A11 DRAM Processor/Display Module (View of Right Side)

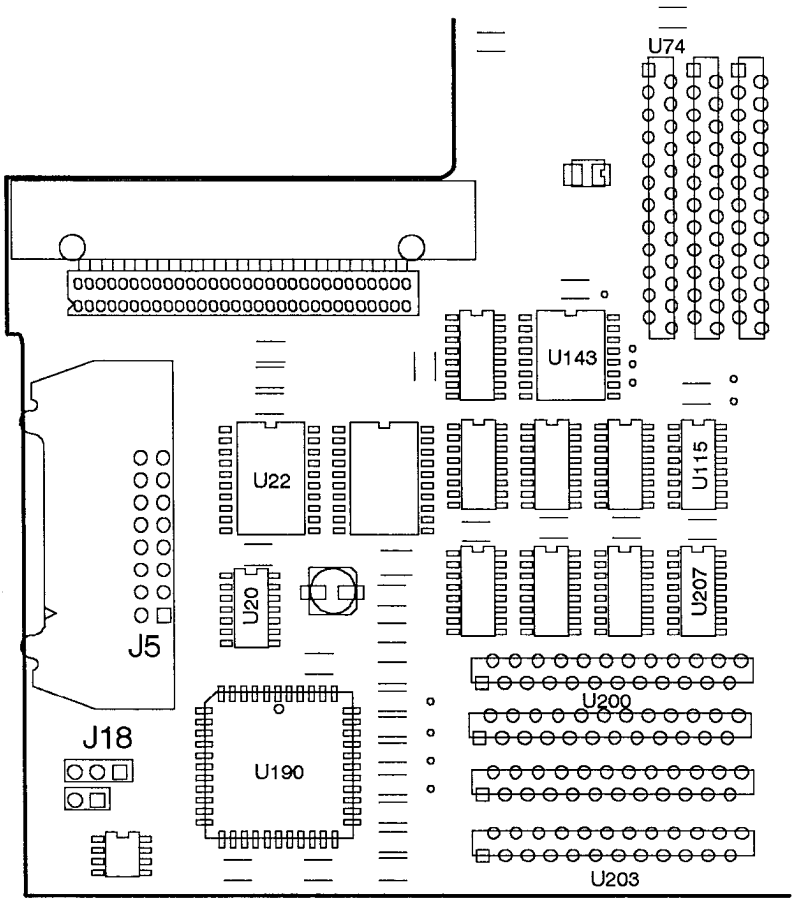


Figure 6-33: A11 DRAM Processor/Display Module (View of Lower Left Corner)

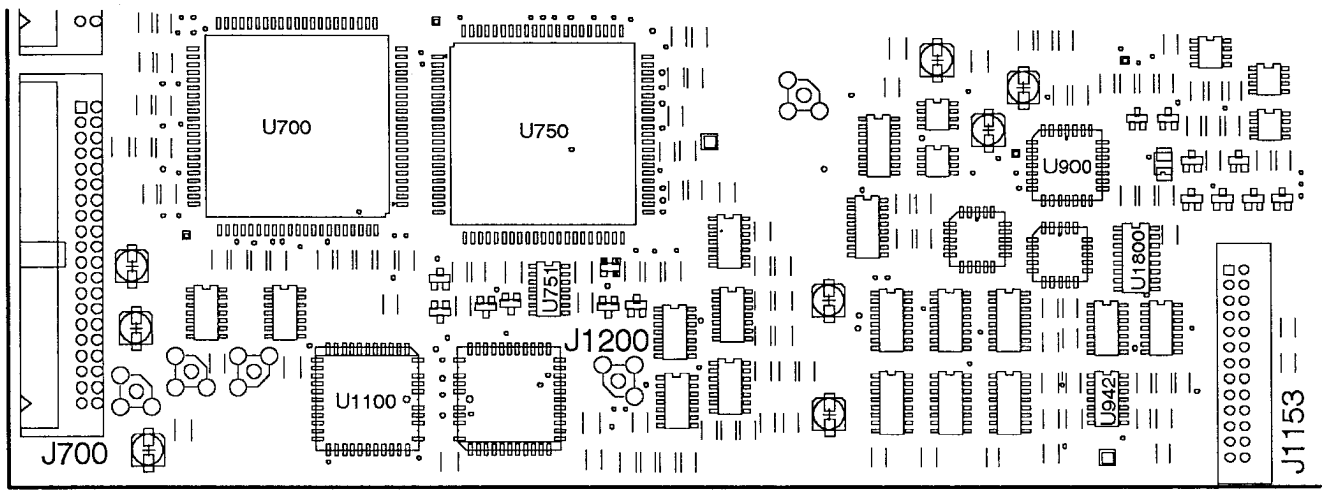


Figure 6-34: A10 Acquisition Module (View of Lower Left Corner)

Options and Accessories

This section describes the various options as well as the standard and optional accessories that are available for the TDS 520 Digitizing Oscilloscope.

Options

The following options are available:

Options A1–A5: International Power Cords

Besides the standard North American, 110 V, 60 Hz power cord, Tektronix ships any of five alternate power cord configurations with the 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: Service Manual

When Option B1 is ordered, Tektronix ships a service manual (this 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 Option M2 is ordered, Tektronix provides five years of warranty/remedial service.
- **Option M3:** When Option M3 is ordered, Tektronix provides five years of warranty/remedial service and four oscilloscope calibrations.
- **Option M8:** When Option M8 is ordered, Tektronix provides four calibrations and four performance verifications, one of each in the second through the fifth years of service.

Option 1K: K218 Scope Cart

With this option, Tektronix ships the K218 Scope Cart, which allows easy transportation of the oscilloscope in most lab environments.

Option 1M: 50,000 Sample Record Length

This option provides a maximum record length of 50,000 points per acquisition (50,000/channel).

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 US letter size media.

Option 1R: Rackmounted TDS 520 Digitizing Oscilloscope

When ordered with Option 1R, Tektronix ships the oscilloscope configured for installation in a 19-inch wide instrument rack. Customers with oscilloscopes not configured for rackmounting can order a rackmount kit (016-1136-00 for field conversions).

Instructions for rackmounting the oscilloscope are shipped with the rackmount kit or 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. For service information, refer to the *TDS Family Option 13 RS-232/Centronics Hardcopy Interface Instruction Manual*, Tektronix part number 070-8567-00.

Option 2F: Advanced DSP Math

With Option 2F, 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 22: Additional Probes

With this option, Tektronix ships two additional probes identical to the two standard-accessory P6139A probes normally shipped with the instrument. This provides one probe for each front-panel input.

Option 23: Active Probes

With Option 23, Tektronix ships two active high speed voltage probes (the P6205 10X FET).

Option 9C: Certificate of Calibration and Test Data Report

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

Standard Accessories

The following standard accessories are included with the digitizing oscilloscope:

Table 7-2: Standard Accessories

Accessory	Part Number
User Manual	070-8317-01
Programmer Manual	070-8318-03
Reference	070-8316-01
Performance Verification	070-8603-00
Front Cover	200-3696-00
U.S. Power Cord	161-0230-01
Probes (quantity two) 10X Passive	P6139A (single unit)

Probe Accessories

Table 7-3 lists accessories to the standard P6139A probe listed in Table 7-2. Except for the probe-tip-to-circuit board adapter, they can also be ordered separately.

Table 7-3: Probe Accessories

Accessory	Part Number
Retractable Hook Tip	013-0107-06
Body shell, tip cover	204-1049-00
Probe-Tip-to-Circuit Board Adapter (quantity two standard, optionally available in package of 25 as 131-5031-00)	No customer orderable part number for double unit
Six-Inch Slip-On Ground Lead	196-3113-02
Low Inductance Ground Lead	195-4240-00
Marker Rings Set (quantity eighteen rings which includes two each of nine colors)	016-0633-00
Ground collar	343-1003-01
Six-Inch Alligator Clip Ground Lead	196-3305-00
Screwdriver: adjustment tool, metal tip	003-1433-00
SMT KlipChip™	206-0364-00
Accessory pouch	016-0708-00

Optional Accessories

You can also order the following optional accessories:

Table 7-4: Optional Accessories

Accessory	Part Number
TDS 520 Service Manual	070-8312-01
Plotter (GPIB and Centronics Standard)	HC100
Oscilloscope Cart	K218
Rack Mount Kit (for field conversion)	016-1136-00
Oscilloscope Camera	C9
Oscilloscope Camera Adapter	016-1154-00
Soft-Sided Carrying Case	016-0909-01
Transit Case	016-1135-00
GPIB Cable (1 meter)	012-0991-01
GPIB Cable (2 meter)	012-0991-00

- P6015A Passive extra high voltage probe, 1000X, 20 kVDC + Peak AC (40 kV peak for less than 100 ms)
- P6205 750 MHz probe bandwidth. Active (FET) voltage probe.
- P6204 Active, high speed digital voltage probe. FET. DC to 1 GHz. DC offset. 50 Ω input. Use with 1103 Tekprobe Power Supply for offset control.
- P6046 Active, differential probe, 1X/10X, DC to 100 MHz, 50 Ω input.
- A6501 Buffer Amplifier (active fixtured), 1 GHz, 1 MΩ, 10X.
- P6501 Option 02: Microprobe with TekProbe power cable (active fixtured), 750 MHz, 1 MΩ, 10X.
- AM 503S — DC/AC Current probe system, AC/DC. Uses A6302 Current Probe.
- AM 503S Option 03: DC/AC Current probe system, AC/DC. Uses A6303 Current Probe.
- P6021 AC Current probe. 120 Hz to 60 MHz.
- P6022 AC Current probe. 935 kHz to 120 MHz.
- CT-1 Current probe — designed for permanent or semi-permanent in-circuit installation. 25 kHz to 1 GHz, 50 Ω input.
- CT-2 Current probe — designed for permanent or semi-permanent in-circuit installation. 1.2 kHz to 200 MHz, 50 Ω input.
- CT-4 Current Transformer — for use with the AM 503S (A6302) and P6021. Peak pulse 1 kA. 0.5 Hz to 20 MHz with AM 503S (A6302).
- P6701A Opto-Electronic Converter, 500 to 950 nm, DC to 850 MHz 1 V/mW.
- P6703A Opto-Electronic Converter, 1100 to 1700 nm, DC to 1 GHz 1 V/mW.
- P6711 Opto-Electronic Converter, 500 to 950 nm, DC to 250 MHz 5 V/mW.
- P6713 Opto-Electronic Converter, 1100 to 1700 nm, DC to 300 MHz. 5 V/mW.
- TVC 501 Time-to-voltage converter. Time delay, pulse width and period measurements.

Probe Accessories

The following optional accessories are recommended for use with the standard probe listed under *Standard Accessories.*

Table 7-5: Probe Accessories

Accessory	Part Number
Connector, BNC: BNC to Probe Tip Adapter	013-0226-00
Connector, BNC: 50 Ω, BNC to Probe Tip Adapter	013-0227-00
Connector, Probe: Package of 100, compact	131-4244-00
Connector, Probe: Package of 25, compact	131-5031-00
Screwdriver Adjustment Tool, Package of five	003-1433-01
Compact-to-Miniature Probe Tip Adapter	013-0202-02
Probe Tip Holder: (holds three tips)	352-0670-00
Three-inch Slip-On Ground Lead	196-3113-03
Probe Holder: Black ABS	352-0351-00
IC Protector Tip, Package of 10	015-0201-07
IC Protector Tip, Package of 100	015-0201-08
Marker Ring Set: Two each of nine colors	016-0633-00
SMT KlipChip™: 20 Adapters	SMG50
Low-Inductance Spring-Tips: Two each of five different springs and insulator	016-1077-00
Probe Tip-to-Chassis Adapter	131-4210-00

NOTE

The next four items below can only be used with the Compact-to-Miniature Probe Tip Adapter.

Dual-Lead Adapter	015-0325-00
BNC-to-Probe Tip Adapter	013-0084-01
G.R.-to-Probe Tip Adapter, 50 Ω	017-0088-00
Bayonet Ground Assembly	013-0085-00

Accessory Software

The following optional accessories are Tektronix software products recommended for use with your digitizing oscilloscope:

Table 7-6: Accessory Software

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

Warranty

Check the back of the this manuals title page for full warranty statements for this product, the probes, and the product listed above.

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 section contains the block diagram and the interconnection diagram for the TDS 520 Digitizing Oscilloscope.

Symbols

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

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

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

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

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

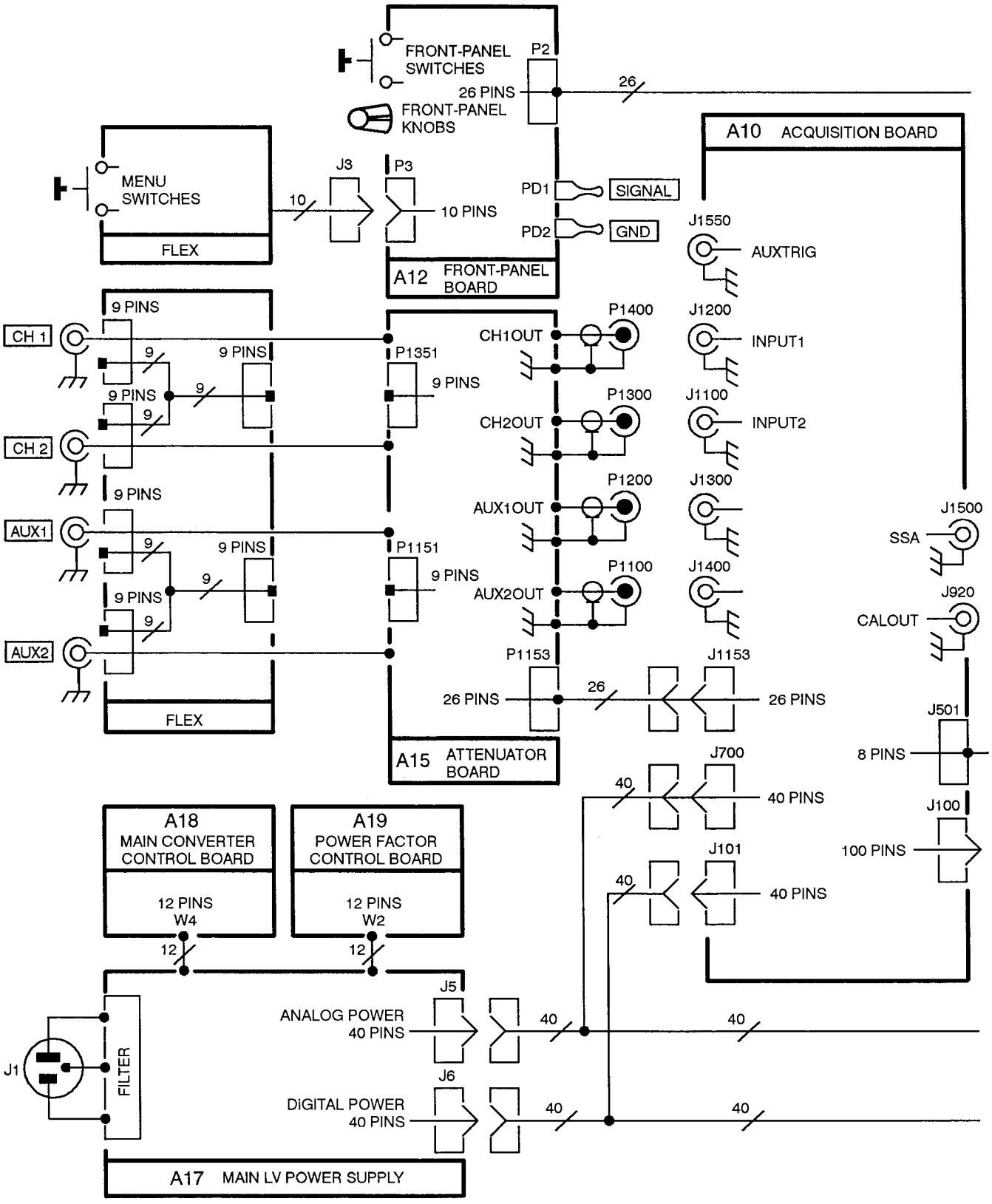


Figure 9-1: TDS 520 Interconnections

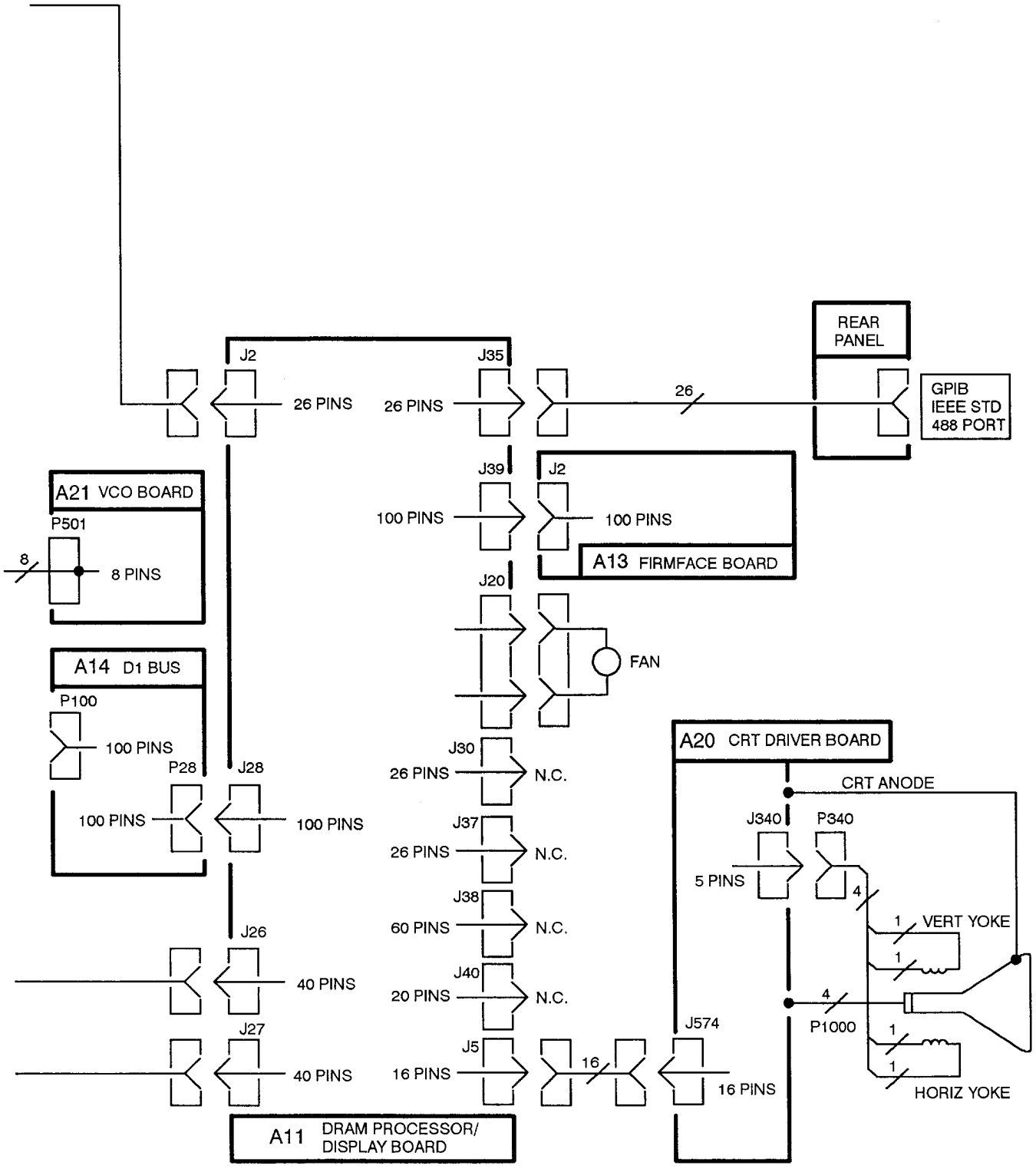


Figure 9-1: TDS 520 Interconnections (Cont.)

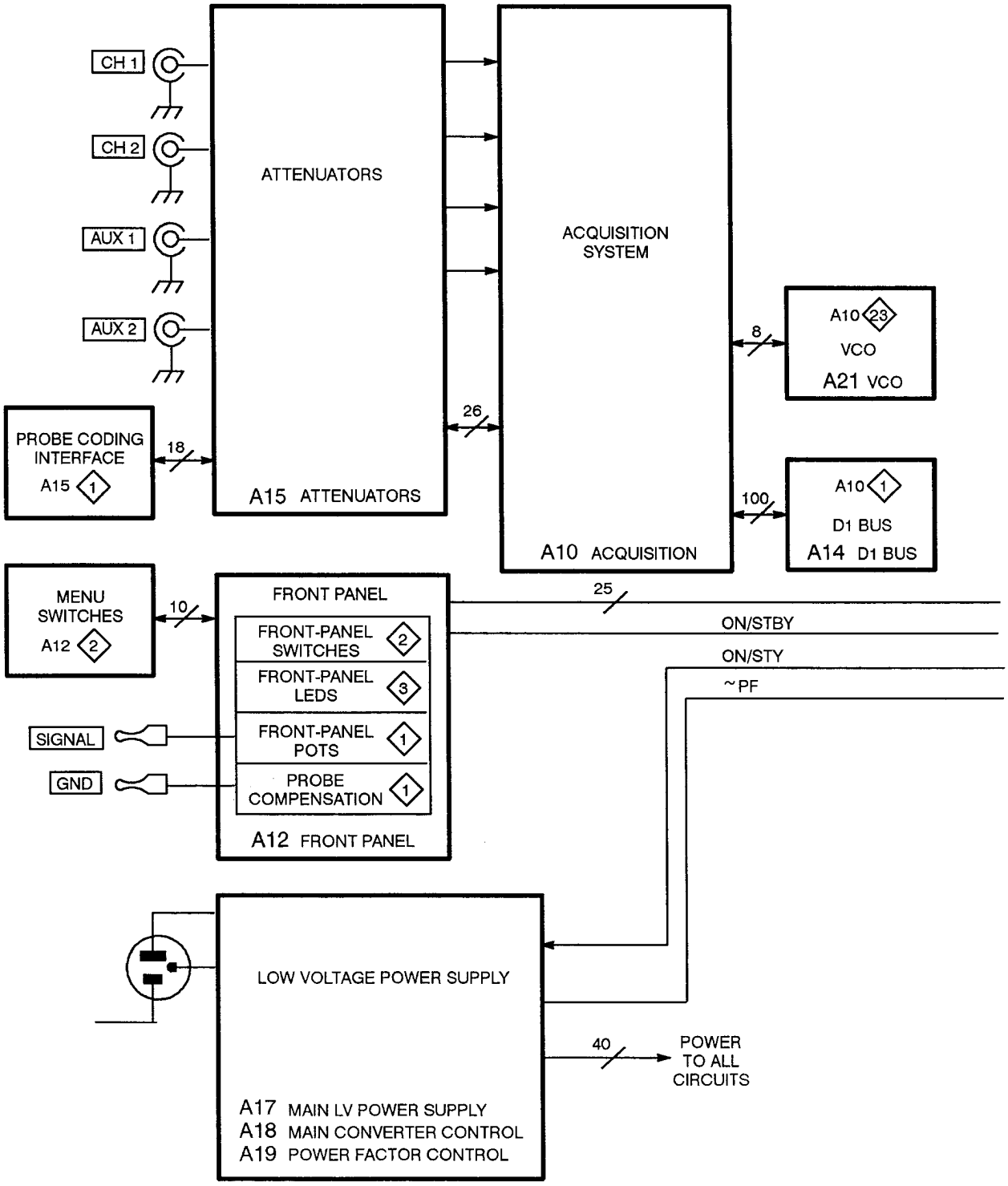


Figure 9-2: TDS 520 Block Diagram

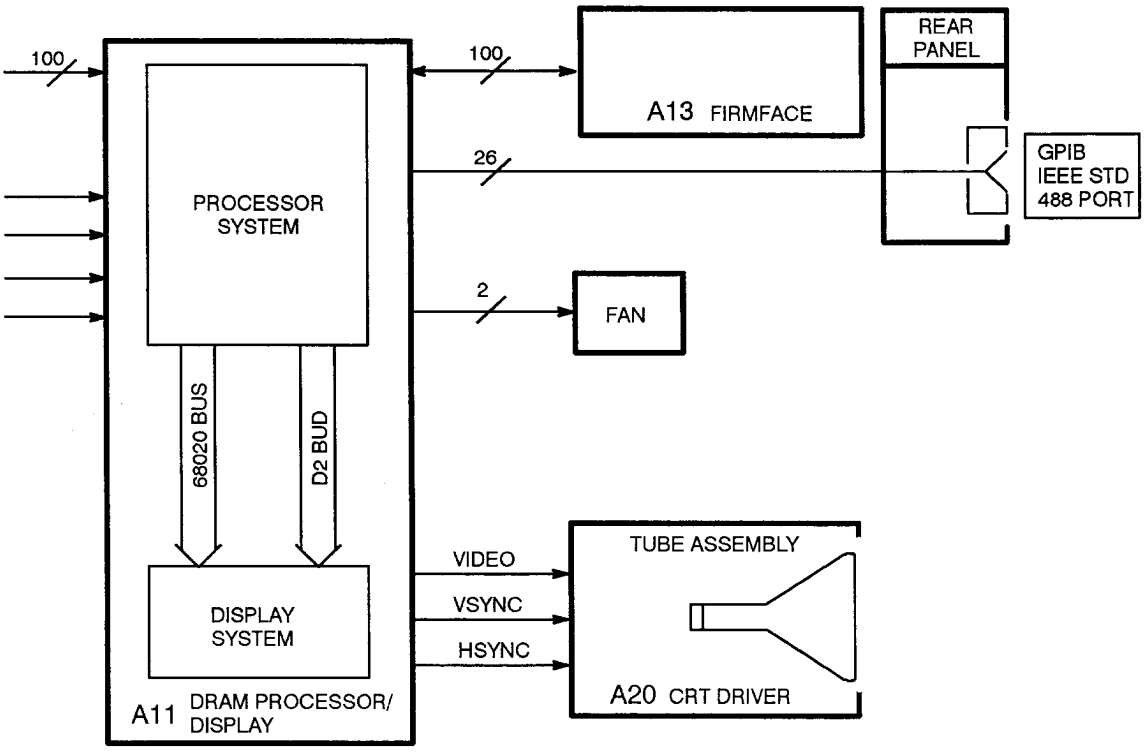


Figure 9-2: TDS 520 Block Diagram (Cont.)

Replaceable Parts List

This section contains a list of the modules that are replaceable for the TDS 520 Digitizing Oscilloscope. 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 520 Digitizing Oscilloscope 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 the all the information you need for ordering replacement parts.

Item Names

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

Indentation System

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

1 2 3 4 5 Name & Description
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
TK0IK	MODERN METALS	UNIT A/K, 5/F GOLD KING IND. BLDG NO. 35–41 TAI LIN ROAD	KWAI–CHUNG N.T. HONG KONG
TK0488	CURRAN COIL SPRING INC	635 NW 16TH	PORTLAND OR 97209–2206
TK0588	UNIVERSAL PRECISION PRODUCTS	1775 NW 216TH	HILLSBORO OR 97123
TK1163	POLYCAST INC	9898 SW TIGARD ST	TIGARD OR 97223
TK1465	BEAVERTON PARTS MFG CO	1800 NW 216TH AVE	HILLSBORO OR 97124–6629
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
TK2193	PHOTO AND SOUND	820 NW 18TH AVENUE	PORTLAND OR 97209
TK2230	COMAIR ROTRON INC, A KLI COMPANY		
TK2338	ACC MATERIALS	ED SNYDER BLDG 38–302	BEAVERTON OR 97077
TK2432	UNION ELECTRIC	15/F #1, FU–SHING N. ROAD	TAIPEI, TAIWAN ROC
TK2469	UNITREK CORPORATION	3000 LEWIS & CLARK WAY SUITE #2	VANCOUVER WA 98601
TK2500	SOLECTEK ACCESSORIES CORP	6370 NANCY RIDGE DR SUITE 109	SAN DIEGO CA 92121
0JR05	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER WA 98661–2999
0J9P9	GEROME MFG CO INC	PO BOX 737 403 NORTH MAIN	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
1GM54	ZYTEC CORPORATION	7575 MARKET PLACE DR	EDEN PRAIRIE MN 55344–3637
11536	OPTICAL COATING LABORATORY INC	2789 NORTHPOINT PKWY	SANTA ROSA CA 95407–7350
2W733	COOPER INDUSTRIES INC BELDEN DIVISION	2200 US HIGHWAY 27 SOUTH PO BOX 1980	RICHMOND IN 47375–0010
22526	BERG ELECTRONICS INC (DUPONT)	857 OLD TRAIL RD	ETTERS PA 17319
22670	G M NAMEPLATE INC	2040 15TH AVE WEST	SEATTLE WA 98119–2728
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
5Y400	TRIAX METAL PRODUCTS INC DIV OF BEAVERTON PARTS MFG CO	1800 NW 216TH AVE	HILLSBORO OR 97124–6629
5Y921	COMAIR ROTRON, A KLI COMPANY	2675 CUSTOMHOUSE COURT	SAN YSIDRO CA 92173
75915	LITTELFUSE INC SUB TRACOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016–3049

CROSS INDEX – MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
76814	NORTHERN ENGRAVING CORP	803 S BLACK RIVER ST	SPARTA WI 54656–2221
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077–0001

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
10-1-1	200-3695-01	B010100	B022202	1	COVER,REAR:W/LABEL	80009	200369501
	200-3695-03	B022203		1	COVER,REAR:W/LABEL	80009	200369503
-2	161-0230-01			1	CABLE ASSY,PWR,:3,18 AWG,92 L,SVT,TAN (STANDARD ACCESSORY)	TK2432	ORDER BY DESC
-3	200-2264-00			1	CAP,FUSEHOLDER:3AG FUSES (AMERICAN)	S3629	FEK 031 1666
	200-2265-00			1	CAP,FUSEHOLDER:5 X 20MM FUSES (EUROPEAN)	S3629	FEK 031.1663
-4	159-0013-00			1	FUSE,CARTRIDGE:3AG,6A,250V,FAST BLOW (AMERICAN)	75915	312006
	159-0210-00			1	FUSE,CARTRIDGE:DIN 5 X 20MM,5AMP,250VSLO (EUROPEAN)	S3629	TYPE FST 034-31
-5	650-2922-00			1	CABINET ASSY:W/ATTACHING PARTS	80009	650292200
-6	367-0247-01			1	HANDLE,CARRYING:11.54 L,W/CLIP	80009	367024701
-7	200-2191-00			2	CAP,RETAINER:PLASTIC	0JR05	ORDER BY DESC
-8	437-0399-00	B010100	B010189	1	CABINET,SCOPE:	0J9P9	ORDER BY DESC
	437-0399-01	B010190		1	CABINET,SCOPE:	80009	437039901
-9	348-1110-00	B010100	B010189	4	FOOT,CABINET:FRONT	TK1163	ORDER BY DESC
	348-1110-01	B010190		4	FOOT,CABINET:FRONT	80009	348111001
-10	348-1254-01			4	PAD,FOOT:TEK BLUE,SANTOPREME	TK1163	ORDER BY DESC
-11	348-0875-00			1	FLIPSTAND,CAB.:	TK0488	ORDER BY DESC
-12	348-1109-01			2	GASKET,SHIELD:45.0 L	80009	348110901
-13	200-3696-00	B010100	B022338	1	COVER,FRONT:PLASTIC (STANDARD ACCESSORY)	TK1163	ORDER BY DESC
	200-3696-01	B022339		1	COVER,FRONT:PLASTIC (STANDARD ACCESSORY)	80009	200369601
-14	386-5954-00			1	PANEL,INPUT:PLASTIC,ATTENUATOR	80009	386595400
-15	366-2114-00			2	KNOB:LARGE,DETENTED	TK1163	ORDER BY DESC
-16	366-2111-00			3	KNOB:SMALL,FLUTED	TK1163	ORDER BY DESC
-17	366-2170-00			1	KNOB:DIMPLED GPK,1.7 DIA	TK1163	ORDER BY DESC
-18	334-7963-00			1	MARKER,IDENT:MKD TDS520,LEXAN	76814	ORDER BY DESC
-19	101-0127-00			1	TRIM,DECORATIVE:FRONT	TK1163	ORDER BY DESC
-20	650-2298-00	B010100	B022641	1	REPLACABLE ASSY:FRAME DISPLAY;W/FLEX	80009	650229800
	650-2298-01	B022642		1	REPLACEABLE AS:FRAME DISPLAY;W/FLEX	80009	650229801
-21	378-0366-01			1	FILTER,LT,CRT:6.75 X 5.50,DARK GRAY	11536	378-0366-01
-22	386-6211-00	B010100	B022039	1	RETAINER,FILTER:5 X 6,PLASTIC	TK1163	ORDER BY DESC
	386-6211-01	B022040	B022508	1	RETAINER,FILTER:LIGHT FILTER RETAINER	TK1163	ORDER BY DESC
	386-6211-02	B022509		1	RETAINER,FILTER:DUST SEAL ASSY,LEXAN	TK1163	386-6211-02
-23	671-1701-00	B010100	B010418	1	CIRCUIT BD ASSY:FIRMFACE (A13)	80009	671170100
	671-1701-01	B010419		1	CIRCUIT BD ASSY:FIRMFACE (A13)	80009	671170101
-24	214-4287-00	B010100	B022409	1	ACTUATOR:ELASTOMER MAT,FRONT PANEL,RUB	TK0IK	ORDER BY DESC
	260-2598-00	B022410	B022544	1	SWITCH,ELAST:SILCON RUBBER SWITCH MAT	TK1918	ORDER BY DESC
	214-4287-00	B022545		1	ACTUATOR:ELASTOMER MAT,FRONT PANEL,RUB	TK0IK	ORDER BY DESC

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
10-1-25	614-0890-01	B010100	B021799	1	FRONT PNL ASSY:TDS520 (A12)	80009	614089001
	614-0896-00	B021800	B022053	1	FRONT PNL ASSY:TDS620 (A12)	80009	614089600
	614-0896-01	B022054		1	FRONT PNL ASSY:TDS520/TDS620 (A12)	80009	614089601
-26	650-2762-00			1	OVERLAY ASSY:	80009	650276200

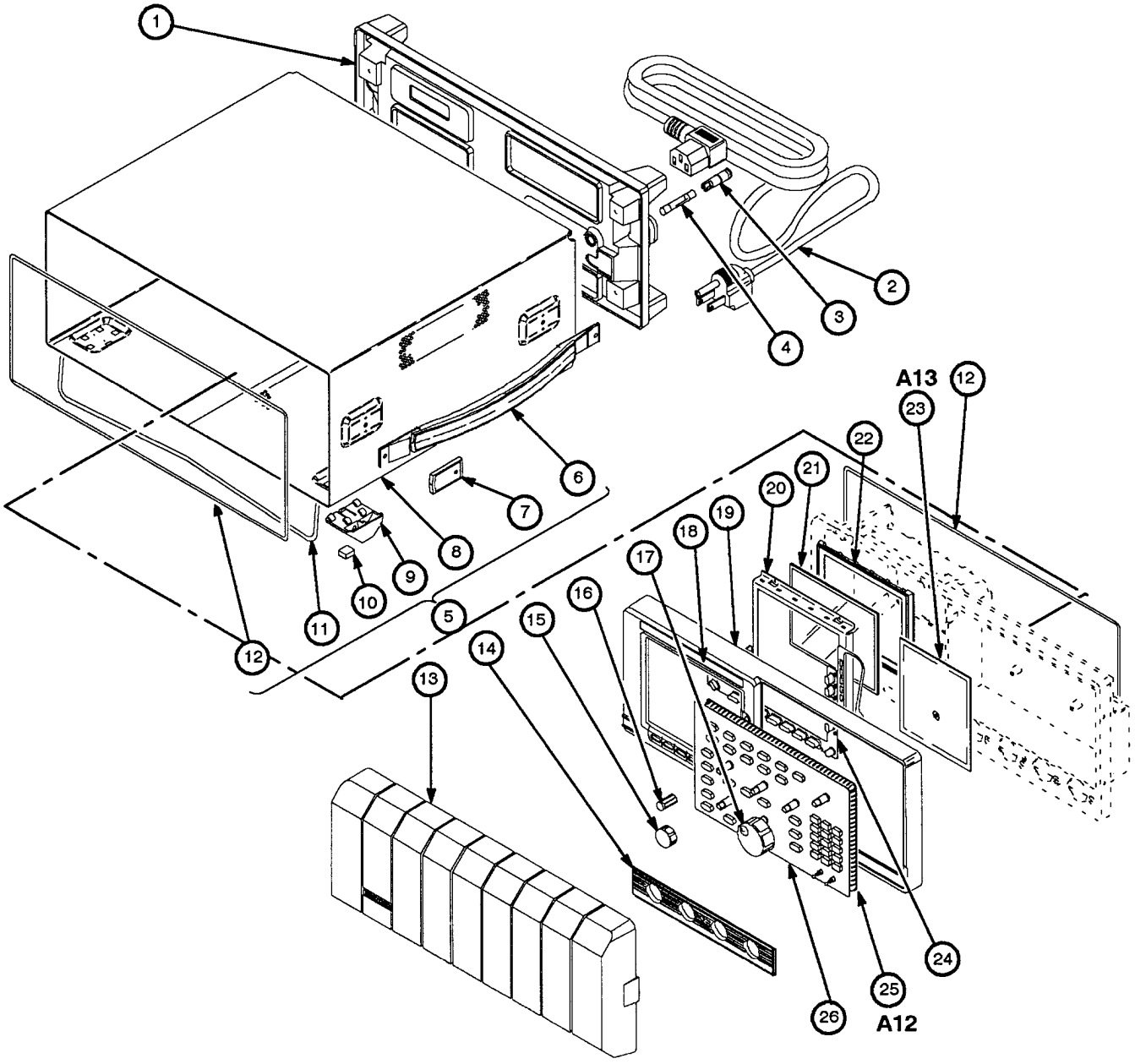


Figure 10-1: External Modules

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
10-2-1	212-0189-00			6	SCREW,MACHINE:8-32 X 0.500,PAN HEAD,TORX	0KB01	ORDER BY DESC
-2	119-3413-00	B010100	B022628	1	FAN,TUBEAXIAL:48 VDC,22W,3350RPM,235 CFM	TK2230	032150
	119-5044-00	B022629		1	FAN,DC:TUBEAXIAL;20-28V,0.275A,5W	5Y921	JQ24F4V/031349
-3	174-2349-00			1	CABLE ASSY:7.0 L,2,2 COND,RIBBON,LDI,1X2	TK2469	ORDER BY DESC
-4	671-2002-01	B010100	B010730	1	CIRCUIT BD ASSY:PROCESSOR DISPLAY (A11, STANDARD)	80009	671200201
	671-2002-02	B10731		1	CIRCUIT BD ASSY:PROCESSOR DISPLAY (A11, STANDARD)	80009	671200202
	671-1477-01	B010100	B010730	1	CIRCUIT BD ASSY:PROC/DISPLAY,EXPANDED (A11, OPTION 1M)	80009	671147701
	671-1477-02	B010731		1	CIRCUIT BD ASSY:PROC/ DISPLAY EXPANDED (A11, OPTION 1M)	80009	671147702
-5	441-1902-00	B010100	B022490	1	CHASSIS,SCOPE:REAR	0J9P9	ORDER BY DESC
	441-1902-01	B022491		1	CHASSIS,SCOPE:REAR	0J9P9	ORDER BY DESC
-6	334-7966-01			1	MARKER,IDENT:MKD REAR BNC,LEXAN	22670	334-7966-01
-7	407-3825-00			2	BRACKET,CKT BD:PLASTIC,REAR	TK1163	ORDER BY DESC
-8	386-5872-00			1	PLATE,REAR:ALUMINUM,STD	0J9P9	ORDER BY DESC
-9	211-0730-00			2	SCR,ASSEM WSHR:6-32 X 0.375,PNH,STL CD PL	0KB01	ORDER BY DESC
-10	348-1300-00	B022838		2	SHLD,GSKT,ELEK:3.165 L,CLIP ON	30817	0098-0564-09-03
-11	671-1568-00			1	CIRCUIT BD ASSY:D1 BUS (A14)	80009	671156800
-12	672-1475-03	B010100	B011462	1	CIRCUIT BD ASSY:ACQUISITION W/VCO (A10, STANDARD)	80009	672147503
	672-1475-04	B011463	B022446	1	CIRCUIT BD ASSY:ACQUISITION W/VCO (A10, STANDARD)	80009	672147504
	672-1475-05	B022447		1	CIRCUIT BD ASSY:ACQ,W/VCO (A10, STANDARD)	80009	672147505
	672-2046-03	B010100	B011462	1	CIRCUIT BD ASSY:ACQUISITION W/VCO (A10, STANDARD)	80009	672204603
	672-2046-04	B011463	B022475	1	CIRCUIT BD ASSY:ACQ/EXPAN MEMORY W/VCO (A10, OPTION 1M)	80009	672204604
	672-2046-05	B022476		1	CIRCUIT BD ASSY:ACQ,1M,W/VCO (A10, OPTION 1M)	80009	672204605
-13	346-0266-00			1	STRAP,CABLE:PLASTIC	0KB05	346-0266-00
-14	174-1519-00			2	CA ASSY,SP:RIBBON,;IDC,40,28 AWG,5.4 L,2X20	TK1899	ORDER BY DESC
-15	337-3816-00	B010397	B010903	1	SHIELD,ELEC:RAM,ALUMINUM	80009	337381600
	337-3816-01	B010904		1	SHIELD,ELEC:RAM,ALUMINUM	0J9P9	337-3816-01
-16	671-1941-00			1	CIRCUIT BD ASSY:VCO (A21)	80009	119409201
-17	119-4092-01	B010100	B010788	1	ATTENUATOR:FOUR CHANNEL,1M/50OHM (A15)	80009	119409201
	119-4092-02	B010789		1	ATTENUATOR:FOUR CHANNEL,1M/50OHM (A15)	80009	119409202
-18	407-3878-00			6	BRACKET,CKT BD:PLASTIC	TK1163	ORDER BY DESC
-19	407-3877-00			2	BRACKET,CKT BD:PLASTIC	TK1163	ORDER BY DESC
-20	441-1901-00	B010100	B022496	1	CHASSIS,SCOPE:TOP	0J9P9	ORDER BY DESC
	441-1901-01	B022497		1	CHASSIS,SCOPE:TOP	0J9P9	ORDER BY DESC

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					CABLE ASSEMBLIES		
10-2-	174-1524-00	B010100	B022583	1	CA ASSY SP:RIBBON,GPIB;IDC,24,28 AWG,4.275L (A11J35 TO BACK PANEL)	TK2469	ORDER BY DESC
	174-1524-01	B022584		1	CA ASSY,SP:RIBBON,GPIB;IDC,24,28 AWG,4.0 L (A11J35 TO BACK PANEL)	TK2469	ORDER BY DESC
	129-1085-00	B010100	B022583	2	SPACER,POST:0.25 L,4-40,BRS,0.25 HEX (USE WITH 174-1524-XX ONLY)	TK0588	129-1085-00
	129-1439-00	B022584		2	SPACER,POST:0.17 L,4-40 BRS,0.25 RND (USE WITH 174-1524-XX ONLY)	TK0588	ORDER BY DESC
	174-1525-00			2	CA ASSY,SP,ELEC:2 X 8-13,28 AWG,VIDEO/MONI (A11J2 TO FT PANEL)(A11J5 TO FT PANEL)	TK2469	ORDER BY DESC
	174-2031-00			2	CABLE ASSY,RF:50 OHM COAX,6.5 L,W/BLUE JKT (A10J1000 TO MAIN TRIG OUTPUT) (A10J1001 TO DELAYED TRIG OUTPUT)	TK2338	174-2031-00
	175-2929-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-6 (A10J1201 TO CH3 OUTPUT)	80009	175292900
	175-8029-00			1	CABLE ASSY,RF:50 OHM COAX,12.0 L,9-2 (A10J1550 TO AUX TRIG INPUT)	80009	175802900

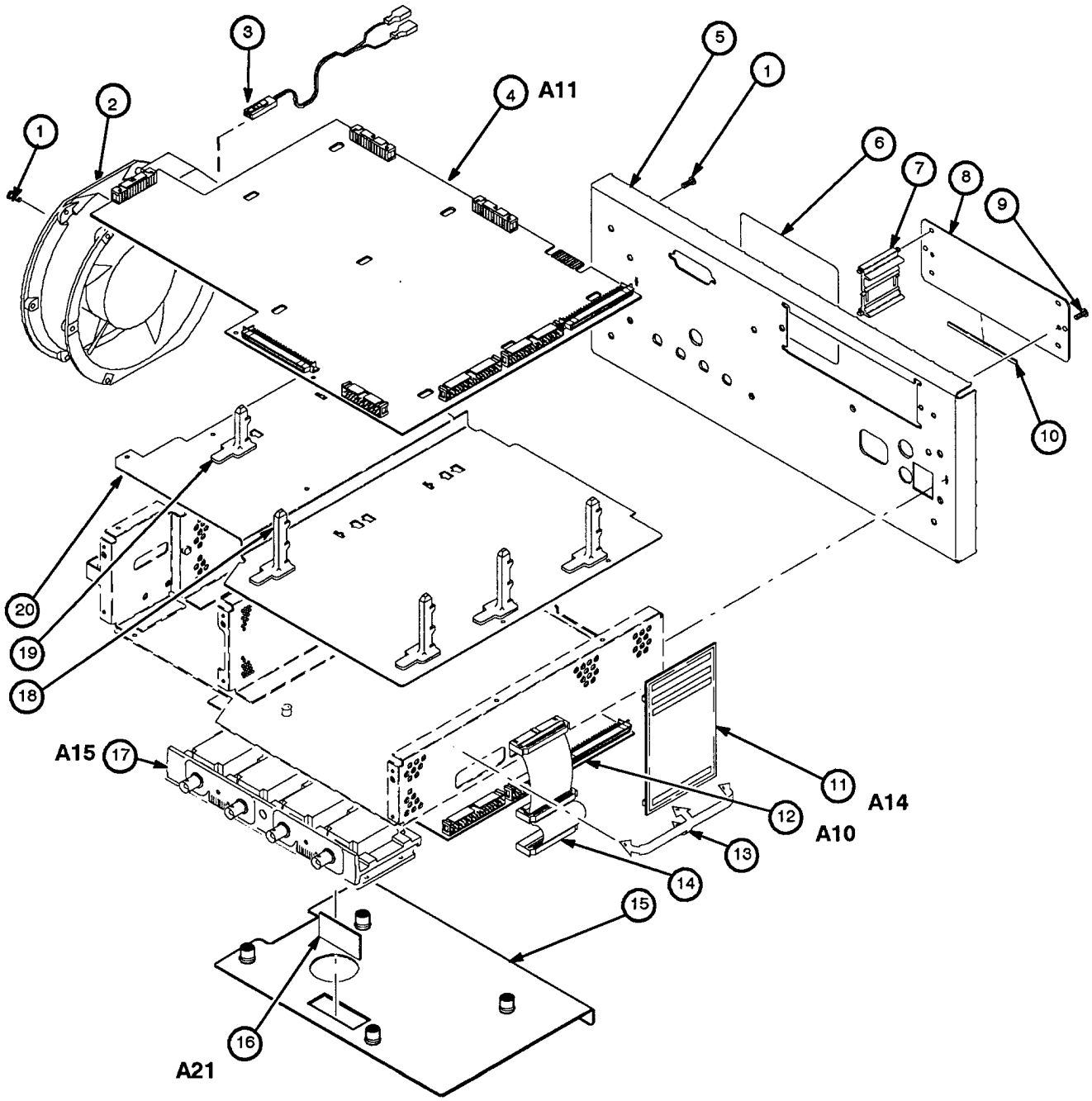


Figure 10-2: Outer-Chassis Modules

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3–1	640–0071–00	B010100	B022222	1	DISPLAY,MONOCHR:7 INCH (A20)	80009	640007100
	640–0071–01	B022223		1	DISPLAY,MONOCHR:7 INCH (A20)	80009	640007101
–2	348–1300–00	B022838		1	SHLD,GSKT,ELEK:3.165 L,CLIP ON	30817	0098–0564–09–03
–3	119–3371–00	B010100	B010567	1	POWER SUPPLY:SWITCHING,400W,MULTI OUT (A16)	1GM54	ORDER BY DESC
	119–3371–01	B010568	B011836	1	POWER SUPPLY:SWITCHING,300 W,MULTI OUT (A16)	80009	119337101
	119–3371–03	B011837	B021996	1	POWER SUPPLY:SWITCHING,300W,MULTI OUT (A16)	80009	119337103
	119–3371–04	B021997	B022061	1	POWER SUPPLY:SWITCHING,300W,MULTI OUT (A16)	80009	119337104
	119–4415–00	B022062	B022090	1	POWER SUPPLY:SWITCHING,300W,MULTI OUT (A16)	80009	119441500
	119–4415–01	B022091		1	POWER SUPPLY:SWITCHING,300W,MULTI OUT (A16)	1GM54	ORDER BY DESC
–4	441–2017–01			1	CHASSIS,SCOPE:MAIN W/SHIELD	0J9P9	ORDER BY DESC
–5	386–5871–00	B010100	B022642	1	SUBPANEL,FRONT:ALUMINUM	TK1465	386–5871–00
	386–5871–01	B022643		1	SUBPANEL,FRONT:ALUMINUM	80009	386587101

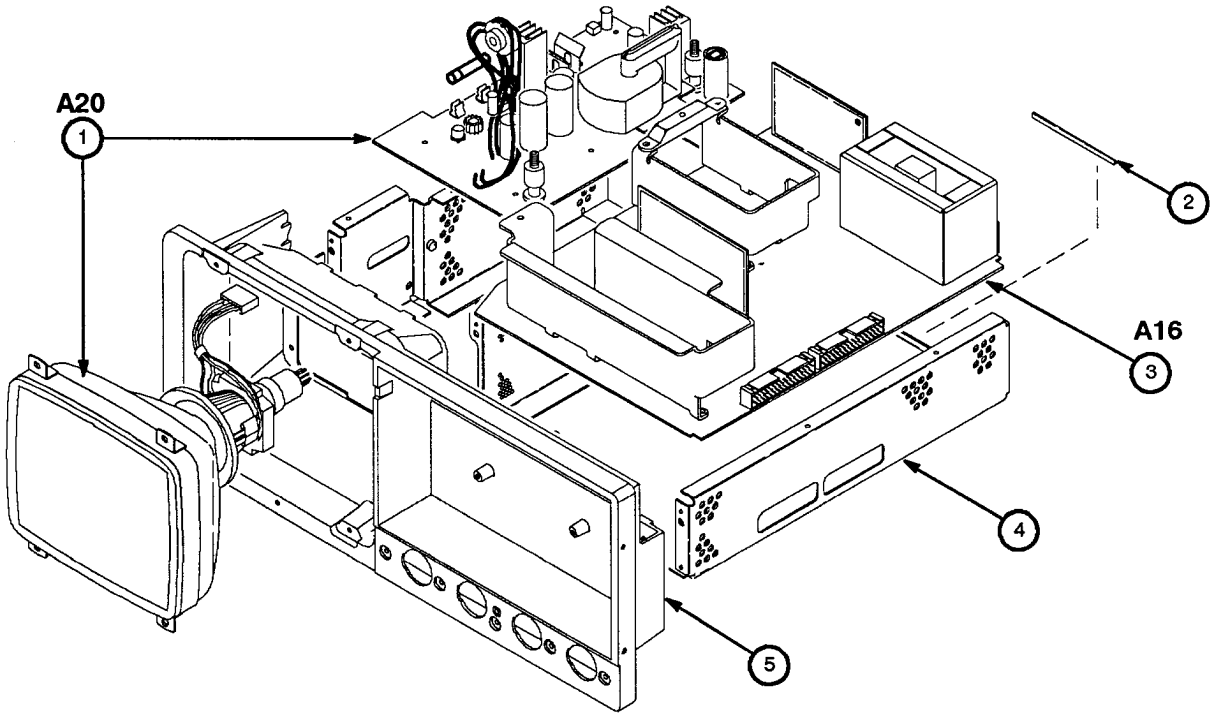


Figure 1-3: Inner-Chassis Modules

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					STANDARD ACCESSORIES		
10-4-1	161-0104-05			1	CABLE ASSY,PWR,:3,18 AWG,240V,98.0 L (OPTION A3-AUSTRALIAN)	S3109	SAA/3-OD3CCFC3X
-2	161-0104-06			1	CABLE ASSY,PWR,:3 X 0.75MM SQ,220V,98.0 L (OPTION A1-EUROPEAN)	S3109	VIIGSOPO-HO5VVF
-3	161-0104-07			1	CABLE ASSY,PWR,:3,1.0MM SQ,240 VOLT,2.5 M (OPTION A2-UNITED KINGDOM)	S3109	ORDER BY DESC
-4	161-0104-08			1	CABLE ASSY,PWR,:3,18 AWG,98 L,SVT,GREY/BLK (OPTION A4-NORTH AMERICAN)	2W733	ORDER BY DESC
-5	161-0167-00			1	CABLE ASSY,PWR,:3.0 X 0.75,6A,240V,2.5M L (OPTION A5-SWITZERLAND)	S3109	ORDER BY DESC
	--------			1	CABLE ASSY,PWR,:3,18 AWG,92 L,SVT,TAN (STANDARD, SEE FIGURE 10-1-2)		
-6	343-1213-00			1	CLAMP,PWR CORD:POLYMIDE	TK1163	ORDER BY DESC
	--------			1	ACCESSORY PKG:TWO P6139A,1.3M PROBES		
	070-8316-01			1	MANUAL,TECH:QUICK REF,TDS520/540	80009	070831601
	070-8317-01			1	MANUAL,TECH:TUTORIAL/USER,TDS520/540	80009	070831701
	070-8318-05			1	MANUAL,TECH:PROGRAMMERS,TDS FAMILY	80009	070831805
	070-8603-00			1	MANUAL,TECH:PERFORM VERIFICATION	80009	070860300

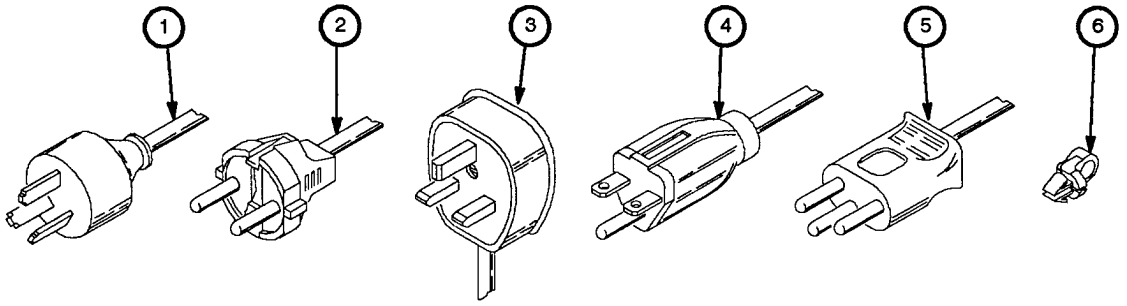


Figure 10-4: Accessories

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					OPTIONAL ACCESSORIES		
	003-1457-01			1	BIT,TORX DRIVER:MODIFY THE T-20,TORX	TK1465	003-1457-01
	012-0991-00			1	CABLE,COMPOSITE:IDC,GPIB:2 M,24 COND	22526	81190-020
	012-0991-01			1	CABLE,GPIB:LOW EMI,1 METER	00779	553577-2
	012-1250-00			1	CABLE,INTCON:SHLD CMPST,PARALLEL CENTR	TK2193	CACC 3049
	012-1298-00			1	CABLE,INTCON:RS232C DB25M-DB9F SERIAL	TK2500	C294-9
	016-0909-01			1	CASE,CARRYING:SOFTSIDED	TK2162	0587
	016-1135-00			1	CASE,CARRYING:26 X 22 X 15,HARD TRANSFER	34416	2622RW-7T-7B
	016-1136-00			1	MOUNTING KIT:RACK MOUNT KIT	80009	016113600
	016-1145-00			1	HOOD ASSEMBLY:TDS SERIES	80009	016114500
	020-1964-00	B010100	B010537	1	SOFTWARE PKG:FIELD ADJUST VERS 1.00	80009	020196400
	020-1964-01	B010538		1	FIELD ADJ KIT:SW & RELEASE NOTES V1.01	80009	020196401
	020-1966-00			1	COMPONENT KIT:FLASH ROM VERSION 1.00	80009	020196600
	020-1979-00	B010100	B010537	1	SOFTWARE PKG:CAL PV,V2.2	80009	020197900
	020-1979-01	B010538		1	CAL PV KIT:SW V2.20 & RELEASE NOTES	80009	020197901
	063-0932-06			1	SOFTWARE PKG:V2.14,(1)3.5,(1)5.25,TDS520	80009	063093206
	070-8567-01			1	MANUAL,TECH:OPT 13 RS-232/CENTRONICS	80009	070856701
	070-8582-00			1	MANUAL,TECH:INSTRUCTION,TDS FAM OPT 2F	80009	070858200
	070-8312-01			1	MANUAL,TECH:SERVICE,TDS520	80009	070831201

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