TEK **Service Reference Manual**

Part No. 070-7422-00
Product Group 47

THE 11403

DIGITIZING OSCILLOSCOPE

WARNING

The following 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 any 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
G100000	Tektronix Guernsey, Ltd., Channel Islands
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, etc.).

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General Information

The *11403 Digitizing Oscilloscope Service Reference* manual is designed for use by qualified service personnel. It contains information necessary to check, troubleshoot, and maintain the 11403 Digitizing Oscilloscope.

Troubleshooting is primarily based on internal diagnostics. These diagnostics isolate problems to the field replaceable unit (FRU) level. If the diagnostics can not detect a defective FRU, then this defective FRU can be isolated using other troubleshooting methods. Once the faulty FRU is identified, use the instructions provided in this manual to remove and replace this FRU. Removing and immediately replacing the faulty FRU allows you to minimize the time your oscilloscope is not operational. Section 5, Replaceable Parts, provides a complete list of the FRUs in this oscilloscope.

If you have never operated the 11403 Oscilloscope, please read the *11403 Digitizing Oscilloscope Tutorial* to become familiar with the basic functions of the oscilloscope.

This section gives information about safety, installing and removing plug-in units, applying power, proper environmental conditions, shipping the oscilloscope, and instrument options.

Safety Summary

This general safety information is directed to operators and service personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

Terms in Manuals

CAUTION statements in manuals identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements in manuals identify conditions or practices that could result in personal injury or loss of life.

Terms on Equipment

CAUTION on equipment means a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER on equipment means a personal injury hazard immediately accessible as one reads the marking.

Symbols in Manuals

Static Sensitive Devices

Symbols on Equipment

		
DANGER High Voltage	*Protective ground (earth) terminal*	*ATTENTION Refer to manual*

Power Source

This oscilloscope 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, by way of the grounding conductor in the power cord, is essential for safe operation.

Grounding the Product

This oscilloscope is grounded through the grounding conductor in the power cord. To avoid electric shock, plug the power cord into a properly wired receptacle before connecting it to the oscilloscope input or output terminal. A protective-ground connection, by way of the grounding conductor in the power cord, is essential for safe operation.

Danger Arising from Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electrical shock.

Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate this oscilloscope in an atmosphere of explosive gasses.

Do Not Service Alone

Do not perform internal service or adjustment of this oscilloscope 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 oscilloscope. To avoid personal injury, do not touch exposed connections and components while the power is on.

Disconnect the power before removing protective panels, soldering, or replacing components.

CRT Handling

Use care when handling a CRT. Breakage of the CRT causes a high-velocity scattering of glass fragments (implosion). Protective clothing and safety glasses should be worn. Avoid striking the CRT on any object which might cause it to crack or implode. When storing a CRT, place it in a protective carton or set it face down in a protected location on a smooth surface with a soft mat under the faceplate.

Use the Proper Fuse

To avoid fire hazard, use only a fuse which is identical in type, voltage rating, and current rating to the fuse specified in Section 5, Replaceable Parts.

Installing and Removing a Plug-in Unit

To install a plug-in unit in an 11403 Oscilloscope (see Fig. 1-1):

1. Set the ON/STANDBY switch to STANDBY to prevent damage to the oscilloscope.
2. Align the grooves in the top and bottom of the plug-in unit with the guides in the plug-in compartment of the oscilloscope.

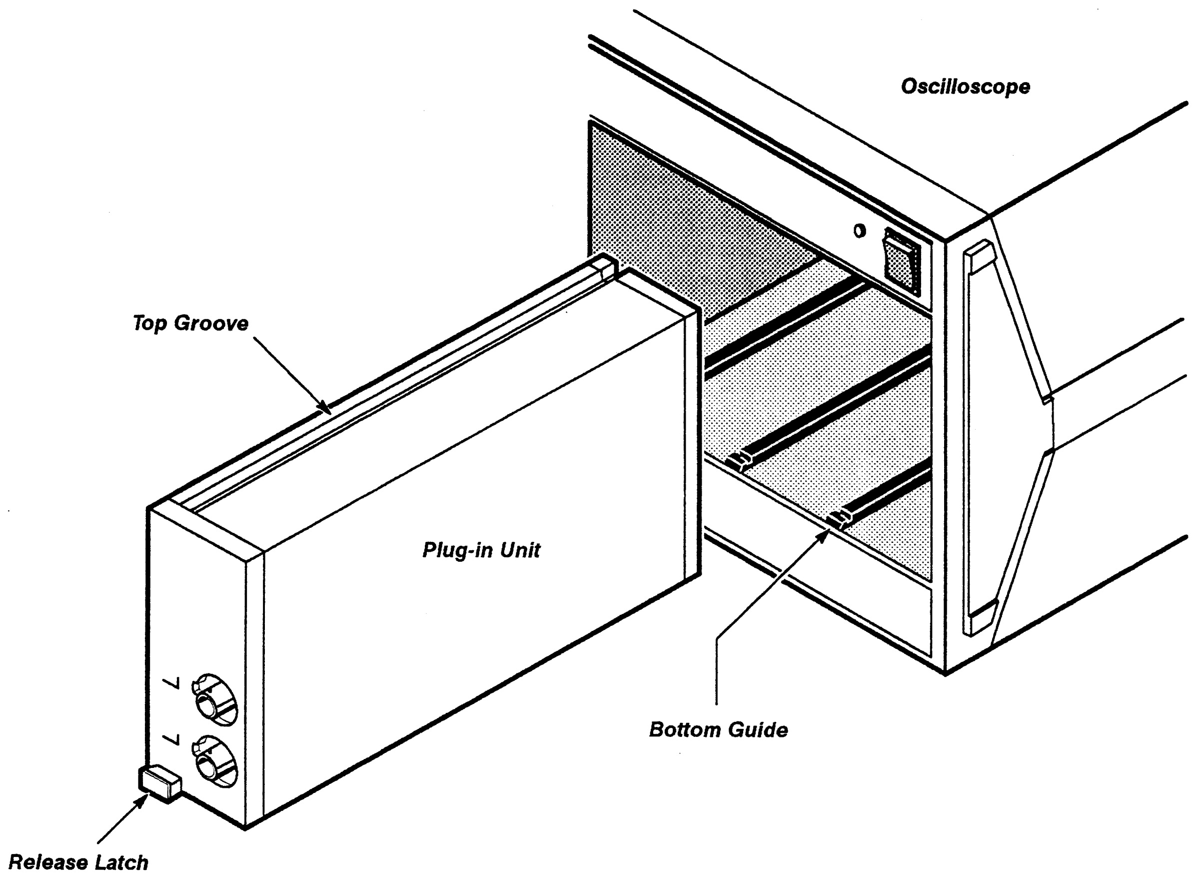


Figure 1-1 *— Installing the Plug-in Unit into an Oscilloscope*

3. Insert the plug-in unit into the oscilloscope until the front panel of the plug-in unit is flush with the front panel of the oscilloscope.

CAUTION

Never install or remove a plug-in unit when the ON/STANDBY switch is ON.

To remove the plug-in unit from the oscilloscope:

1. Set the ON/STANDBY switch to STANDBY to prevent damage to the oscilloscope.
2. Pull the release latch to disengage the plug-in unit from the oscilloscope.
3. Remove the plug-in unit from the plug-in compartment.

Power Information

The rear panel LINE VOLTAGE SELECTOR allows you to select either a 115 V or 230 V (48 to 440 Hz) nominal supply source. Both 115 V and 230 V operation use the 6 A, 250 V line fuse.

AC Power Source and Connection

The 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 of 250 V.

WARNING

Before making connection to the power source, ensure that the LINE VOLTAGE SELECTOR is set to match the voltage of the power source, and has a suitable two-pole, three-terminal grounding-type plug.

Grounding

This oscilloscope 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 electrical shock hazard.

For electric shock protection, the grounding connection must be made before making a connection to the oscilloscope input or output terminals.

Power Cord Information

A power cord with appropriate plug configuration is supplied with each oscilloscope. Table 1-1, Power-Cord Conductor Identification, 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 1-2, Power Cord and Plug Identification.

***Table 1-1** — Power-Cord Conductor Identification*

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

Memory Backup Power

A self-contained power source within the oscilloscope allows the retention of volatile memory upon loss of the AC power source. The self-contained power source provides memory backup power which stores the last-selected front and CRT touch panel settings of the oscilloscope. Waveforms stored in memory may also be retained. A self-contained power source also supplies power to the IC that generates the time/date parameters, and records the hours of oscilloscope on-time and the number of power-on sequences.

The self-contained power source has a nominal shelf life of approximately five years (depending on the amount of memory installed). Partial or total loss of stored settings upon power-on may indicate that one or both power sources need to be replaced.

Operating Environment

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

Operating Temperature

The 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 reach the safe operating temperature before applying power.

Enhanced Accuracy is available after a 20-minute warmup period. After entry into Enhanced Accuracy, the oscilloscope will revert to normal accuracy if the internal oscilloscope temperature changes more than ±5°C.

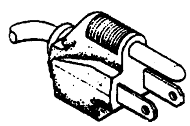
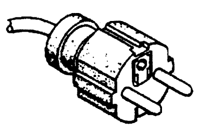
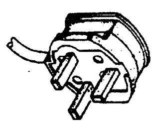
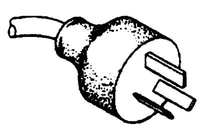
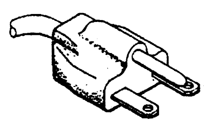
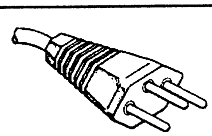
Ventilation Requirements

A fan draws air in through the side panels of the oscilloscope and blows the air out through the rear of the oscilloscope to cool the oscilloscope. Therefore, to ensure proper cooling of the oscilloscope, allow at least two inches clearance on both sides and at the rear of the oscilloscope. The top and bottom of the oscilloscope do not require ventilation clearance.

CAUTION

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

Table 1-2 – Power Cord and Plug Identification

Plug Configuration	Usage (Max Rating)	Reference Standards & Certification	Option #
	North American 125 V/6 A	[1]ANSI C73.11 [2]NEMA 5-15-P [3]IEC 83 [10]UL [11]CSA	Standard
	European 220 V/6 A	[3]ICE 83 [4]CEE (7), II, IV, VII [8]VDE [9]SEMKO	A1
	United Kingdom 240 V/6 A	[3]IEC 83 [5]BSI 1363	A2
	Australian 240 V/6 A	[6]AS C112 [12]ETSAF	A3
	North American 250 V/10 A	[1]ANSI C73.20 [2]NEMA 6-15-P [3]IEC 83 [10]UL [11]CSA	A4
	Switzerland 240 V/6 A	[7]SEV	A5

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

Packaging for Shipment

If you are shipping the oscilloscope over long distances by commercial transportation, use the original carton and packaging material in which it was shipped to you.

Also, if you are shipping the oscilloscope to a Tektronix service center for service or repair, attach a tag to the oscilloscope showing the following:

- Owner of the oscilloscope (with address)
- Name of person to contact at your firm
- Complete oscilloscope type and serial number
- If possible, furnish complete system firmware versions as displayed in the **Ident** pop-up menu selected from the UTILITY major menu
- A description of the service required

If the original packaging is unfit for use or not available, then package the oscilloscope as follows:

☐ Step 1: Obtain a corrugated cardboard shipping carton with a 375-pound test strength and having inside dimensions at least six inches greater than the oscilloscope dimensions. (This allows for cushioning.)

☐ Step 2: Wrap the oscilloscope with polyethylene sheeting or equivalent material to protect the finish.

☐ Step 3: To cushion the oscilloscope on all sides tightly pack dunnage or urethane foam between the carton and the oscilloscope, allowing three inches on each side.

☐ Step 4: Seal the carton with shipping tape or with an industrial stapler.

☐ Step 5: Mark the address of your local Tektronix service center and your return address on the carton in one or more prominent locations.

Instrument Options

Your oscilloscope may be equipped with one or more instrument options. A brief description of each available option is given in the following discussion. Option information is also incorporated into the appropriate sections of the manual. Refer to Contents at the beginning of this manual for the location of option information. For further information and prices of instrument options, see your *Tektronix Products Catalog* or contact your local Tektronix service center.

Option 1C—adds eight BNC connectors to the front and rear panels so that signals to and from the rear panel can be routed to and from the front panel. This option can be added at any time.

Option 1R—adds slide rails and rackmounting hardware to convert the benchtop oscilloscope to a standard 19-inch rackmount version. This option can be added at any time.

Option 2D—adds 768 Kbytes of nonvolatile memory to expand the memory for stored waveforms and settings. This option can be added at any time.

Option 4D—increases the GPIB transfer speed up to ten times. Improves the overall throughput of the oscilloscope; especially the transmission of waveform and measurement data. This option can be added at any time.

Option A1—replaces the standard power cord with the Universal European 220 V power cord.

Option A2—replaces the standard power cord with the United Kingdom 240 V power cord.

Option A3—replaces the standard power cord with the Australian 240 V power cord.

Option A4—replaces the standard power cord with the North American 250 V power cord.

Option A5—replaces the standard power cord with the Switzerland 240 V power cord.

Checks and Adjustments

This section contains procedures to examine measurement limits, check electrical specifications, and to manually set all internal adjustments. This procedure provides a logical sequence of check and adjustment steps, and is intended to return the oscilloscope to specified operation following repair, or as a part of a routine maintenance program. To functionally test the oscilloscope, perform the parts which have a "yes" indication in the Functional Test column of Table 2-1, Measurement Limits, Specifications, Adjustments and Functional Tests.

Refer to the *11403 Digitizing Oscilloscope User Reference* manual for more information about advertised specifications and oscilloscope operation. At the beginning of each part the specifications or measurement limits are given. Then, the setup for each procedure in that part provides information concerning test equipment setup or interconnection. Refer to Table 2-2, Test Equipment for more information concerning test equipment used in these setups.

Table 2-1 *— Measurement Limits, Specifications, Adjustments, and Functional Tests*

Part and Description	**Measurement Limits** ***(Examine)***	**Specifications** ***(Check)***	**Adjustments** ***(Adjust)***	**Functional Test**
Part 1 Power-On Diagnostics	none	none	none	yes
Part 2 Extended Diagnostics	none	none	none	yes
Part 3 Power Supply	none	none	none	no
Voltage Supply	+4.85 V to +5.25 V	none	none	
Voltage Reference	+5.15 V to +5.25 V	none	R800 +5.2 V REF for +5.20 V	
Regulator Reference	+9.95 V to +10.05 V	none	R830 +10 V REF for +10.00 V	
Part 4 Display				
Cutoff	visible		A8 CRT Driver board SCREEN adjustment on transformer until display appears	no
Convergence	primary colors are not separated in the white grid		CONVERGENCE, R210, for optimum convergence of red, green, and blue.	
Focus	focused grid pattern		A8 CRT Driver board FOCUS adjustment on transformer for optimum focus on white grid pattern.	

Table 2-1 — Measurement Limits, Specifications, Adjustments, and Functional Tests (Cont.)

Part and Description	Measurement Limits (Examine)	Specifications (Check)	Adjustments (Adjust)	Functional Test
Part 4 Display (Cont.)				
Vertical Size and Position	align with tic marks		VERT SIZE, L321, and VERT POS, R311, for optimum alignment	
Horizontal Size, Linearity and Position	align with tic marks and optimum appearance		H-SIZE, R501, H-LIN, R502, and H-POS, R500, for optimum alignment and linearity	
Gray Scale	white at the top of the display and gray at the bottom, and the right side of the display is cut off		A8 CRT Driver board SCREEN adjustment on transformer; RED, R200;GREEN, R201, and BLUE; R203, are adjusted for cutoff and color balance	
Color Impurity	no severe color impurities in red, green, and blue display		Cycle power on and off	
Part 5 Enhanced Accuracy		successful execution	none	yes
Part 6 Calibration Output Accuracy				yes
Probe Calibration Output Voltage Accuracy		±0.06% (or ±6 mV)	R1576 offset for -10.000 V ±0.002 V R1582 gain for +9.9951 V ±0.002 V	
Attenuator Ratios and Calibrator DAC Linearity	attenuator ratios within ±0.04%; calibrator DAC linearity within ±0.75 of LSB		none	
Part 7 Probe Compensation Voltage				no
Output Voltage Accuracy	6.0 V ±0.18 V		none	
Part 8 Acquisition				no
10 MHz Signal Amplitude	≥1.0 V p-p		10 MHz, C217, for maximum signal amplitude (must be ≥0.8 V p-p)	
Phase Lock Loop	+6.0 V ±1.0 V		VCO, C500, for 6.0 V ±0.3 V	

***Table 2-1** – Measurement Limits, Specifications, Adjustments, and Functional Tests (Cont.)*

Part and Description	Measurement Limits *(Examine)*	Specifications *(Check)*	Adjustments *(Adjust)*	Functional Test
Part 8 Acquisition (Cont.)				no
Differential Amplifier V+	10.500 V ±10 mV		Diff Amp V+, R666, for 10.500 V	
Part 9 Vertical Input Offset	±0.2 div		none	no
Part 10a Sampler and Digitizer Performance Verification Procedure	8.000 U ± 0.080 U		none	no
Part 10b Sampler and Digitizer Functional Test Procedure	refer to Table 2-4, Vertical Accuracy Error Limits, for the measurement limits for this part		none	yes
Part 11 ADC Linearity		≤1% (2 LSBs)	none	no
Part 12 Equivalent Time Step Response				no
Rise Time	≤300 ps		none	
Aberrations	≤5% p-p within the first 20 ns after the step; ≤1% peak-to-peak after first 20 ns from the step		none	
Part 13a Bandwidth Performance Verification Procedure	≥82.3% of the reference amplitude at 1 GHz		none	no
Part 13b Bandwidth Functional Test Procedure	≥70.7% of the reference amplitude at the maximum bandwidth		none	yes
Part 14 ADC RMS Noise		≤10 mV (60 dB of full scale)	none	no
Part 15 Trigger Sensitivity at 1 GHz		triggered with 1.5 div (1.5 U) at 1 GHz	none	no
Part 16 Trigger Enhancement	delay limit is 330 ps± 70 ps		C212 to eliminate spiking (collisions)	no

Table 2-1 — Measurement Limits, Specifications, Adjustments, and Functional Tests (Cont.)

Part and Description	Measurement Limits (Examine)	Specifications (Check)	Adjustments (Adjust)	Functional Test
Part 17a Time Base Performance Verification Procedure				no
Time Base Accuracy		±(0.002% +100 ps)	none	
Window Position Accuracy		±(0.002% +100 ps)		
Part 17b Time Base Functional Test Procedure	±(0.002% + 100 ps)		none	yes
Part 18 Events Window Position Accuracy		150 MHz maximum event frequency	none	no
Part 19 Input/Output				no
Real Time Clock	1,000,000 µs ±5 µs		C510 REAL TIME CLOCK for 1,000,000 µs	
Temperature Sensor Voltage Reference	+6.500 V ±5 mV		R112 TEMP SENSOR VOLTAGE REF for +6.500 V	
Part 20 Triggering	Trigger-Level DC Accuracy within 2.0% of full scale (20 LSBs)		none	no
		DC Noise-Reject Coupled of 1.2 divisions or less from DC to 50 MHz	none	
		AC Coupled of 0.5 divisions from 60 Hz to 50 MHz, increasing to 1.5 divisions at 1 GHz	none	
		DC Coupled of 0.5 divisions from DC to 50 MHz, increasing to 1.5 divisions at 1 GHz	none	
	HF Reject Coupled functional		none	
	LF Reject Coupled functional		none	

Test Equipment

The test equipment in Table 2-2 contains suggested test equipment for use in this manual. The Functional Test column of Table 2-2 indicates, with a check mark (✓), the test equipment that is recommended if you are performing a functional test. Procedure steps are based on the test equipment examples given, but other equipment with similar specifications may be substituted. Test results, setup information, and related connectors and adapters may be altered by the use of different equipment.

***Table 2-2** — Test Equipment*

Description	Minimum Specification	Examples of Recommended Test Equipment	Functional Test
Function Generator	50 Hz to 3 MHz, Variable offset, Amplitude variable from 0 to 10 V, Sine Wave and Square Wave output	TEKTRONIX FG 503 3 MHz Function Generator with a TM 500-Series Power Module	✓
High Frequency Sine Wave Generator	250 Mhz to 1000 MHz, Variable amplitude, 6 MHz reference	TEKTRONIX SG 504 Leveled Sine Wave Generator with a TM 500-Series Power Module	✓
Medium Frequency Sine Wave Generator	250 kHz to 250 MHz, Variable amplitude, 50 kHz reference	TEKTRONIX SG 503 Leveled Sine Wave Generator with a TM 500-Series Power Module	✓
Time Mark Generator	1 ns through 5 s markers in a 1–2–5 sequence, at least 5 parts in 10^7 accuracy	TEKTRONIX TG 501 Time Mark Generator with a TM 500-Series Power Module	✓
Calibration Generator	5 V output amplitude, accuracy within 0.23%	TEKTRONIX PG 506 Calibration Generator with a TM 500-Series Power Module	✓
Frequency Counter	1 part in 10^6 accuracy	TEKTRONIX DC 603A Universal Counter/Timer with a TM 500-Series Power Module	
Test Oscilloscope	≥80 MHz bandwidth	TEKTRONIX SC 504 Oscilloscope	
Logic Probe		TEKTRONIX P6401 Logic Probe	
Probe, 10X	Probe capacitance of ≤12pF, DC to 150 MHz, 10X, w/ground lead	TEKTRONIX P6106A	
Plug-in Amplifier	11000-Series	Any TEKTRONIX 11000-Series plug-in Amplifiers	✓

Table 2-2 — *Test Equipment (Cont.)*

Description	Minimum Specification	Examples of Recommended Test Equipment	Functional Test
Test Terminal	Any GPIB (IEEE-1978) controller, or ASCII terminal equipped with an RS-232-C port. Requires compatible RS-232-C serial interface cable	Compaq Portable II PC with terminal emulation software	
Digital Multimeter	≤0.005% accuracy	Fluke 8842A Digital Multimeter	✓
Signal Standardizer	Tektronix Calibration Fixture with Interface connector modified for 11000-Series use	Tektronix Part 067-0587-10 Signal Standardizer	
Coaxial Cable, 50 Ω	50 Ω, 36-inch, male BNC connectors	Tektronix Part 012-0482-00	✓
Adapters	BNC Female to Alligator Clips	Tektronix Part 013-0076-00	
	Probe tip to ground	Tektronix Part 013-0993-00	
Attenuator, 5X (2 required).	Impedance, 50 Ω; one male and female BNC connector	Tektronix Part 011-0060-02	✓
Power Supplies Troubleshooting Fixture		TEKTRONIX 067-1264-00 Extended Diagnostics 11000-Series Power Supplies troubleshooting fixture	
External Loopback Connector	RS-232-C connector	Tektronix Part 013-0198-00	
Alignment Tool (plastic hex)	Plastic hex	Tektronix Part 003-0301-00	
Term Conn Link (Plastic Short Circuit Jumper)	short circuit jumper	Tektronix Part 013-0993-00	
Alignment Tool (insulated slot)	Insulated slot	Tektronix Part 003-0675-01	
Alignment Tool (square-tip)	Square-Tip	Tektronix Part 003-1400-00	
Magnetic Screwdriver	Holder for Torx tips	Tektronix Part 003-0293-00	
Torx Screwdriver Tips	#10 tip	Tektronix Part 003-0814-00	
	#15 tip	Tektronix Part 003-0966-00	
	#20 tip	Tektronix Part 003-0866-00	

Table 2-2 — Test Equipment (Cont.)

Description	Minimum Specification	Examples of Recommended Test Equipment	Functional Test
Shorting Strap	Two alligator clips on a short pigtail conductor		
Integrated Circuit Extracting Tools	IC Extraction Pliers	General Tool P/N 8212566-1 or equivalent	
	IC Insertion-Extraction Pliers 28-pin type	General Tool P/N U505BG or equivalent	
Circuit Board Removal Tools	Straight-slot screwdriver, large		
	Torx screwdriver. T-7, T-8, T-10, T-15, T-20, T-25		
	Allen (Hex) Wrench, 1/16-inch		
	Nutdrivers, 3/16″, 1/4″, 7/16″		
	Needle-nose pliers		

Using These Procedures

Each part begins with a setup illustration that shows the necessary test equipment and connections. Refer to Table 2-2, Test Equipment, for an example of the equipment for each part.

Note: *Each part that requires you to access test points or adjustment locations within the oscilloscope, assumes that the top and bottom covers were previously removed. If you are performing a functional test, it is not necessary to remove the covers.*

Conventions in this Manual

These procedures use the following conventions:

- CAPITAL letters within the body of text identify front panel controls, indicators, test points, adjustment locations, and connectors on the oscilloscope (for example, MEASURE) and plug-in unit.
- **Bold** letters identify menu labels and display messages.
- Initial Capital letters identify connectors, controls, and indicators (for example, Position) on associated test equipment.

In some steps, the first word is italicized to identify a step that contains a performance verification and/or an adjustment instruction. For example, if *Check* is the first word in the title of a step, an electrical specification is checked. If *Adjust* appears in the title, the step involves an electrical adjustment. If *Examine* is the first word in the title, the step concerns measurement limits that are used as calibration guides; these limits are not to be interpreted as electrical specifications.

Menu Selections and Measurement Techniques

Details on measurement techniques and instructions for making menu selections are generally not included in this manual. Comprehensive descriptions of menus and oscilloscope features are located in the *11403 User Reference* manual.

Warm-up

For the first 20 minutes after power-on, the 11403 oscilloscope is in either **Warmup** or **New configuration-partial enhanced accuracy occurring** mode, depending on whether or not a plug-in unit has been added or removed since the last Enhanced Accuracy procedure. In either case, the oscilloscope is fully operational but its accuracy is not specified.

In many of the setup illustrations, a signal standardizer or an plug-in amplifier is shown installed in the oscilloscope for the sole purpose of keeping the signal standardizer or plug-in amplifier warmed-up. If you are performing a functional test, you should replace the signal standardizer with a plug-in amplifier in the left plug-in compartment of the oscilloscope for Parts 5, Enhanced Accuracy and Part 6, Calibration Output Accuracy.

Tutorial Manual

The tutorial manuals, the *11403 Digitizing Oscillcscope Tutorial* is strongly recommended to familiarize the first-time user with 11403 Oscilloscope controls and features.

Part 1 Power-On Diagnostics

Perform this part within the ambient temperature range of +18° and +28°C, to ensure proper oscilloscope operation.

Setup to Power-On Diagnostics

- [ ] Step 1: With the oscilloscope's front panel ON/STANDBY switch set to STANDBY, remove the top and bottom covers from the oscilloscope.
- [ ] Step 2: With the rear panel PRINCIPAL POWER SWITCH set to OFF, connect the oscilloscope to a suitable power source.
- [ ] Step 3: Install a signal standardizer (or an amplifier if you are performing a functional test) in the left plug-in compartment of the oscilloscope.
- [ ] Step 4: Set the PRINCIPAL POWER SWITCH to ON and then the ON/STANDBY switch to ON.

  When the oscilloscope is first installed, the PRINCIPAL POWER SWITCH should be set to the ON position and remain in this position. Thereafter, use the ON/STANDBY switch to perform all power switching.

- [ ] Step 5: Power on the following test equipment so that it is warmed up with the oscilloscope to be tested (a complete list of test equipment is shown in Table 2-2):
  - Digital multimeter
  - Function generator
  - Calibration generator
  - Frequency counter
  - Medium frequency sine wave generator
  - High frequency sine wave generator
  - Time mark generator
  - Test oscilloscope

Procedure to Power-On Diagnostics

Each time the ON/STANDBY switch is set to ON, the oscilloscope performs power-on diagnostics on its microprocessor subsystems and Self-Test diagnostics on all of its major circuits.

CAUTION

Turning the oscilloscope power off during probe calibration, Enhanced Accuracy, or Extended Diagnostics may result in some internal data being corrupted.

When power-on diagnostics begin, the messages **Diagnostics in Progress** and **Comm Test in Progress** are displayed on the screen. Diagnostic routines are then performed on each of the oscilloscope's microprocessor subsystems: Display, Executive, and Digitizer. Then, the communication between these subsystems is tested. If the oscilloscope is being powered-on from a cold condition, then the diagnostics may be complete before the CRT is warmed-up sufficiently (that is before the CRT is able) to display these messages.

The start of Self-Tests diagnostics indicates successful completion of power-on diagnostics. The message, **Dsy Kernel Failure**, or a beep and illuminated menu button indicators indicates a failure in power-on diagnostics.

Self-Test Diagnostics

When Self-Test diagnostics begin, the message **Self-Test in Progress** is displayed. Flashing and pattern changes on the display indicates test progress. Return to normal operation indicates successful completion of the Self-Test diagnostics. Any failures cause the oscilloscope to execute the remaining tests, and then display the **EXTENDED DIAGNOSTIC** menu structure. Record the displayed error codes for the failed circuit block(s), and then refer to Diagnostic Troubleshooting in Section 3.

Front panel controls are active during the Self-Test diagnostics sequence and any disturbance will cause a test failure. If such a failure occurs, the oscilloscope will automatically enter the Extended Diagnostic mode and display the **EXTENDED DIAGNOSTIC** menu structure. Touch the **Exit** selector twice to remove the menu and resume normal operation. However, if the diagnostics detect a fatal Digitizer fault, exiting this menu structure and returning to normal operation will not be possible.

Self-Tests diagnostics verify the following circuits:

- Executive Control
- Front Panel
- Internal I/O
- External I/O
- Subsystem Communication
- Display Control
- Video Generator
- Digitizer Control
- Timebases
- Points Acquisition
- Triggers
- Points/Address Generator
- Left plug-in amplifier compartment (if installed)
- Center plug-in amplifier compartment (if installed)
- Right plug-in amplifier compartment (if installed)

Completion of Power-On Diagnostics

When the graticule is displayed and the front panel settings in effect at the last power-off are restored, the oscilloscope has passed power-on diagnostics.

Part 2 Extended Diagnostics

The Extended Diagnostics perform more extensive testing than the Self-Test diagnostics. Extended Diagnostics is designed as a troubleshooting aid for service personnel.

Setup to Invoke Extended Diagnostics

No change from previous settings.

Procedure to Invoke Extended Diagnostics

Perform the following steps to enter the **EXTENDED DIAGNOSTICS** menu structure and execute the indicated tests.

☐ Step 1: Press the UTILITY button, and then **Page to Utility 2**.

☐ Step 2: Touch **Extended Diagnostics**, and then **Extended Diagnostic** in the **Verify Selection** pop-up menu.

☐ Step 3: Touch **All** and then **Run** to start the tests.

☐ Step 4: Ensure that all tests have executed and have a **Pass** status.

☐ Step 5: Touch the following selectors in order:

Block

External I/O

Area

GPIB

Routine

☐ Step 6: Touch **Run** to start the **Intrpt Reset** test.

☐ Step 7: Touch **Reset Status** and then **Run** to start the test.

☐ Step 8: Touch **Data Lines** and then **Run** to start the test.

☐ Step 9: Touch **Interrupt** and then **Run** to start the test.

☐ Step 10: Ensure that all four tests executed and passed.

☐ Step 11: Touch **Exit** to leave the **EXTENDED DIAGNOSTICS** menu structure.

Part 3 Power Supply

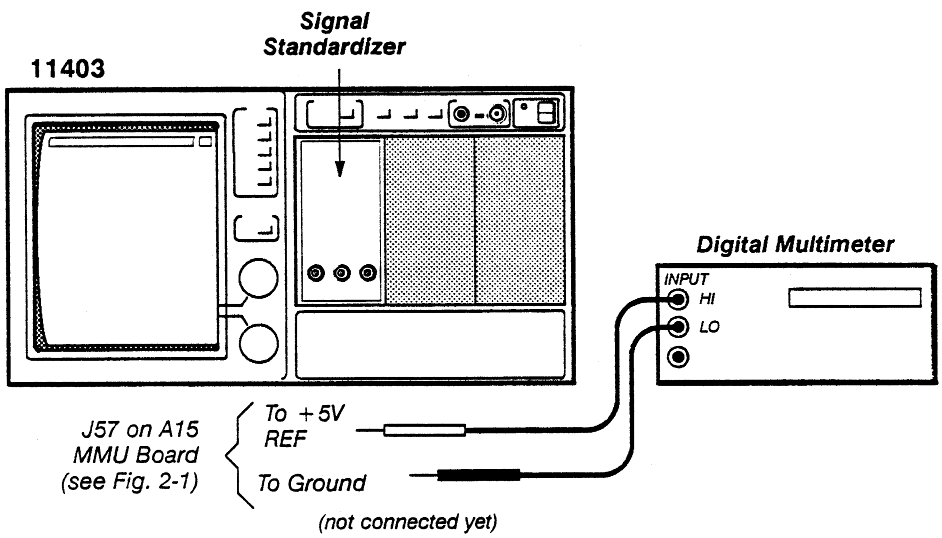
This part shows the setup and lists the procedure to examine the measured voltage supply, and to examine/adjust the voltage reference and the regulator reference (see Figs. 2-1, 2-2, and 2-3).

Measurement Limits

The measurement limits for this part are as follows:

- the measured voltage supply must be within the limits of +4.85 V and +5.25 V
- the voltage reference must be within +5.15 V and +5.25 V
- the regulator reference must be within +9.95 V and +10.05 V

Setup to Examine the Voltage Supply



Setup to Examine the Voltage Supply

Procedure to Examine the Voltage Supply

☐ Step 1: **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

11403 Oscilloscope
- ON/STANDBY .... ON

Digital multimeter
- Mode .... DC Voltage

Signal standardizer .... not used in this part

☐ Step 2: Disconnect connector J57 on the A15 MMU board. Note the position of the multi-pin connector's index triangle to ensure that the connector can be correctly replaced.

☐ Step 3: Connect the digital multimeter to the J57 connector as indicated in the setup illustration.

☐ Step 4: *Examine* that the digital multimeter reads within the limits of +4.85 V and +5.25 V.

STOP

DO NOT attempt to optimize the following adjustment settings if the reading is within the stated limits. Proceed to Part 4, Display.

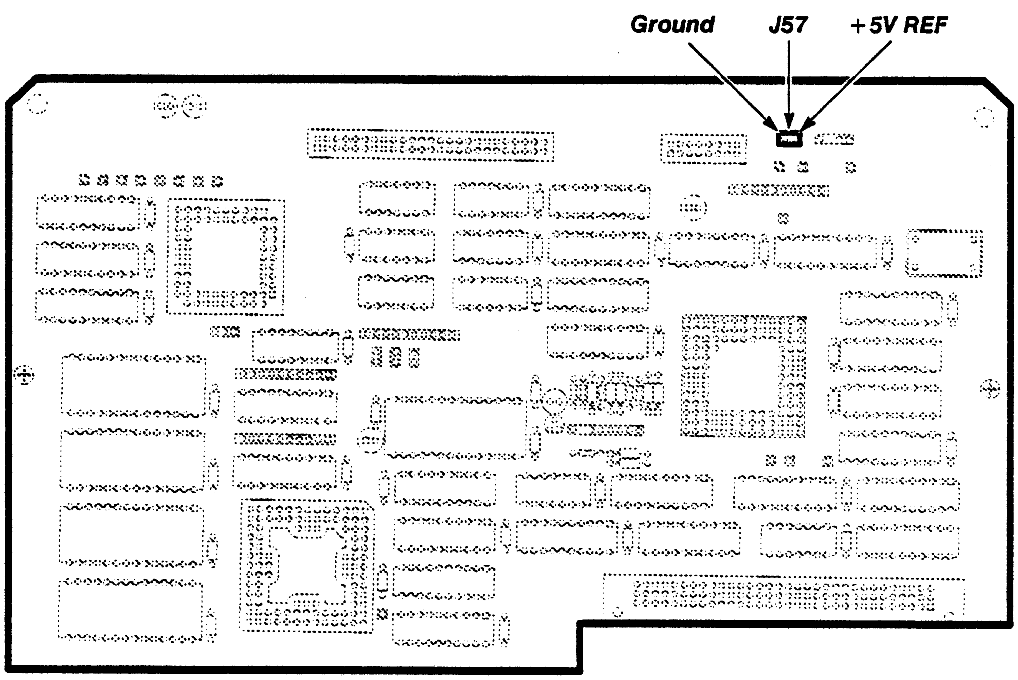
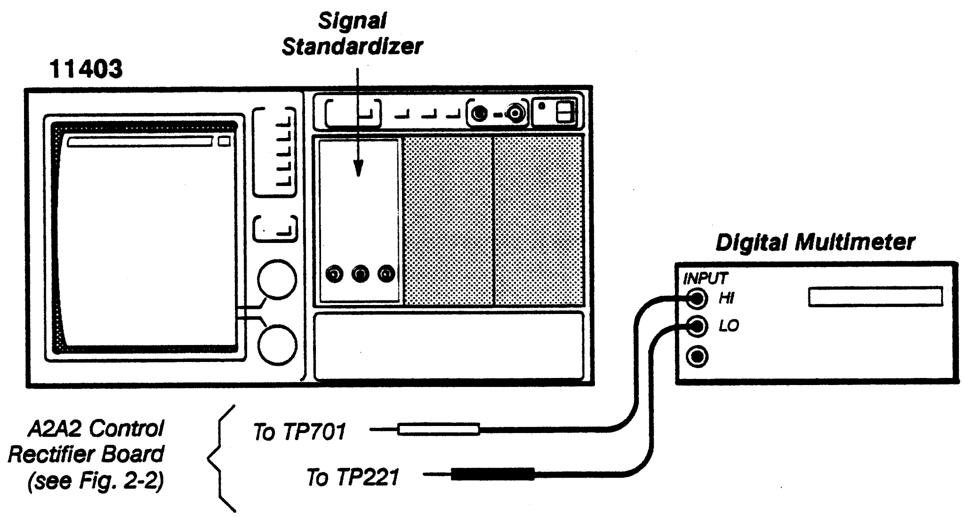


***Figure 2-1** — A15 MMU Board Test Point Locations*

Setup to Examine/Adjust the Voltage Reference



Setup to Examine/Adjust the Voltage Reference

Procedure to Examine/Adjust the Voltage Reference

☐ Step 1: Perform the following settings in the order listed:

11403 Oscilloscope:

a. Set the front panel ON/STANDBY switch to STANDBY and the rear panel PRINCIPAL POWER SWITCH to OFF. Disconnect the oscilloscope from the power source.

b. Remove the Power Supply module following the procedure listed under Power Supply Module Removal/Replacement in Section 3.

c. Create a short between test points TP830 and TP831 on the A2A2 Control Rectifier board using a shorting strap.

d. Connect the oscilloscope Power Supply module to a suitable line power source.

e. Set the PRINCIPAL POWER SWITCH to ON.

Digital multimeter
Mode .... DC Voltage
Signal standardizer .... not used in this part

☐ Step 2: *Examine* that the digital multimeter reads +5.20 V, within the limits of +5.15 and +5.25 V.

STOP

DO NOT attempt to adjust the following adjustment setting, if the reading is within the stated limits. Proceed to Step 4.

WARNING

Use extreme caution when performing the following adjustment.

- [ ] Step 3: *Adjust* +5.2 V REF adjustment R800 on the A2A2 Control Rectifier board for +5.20 V.
- [ ] Step 4: Remove the digital multimeter leads from the test points.
- [ ] Step 5: Set the PRINCIPAL POWER SWITCH to OFF.
- [ ] Step 6: Disconnect the oscilloscope from the power source.
- [ ] Step 7: Remove all test leads and the shorting strap.
- [ ] Step 8: Replace the Power Supply module following the procedure listed under Power Supply Module Removal/Replacement in Section 3.
- [ ] Step 9: Set the PRINCIPAL POWER SWITCH to ON, and the ON/STANDBY switch to ON.

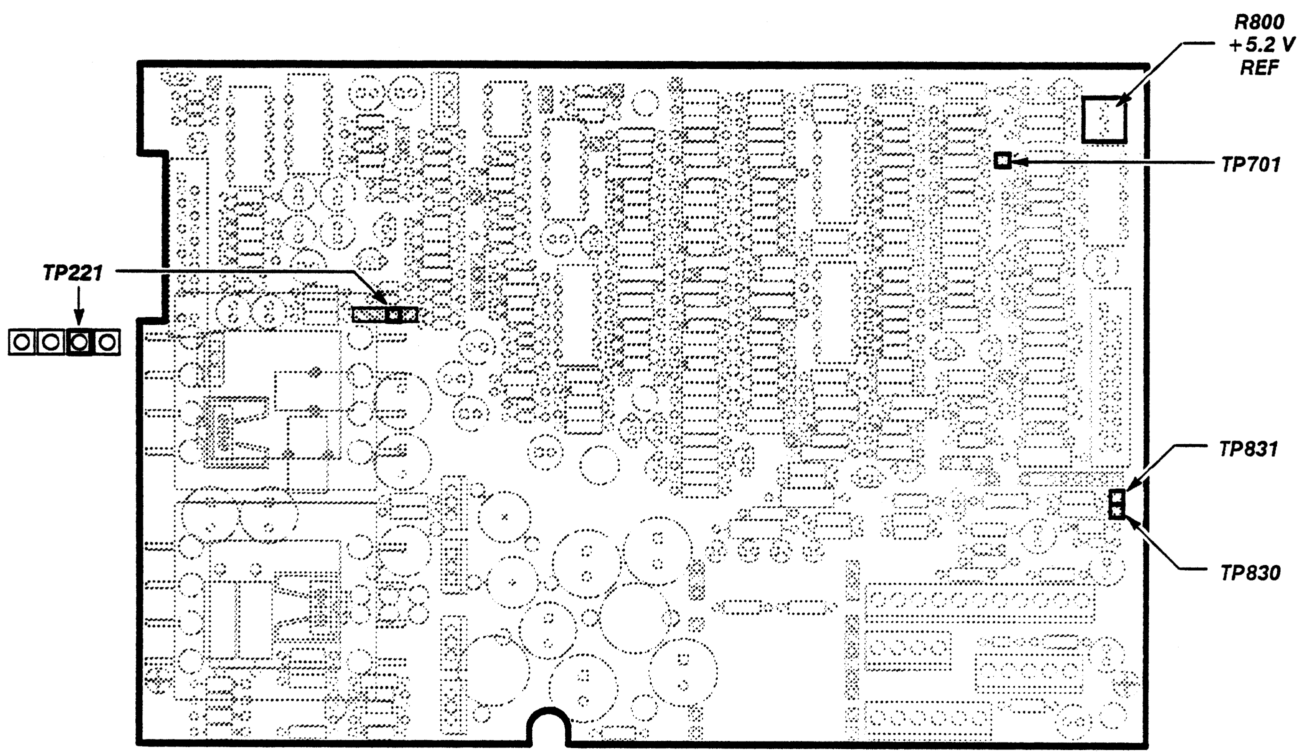
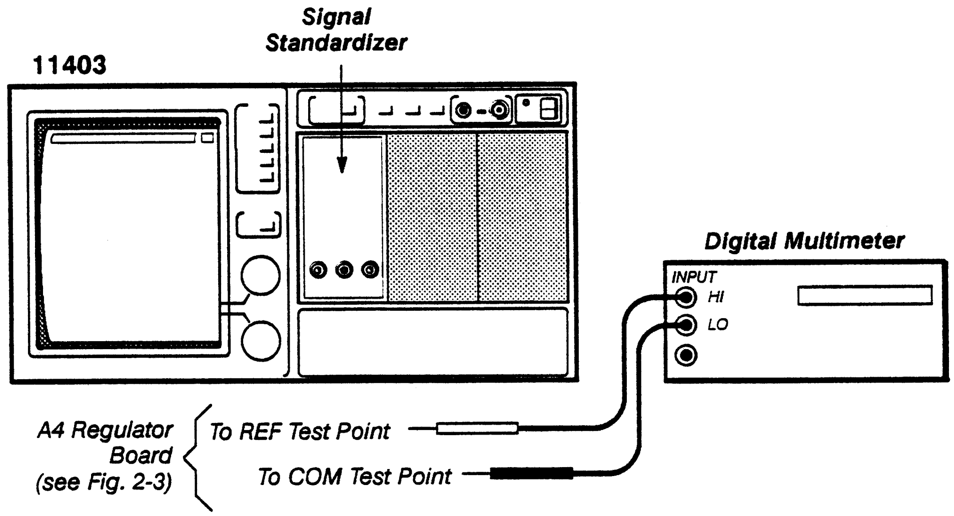


***Figure 2-2** — A2A2 Control Rectifier Board Test Point and Adjustment Locations*

Setup to Examine/Adjust the Regulator Reference



Setup to Examine/Adjust the Regulator Reference

Procedure to Examine/Adjust the Regulator Reference

☐ Step 1: Perform the following settings in the order listed:

11403 Oscilloscope .... no settings required
Digital multimeter
  Mode .... DC Voltage
Signal standardizer .... not used in this part

☐ Step 2: *Examine* that the digital multimeter reads +10.00 V, within the limits of +9.95 V and +10.05 V.

STOP

DO NOT attempt to adjust the following adjustment, R830, if the reading is within the stated limits. Proceed to Step 4.

WARNING

Use extreme caution when making the following adjustment due to the dangerous potentials present. Access the test points from the right side of the oscilloscope.

☐ Step 3: *Adjust* +10 V REF adjustment R830 on the A4 Regulator board for +10.00 V.

☐ Step 4: Remove the test leads.

☐ Step 5: Repeat Part 1, Power-On Diagnostics.

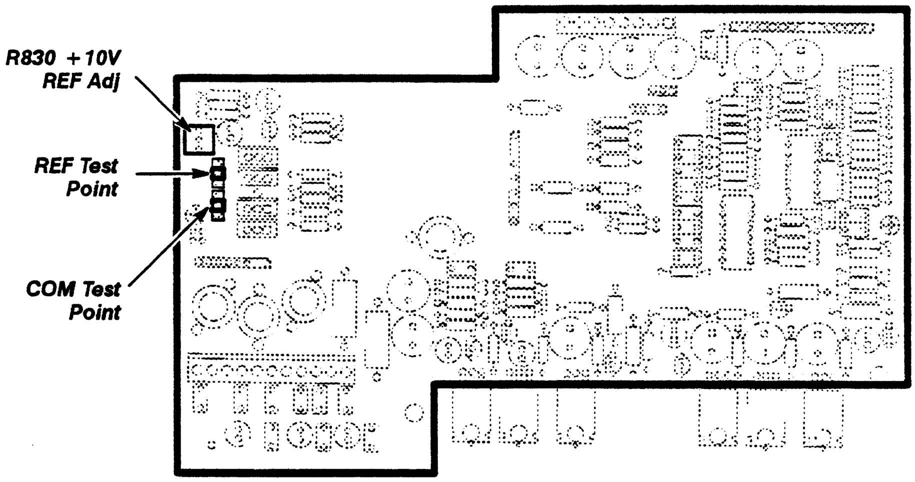


Figure 2-3 — A4 Regulator Board Test Point and Adjustment Locations

Part 4 Display

This part shows the setup and lists the procedure to examine/adjust the A7 CRT Socket board and the A8 CRT Driver board (see Figs. 2-4 and 2-5).

The adjustments in this part only affect the visual aspects of the CRT display and you should only perform these adjustments when the CRT, A7 CRT Socket board or A8 CRT Driver board components are replaced. These adjustments do not affect oscilloscope accuracy since all measurements are made on the acquired data, not the displayed data. Unless alignment or brightness difficulties are apparent, proceed to Part 5, Enhanced Accuracy.

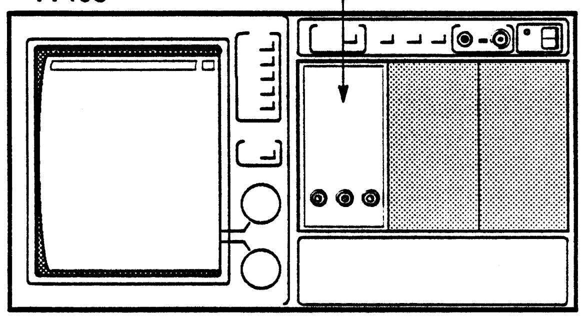
For all *Examine* steps in this part, if the display parameter examined is within the stated limits, then do not perform the *Adjust* step following that *Examine* step. Instead, proceed to the step following the *Adjust* step.

Measurement Limits

The measurement limits are set on the CRT as follows:

- The display must be visible (not cut off).
- The red, green, and blue traces must not be separated.
- Focus is adjusted for minimum line width.
- Vertical size is adjusted to align the corners of the grid pattern with the tic marks on the edges of the front panel bezel.
- Horizontal size is adjusted to align the corners of the grid pattern with the tic marks on the top and bottom edges of the front panel bezel, and the horizontal linearity is adjusted for uniform grid box length.
- Horizontal linearity is adjusted for optimum appearance using internally generated grid pattern.
- Red, green, and blue colors must have optimum white to gray scale linearity.
- **Red Display**, **Green Display**, and **Blue Display** in Extended Diagnostics must not contain severe color impurities.

Setup to Examine/Adjust the Display



Setup to Examine/Adjust the Display

Procedure to Examine/Adjust the Display

WARNING

Use extreme caution when performing the following adjustment.

☐ Step 1: Perform the following settings in the order listed:

11403 Oscilloscope
ON/STANDBY .... STANDBY
Signal standardizer .... not used in this part

☐ Step 2: Remove the three screws that secure the CRT cover, and then remove the cover.

☐ Step 3: Remove the two screws that secure the cover that shields the A7 CRT Socket board (CRT Socket board cover).

☐ Step 4: Set the ON/STANDBY switch to ON.

☐ Step 5: *Examine* that the display is visible.

☐ Step 6: *Adjust* the SCREEN adjustment, located on the transformer mounted to the A8 CRT Driver board, clockwise until the display appears.

☐ Step 7: Press the UTILITY button, and then touch **Page to Utility 2 Menu.**

☐ Step 8: Touch **Extended Diagnostic** and then **Extended Diagnostic** in the **Verify Selection** pop-up menu.

☐ Step 9: Touch **Block** and then **Front Panel.**

☐ Step 10: Touch **Area** and then **Test Pattern.**

☐ Step 11: Touch **Routine** and then **White Grid.**

☐ Step 12: Touch **Run** in the UTILITY major menu.

☐ Step 13: *Examine* that the primary colors (red, green, and blue) are not separated in the white grid pattern.

WARNING

Do not touch the back side of the A7 CRT Socket board. Due to dangerous voltage levels, use extreme caution when performing the following adjustment.

☐ Step 14: *Adjust* the CONVERGENCE adjustment, R210, on the A7 CRT Socket board for the optimum vertical convergence of the red, green, and blue colors.

☐ Step 15: *Examine* that the grid pattern is focused.

☐ Step 16: *Adjust* the Focus adjustment, located on the transformer mounted on the A8 CRT Driver board, for the optimum focus of the white grid pattern.

☐ Step 17: *Examine* that the grid is aligned with the top and bottom tic marks along the inside vertical edge of the front panel bezel. To eliminate any parallax error, look directly ahead at the CRT, and then align the top of the grid with the top vertical tic mark and the bottom of the grid with the bottom tic mark.

☐ Step 18: *Adjust* VERT SIZE, L321, and VERT POS, R311, adjustments on the A8 CRT Driver board to align the grid with the tic marks along the inside vertical edge of the front panel bezel.

☐ Step 19: *Examine* that the grid is aligned with the horizontal tic marks at the top and bottom of the front panel bezel and that the grid boxes are of uniform length throughout the grid pattern.

☐ Step 20: *Adjust* the H SIZE, R501, H LIN, R502, and H POS, R500, adjustments on the A8 CRT Driver board for optimum overall linearity and position. Use the horizontal tic marks at the top and bottom of the front panel bezel to properly aligned the grid.

☐ Step 21: H-SIZE, H-LIN, and H-POS adjustments interact, therefore you may need to repeat Steps 19 and 20 until H-SIZE, H-LIN, and H-POS are all optimally adjusted.

☐ Step 22: Touch **Exit** to return to the **EXTENDED DIAGNOSTIC** menu structure.

☐ Step 23: Touch **Gray Scale** in the **Routine** pop-up menu.

☐ Step 24: *Examine* that the color scale is white at the top, gray at the bottom, and the background on the right side of the display is cut off (that is, the vertical raster lines are not visible on the right side of the display).

STOP

If the gray scale meets the previous conditions, do not perform the adjustments in steps 25, 26, and 28. Proceed to Step 29.

☐ Step 25: *Adjust* the Red, R200, Green, R201, and Blue, R203, adjustments on the A7 CRT Socket board fully counterclockwise.

☐ Step 26: *Adjust* the SCREEN adjustment, located on the transformer that is mounted on the A8 CRT Driver board, so that the bottom block of the gray scale is visible but the background on the right side of the display is still cut off.

☐ Step 27: Note which color (red, green, or blue) appears more prominently in the display. DO NOT adjust this color in the following step.

☐ Step 28: *Adjust* the RED, R200, GREEN, R201, or BLUE, R203, adjustments on the A7 CRT Socket board for a pure white to gray scale display. Only adjust the colors that appear not to be prominent. For example, if the display appears to be more red, then adjust the GREEN and BLUE adjustments.

Note: *The SCREEN adjustment may have to be adjusted slightly if any of the colors are adjusted. If the vertical raster lines are visible in the background, then adjust the SCREEN adjustment so that the background is just cut off, but the bottom gray box is still visible.*

☐ Step 29: Touch **Exit** to return to the **EXTENDED DIAGNOSTIC** menu structure.

☐ Step 30: Touch **Red Display**, and then **Run.**

☐ Step 31: *Examine* the red display for any severe color impurities.

☐ Step 32: Touch **Exit** to return to the EXTENDED DIAGNOSTICS menu structure.

☐ Step 33: Touch **Green Display** and then **Run.**

☐ Step 34: *Examine* the green display for any severe color impurities.

☐ Step 35: Touch **Exit** to return to the **EXTENDED DIAGNOSTIC** menu structure.

☐ Step 36: Touch **Blue Display** and then **Run.**

☐ Step 37: *Examine* the blue display for any severe color impurities.

☐ Step 38: If any of the color displays (that is, the **Red Display**, **Green Display**, or **Blue Display**) showed severe color impurities, then perform the following to restore the color purity:

- Ensure that the oscilloscope environment is free of all external magnetic fields. For example, a magnetic screwdriver in the near proximity of the oscilloscope could cause color impurities on the screen.
- Set the ON/STANDBY switch to STANDBY.
- Set the ON/STANDBY switch to ON.
- *Examine* the color displays again, and verify that the color impurities are removed.

Note: *When the oscilloscope is moved in the earth's magnetic field, color impurities will appear on the display. This is normal. To remove the impurity, repeat step 38.*

☐ Step 39: Set the ON/STANDBY switch to STANDBY.

☐ Step 40: Replace the CRT Socket board cover and the CRT cover.

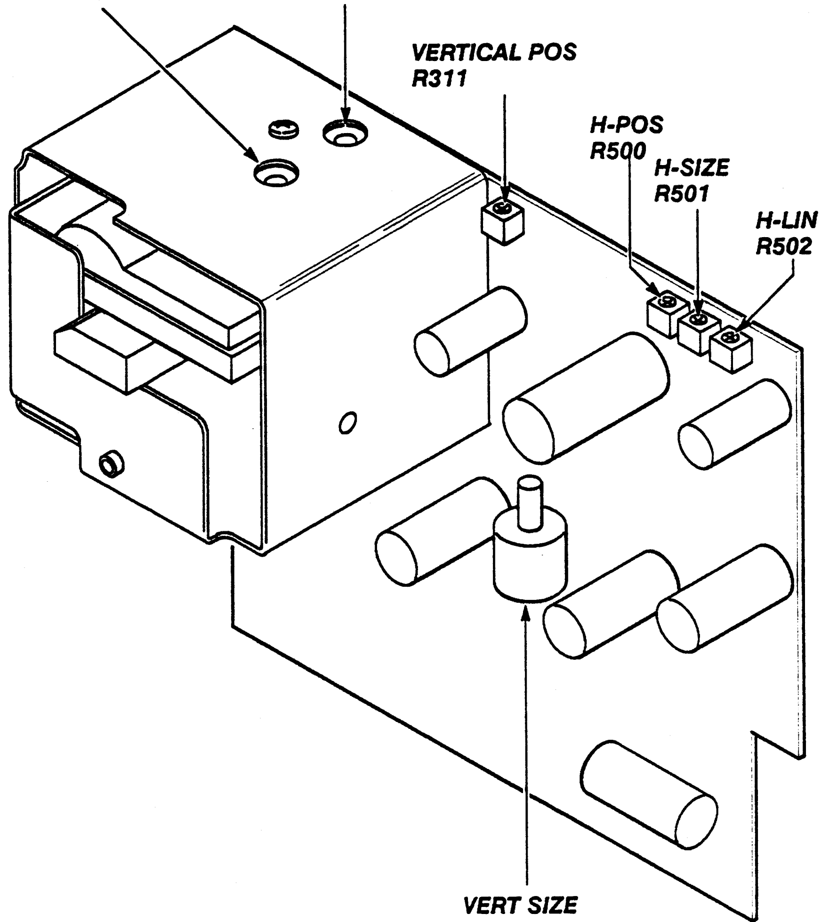


Figure 2-4 — *A8 CRT Driver Board Adjustment Locations*

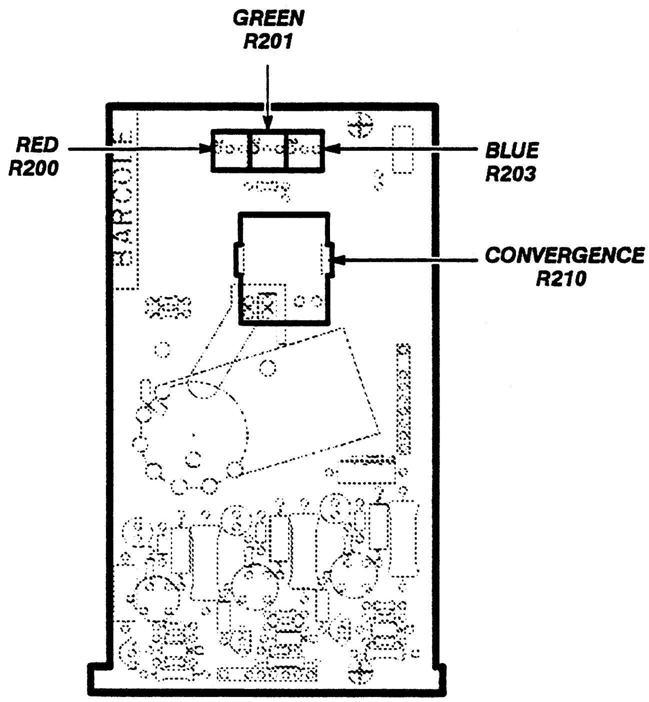


Figure 2-5 — *A7 CRT Socket Board Adjustment Locations*

Part 5 Enhanced Accuracy

When displayed, the Enhanced Accuracy symbol (**EA**) indicates that the oscilloscope is at its highest accuracy state. The oscilloscope saves the time of calibration and ambient temperature for use in maintaining the Enhanced Accuracy state.

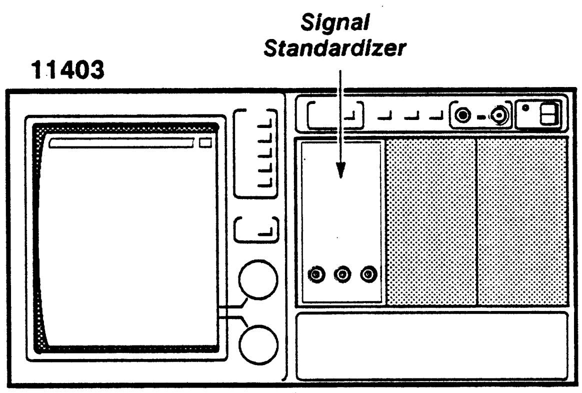
For more information about the Enhanced Accuracy state, refer to the *11403 Digitizing Oscilloscope User Reference* manual.

To verify the DC measurement accuracy of the oscilloscope while in the Enhanced Accuracy state, apply and monitor test voltages, and then compare these test voltages with the measurements performed on the screen.

Specification

When invoked, Enhanced Accuracy must pass.

Setup to Check the Enhanced Accuracy State



Setup to Check the Enhanced Accuracy State

Procedure to Check the Enhanced Accuracy State

☐ Step 1: Perform the following settings in the order listed:

11403 Oscilloscope .... no settings required
Signal standardizer .... not used in this part

☐ Step 2: Twenty minutes after power-on, the oscilloscope can attempt to achieve the Enhanced Accuracy state. Press the ENHANCED ACCURACY button. The prompt **Press ENHANCED ACCURACY again to confirm request** will appear at the top of the display.

☐ Step 3: Press the ENHANCED ACCURACY button again. Attaining the Enhanced Accuracy state requires a couple of minutes.

CAUTION

Turning the oscilloscope power off during this process may result in some loss of the nonvolatile RAM data. This could cause diagnostic errors at the next power-on and affect normal oscilloscope operation in unpredictable ways.

☐ Step 4: *Check* for the following messages:

- **Enhanced Accuracy in Progress Please Leave Instrument on Until Complete** indicating that the oscilloscope is attempting to attain the Enhanced Accuracy state.
- **Enhanced Accuracy completed and passed** indicating that the Enhanced Accuracy state has been attained. The **EA** indicator also appears on the display when the Enhanced Accuracy state is achieved.

Part 6 Calibration Output Accuracy

This part shows the setup and lists the procedure to check the probe calibration output voltage, and to examine the attenuator ratios and calibrator (DAC) linearity (see Fig. 2-6).

Specification

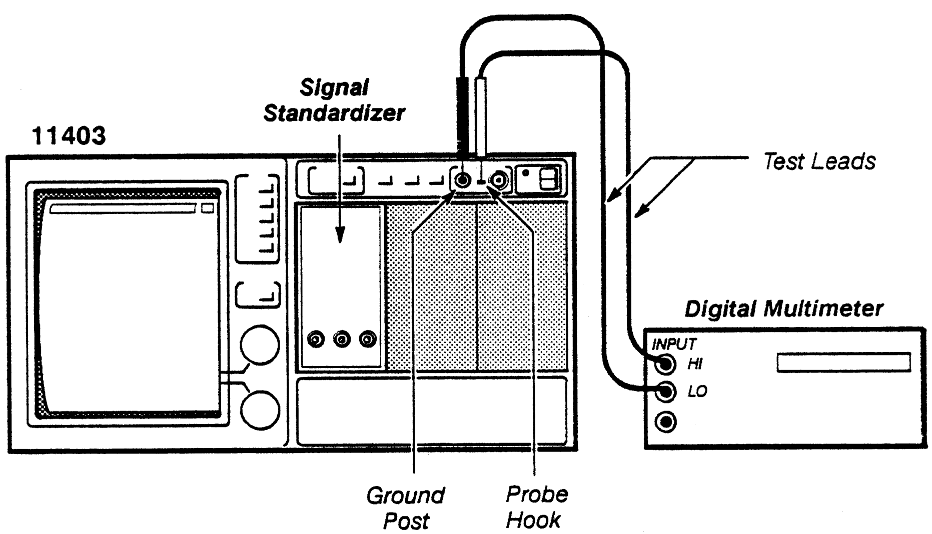
Probe calibration output voltage accuracy ±0.06% (or ±6 mV).

Measurement Limits

The measurement limits for this part are as follows:

- Attenuator Ratios ±0.04%.
- Calibrator Digital-to-Analog Converter (DAC) Linearity of ±0.75 LSB.

Setup to Check/Adjust the Probe Calibration Output Voltage Accuracy



Setup to Check/Adjust the Probe Calibration Output Accuracy

Procedure to Check/Adjust the Probe Calibration Output Voltage Accuracy

☐ Step 1: **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

11403 Oscilloscope
- UTILITY button .... press
  - **Page to Utility 2 Menu** .... touch
  - **Extended Diagnostic** .... touch
  - **Verify Selection** pop-up menu .... **Extended Diagnostic**
    - **Subsys** pop-up menu .... **Digitizer**
    - **Block** pop-up menu .... **Points Acq**
    - **Area** pop-up menu .... **FP Cal Refs**

Routine pop-up menu .... **FP -10.0000 V**
.... **Run**

Digital multimeter
Set to measure .... 10.0000 V DC
Signal standardizer .... not used in this part

☐ Step 2: *Check* that the Digital multimeter reads within the limits of -10.0060 V and -9.9940 V.

STOP

DO NOT attempt to optimize the following adjustment setting if the digital multimeter reading is within the stated limits or if you are performing a functional test. Proceed to Step 4.

To gain access to the A5 Acquisition board adjustment locations, remove the nine Torx head screws on the A5 Acquisition board. Then, pivot and lock the A5 Acquisition board in the extended position. Refer to FRU Board Assembly Removal, A5 Acquisition Board, in Section 3 of this manual, for the location of these Torx head screws.

☐ Step 3: *Adjust* the OFFSET adjustment R1576 on the A5 Acquisition board for -10.000 V, within the limits of -9.998 V and -10.002 V.

☐ Step 4: Touch **Exit.**

☐ Step 5: Touch **FP +9.9951 V** in the **Routine** pop-up menu and then **Run** at the bottom of the screen.

☐ Step 6: *Check* the digital multimeter for +9.9951 V, within the limits of +9.9891 V and +10.0011 V.

STOP

DO NOT attempt to optimize the following adjustment setting if the digital multimeter reading is within the stated limits or if you are performing a functional test. Proceed to Step 8.

☐ Step 7: *Adjust* the GAIN adjustment R1582 on the A5 Acquisition board for +9.9951 V, within the limits of +9.9931 V and +9.9971 V.

☐ Step 8: Touch **Exit.**

☐ Step 9: Touch **Exit** twice to clear the EXTENDED DIAGNOSTICS menu.

☐ Step 10: If any adjustments were performed, perform the ENHANCED ACCURACY procedure (refer to Part 5, Enhanced Accuracy).

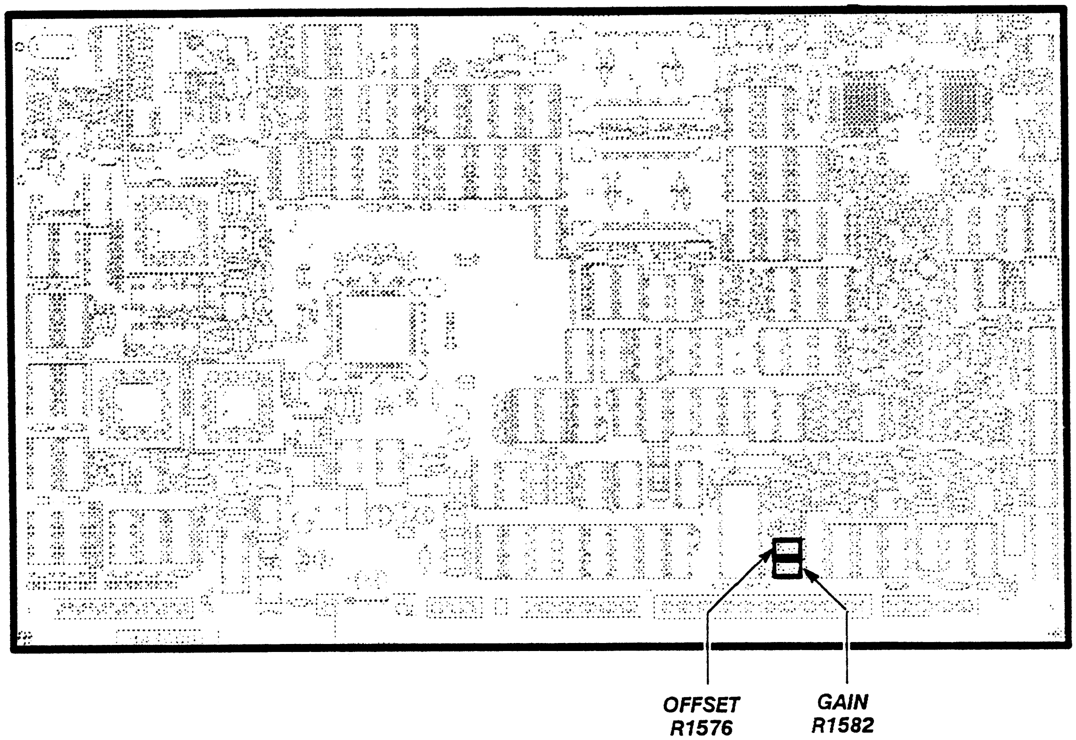
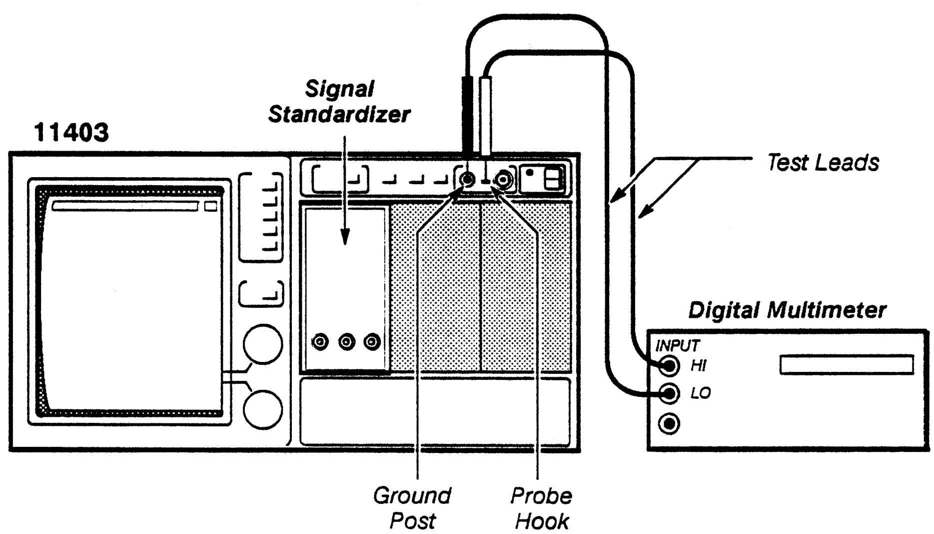


Figure 2-6 — *A5 Acquisition Board Adjustment Locations*

Setup to Examine the Attenuator Ratios and Calibrator DAC Linearity



Setup to Examine the Attenuator Ratios and Calibrator DAC Linearity

Procedure to Examine the Attenuator Ratios and Calibrator DAC Linearity

☐ Step 1: **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

11403 Oscilloscope
- UTILITY button .... press
  - **Page to Utility 2 Menu** .... touch
  - **Extended Diagnostic** .... touch
  - **Verify Selection** pop-up menu .... **Extended Diagnostic**
    - **Subsys** pop-up menu .... **Digitizer**
    - **Block** pop-up menu .... **Points Acq**
    - **Area** pop-up menu .... **FP Cal Refs**
    - **Routine** pop-up menu .... **FP -10.0000 V**
    - .... **Run**

Digital multimeter
- Mode .... DC Voltage

Signal standardizer .... not used in this part

☐ Step 2: Record the negative voltage reading from the digital multimeter as V_2 for later use.

☐ Step 3: Touch **Exit.**

☐ Step 4: Touch **FP +9.9951 V** in the **Routine** pop-up menu.

☐ Step 5: Touch **Run** at the bottom of the screen, and then record the voltage reading from the digital multimeter as V_5 for later use.

- [ ] Step 6: Add the absolute value of the voltage recorded in Step 2 (V_2) to the absolute value recorded in Step 5 (V_5). Record this voltage as V_6 for later use.
- [ ] Step 7: Touch **Exit.**
- [ ] Step 8: Touch **FP −5.0000 V** (when performing successive tests, refer to Table 2-3 for the correct selector for repetitions 2, 3, and 4) in the **Routine** pop-up menu.
- [ ] Step 9: Touch **Run** at the bottom of the screen.

Note: *If your digital multimeter does not have an offset feature, then record the absolute value of the measured voltages in steps 9 and 13. Then, add these values and multiply the result by 2 (when performing successive tests, refer to the Step 14 Multiplier in Table 2-3 for the correct multiplier for repititions 2, 3, and 4). Record this value as V_{14} for later use.*

- [ ] Step 10: Push the offset button on the digital multimeter.
- [ ] Step 11: Touch **Exit.**
- [ ] Step 12: Touch **FP +4.9976 V** (when performing successive tests, refer to Table 2-3 for the correct selector for repetitions 2, 3, and 4) in the **Routine** pop-up menu.
- [ ] Step 13: Touch **Run** at the bottom of the screen.
- [ ] Step 14: Record the voltage reading on the digital multimeter, and then multiply this reading by 2 (when performing successive tests, refer to the Step 14 Multiplier in Table 2-3 for the correct multiplier for repetitions 2, 3, and 4). Record this voltage as V_{14} for later use.
- [ ] Step 15: *Examine* that the difference between the voltages recorded in Step 6 (V_6) and Step 14 (V_{14}) is $\leq\pm0.008$ V ($\pm0.04\%$).
- [ ] Step 16: Push the offset button on the digital multimeter so that the offset is turned off.
- [ ] Step 17: Repeat Steps 7 through 16 three times (repetitions 2, 3, and 4 in Table 2-3, respectively) using the selectors and multipliers supplied in Table 2-3 for Steps 8, 12, and 14.

Table 2-3 *— Voltages for Examining Attenuator Ratios*

Repetition	Step 8 Selector	Step 12 Selector	Step 14 Multiplier	Recorded Voltages (V_{14})
2	FP −2.5000 V	FP +2.4988 V	multiply by 4	________
3	FP −1.000 V	FP +999.51 mV	multiply by 10	________
4	FP −100.00 mV	FP +99.951 mV	multiply by 100	________

☐ Step 18: Touch **Exit.**

☐ Step 19: Touch **FP 0.0000 V** in the **Routine** pop-up menu.

☐ Step 20: Touch **Run** at the bottom of the screen.

☐ Step 21: Record the voltage reading on the digital multimeter as V_{21}.

☐ Step 22: *Examine* that

$$\left(\left(\frac{V_2 + V_5 + 4.9mV}{2}\right) - V_{21}\right)$$

is within the limits of ±3.7 mV (±0.75 LSBs).

☐ Step 23: Touch **Exit** once to leave the routine, and then touch **Exit** twice to leave the **EXTENDED DIAGNOSTIC** menu structure.

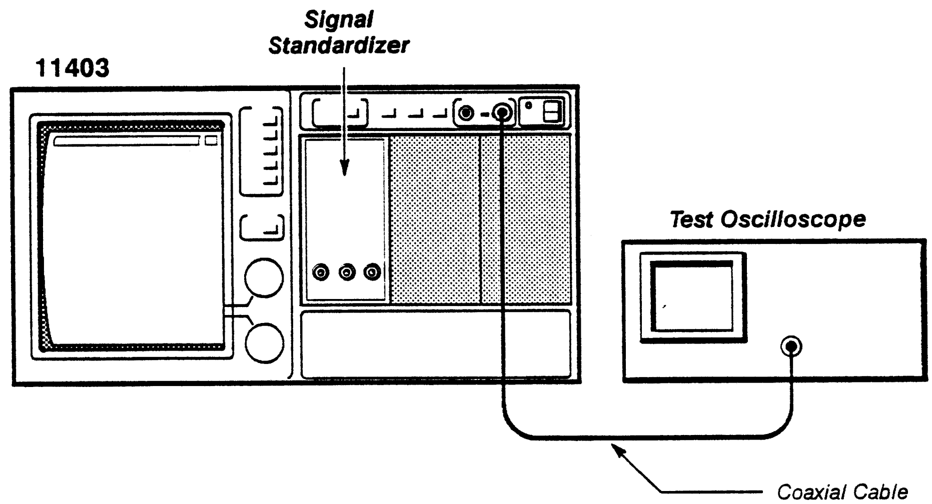
Part 7 Probe Compensation Voltage

This part shows the setup and lists the procedure to examine the probe compensation voltage.

Measurement Limit

Probe compensation output voltage is 6.0 V, ± 0.18 V (±3%) into a 1 MΩ load

Setup to Examine the Probe Compensation Voltage



Setup to Examine the Probe Compensation Voltage

Procedure to Examine the Probe Compensation Voltage

☐ Step 1: First **Initialize** the oscilloscope settings, then perform the following in the order listed:

11403 Oscilloscope
- UTILITY button .... press
  - **Page to Utility 2 Menu** .... touch
  - **Extended Diagnostics** .... touch
  - **Verify Selection** pop-up menu .... **Extended Diagnostic**
    - **Subsys** pop-up menu .... **Digitizer**
    - **Block** pop-up menu .... **Points Acq**
    - **Area** pop-up menu .... **FP Cal Refs**
    - **Routine** pop-up menu .... **FP 1 kHz**
    - .... **Run**

Test oscilloscope .... Set controls to measure a 6 V p-p square wave signal

Signal standardizer .... not used in this part

☐ Step 2: *Examine* the test oscilloscope display for a 6 V peak-to-peak square wave, within the limits of 5.820 V and 6.180 V.

Part 8 Acquisition

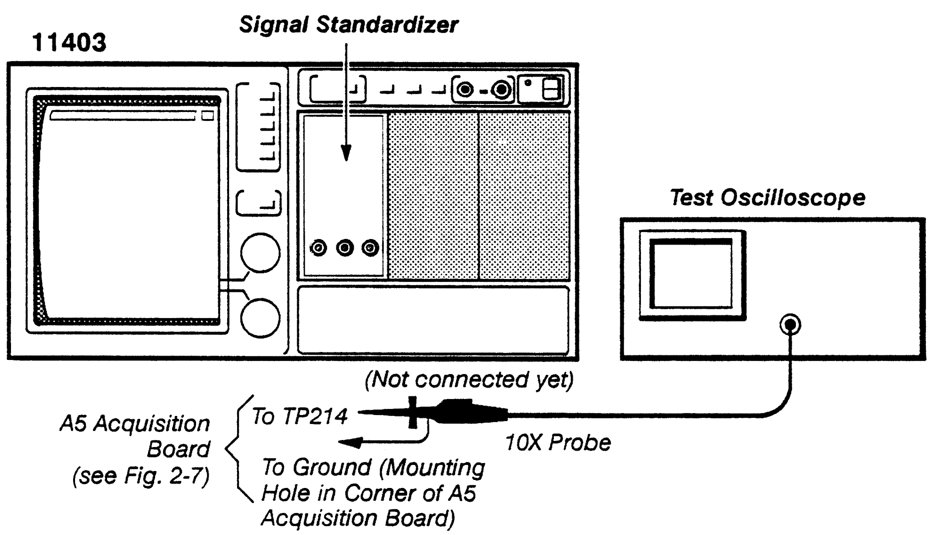
This part shows the setup and lists the procedure to examine/adjust the 10 MHz peak-to-peak signal amplitude, the phase lock loop voltage, the differential amplifier voltage, and the difference amplifier step response (see Figs. 2-7, 2-8, and 2-9).

Measurement Limits

The measurement limits for this part are as follows:

- 10 MHz signal amplitude ≥1.0 V p-p
- Phase lock loop +6.0 V, ±1.0 V
- Differential amplifier V +10.500 V, ±10 mV

Setup to Examine/Adjust the 10 MHz Signal Amplitude



Setup to Examine/Adjust the 10 MHz Signal Amplitude

Procedure to Examine/Adjust the 10 MHz Signal Amplitude

☐ Step 1: Perform the following settings in the order listed:

11403 Oscilloscope:

a. Set the ON/STANDBY switch to STANDBY.

b. Set the oscilloscope on its right side.

c. Remove the nine Torx head screws on the A5 Acquisition board (located on the bottom of the oscilloscope).

d. Pivot and lock the A5 Acquisition board in the extended position.

e. Connect the 10X probe to the test points indicated in the setup illustration.

f. Set the ON/STANDBY switch to ON.

Test oscilloscope
- Vertical Sensitivity (at probe tip) .... 500 mV/division
- Horizontal time/div .... 50 ns/division
- Triggering .... Internal

Signal standardizer .... not used in this part

☐ Step 2: *Examine* that the amplitude of the waveform on the test oscilloscope is at least 1 V peak-to-peak.

STOP *DO NOT attempt to optimize the following adjustment setting, if the signal amplitude is within the stated limits. Proceed to Step 4.*

☐ Step 3: *Adjust* the 10 MHz adjustment, C217, for maximum signal amplitude (0.8 V peak-to-peak minimum acceptable amplitude for this adjustment). Rotate the adjustment slowly to allow the circuit to settle to its final value.

☐ Step 4: Remove the 10X probe.

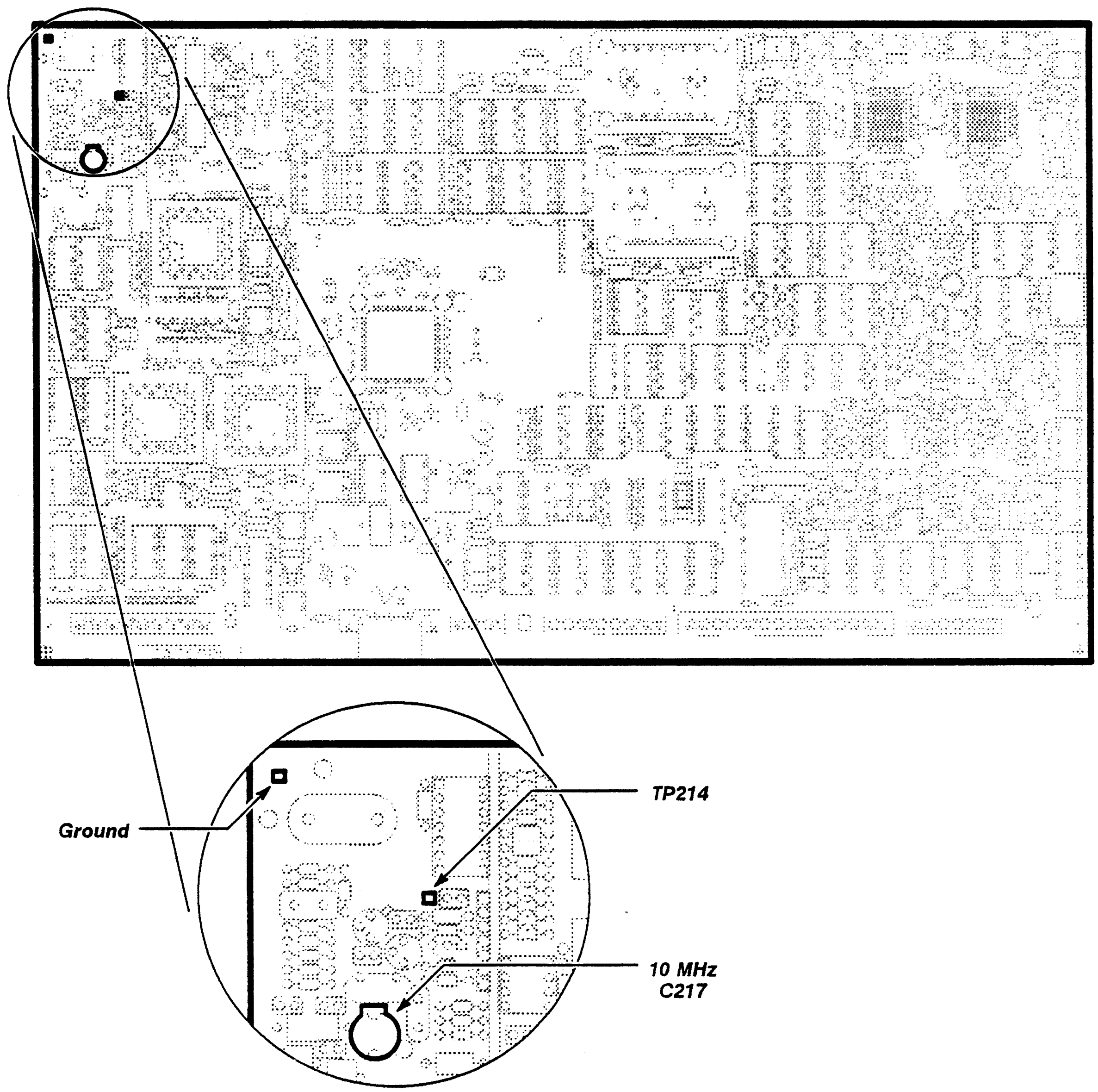
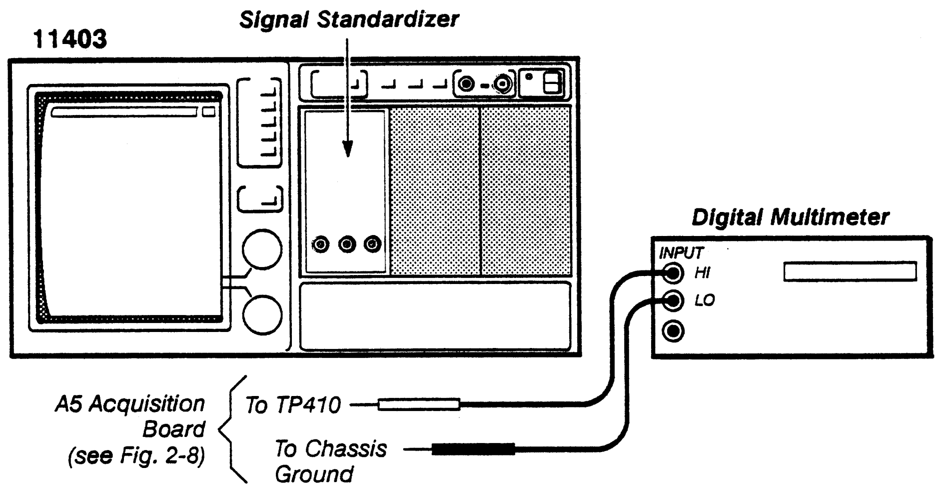


Figure 2-7 — *A5 Acquisition board (10 MHz) Test Point and Adjustment Locations*

Setup to Examine/Adjust the Phase Lock Loop



Setup to Examine/Adjust the Phase Lock Loop

Procedure to Examine/Adjust the Phase Lock Loop

☐ Step 1: Perform the following settings in the order listed:

11403 Oscilloscope .... no setting changes required
Digital multimeter
  Mode .... DC Voltage
Signal standardizer .... not used in this part

☐ Step 2: *Examine* that the digital multimeter (DMM) reads within the limits of +7.0 V and +5.0 V.

STOP

DO NOT attempt to optimize the following adjustment setting, if the reading is within the stated limits. Proceed to Step 4.

☐ Step 3: *Adjust* the VCO adjustment, C500, for +6.0 V, ±0.3 V .

☐ Step 4: Remove the DMM leads.

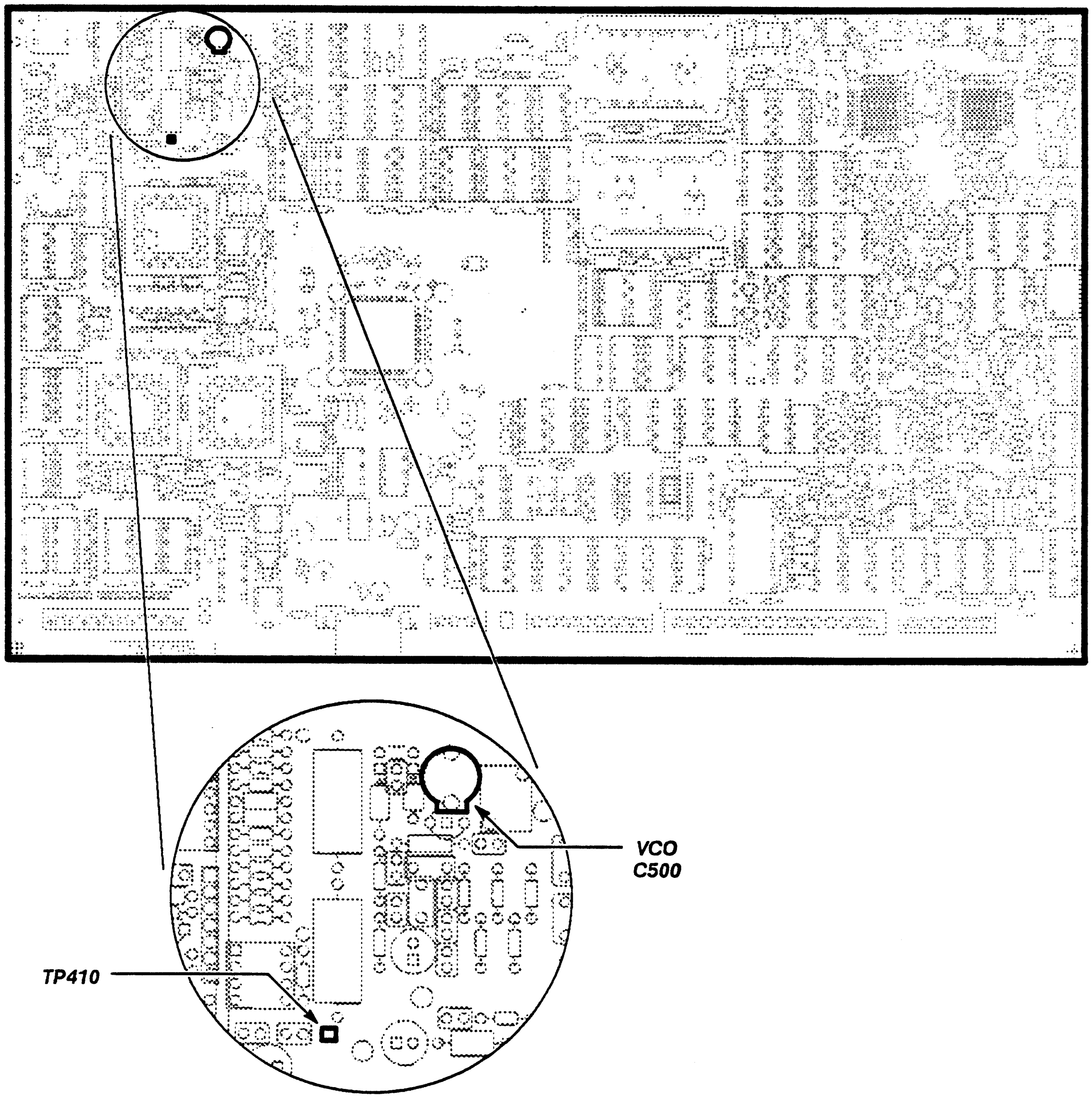
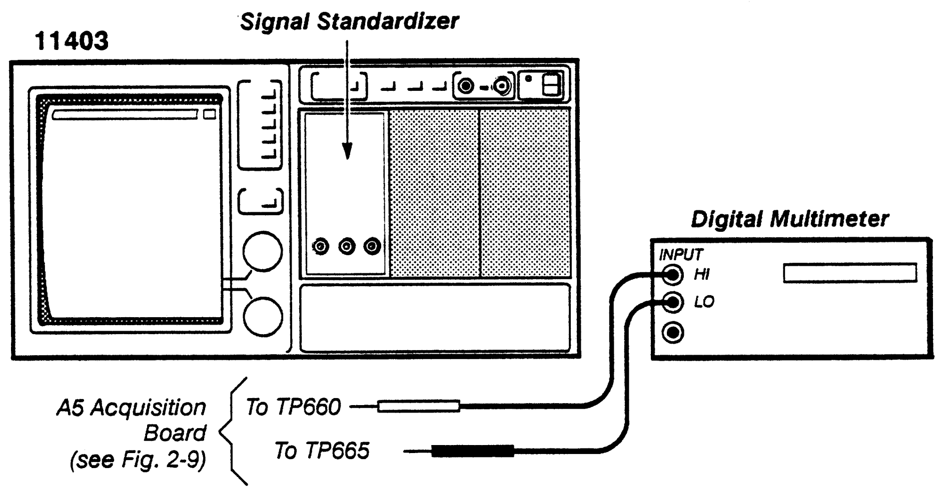


Figure 2-8 — A5 Acquisition board (VCO) Test Point and Adjustment Locations

Setup to Examine/Adjust the Differential Amplifier V+



Setup to Examine/Adjust the Differential Amplifier V+

Procedure to Examine/Adjust the Differential Amplifier V+

☐ Step 1: Perform the following settings in the order listed:

11403 Oscilloscope .... no setting changes required
Digital multimeter
Mode .... DC Voltage
Signal standardizer .... not used in this part

☐ Step 2: *Examine* that the digital multimeter (DMM) reads within the limits of 10.510 V and 10.490 V.

STOP *DO NOT attempt to optimize the following adjustment setting,if the reading is within the stated limits. Proceed to Step 4.*

☐ Step 3: *Adjust* the Diff Amp V+ adjustment, R666, for 10.500 V.

☐ Step 4: Remove the DMM leads.

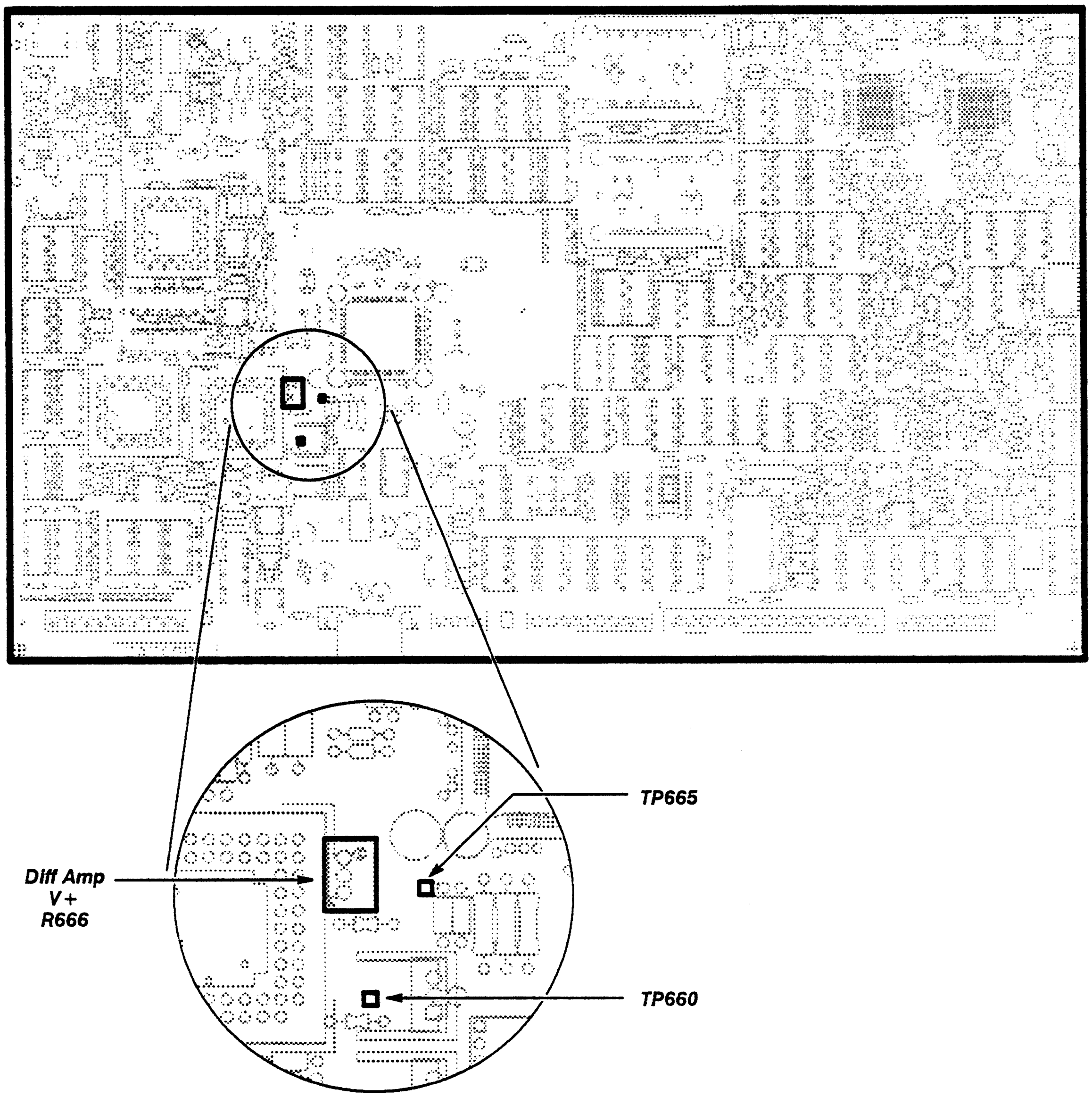


Figure 2-9 — *A5 Acquisition board (Diff Amp V+) Test Point and Adjustment Locations*

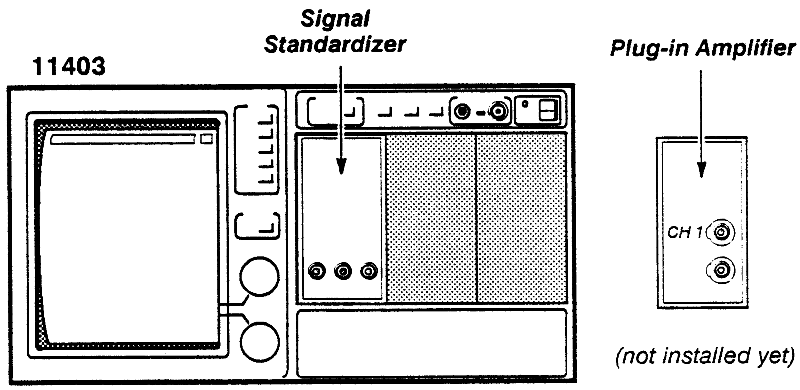
Part 9 Vertical Input Offset

This part shows the setup and lists the procedure to examine the vertical input offset.

Measurement Limit

Vertical input offset must be within ±0.2 division.

Setup to Examine the Vertical Input Offset



Setup to Examine the Vertical Input Offset

Procedure to Examine the Vertical Input Offset

☐ Step 1: First **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

11403 Oscilloscope

Def Wfm	touch
L	touch
Enter Desc	touch
MEASURE button	press
Measurements	**Mean**
Mean	touch
Data Interval	**Whole Zone**

Signal standardizer

Vert or Horiz	Com Mode

Plug-in amplifier	not used in this part unless setting the vertical input offset

☐ Step 2: *Examine* that the **Mean** readout on the screen is within ±200 mU (±0.2 divisions).

☐ Step 3: Repeat Steps 1 and 2 for the Center and Right plug-in compartments. Do not move the signal standardizer to examine the Center and Right compartments. When performing the settings, simply substitute **C** or **R** for **L** in the **Vertical Description** pop-up menu (after you touch **Def Wfm**).

If the Checks for Left, Center, and Right plug-in compartments are within the stated limits, proceed to Part 10a, Sampler and Digitizer.

Procedure to Set Vertical Input Offset

- [ ] Step 4: Set the ON/STANDBY switch to STANDBY.
- [ ] Step 5: Install a plug-in amplifier in the left compartment.
- [ ] Step 6: Set the ON/STANDBY switch to ON. Ignore any plug-in unit diagnostic errors that may be displayed on the screen.
- [ ] Step 7: Notice that the messages **Enhanced Accuracy in Progress, Please Leave Instrument on Until Complete** and **New configuration - partial enhanced accuracy occurring** appear on the screen. Proceed to Step 8 when the message **Enhanced Accuracy completed and passed** appears on the screen (you do not have to wait 20 minutes).
- [ ] Step 8: Repeat Steps 4 through 7 for the Center and Right plug-in compartments. (Move the amplifier to the appropriate compartment to set the vertical input offset.)
- [ ] Step 9: Remove the amplifier, and repeat the setup and procedure to examine the vertical input offset.

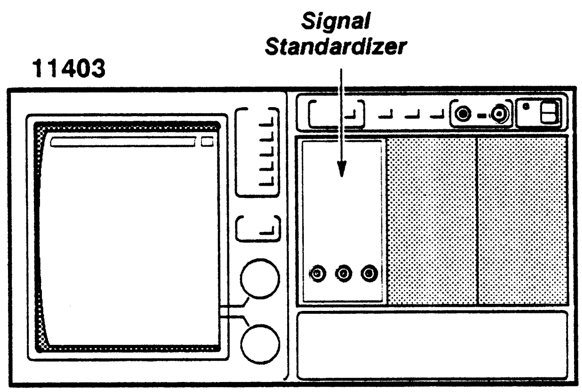
Part 10a Sampler and Digitizer Performance Verification Procedure

In this part, the gain is checked using the signal standardizer as a signal source. The delta voltage between the 1st and 9th steps is measured with the cursors function (see Fig. 2-10).

Measurement Limit

Vertical input sensitivity accuracy must be within 1% when checked with a signal standardizer referenced to 8 divisions.

Setup to Examine the Sampler Gain



Setup to Examine the Sampler Gain

Procedure to Examine the Sampler Gain

☐ Step 1: First **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

11403 Oscilloscope

- **Def Wfm** .... touch
  - **L** .... touch
  - **Enter Desc** .... touch
- **Main Size** .... 2 ms/div
  - **Acquire Desc** .... touch
    - **Average N** .... **On**
- TRIGGER button .... press
  - **Time Holdoff** .... 15.5 ms (set knob resolution to Medium for final setting)

Signal standardizer

- Test .... Vert or Horiz Gain
- Rate .... 1 kHz

The oscilloscope must be in the Enhanced Accuracy state to perform this part. If the **EA** symbol is not visible on the left side of the display, then press the ENHANCED ACCURACY button twice and check that the message, **Enhanced**

Accuracy In Progress, Please Leave Instrument on Until Complete appears on the screen. When the message **Enhanced Accuracy completed and passed** appears, proceed to Step 2.

☐ Step 2: Set the signal standardizer Position control to center the waveform on the screen.

☐ Step 3: Touch the **Cursors** icon and position **Cursor 1** to the center of the first step and **Cursor 2** to the center of the last step (see Fig. 2-10).

☐ Step 4: *Examine* that the ΔV readout is within the limits of 7.920 U and 8.080 U.

☐ Step 5: Repeat this part for the Center and Right plug-in compartment and record the results. The trigger source must be selected for each plug-in compartment (that is, select **C** or **R** in the **Main Trigger Source Description** pop-up menu).

STOP

If any of the ΔV values are outside the limits stated in Step 4, then repeat the Enhanced Accuracy procedure (refer to Part 5) and then repeat Steps 2, 3, and 4 in this part. If the ΔV readout is within the stated limits, proceed to Part 11, Analog-to-Digital Converter Linearity.

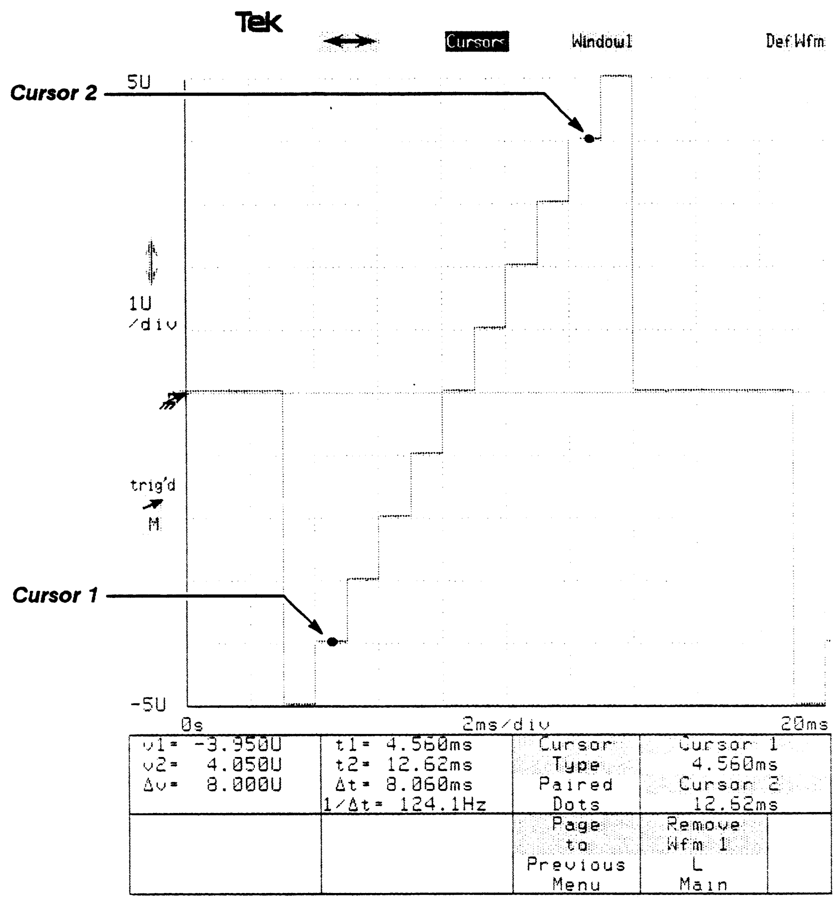


Figure 2-10 — Cursor Placement on the Staircase Waveform

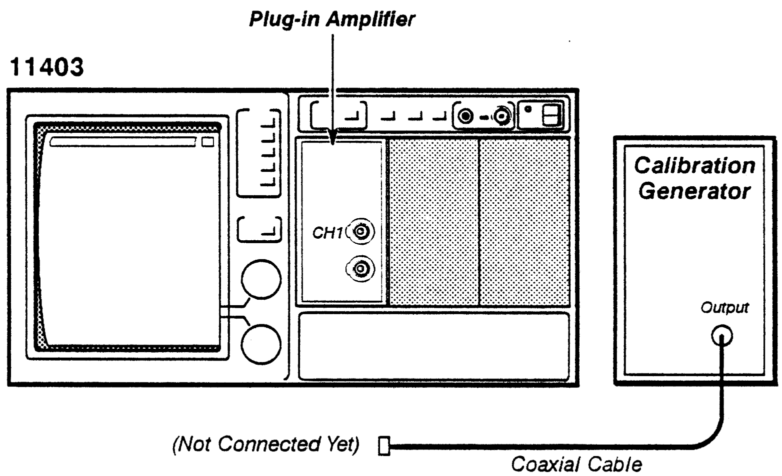
Part 10b Sampler and Digitizer Functional Test Procedure

This part shows the setup and lists the procedure to functionally test the vertical accuracy. You should only perform this part if you are performing a functional test. Otherwise, perform Part 10a, Sampler and Digitizer Performance Verification Procedure, and then proceed to Part 11, Analog-to-Digital Converter (ADC) Linearity.

Measurement Limits

Refer to Table 2-4, Vertical Accuracy Error Limits for the appropriate measurement limits in this part.

Setup to Examine the Vertical Accuracy



Setup to Examine the Vertical Accuracy

Procedure to Examine the Vertical Accuracy

☐ Step 1: **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

Plug-in amplifier
- CH 1 display on/off .... On

11403 Oscilloscope
- **Acquire Desc** .... **Average N** to **On**
- MEASURE button .... press
- **Measurements** pop-up menu .... **Mid, Peak-Peak**

Calibration generator
- Mode .... Std Ampl
- Amplitude .... 5 V

☐ Step 2: *Examine* that the **Mid** measurement is equal to or less than the value listed in the DC Balance column of Table 2-4.

☐ Step 3: Connect the 5 V signal from the calibration generator to the CH 1 input connector.

Note: *If the plug-in amplifier has only a 50 Ω input impedance you must increase the calibration generator Amplitude to 10 V.*

☐ Step 4: Set the **Vert Offset:L1** to positive 2.5 V to center the waveform.

☐ Step 5: Touch the horizontal icon, and set the **Main Size** to 100 μs/div.

☐ Step 6: *Check* that the **Peak-Peak** measurement is 5 V, plus or minus the value listed in the ΔV DC Accuracy column of Table 2-4.

***Table 2-4** — Vertical Accuracy Error Limits*

Plug-in	ΔV DC Accuracy	DC Balance
11A32	57 mV	200 mV
11A33	55 mV	150 mV
11A34	57 mV	200 mV
11A52	50 mV	120 mV
11A71	65 mV	200 mV
11A72	60 mV	200 mV

Repeat this part for the Center and Right plug-in compartments.

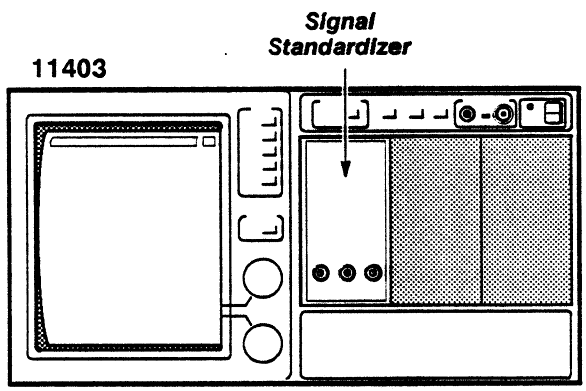
Part 11 Analog-to-Digital Converter (ADC) Linearity

In this part, ADC linearity is checked using a two division signal that is placed at three positions on the screen.

Specification

ADC linearity – Compression or expansion of a center screen two-division signal positioned anywhere vertically within the graticule is ≤2 LSBs. (2 LSBs of 200 LSBs = 1%).

Setup to Check the ADC Linearity



Setup to Check the ADC Linearity

Procedure to Check the ADC Linearity

☐ Step 1: **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

11403 Oscilloscope

- **Def Wfm** .... touch
  - **Avg(** .... touch
  - **L** .... touch
  - **)** .... touch
  - **Enter Desc** .... touch
- **Main Size** .... 200 µs/div
- MEASURE button .... press
  - **Measurements** .... **Peak-Peak**
- Signal standardizer
  - Test .... + Step Response
  - Rep Rate .... 1 kHz

☐ Step 2: Set the signal standardizer Position knob so that the top of the square wave is one division above the horizontal centerline.

☐ Step 3: Set the signal standardizer Amplitude so that the **Peak-Peak** reading is between 1.950 U and 2.050 U. Record this value as V_3 for later use.

Note: *Turn the **Main Pos** knob one click to restart the waveform averaging process. This accelerates the averaging process that occurs after you change the waveform amplitude or position.*

☐ Step 4: Set the signal standardizer Position knob so that the top of the square wave is four divisions above the horizontal centerline.

☐ Step 5: Wait ten seconds for the **Peak-Peak** reading to settle, then record the **Peak-Peak** reading as V_5.

☐ Step 6: Set the signal standardizer Position knob so that the top of the square wave is two divisions below the horizontal centerline.

☐ Step 7: Wait ten seconds for the **Peak-Peak** reading to settle, then record the **Peak-Peak** reading as V_7.

☐ Step 8: Check the following:

$V_5 - V_3$ is within ±0.020U (±1% of 2 divisions)
$V_7 - V_3$ is within ±0.020U (±1% of 2 divisions)

Repeat this part with the signal standardizer placed in the Center and Right plug-in compartments. You will need to define the corresponding waveform and trigger source for both the Center and Right plug-in compartments (that is, select **Avg(C)** or **Avg(R)** in the Vertical Description pop-up menu (after you touch **DefWfm**), and then select **C** or **R** in the **Main Trigger Source Description** pop-up menu).

Part 12 Equivalent Time Step Response

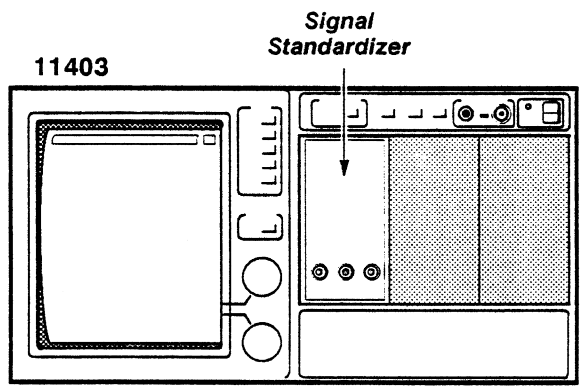
In this part, rise time and aberrations are examined using a signal standardizer. The **Rise** and **Peak-Peak** measurement functions of the oscilloscope provide the specific value readout.

Measurement Limits

The measurement limits for this part are as follows:

- rise time must be ≤300 ps (this limit includes the rise time of the signal standardizer)
- aberrations must be ≤5% peak-to-peak within the first 20 ns after the step, and ≤1% after the first 20 ns from the step

Setup to Examine the Equivalent Time Step Response



Setup to Examine the Equivalent Time Step Response

Procedure to Examine the Equivalent Time Step Response

☐ Step 1: **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

11403 Oscilloscope

Def Wfm	touch
L	touch
Enter Desc	touch
Acquire Description	touch
Average N	**On**
Main Size	1 ns/div
Main Pos	0 ns
MEASURE button	press
Measurements	**Rise**
	Peak-Peak
	Over Shoot
	Under Shoot

Signal standardizer

Test Vert or Horiz .... +Step Response

Rep Rate .... 1 MHz

☐ Step 2: Set the signal standardizer Position and Amplitude controls for a 6-division step centered on the screen.

☐ Step 3: *Examine* that the **Rise** (rise time) readout is ≤300 ps.

☐ Step 4: Set the **Main Size** to 5 ns/div.

☐ Step 5: Set the **Main Pos** to position the 50% amplitude of the step one division from the left-most edge of the screen.

☐ Step 6: Touch **Over Shoot** in the MEASURE major menu and then **Left Limit** in the **Over Shoot** pop-up menu.

☐ Step 7: Set the **Left Limit** readout to 0% and the **Right Limit** readout to 50%.

☐ Step 8: *Examine* that the **Over Shoot** and **Under Shoot** readings are ≤5.0%.

☐ Step 9: Set the Rep Rate on the signal standardizer to 100 kHz.

☐ Step 10: Set the **Main Size** to 50 ns/division.

☐ Step 11: Set the **Main Pos** control to position the step one division from the left side of the screen.

☐ Step 12: Touch **Peak-Peak** in the MEASURE major menu and then **Left Limit** in the **Peak-Peak** pop-up menu.

☐ Step 13: Set the **Left Limit** readout to 14%.

☐ Step 14: Set the **Right Limit** readout to 100%.

☐ Step 15: *Examine* that the **Peak-Peak** reading is ≤60 mU (1% of the step amplitude).

☐ Step 16: Repeat this part for the Center and Right plug-in compartments. The trigger source must be set for the appropriate plug-in compartment (that is, select **C** or **R** in the **Main Trigger Source Description** pop-up menu).

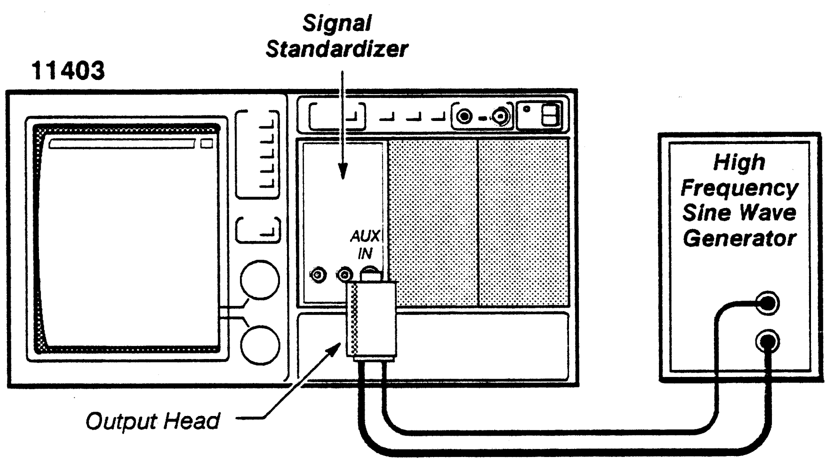
Part 13a Bandwidth Performance Verification Procedure

A reference signal with a frequency of 6 MHz is set to an amplitude of six divisions. The frequency is increased to 1 GHz, and then the displayed amplitude is examined for at least 4.94 div.

Measurement Limit

The relative amplitude at 1 GHz must be ≥82.3% of the reference amplitude.

Setup to Examine the Bandwidth



Setup to Examine the Bandwidth

Procedure to Examine the Bandwidth

☐ Step 1: **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

11403 Oscilloscope
- **Def Wfm** .... touch
  - **L** .... touch
  - **Enter Desc** .... touch
- MEASURE button .... press
  - **Measurements** .... **Peak-Peak**

Signal standardizer
- Test .... Vert or Horiz Freq Resp

High frequency sine wave generator
- Frequency .... 6 MHz (Ref)
- Amplitude .... Set to turn on the signal standardizer CW Leveled light

☐ Step 2: Use the signal standardizer Amplitude and Position control to obtain a centered display and a **Peak-Peak** reading of 6 U.

☐ Step 3: Set the high frequency sine wave generator to 1 GHz.

☐ Step 4: Verify that the signal standardizer's CW Leveled light is still on. If the light is not on, then increase the high frequency sine wave generator's amplitude until the light illuminates.

☐ Step 5: *Examine* that the **Peak-Peak** voltage readout on the screen is ≥4.94 division (82.3% of the reference amplitude).

☐ Step 6: Repeat this part for the Center and Right plug-in compartments. You must move the signal standardizer to the Center or Left plug-in compartment and also define the corresponding waveform (that is, substitute **C** or **R** for **L** in the **Horizontal Description** pop-up menu after you touch **Def Wfm**).

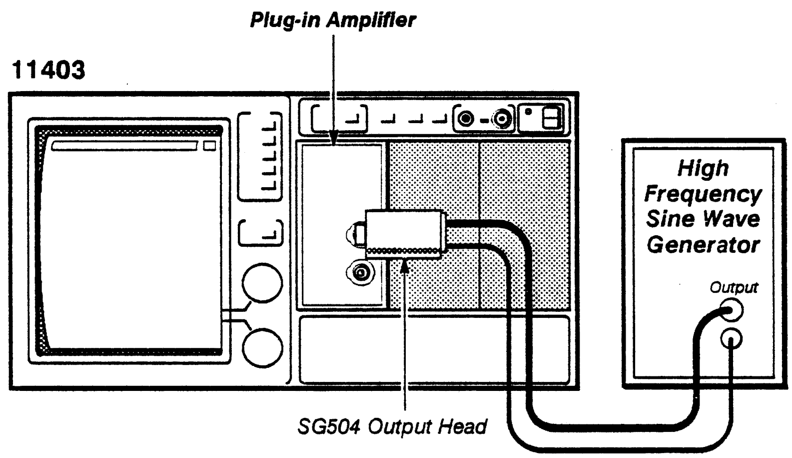
Part 13b Bandwidth Functional Test Procedure

This part shows the setup and lists the procedure to functionally test the bandwidth of the oscilloscope. You should only perform this part if you are performing a functional test. Otherwise, perform Part 13a, Bandwidth Performance Verification Procedure, and then proceed to Part 14, Analog-to-Digital Converter (ADC) RMS Noise.

Measurement Limit

The peak-to-peak amplitude of the sine wave, at the maximum bandwidth, must be ≥70.7% of the reference amplitude

Setup to Examine the Bandwidth



Setup to Examine Bandwidth

Procedure to Examine the Bandwidth

☐ Step 1: **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

Plug-in amplifier
- CH 1 display on/off . . . . On

High frequency sine wave generator
- Frequency . . . . Ref

11403 Oscilloscope
- **Impedance** . . . . **50 Ω**
- **Vert Size** . . . . 200 mV/div
- MEASURE button . . . . press
  - **Measurements** pop-up menu . . . . **Peak-Peak**

☐ Step 2: Set the high frequency sine wave generator output for a 1.2 V **Peak-Peak** measurement.

☐ Step 3: Set the high frequency sine wave generator for variable-frequency output and the Frequency control to the maximum bandwidth frequency specified for the system under test. The **BW Limit** selector (press the WAVEFORM button) shows this upper limit for the plug-in unit under test.

☐ Step 4: Touch the horizontal icon, and then set the **Main Size** to 1 ns/division.

☐ Step 5: *Check* that the **Peak-Peak** measurement readout is at least 848 mV (70.7% of the **Peak-Peak** measurement in Step 2 of this part).

Repeat this part for the Center and Right plug-in compartments.

Note: *In order to avoid a 20-minute warmup period, set the ON/STANDBY switch to STANDBY, move the amplifier to an adjacent compartment, and then set the ON/STANDBY switch to ON within 15 seconds. If the power is off longer than 15 seconds, the oscilloscope will cool, and another 20-minute warmup will be required. If this occurs, wait 20 minutes with the power on and then perform the Enhanced Accuracy procedure (refer to Part 5, Enhanced Accuracy).*

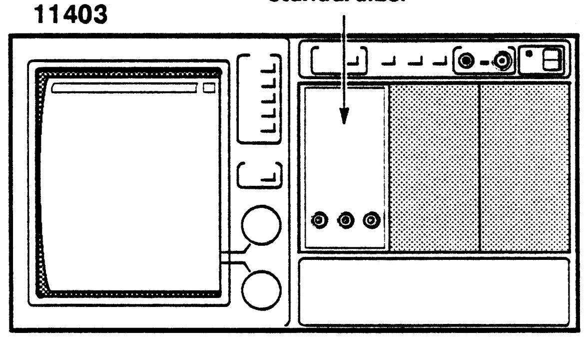
Part 14 Analog-to-Digital Converter (ADC) RMS Noise

In this part, the RMS measurement function measures the noise on the waveform from the plug-in compartment containing the signal standardizer.

Specification

ADC noise (relative to full scale) must be ≤60 dB.

Setup to Check the ADC RMS Noise



Setup to Check the ADC RMS Noise

Procedure to Check the ADC RMS Noise

☐ Step 1: **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

Signal standardizer
- Test .... Vert or Horiz Com Mode

11403 Oscilloscope
- **Def Wfm** .... touch
  - **L** .... touch
  - **-** .... touch
  - **Avg (** .... touch
  - **L** .... touch
  - **)** .... touch
  - **Enter Desc** .... touch
- MEASURE button .... press
  - **Measurements** .... **RMS**
    - **RMS** .... touch
    - **Data Interval** .... **whole zone**

☐ Step 2: *Check* that **RMS** readout on screen is ≤10 mU (60 dB of full scale).

☐ Step 3: Repeat this part for the Center and Right plug-in compartments. Do not move the signal standardizer to check the Center and Right compartments. When you are repeating the settings, substitute **C** or **R** for **L** in the **Vertical Description** pop-up menu (after you touch **Def Wfm**).

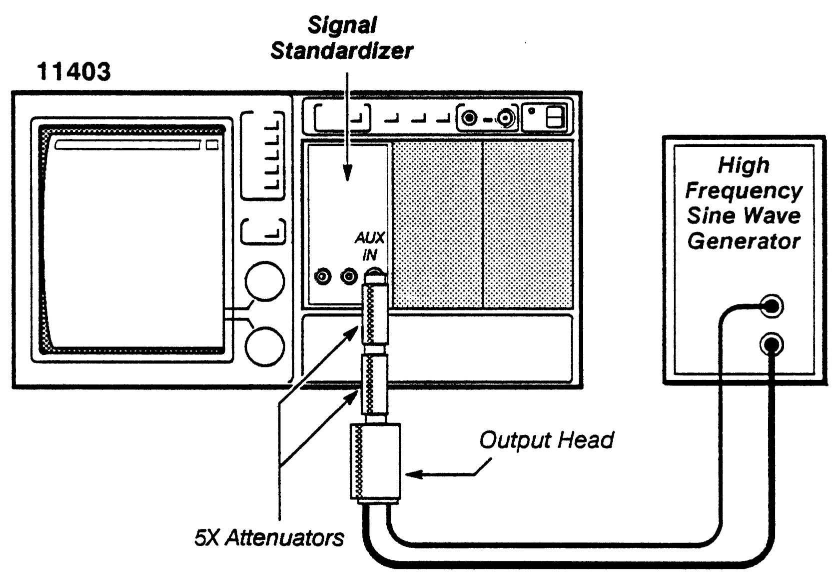
Part 15 Trigger Sensitivity at 1 GHz

In this part, trigger sensitivity is verified using the specified output frequency and amplitude of a high frequency sine wave generator applied to a signal standardizer, and checking for a screen-displayed trigger indicator.

Specification

Trigger Sensitivity — the display will trigger on a 0.5 division (0.5 U) signal from DC to 50 MHz, increasing to 1.5 division (1.5 U) at 1 GHz.

Setup to Check the Trigger Sensitivity at 1 GHz



Setup to Check the Trigger Sensitivity at 1 GHz

Procedure to Check the Trigger Sensitivity at 1 GHz

☐ Step 1: **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

11403 Oscilloscope
- **Def Wfm** . . . . touch
  - **L** . . . . touch
  - **Enter Desc** . . . . touch
- MEASURE button . . . . press
  - **Measurements** . . . . **Peak-Peak**

High frequency sine wave generator
- Frequency . . . . 1 GHz

Signal standardizer
- Test Vert or Horiz . . . . Freq Resp
- Amplitude . . . . fully clockwise

☐ Step 2: Set the high frequency sine wave generator output Amplitude control for a **Peak-Peak** readout of 1.5 U. (The CW Leveled light on the signal standardizer should be off.)

☐ Step 3: Set the signal standardizer Test to Trigger Freq Resp. Note that the signal will disappear at this time.

☐ Step 4: *Check* that the **not** display above the **trig'd** icon can be extinguished by rotating the signal standardizer Position control.

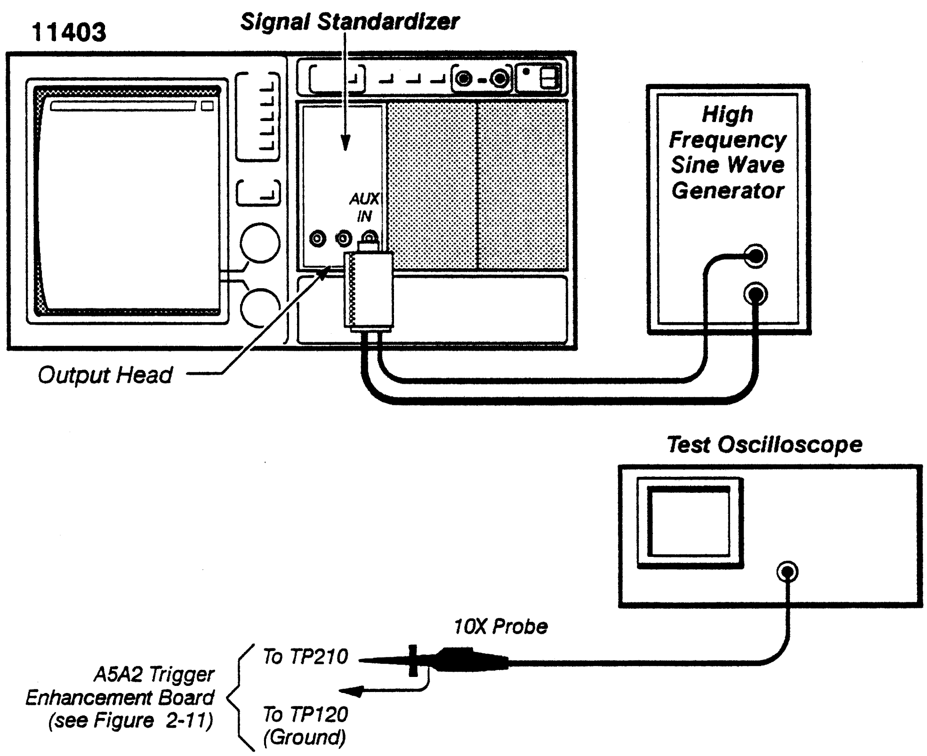
Part 16
Trigger Enhancement

In this part, the operation of the A5A2 Trigger Enhancement board is examined and adjusted if necessary (see Fig. 2-11).

Measurement Limit

The delay limit must be within 330 ps ±70 ps

Setup to Examine/Adjust the A5A2 Trigger Enhancement Board



Setup to Examine/Adjust A5A2 the Trigger Enhancement Board

Procedure to Examine/Adjust the A5A2 Trigger Enhancement Board

To gain access to the A5A2 Trigger Enhancement board, remove the nine Torx head screws on the A5 Acquisition board. Then, pivot and lock the A5 Acquisition board in the extended position. (Refer to FRU Board Assembly Removal, A5 Acquisition Board, in Section 3 of this manual, for the location of the Torx head screws to remove.)

Prior to performing this part, ensure that all of the test equipment is connected as shown in the setup, and that the oscilloscope is fully warmed up (powered-on for at least 20 minutes). Also, install a plastic, short circuit jumper across pins 2 and 3 of the J2 jumper on the A5A2 Trigger Enhancement board.

☐ Step 1: **Initialize** the oscilloscope settings, then perform the following settings in the order listed.

Signal standardizer
- Test .... Vert or Horiz Aux In
- Amplitude .... 9 o'clock position
- Position .... 12 o'clock position

Test oscilloscope
- Vertical Sensitivity (at probe tip) .... 500 mV/div
- Vertical Position (Offset) .... set so that the waveform is centered
- Horizontal time/div .... 50 ns/div
- Vertical Coupling .... DC
- Triggering .... Auto Trigger
- Trigger Level ...... set so that the display is not triggered (free run)

11403 Oscilloscope
- **Def Wfm** .... touch
  - **L** .... touch
  - **Enter Desc** .... touch
- **Main Size** .... 50 ns/div
- WAVEFORM button .... press
  - **Horizontal Desc** .... touch
    - **Main Record Length** .... **512 points**
    - **Window Record Length** .... **512 points**

High frequency sine wave generator
- Frequency .... approximately 900 MHz
- Amplitude .... set for a 6-division waveform

☐ Step 2: Touch the **Window 1** icon at the top of the screen.

☐ Step 3: Set the **Window 1 Pos** knob to 400 ns.

☐ Step 4: Set the **Window 1 Size** knob to 500 ps/div.

☐ Step 5: Set the high frequency sine wave generator (fine resolution) Frequency knob to a setting that displays spikes on the sine wave, then maximize the number of spikes displayed.

☐ Step 6: Carefully set the high frequency sine wave generator's Frequency (fine resolution) to obtain the most transitions on the test oscilloscope. The number of transitions is maximized when the intensity of the minimum and maximum levels are equal. Verify that spikes are still displayed on the 11403 Oscilloscope screen.

☐ Step 7: Select the Window 1 **Cursors** icon.

☐ Step 8: Touch **Cursor Type** and then **Vertical Bars** in the **Cursor Type** pop-up menu.

☐ Step 9: Touch **Cursor 1** and then **Fine** in the **Numeric Entry & Knob Res** pop-up menu.

☐ Step 10: Position **Cursor 1** to the first, rising, zero-crossing point on the sine wave. (It may be necessary to slightly readjust the sine wave generator's frequency, as described in Step 6.)

☐ Step 11: Rotate the high frequency sine wave generator (fine resolution) Frequency knob counter-clockwise (decreasing the frequency) through a null of the transitions on the test oscilloscope's waveform, then continue to rotate the knob counter-clockwise until the next maximum number of transitions is displayed.

☐ Step 12: Set the **Cursor 2** vertical bar to the zero crossing of the first rising edge of the sine wave to the right of **Cursor 1**.

☐ Step 13: *Examine* that the Δt readout on the screen is 330 ps $\pm$ 70 ps.

STOP

DO NOT attempt to optimize the following adjustment setting if the reading is within the stated limits. Remove the short circuit jumper and 10X probe. Reinstall the A5 Acquisition board and proceed to Part 17a, Time Base Performance Verification Procedure.

☐ Step 14: Set the high frequency sine wave generator (fine resolution) Frequency knob to a setting that displays spikes on the 11403 oscilloscope's waveform, and then maximize the number of spikes displayed.(You can either increase or decrease the frequency to obtain this setting.)

☐ Step 15: Carefully set the high frequency sine wave generator's Frequency (fine resolution) to obtain the most transitions on the test oscilloscope. Verify that spikes are still displayed on the 11403 Oscilloscope screen.

☐ Step 16: Position **Cursor 1** to the first rising zero crossing point of the sine wave.

☐ Step 17: Set **Cursor 2** to the right of **Cursor 1** to obtain a Δt readout on the screen of 330 ps

☐ Step 18: Rotate the high frequency sine wave generator (fine resolution) Frequency knob counter-clockwise to align the rising edge of the sine wave to the zero crossing of **Cursor 2**.

☐ Step 19: *Adjust* C212 on the A5A2 Trigger Enhancement board slightly to obtain the most transitions on the test oscilloscope's waveform.

☐ Step 20: Repeat Steps 14, 15, 16, 11, 12 and 13 (in that order). If the limits stated in Step 13 are not met, then repeat Steps 14 through 20.

☐ Step 21: Move the short circuit jumper to its original position (to pins 1 and 2) on J2, and then remove the 10X probe from TP210 and TP120.

☐ Step 22: Rotate the high frequency sine wave generator Frequency knob (fine resolution) through its entire frequency range, and observe that no spikes appear on the sine wave. Spikes may occur momentarily when you turn the knob; however, they should disappear when a constant frequency is established.

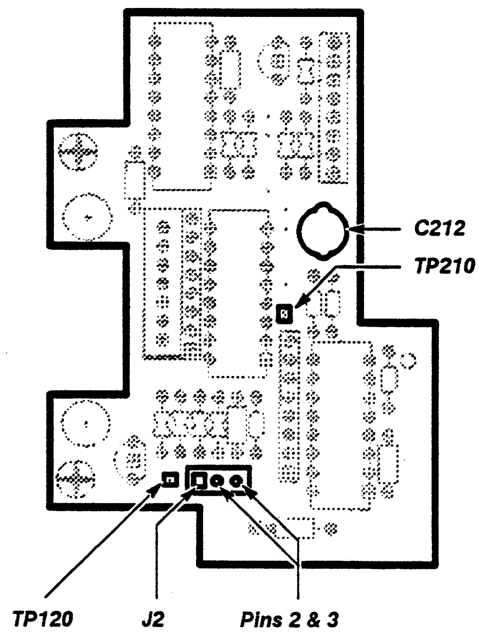


Figure 2-11 — *A5A2 Trigger Enhancement Board Test Point and Adjustment Locations*

Part 17a Time Base Performance Verification Procedure

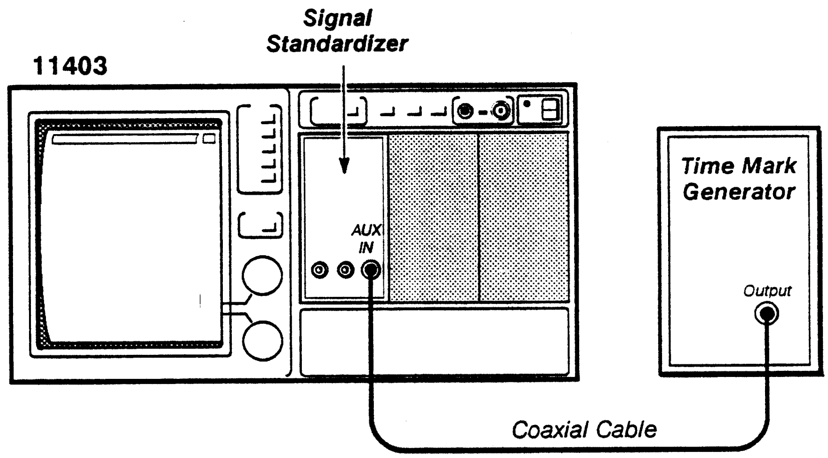
This part shows the setup and lists the procedure to check the horizontal timing accuracy.

Specifications

Time base accuracy must be within ±(0.002% + 100ps) of the measurement interval.

Trigger window position accuracy must be within ±(0.002% + 100ps).

Setup to Check the Time Base Accuracy



Setup to Check the Time Base Accuracy

Procedure to Check the Time Base Accuracy

☐ Step 1: **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

11403 Oscilloscope
- **Def Wfm** .... touch
  - **L** .... touch
  - **Enter Desc** .... touch
  - **Main Size** .... 1 ns/div

Time mark generator
- Marker (Sec) .... 5 ns

Signal standardizer
- Test .... Vert or Horiz Freq Resp
- Amplitude .... set for a 6 division display

1 ns/Division Accuracy

☐ Step 2: Press the TRIGGER button, and then touch **Level**.

☐ Step 3: Set the **Trig Level** and **Time Holdoff** for a stable display.

☐ Step 4: Press the WAVEFORM button, and then touch **Acquire Desc**.

☐ Step 5: Set **Average N** to **On** in the **Acquire Desc** pop-up menu.

☐ Step 6: Press the MEASURE button, and then touch **Measurements**.

☐ Step 7: Touch **Period** in the **Measurements** pop-up menu.

☐ Step 8: *Check* that the **Period** result is 5 ns ±100 ps (0.002% of the measurement interval is negligible) .

☐ Step 9: Press WAVEFORM, and then touch **Acquire Desc**.

☐ Step 10: Set **Average N** to **Off** in the **Acquire Desc** pop-up menu.

5 μs/Division Accuracy

☐ Step 11: Touch the horizontal icon, and then set **Main Size** to 5 μs/division. Set **Main Pos** to 0 s. (Ignore the main waveform in the following steps, since it will appear to be unstable.)

☐ Step 12: Touch **Window 1**.

☐ Step 13: Set the **Window1 Pos** to 0 s.

☐ Step 14: To select the main waveform perform the following:

- touch **Page to All Wfms Menu**
- touch **I:L1 Main**
- touch **Page to Waveform Menu**

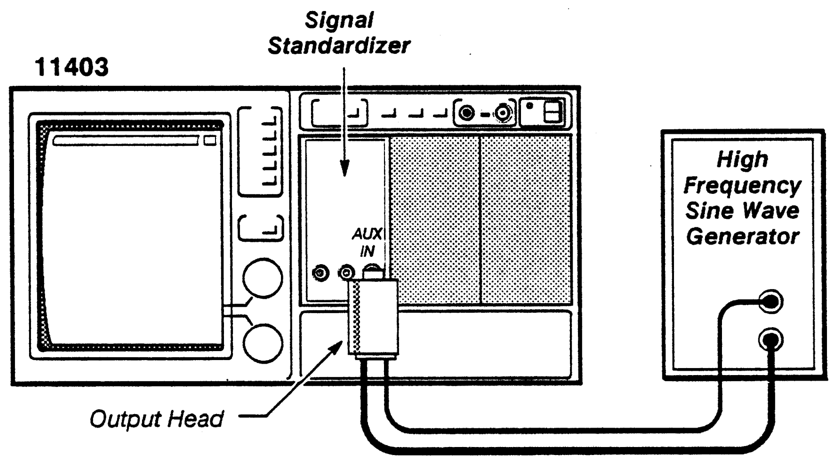
☐ Step 15: Touch **Window 2**.

☐ Step 16: Set the **Window2 Pos** to 50 μs.

☐ Step 17: Set the **Window Size** to 1 ns/div.

☐ Step 18: *Check* that the horizontal positions of the two waveforms match within 1.1 ns (0.002% of 50 μs + 100ps). Touch the vertical icon, and then adjust the **Trace Sep** (separation) to reposition the window waveform so that the difference is easier to see.

Setup to Check the Window Position Accuracy



Setup to Check the Window Position Accuracy

Procedure to Check the Window Position Accuracy

☐ Step 1: **Initialize** the oscilloscope settings, then perform the following settings in the order listed.

11403 Oscilloscope
- **Def Wfm** .... touch
  - **L** .... touch
  - **Enter Desc** .... touch
- **Main Size** .... 2 ns/div
- TRIGGER button .... press
  - **Slope** .... – (negative)

High frequency sine wave generator
- Frequency .... 333 MHz (approximately)

Signal standardizer
- Test .... Vert or Horiz Freq Resp

☐ Step 2: Set the high frequency (HF) sine wave generator and signal standardizer Amplitude controls for ≈6-division leveled signal centered on the screen. (The signal is leveled when the CW Leveled indicator on the signal standardizer is illuminated.)

☐ Step 3: If the display is unstable, then set the **Time Holdoff** for a stable display (use **Fine** resolution).

☐ Step 4: Press the WAVEFORM menu button, and then touch **Acquire Desc**.

☐ Step 5: Set the **Average N** to **On** in the **Acquire Description** pop-up menu.

☐ Step 6: Press the MEASURE button, and then touch **Measurements**.

☐ Step 7: Touch **Delay** in the **Measurements** pop-up menu and then **Delay** in the MEASURE major menu.

☐ Step 8: Touch **Left Limit** in the **Delay** pop-up menu, and then set the **Left Limit** knob to position the limit line on the signals first negative peak.

☐ Step 9: Set the **Right Limit** knob to position the limit line on the signal's sixth positive peak (with an intensified zone of five complete cycles).

☐ Step 10: Set the HF sine wave generator frequency control for a **Delay** readout on the screen of 15 ns, within the limits of 14.99 ns and 15.01 ns.

☐ Step 11: Set the **Right Limit** knob to display an intensified zone of six complete cycles.

☐ Step 12: *Check* that the **Delay** readout on the screen is within the limits of 17.9 ns and 18.1 ns.

☐ Step 13: *Check* that the **Delay** readout for each **Right Limit** setting in the Set Right Limit Line to Display column is within the limits listed under the Check Delay Readout column of Table 2-5, Main Delay Readout.

Table 2-5 *— Main Delay Readout*

Set Right Limit Line to Display	Check Delay Readout
4 cycles	11.9 ns to 12.1 ns
3 cycles	8.9 ns to 9.1 ns
2 cycles	5.9 ns to 6.1 ns

☐ Step 14: Touch **Window 1**.

☐ Step 15: Set the **Window Size** knob to 2 ns/div.

☐ Step 16: Touch **Delay** in the MEASURE major menu, and then touch **Left Limit** in the **Delay** pop-up menu.

☐ Step 17: Set the **Left Limit** and **Right Limit** to display an intensified zone of six complete cycles.

☐ Step 18: *Check* that the **Delay** readout on the screen is within the limits of 17.9 ns and 18.1 ns.

☐ Step 19: *Check* the **Delay** readout as shown in Table 2-6, Window Delay Readout.

Table 2-6 — *Window Delay Readout*

Set Right Limit Line to Display	Delay Readout Limits
5 cycles	14.9 ns to 15.1 ns
4 cycles	11.9 ns to 12.1 ns
3 cycles	8.9 ns to 9.1 ns
2 cycles	5.9 ns to 6.1 ns

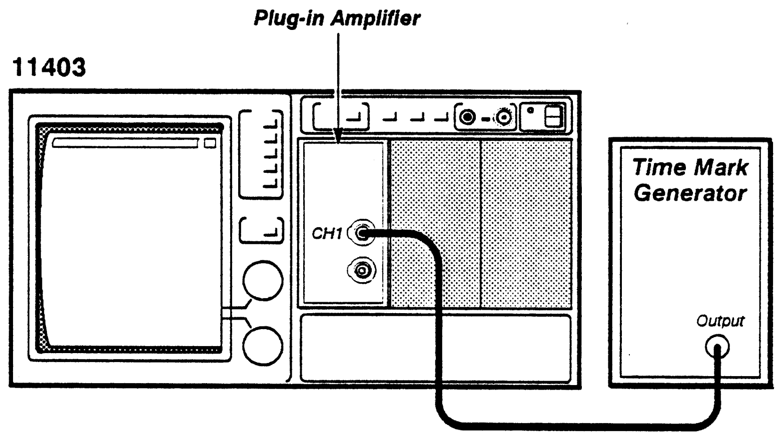
Part 17b Time Base Functional Test Procedure

This part shows the setup and lists the steps to functionally test the horizontal timing accuracy. You should only perform this part if you are performing a functional test. Otherwise, perform Part 17a, Time Base Performance Verification, and then proceed to Part 18, Events Window Position Accuracy.

Specification

Time Base accuracy must be within ±(0.002% + 100 ps).

Setup to Check the Time Base Accuracy



Setup to Check the Time Base Accuracy

Procedure to Check the Time Base Accuracy

☐ Step 1: **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

Time mark generator
- Marker (sec) .... 5 ns

Plug-in amplifier
- CH 1 display on/off .... on

11403 Oscilloscope
- **Impedance** .... **50 Ω**
- **Vert Size: L1** .... 200 mV/div
- **Vert Offset: L1** .... 500 mV
- **Main Size** .... 1 ns/div
  - **Acquire Desc** .... touch
  - **Acquire Description** pop-up menu .... **Average N** to **On**

1 ns/Division Accuracy

- [ ] Step 2: Press the MEASURE button, and then touch **Measurements.**
- [ ] Step 3: Touch **Period** in the **Measurements** pop-up menu.
- [ ] Step 4: *Check* that the **Period** reading is 5 ns ±100 ps (the 0.002% of the measurement interval is negligible).
- [ ] Step 5: Press the WAVEFORM button, and then touch **Acquire Desc.**
- [ ] Step 6: Set **Average N** to **Off** in the **Acquire Description** pop-up menu.

5 µs/Division Accuracy

- [ ] Step 7: Touch the horizontal icon, and then set **Main Size** to 5 µs/div. (Ignore the main waveform in the following steps, since it will appear unstable.)
- [ ] Step 8: Touch **Window 1.**
- [ ] Step 9: Set the **Window1 Pos** to 0 s.
- [ ] Step 10: To select the main waveform perform the following:
  - touch **Page to All Wfms Menu**
  - touch **I:L1 Main**
  - touch **Page to Waveform Menu**
- [ ] Step 11: Touch **Window 2.**
- [ ] Step 12: Set the **Window2 Pos** to 50 µs.
- [ ] Step 13: Set the **Window Size** to 1 ns/div.
- [ ] Step 14: *Check* that the horizontal positions of the two waveforms match within 1.1 ns (0.002% of 50 µs + 100ps). Touch the vertical icon, and then adjust the **Trace Sep** (separation) to reposition the window waveform so that the difference is easier to see.

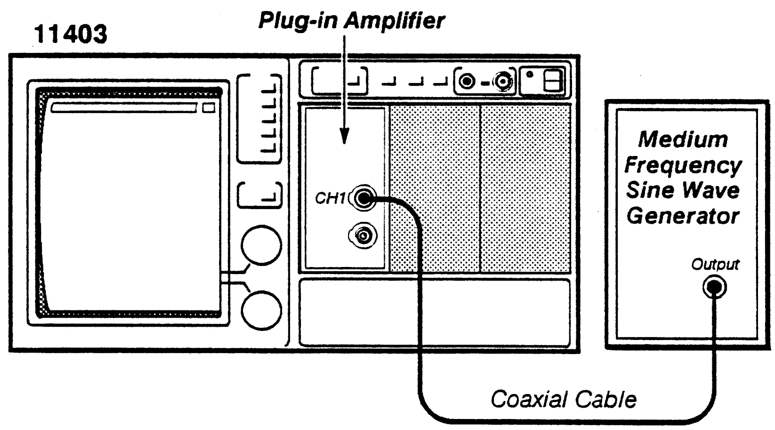
Part 18 Events Window Position Accuracy

In this part, triggering events on the screen are counted with relation to an equal number set by the events holdoff control knob.

Specification

Maximum window holdoff event frequency is 150 MHz.

Setup to Check the Events Window Position Accuracy



Setup to Check the Events Window Position Accuracy

Procedure to Check the Events Window Position Accuracy

☐ Step 1: **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

Plug-in Amplifier
- CH 1 display on/off .... on

11403 Oscilloscope
- **Vert Size: L1** .... 500 mV/div
- **Main Size** .... 10 ns/div

Medium frequency sine wave generator
- Frequency .... 150 MHz
- Amplitude .... Approx 6 div display

11403 Oscilloscope
- **Window1** icon .... touch
- TRIGGER button .... press
  - **Window Holdoff Md** pop-up menu .... **Holdoff by Events Triggered from Window**

☐ Step 2: Set the **Window1 Pos** knob to 0 s.

☐ Step 3: Touch the **W**(window) **trig'd** icon, and set the **Events Holdoff** knob to 1.

☐ Step 4: *Check* that the two trigger indicator arrows on the main waveform are one cycle apart.

☐ Step 5: Set the **Events Holdoff** knob to 2.

☐ Step 6: *Check* that the two trigger indicator arrows on the waveform are two cycles apart.

☐ Step 7: *Check* that the window trigger indicator arrow moves one additional cycle to the right for each increment of **Events Holdoff** (up to an **Events Holdoff** reading of 10).

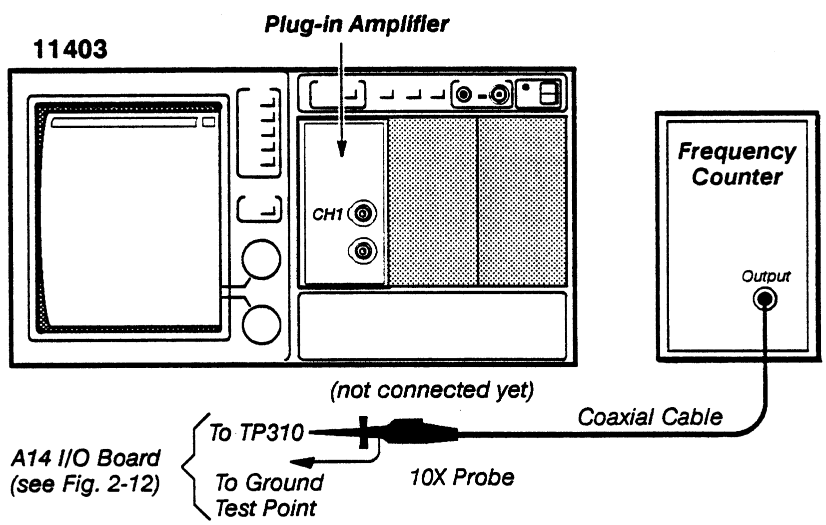
Part 19 Input/Output

In this part, the real time clock frequency is measured with a frequency counter, and the temperature sensor voltage reference is measured with a digital multimeter (see Figs. 2-12 and 2-13).

Measurement Limits

Real time clock 1,000,000 μs, ±5 μs
Temperature sensor voltage reference +6.500 V, ±5 mV.

Examine/Adjust the Real Time Clock



Setup to Examine/Adjust the Real Time Clock

Procedure to Examine/Adjust the Real Time Clock

☐ Step 1: Perform the following items in the order listed:

11403 Oscilloscope

a. Set the front panel ON/STANDBY switch to STANDBY.

b. Remove the CRT cover from the oscilloscope.

c. Remove both of the plastic retaining strips from top of the card cage.

d. Remove the A18 Memory board and place it in the right-most slot (as viewed facing the CRT).

e. Remove the A14 I/O board and place it in the slot previously occupied by the A18 Memory board (the second slot from the left).

f. Remove the A17 Executive Processor board and place it in the slot previously occupied by the A14 I/O board (the third slot from the left).

g. Connect the 10X probe to the test points indicated in the setup illustration.

h. Reconnect all cables to their correct connectors.

i. Set the ON/STANDBY switch to ON.

Frequency counter

- Mode .... Period
- Trigger .... DC
- Slope .... – (negative)
- Time Base .... 1 MHz

Plug-in amplifier .... not used in this part

☐ Step 2: Press the UTILITY button, and then touch **Page to Utility 2 Menu.**

☐ Step 3: Touch **Extended Diagnostics** in the UTILITY major menu, and then **Extended Diagnostics** in the **Verify Selection** pop-up menu.

☐ Step 4: Touch **Area** and then **Realtime Clk** from the **Area** pop-up menu.

☐ Step 5: Touch **Routine** and then **Calibrate** in the **Routine** pop-up menu.

☐ Step 6: Touch **Run.**

☐ Step 7: *Examine* that the frequency counter reads within the limits of 1,000,005 μs and 999,995 μs.

STOP *DO NOT attempt to optimize the following adjustment setting if the period is within the stated limits. Proceed to the Examine/Adjust Temperature Sensor Voltage Reference procedure that follows.*

☐ Step 8: *Adjust* the REAL TIME CLOCK adjustment C510 for 1,000,000 μs.

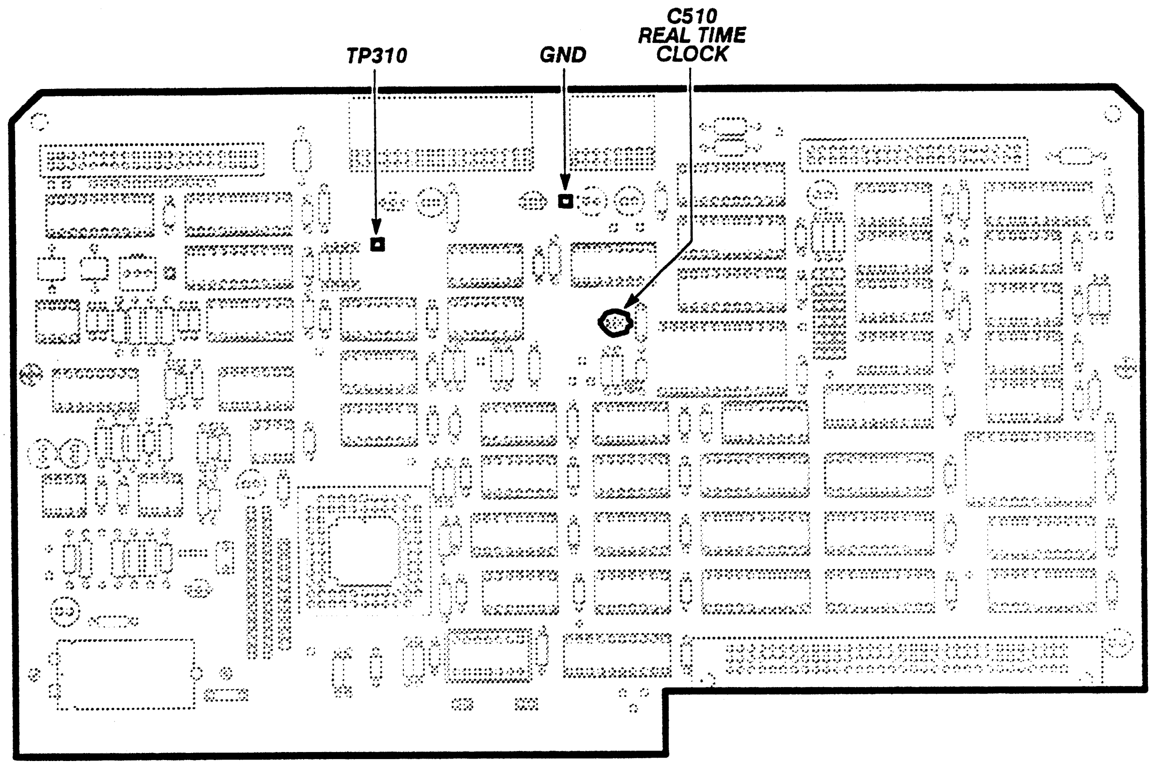
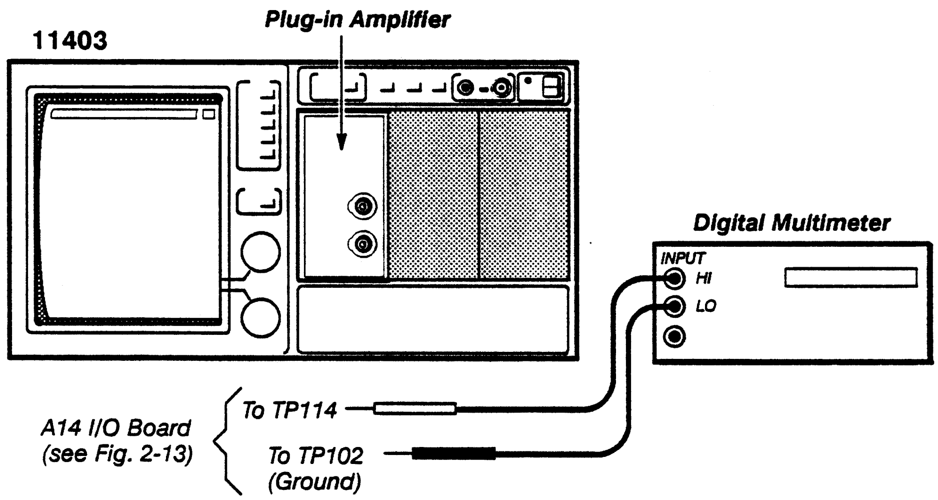


Figure 2-12 – A14 I/O Board (Real Time Clock) Test Point and Adjustment Locations

Setup to Examine/Adjust the Temperature Sensor Voltage Reference



Setup to Examine/Adjust the Temperature Sensor Voltage Reference

Procedure to Examine/Adjust the Temperature Sensor Voltage Reference

☐ Step 1: Perform the following in the order listed:

11403 Oscilloscope .... no setting changes required
Digital multimeter
  Mode .... DC
Plug-in amplifier .... not used in this part

☐ Step 2: *Examine* that the digital multimeter reads within the limits +6.505 V and +6.495 V.

STOP

DO NOT attempt to optimize the following adjustment setting if the digital multimeter reading is within the stated limits. Proceed to Step 4.

☐ Step 3: *Adjust* TEMP SENSOR VOLTAGE REF adjustment R112 for +6.500 V.

☐ Step 4: Set the ON/STANDBY switch to STANDBY.

☐ Step 5: Move all boards to their original location and replace the plastic retaining strips.

☐ Step 6: Replace the CRT cover.

☐ Step 7: Set the ON/STANDBY to ON.

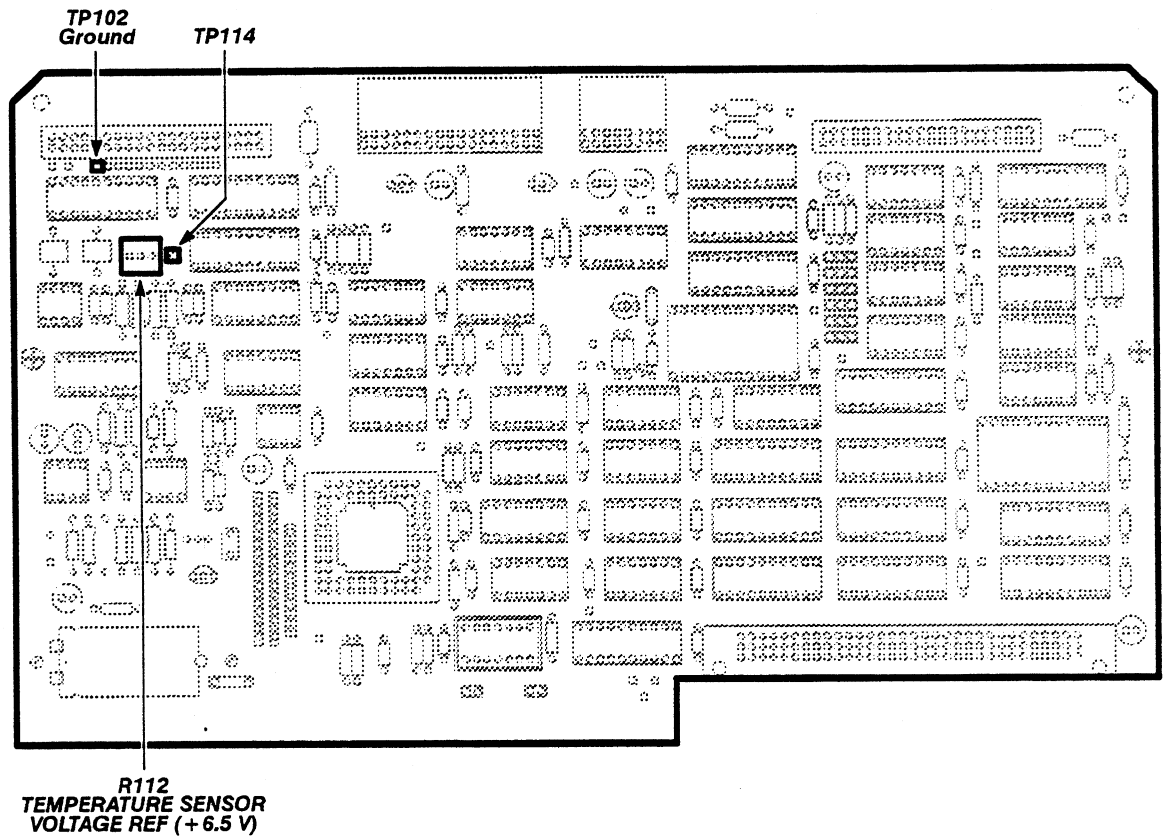


Figure 2-13 — *A14 I/O Board (Temperature Sensor) Test Point and Adjustment Locations*

Part 20 Triggering

In this part, the trigger voltage is set to various values and is checked/examined using the cursors readout on the screen.

Specifications

The specifications for this part are as follows:

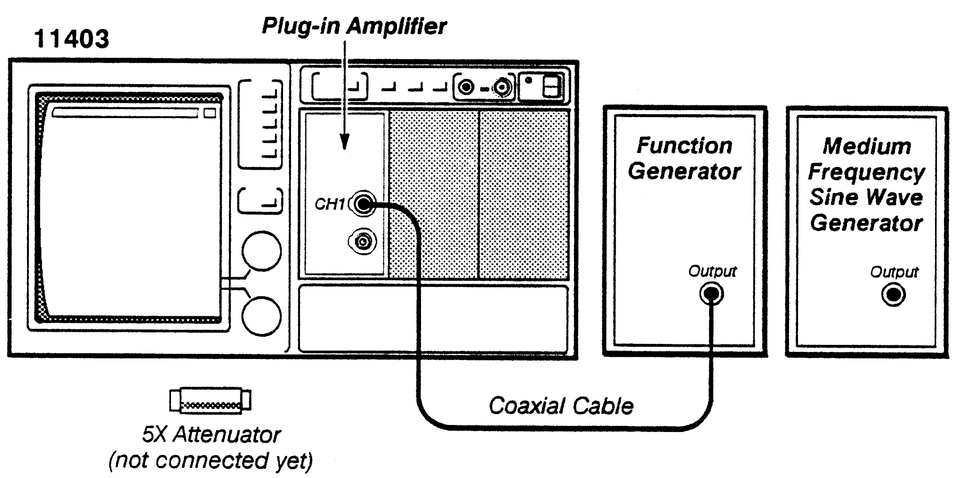
- DC noise-reject coupled must be 1.2 divisions or less from DC to 50 MHz.
- AC coupled must be 0.5 divisions from 60 Hz to 50 MHz.
- DC coupled must be 0.5 division from DC to 50 MHz, increasing to 1.5 divisions at 1 GHz.

Measurement Limits

The measurement limits for this part are as follows:

- Trigger-level DC accuracy within 2.0% of full scale (20 LSBs).
- DC HF reject coupled must be functional.
- AC LF reject coupled must be functional.

Setup to Check/Examine Triggering



Setup to Check/Examine Triggering

Procedure to Check/Examine Triggering

☐ Step 1: Perform the following items in the order listed:

a. First perform the Enhanced Accuracy procedure (refer to Part 5, Enhanced Accuracy).

b. **Initialize** the oscilloscope settings, then perform the following in the order listed:

Plug-in amplifier	
CH 1 display on/off	on
11403 Oscilloscope	
L1 display on/off	on
Impedance	**50 Ω**
Vert Size	100 mV/div
Main Size	100 μs/div
Main Pos	0 s
MEASURE button	press
Measurements	**Peak-Peak**
STORE/RECALL button	press
Store Settings	**Store next FPS** (note the front panel setting (FPS) number)
Function generator	
Waveform	triangular
Frequency	1 kHz
Amplitude	10-division signal
11403 Oscilloscope	
Main Size	50 μs/div
WAVEFORM button	press
Acquire Description	**Average N** to **On**
Cursors icon	touch
Trigger icon	touch
Trig Level	400 mV
Medium frequency sine wave generator	
Frequency	50 MHz

Examine the Trigger Level DC Accuracy

☐ Step 2: *Check* that the cursor readout is V1 = 400 mV, ±20 mV (2.0% of full scale).

☐ Step 3: Set the **Trig Level** to −400 mV.

☐ Step 4: *Check* that the cursor readout is V1 = −400 mV, ±20 mV (2.0% of full scale).

☐ Step 5: Touch the horizontal icon, and then set the **Main Size** to 100 μs/div.

☐ Step 6: Touch **Window 1**, then set the **Window 1 Pos** to 0 s.

- [ ] Step 7: Press the TRIGGER button, and then set the **Window Holdoff Md** to **Holdoff by Time Triggered from Window.**
- [ ] Step 8: Set **Trigger Select** to **Window.**
- [ ] Step 9: Select the **Cursors** label.
- [ ] Step 10: Select the **W**(window) **trig'd** icon, then set the window1 **Trigger Level** to 400 mV.
- [ ] Step 11: *Check* that the **Cursor** readout is V1 = 400 mV, ±20 mV (2.0% of full scale).
- [ ] Step 12: Set the window 1 **Trigger Level** to –400 mV.
- [ ] Step 13: *Check* that the **Cursor** readout is V1 = –400 mV, ±20 mV (2.0% of full scale).

Check the AC Coupled 50 MHz Sensitivity

- [ ] Step 14: Connect the medium frequency (MF) sine wave generator through a 5X attenuator to the CH 1 input connector.
- [ ] Step 15: Press the STORE/RECALL button, and then touch **Recall Setting**.
- [ ] Step 16: Touch **FPSX**, where X is the FPS number noted in the initial settings in step 1.
- [ ] Step 17: Press the TRIGGER button, and then set **Coupling** to **AC**.
- [ ] Step 18: Touch the horizontal icon, and then set the **Main Size** to 10 ns/div.
- [ ] Step 19: Press the MEASURE button, and then set the MF frequency sine wave generator output for a **Peak-Peak** measurement of 50 mV (0.5 divs).
- [ ] Step 20: Select the **trig'd** icon.
- [ ] Step 21: *Check* that you can adjust the **Trig Level** and achieve a stable display (use **Fine** resolution).
- [ ] Step 22: Select the **Window 1** icon.
- [ ] Step 23: Set **Window Size** to 10 ns/div.
- [ ] Step 24: Press the TRIGGER button, and then set the **Window Holdoff Md** to **Holdoff by Time Triggered from Window.**
- [ ] Step 25: Set **Trigger Select** to **Window.**
- [ ] Step 26: Touch the **W**(window) **trig'd** icon.
- [ ] Step 27: *Check* that you can adjust the window **Trig Level** and achieve a stable display.

Check the DC Noise Reject

- ☐ Step 28: Press the MEASURE button, and then set the MF sine wave generator output for a **Peak-Peak** measurement of 120 mV(1.2 divisions).
- ☐ Step 29: Press the TRIGGER button, and then set the window trigger **Coupling** to **DC Noise Reject**.
- ☐ Step 30: *Check* that you can adjust the window **Trig Level** and achieve a stable display.
- ☐ Step 31: Set **Trigger Select** to **Main**.
- ☐ Step 32: Set the main trigger **Coupling** to **DC Noise Reject**.
- ☐ Step 33: *Check* that you can adjust the main **Trig Level** and achieve a stable display.

Check the DC Coupling

- ☐ Step 34: Connect the coaxial cable from the CH 1 input to the CALIBRATOR output connector of the oscilloscope (remove the 5X attenuator).
- ☐ Step 35: Select the UTILITY button.
- ☐ Step 36: Touch **Probes**, then select **L1** (this probe calibration deskews the system).
- ☐ Step 37: Press the STORE/RECALL button, and then touch **Recall Setting**.
- ☐ Step 38: Touch **FPSX**, where X is the FPS number noted in the initial settings.
- ☐ Step 39: Connect the coaxial cable from the CH 1 input to the MF sine wave generator.
- ☐ Step 40: Set the MF sine wave generator output to its 50 kHz Reference frequency.
- ☐ Step 41: Press the MEASURE button, and then set the MF Sine Wave Generator Output Amplitude for a **Peak-Peak** measurement of 600 mV.
- ☐ Step 42: Touch the horizontal icon, and then set the **Main Size** to 2 μs/div.
- ☐ Step 43: Set the **Main Pos** to position the trigger indicator (arrow) to the center vertical graticule line (−10.2 μs readout).
- ☐ Step 44: *Examine* that the rising portion of the sine wave crosses the center of the screen, ±0.2 divisions.
- ☐ Step 45: Touch the vertical icon, and then set the **Vert Offset** to move the waveform above and below its original position.
- ☐ Step 46: *Check* that the trigger indicator (arrow) remains at the same level, at the center of the screen.
- ☐ Step 47: Set the **Vert Offset** control for a 0 V readout.

Examine the DC HF Reject

- [ ] Step 48: Touch the TRIGGER button, and then set the **Coupling** to **DC HF Reject.**

- [ ] Step 49: *Examine* that the waveform moved to the left of the trigger indicator (arrow); between 0.5 and 2.0 divisions.

Examine AC LF Reject

- [ ] Step 50: Set the trigger **Coupling** to **AC LF Reject.**

- [ ] Step 51: *Examine* that the trigger indicator (arrow) disappears and that the zero crossing of the positive-going edge of the waveform now appears between 0.5 and 2.0 divisions to the right of the center vertical graticule line.

Check AC Coupling

- [ ] Step 52: Set the trigger **Coupling** to **AC**.

- [ ] Step 53: Set the **Vert Offset** to any setting.

- [ ] Step 54: *Check* that the waveform remains triggered at the same point regardless of the **Vert Offset** setting.

Maintenance

This section contains information for performing preventive maintenance, corrective maintenance, and diagnostic troubleshooting on the 11403 Digitizing Oscilloscope.

Preventive Maintenance

Performing a regular maintenance program can prevent the oscilloscope from malfunctioning and may improve the reliability of the oscilloscope. The environment in which the oscilloscope operates will determine the frequency of this maintenance. A convenient time for performing preventive maintenance is prior to making an electrical adjustment.

Removing the Cabinet Panel

WARNING

Dangerous potentials exist at several points throughout this oscilloscope. If you operate the oscilloscope with the covers removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Therefore, disconnect the power before cleaning the oscilloscope or replacing any parts.

The top and bottom cabinet covers (or panels) protect you from operating potentials present within the oscilloscope. In addition, the covers reduce radiation of electromagnetic interference from the oscilloscope. If you must remove the covers, then loosen the fasteners and lift the covers off. Otherwise, operate the oscilloscope with the covers in place to protect the interior from dust.

Cleaning the Oscilloscope

The oscilloscope should be cleaned as often as operating conditions require. Dirt present in the oscilloscope can cause overheating and component breakdown. If dirt accumulates on components, it will act as an insulating blanket and prevent efficient heat dissipation. Dirt also provides an electrical conduction path which may cause the oscilloscope to fail. The side panels reduce the amount of dust that reaches the interior of the oscilloscope. Therefore, keep the side panels in place for safety and cooling as well.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics in this oscilloscope. Use a nonresidue type of cleaner, preferably isopropyl alcohol or totally denatured ethyl alcohol. Before using any other type of cleaner, consult your local Tektronix service center or representative.

Exterior—Any dust present on the exterior of the oscilloscope can be removed with a soft cloth or small brush. The brush is also useful for dislodging dirt on and around the front panel controls. Remove any dirt which remains with a soft cloth dampened in a mild detergent and water solution. Do not use abrasive cleaners.

CRT—Clean the CRT faceplate with a soft, lint-free cloth dampened with denatured alcohol.

Interior—Cleaning the interior of the oscilloscope should seldom be necessary. If you do need to clean the interior, then blow off the dust with dry, low-velocity air (approximately 5 lb/in^2). Again, remove any dirt which remains with a soft brush or a cloth dampened with a mild detergent and water solution. Use a cotton-tipped applicator for cleaning in narrow spaces, or for cleaning more delicate circuit components. And, use a washcloth dampened with water to remove any residue from the areas you have cleaned.

CAUTION

To prevent damage from electrical arcing, boards and components must be dry before applying power.

Ensure that you carefully examine the high-voltage circuits. Excessive dirt in these circuit areas may cause high-voltage arcing and result in improper oscilloscope operation.

Visual Inspection

The oscilloscope should be inspected occasionally for defects; such as broken connections, improperly seated semiconductors, damaged or improperly installed boards, and heat-damaged parts. The corrective procedure for most visible defects is obvious; however, particular care must be taken if heat-damaged parts are found. Since overheating usually indicates other trouble in the oscilloscope. And therefore, correcting the cause of overheating is important to prevent the damage from recurring.

Periodic Electrical Adjustment

To ensure accurate measurements, check the electrical adjustment of this oscilloscope after each 2,000 hours of operation, or every 24 months if you use the oscilloscope infrequently.

Corrective Maintenance

Corrective maintenance consists of module and board replacement procedures for repairing the oscilloscope.

Power Supply Voltage Hazard

Use caution if working near any metal-faced components in the Power Supply module.

WARNING

All metal components, including any metal-faced components, in the Power Supply module should be considered hazardous; since the voltage potential of these components may be equivalent to the AC line voltage potential.

Always disconnect the line power cord before attempting any disassembly procedures.

An electric-shock hazard exists when the oscilloscope is not grounded. Do not remove the ground wire (green-yellow wire) that connects the Power Supply module chassis to the oscilloscope.

Ordering Parts

When ordering replacement parts from Tektronix, Inc., include the following information:

- oscilloscope type
- oscilloscope serial number
- description of the part
- Tektronix part number

Static-Sensitive Device Classification

CAUTION

Static discharge can damage any semiconductor component in this oscilloscope.

This oscilloscope contains electrical components that are susceptible to damage from static discharge. Refer to Table 3-1, Relative Susceptibility to Damage from Static Discharge, for the relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

ATTENTION

*If an FRU (field replacement unit) being replaced contains firmware, the **firmware must be removed from the old FRU and installed on the new FRU**. The replacement assemblies (FRUs) will not have any firmware installed from the factory or Module Repair station.*

Table 3-1 – Relative Susceptibility to Damage from Static Discharge

Semiconductor Classes	Relative Susceptibility Levels[1]
MOS or CMOS microcircuits, and discrete or linear microcircuits with MOS inputs (most sensitive)	100 to 500 V
ECL	200 to 500 V
Schottky signal diodes	250 V
Schottky TTL	500 V
High-frequency bipolar transistors	400 to 600 V
JFETs	600 to 800 V
Linear microcircuits	400 to 1000 V (est.)
Low-power Schottky TTL	900 V
TTL (least sensitive)	1200 V

[1]*Voltage discharged from a 100 pF capacitor through a resistance of 100 Ω.*

Observe the following precautions to avoid damage to components:

- Minimize handling of static-sensitive components.
- Transport and store static-sensitive components or assemblies in their original containers, anti-static tube rail, or conductive foam. Label any package that contains static-sensitive assemblies or components.
- Wear a wrist strap while handling these components to discharge the static voltage from your body. Perform servicing of these static-sensitive assemblies or components at a static-free work station (only qualified service personnel should service these components). We recommend using the static control mat. Refer to Table 2-2 Test Equipment, for the part numbers of the wrist strap and static control mat.
- Clear the work station surface of any objects capable of generating or holding a static charge.
- Whenever possible, store the component leads in conductive foam or rails to keep these leads shorted together.
- Pick up components by the body, never by the leads.
- Do not slide the components over any surface.
- Avoid handling components in areas that have a floor or work-surface covering that can generate a static charge.

Removing/Replacing FRUs

Table 3-2, FRU Removal/Replacement Figure Cross Reference, is a convenient reference for finding connector and screw locations when removing and replacing field replaceable units (FRUs). The first column in the table lists the FRU to be removed or replaced. The second column lists the figure(s) that you should reference for the location of connector, screw, and index locations while you are using the procedure to remove/replace this FRU.

***Table 3-2** – FRU Removal/Replacement Figure Cross Reference*

FRU to be Removed/ Replaced	Figures to Reference During Removal	Page
Batteries	Figure 3-1 – Field Replaceable Units (FRU) Locator	3-9
	Figure 3-23 – Removing/Replacing the A14 I/O Board	3-43
	Figure 3-26 – Removing/Replacing the A18 Memory Board	3-49
Cathode Ray Tube (CRT)	Figure 3-1 – Field Replaceable Units (FRU) Locator	3-9
	Figure 3-2 – Removing/Replacing the CRT Cover	3-14
	Figure 3-3 – Removing/Replacing the Cathode Ray Tube	3-15
	Figure 3-4 – Removing/Replacing the CRT Torx Head Screws	3-16
	Figure 3-7 – Top View of the Card Cage	3-21
	Figure 3-16 – A9 Touch Panel Assembly Torx Head Screws	3-34
	Figure 3-30 – Multi-Pin Connector Orientation	3-58
Fan Motor	Figure 3-1 – Field Replaceable Units (FRU) Locator	3-9
	Figure 3-5 – Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector Plate	3-19
Power Supply Module	Figure 3-1 – Field Replaceable Units (FRU) Locator	3-9
	Figure 3-5 – Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector Plate	3-19
	Figure 3-6 – A2A2 Control Rectifier Board Connector Locations	3-20
	Figure 3-30 – Multi-Pin Connector Orientation	3-58
A1 Plug-in Interface board	Figure 3-1 – Field Replaceable Units (FRU) Locator	3-9
	Figure 3-5 – Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector Plate	3-19
	Figure 3-6 – A2A2 Control Rectifier Board Connector Locations	3-20
	Figure 3-7 – Top View of the Card Cage	3-21
	Figure 3-8 – Removing/Replacing the Plug-in Compartment Torx Head Screw Locations	3-23
	Figure 3-9 – Removing/Replacing the A1 Plug-in Interface Board	3-24
	Figure 3-10 – Removing/Replacing the A4 Regulator Board	3-25
	Figure 3-11 – Removing/Replacing the A5 Acquisition Board	3-26
	Figure 3-13 – Removing/Replacing the A6 Time Base Board	3-30
	Figure 3-30 – Multi-Pin Connector Orientation	3-58
A4 Regulator board	Figure 3-1 – Field Replaceable Units (FRU) Locator	3-9
	Figure 3-5 – Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector Plate	3-19
	Figure 3-6 – A2A2 Control Rectifier Board Connector Locations	3-20
	Figure 3-10 – Removing/Replacing the A4 Regulator Board	3-25
	Figure 3-30 – Multi-Pin Connector Orientation	3-58

***Table 3-2** – FRU Removal/Replacement Figure Cross Reference (Cont.)*

FRU to be Removed/ Replaced	Figures to Reference During Removal	Page
A5 Acquisition board	Figure 3-1 – Field Replaceable Units (FRU) Locator	3-9
	Figure 3-11 – Removing/Replacing the A5 Acquisition Board	3-26
	Figure 3-30 – Multi-Pin Connector Orientation	3-58
A5A2 Trigger Enhancement board	Figure 3-1 – Field Replaceable Units (FRU) Locator	3-9
	Figure 3-11 – Removing/Replacing the A5 Acquisition Board	3-26
	Figure 3-12 – Removing/Replacing the A5A2 Trigger Enhancement Board	3-28
	Figure 3-30 – Multi-Pin Connector Orientation	3-58
A6 Time Base board	Figure 3-1 – Field Replaceable Units (FRU) Locator	3-9
	Figure 3-11 – Removing/Replacing the A5 Acquisition Board	3-26
	Figure 3-13 – Removing/Replacing the A6 Time Base Board	3-30
	Figure 3-30 – Multi-Pin Connector Orientation	3-58
A7 CRT Socket Board and A8 CRT Driver board	Figure 3-1 – Field Replaceable Units (FRU) Locator	3-9
	Figure 3-2 – Removing/Replacing the CRT Cover	3-14
	Figure 3-3 – Removing/Replacing the Cathode Ray Tube	3-15
	Figure 3-7 – Top View of the Card Cage	3-21
	Figure 3-14 – Removing/Replacing the A7 CRT Socket Board	3-32
	Figure 3-15 – Removing/Replacing the A8 CRT Driver Board	3-33
	Figure 3-18 – Removing/Replacing the A10 Front Panel Control Board Torx Head Screws	3-37
	Figure 3-19 – Removing/Replacing the A10 Front Panel Control Board	3-38
	Figure 3-30 – Multi-Pin Connector Orientation	3-58
A9 Touch Panel Assembly	Figure 3-1 – Field Replaceable Units (FRU) Locator	3-9
	Figure 3-16 – A9 Touch Panel Assembly Torx Head Screws	3-34
	Figure 3-17 – Removing and Replacing the A9 Torx Panel Assembly	3-35
	Figure 3-19 – Removing/Replacing the A10 Front Panel Control Board	3-38
	Figure 3-30 – Multi-Pin Connector Orientation	3-58
A10 Front Panel Control board	Figure 3-1 – Field Replaceable Units (FRU) Locator	3-9
	Figure 3-2 – Removing/Replacing the CRT Cover	3-14
	Figure 3-18 – Removing/Replacing the A10 Front Panel Control Board Torx Head Screws	3-37
	Figure 3-19 – Removing/Replacing the A10 Front Panel Control Board	3-38
	Figure 3-30 – Multi-Pin Connector Orientation	3-58
A11 Front Panel Button board	Figure 3-1 – Field Replaceable Units (FRU) Locator	3-9
	Figure 3-2 – Removing/Replacing the CRT Cover	3-14
	Figure 3-18 – Removing/Replacing the A10 Front Panel Control Board Torx Head Screws	3-37
	Figure 3-19 – Removing/Replacing the A10 Front Panel Control Board	3-38
	Figure 3-20 – Removing/Replacing the A11 Front Panel Button Board	3-39
	Figure 3-30 – Multi-Pin Connector Orientation	3-58
A12 Rear Panel Assembly	Figure 3-1 – Field Replaceable Units (FRU) Locator	3-9
	Figure 3-5 – Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector Plate	3-19
	Figure 3-21 – Removing/Replacing the A12 Rear Panel Assembly	3-41
	Figure 3-23 – Removing/Replacing the A14 I/O Board	3-43
	Figure 3-30 – Multi-Pin Connector Orientation	3-58

Table 3-2 – FRU Removal/Replacement Figure Cross Reference (Cont.)

FRU to be Removed/ Replaced	Figures to Reference During Removal	Page
A13 Mother board	Figure 3-1 – Field Replaceable Units (FRU) Locator	3-9
	Figure 3-2 – Removing/Replacing the CRT Cover	3-14
	Figure 3-7 – Top View of the Card Cage	3-21
	Figure 3-22 – Removing/Replacing the A13 Mother Board	3-42
	Figure 3-23 – Removing/Replacing the A14 I/O Board	3-43
	Figure 3-24 – Removing/Replacing the A15 MMU Board	3-45
	Figure 3-25 – Removing/Replacing the A17 Executive Processor Board	3-47
	Figure 3-26 – Removing/Replacing the A18 Memory Board	3-49
	Figure 3-30 – Multi-Pin Connector Orientation	3-58
A14 Input/Output (I/O) board	Figure 3-2 – Removing/Replacing the CRT Cover	3-14
	Figure 3-7 – Top View of the Card Cage	3-21
	Figure 3-23 – Removing/Replacing the A14 I/O Board	3-43
	Figure 3-30 – Multi-Pin Connector Orientation	3-58
A15 MMU board	Figure 3-2 – Removing/Replacing the CRT Cover	3-14
	Figure 3-7 – Top View of the Card Cage	3-21
	Figure 3-23 – Removing/Replacing the A14 I/O Board	3-43
	Figure 3-24 – Removing/Replacing the A15 MMU Board	3-45
	Figure 3-30 – Multi-Pin Connector Orientation	3-58
A17 Executive Processor board	Figure 3-2 – Removing/Replacing the CRT Cover	3-14
	Figure 3-7 – Top View of the Card Cage	3-21
	Figure 3-25 – Removing/Replacing the A17 Executive Processor Board	3-47
	Figure 3-30 – Multi-Pin Connector Orientation	3-58
A18 Memory board	Figure 3-2 – Removing/Replacing the CRT Cover	3-14
	Figure 3-7 – Top View of the Card Cage	3-21
	Figure 3-25 – Removing/Replacing the A17 Executive Processor Board	3-47
	Figure 3-26 – Removing/Replacing the A18 Memory Board	3-49
	Figure 3-30 – Multi-Pin Connector Orientation	3-58

Note: *In addition to the figures listed in Table 3-2, the exploded-view drawings in Section 5, Replaceable Parts, may be helpful in removing or disassembling individual FRUs or subassemblies. Also, Figure 3-1 and 3-28 are useful for determining the location of FRUs and FRU ICs.*

The following FRU removal/replacement procedures assume that the top and/or bottom covers are removed from the oscilloscope. To loosen the cover fasteners, use a coin or a straight-slot screwdriver with a large-sized tip. Then, use one of these devices to rotate the cover fasteners a quarter-turn counter-clockwise.

Whenever a specific area is mentioned (such as the right side), it will usually be in reference to the front of the oscilloscope. If another reference is intended, it will be indicated (for example, viewing from the left side or viewing from the rear of the oscilloscope).

All connector names are labeled on the board and/or on the actual connector.

WARNING

To avoid electric-shock hazard and oscilloscope damage, always disconnect the oscilloscope from its power source before removing or replacing FRUs.

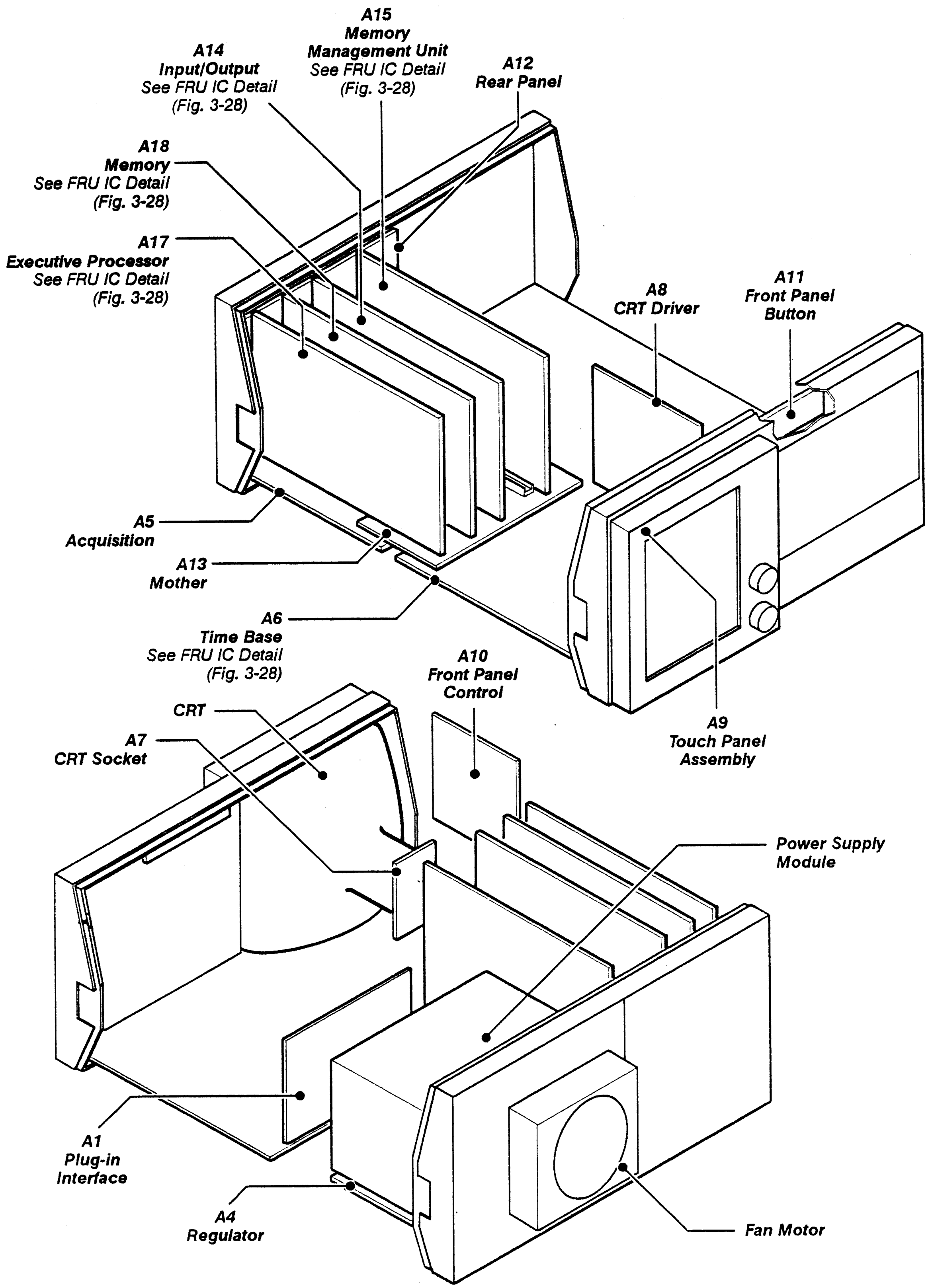


Figure 3-1 — *Field Replaceable Units (FRU) Locator*

Electrical Lock-On of the Front Panel ON/STANDBY Power Switch

Some applications of the oscilloscope may require that the power remain on. To electrically lock the power on, use the following procedure:

- [ ] Step 1: Switch the rear panel PRINCIPAL POWER SWITCH to OFF.
- [ ] Step 2: Remove the AC power cable.
- [ ] Step 3: Position the oscilloscope on its left (handle) side.
- [ ] Step 4: Remove the bottom cover.
- [ ] Step 5: Locate the A4 Regulator board.
- [ ] Step 6: Locate the J820 jumper on the A4 Regulator board (see Fig. 3-10).
- [ ] Step 7: Without dropping the jumper, reposition the J820 jumper from its two outer (right side) pins to its two inner (left side) pins.
- [ ] Step 8: Replace the bottom cover. Turn the oscilloscope in the upright position.
- [ ] Step 9: Reconnect the AC power cable and switch the PRINCIPAL POWER SWITCH to ON.

  The power will now remain on regardless of the setting of the ON/STANDBY power switch.
- [ ] Step 10: To turn the power off while the ON/STANDBY power switch is disabled, use the PRINCIPAL POWER SWITCH.

To return the ON/STANDBY Power Switch to normal operation , follow the previous steps using the reverse process.

Battery Disposal and First Aid

The oscilloscope contains the following number of batteries on the following boards:

- one battery (BT130) on the A14 I/O board
- one battery (BT150) on the A18 Memory board

See Figures 3-23 and 3-26 for the location of these batteries.

WARNING

To avoid personal injury, observe proper procedures for the handling of lithium batteries. ***Improper handling may cause fire, explosion, or severe burns.*** *Do not recharge, crush, disassemble, heat the battery above 100°C (212°F), incinerate, or expose the contents to water.*

Dispose of the Battery—according to local, state and federal regulations.

Note: *Typically, small quantities of batteries (less than 20) can be safely disposed along with ordinary garbage in a sanitary landfill.*

Larger quantities must be sent by surface transport to a hazardous waste disposal facility. The batteries should be individually packaged to prevent shorting. Then, pack them into a sturdy container that is clearly labeled, ***Lithium Batteries—DO NOT OPEN.***

Emergency and first aid information—for lithium batteries.

- **Manufacturer:** Panasonic
- **Battery Type:** Lithium Poly-Carbon monoflouride, BR 2/3 A
- **Solvent** (electrolyte): Gama Butyrlactone is of low toxicity. This solvent can cause some eye and respiratory irritation. According to the manufacturer, the solvent may be released during venting. Venting is an out gassing of battery material. Short circuiting (for more than a few seconds) or overheating the battery usually causes venting.
- **Solute:** LIBF4

Table 3-3, Emergency Procedures, lists the actions to take if you come in contact with battery solvent.

Table 3-3 *— Emergency Procedures*

Contact	Do This:
Skin	Wash promptly with plenty of water.
Eyes	Flush immediately with plenty of water and use an emergency eye wash, if available. Report to a medical professional for treatment.
Inhalation	Leave the area and get fresh air. Report to a medical professional for treatment.
Ingestion	Non-toxic according to laboratory testing. However, report to a medical professional for advice.

In case of venting, clear the immediate area. Usually, venting will only last a few seconds.

Cathode Ray Tube (CRT) Removal/Replacement

WARNING

The cathode ray tube (CRT) may retain a dangerous electrical (16 kV) charge. Before removing the CRT, the anode must be fully discharged. Short the anode lead from the CRT to the chassis. Wait approximately ten minutes and again firmly short the anode lead to the chassis. Then, remove the CRT.

Use extreme care when handling the CRT. If the CRT breaks, the glass fragments scatter at a high velocity (implosion). Protective clothing and safety glasses should be worn. Avoid striking the CRT on any object which might cause it to crack or implode. When storing a CRT, place it in a protective carton. Or, set the CRT face down in a protected location with smooth surface and with the CRT faceplate on a soft mat.

See Figures 3-1, 3-2, 3-3, 3-4, 3-7, 3-16, and 3-30 for module, connector, screw, and index locations.

Remove the CRT as follows:

- [ ] Step 1: Remove the three Torx head screws the secure the CRT cover, and then the CRT cover
- [ ] Step 1: Set the oscilloscope in the inverted position.
- [ ] Step 2: Use a $^1/_{16}$-inch allen wrench to loosen the two small screws that secure the two control knobs. Carefully remove the control so knobs that you do not lose the small allen screws inside the knobs.

CAUTION

When replacing the two control knobs, do not overtighten the two allen screws.

- [ ] Step 3: Remove the two Torx head screws on the bottom of the A9 Touch Panel Assembly.
- [ ] Step 4: Lift up on the bottom of the A9 Touch Panel Assembly and swing the assembly outward. The top of the A9 Touch Panel Assembly is held in place with two tabs that hook under the top of the chassis. Pull the assembly out until you can access the black ground wire that connects the A9 Touch Panel Assembly to the oscilloscope chassis.
- [ ] Step 5: Disconnect the quick-disconnect ground connector that connects the black ground wire to the oscilloscope chassis.
- [ ] Step 6: Set the A9 Touch Panel Assembly aside. To avoid stressing the ribbon cable that is still connected to the A9 Touch Panel Assembly, and to keep the assembly from cluttering your workspace, place the A9 Touch Panel Assembly inside the plug-in compartments. Do not damage the A9 Touch Panel Assembly when placing it inside the plug-in compartments.
- [ ] Step 7: Carefully set the oscilloscope on its left side.
- [ ] Step 8: Remove the two plastic circuit board guides from the top of the card cage.

☐ Step 9: Remove the two Torx head screws that secure the A7 CRT Socket board cover. Use a short Torx head screwdriver to remove the rear-most Torx head screw.

☐ Step 10: Remove the A7 CRT Socket board cover.

☐ Step 11: Slowly pull the A7 CRT Socket board towards the rear of the oscilloscope to unplug the A7 CRT Socket board from the CRT.

Note: *When reattaching the A7 CRT Socket board to the CRT, align the pins of the CRT to the receptacles on the A7 CRT Socket board. Then, slowly push the pins into the receptacles.*

Do not force the connection into place; doing so can bend or break some of the pins. If the pins do not slide easily into the receptacles, then pull the A7 CRT Socket board away from the CRT, and realign the A7 CRT Socket board to the CRT.

WARNING

The CRT anode voltage is 16 kV. Again, ground the anode lead from the CRT to the chassis to remove any stored charge remaining in the CRT. Wait approximately ten minutes, then ground the anode load to the chassis again.

☐ Step 12: Disconnect connector J54 from the A8 CRT Driver board. Note the position of the multi-pin connector's index triangle to ensure that you can correctly replace the connector.

☐ Step 13: Remove the four Torx head screws that secure the CRT to the top of the oscilloscope chassis. Two of the screws are removed from the front of the front panel chassis, and two of the screws are removed from behind the front panel casting.

☐ Step 14: Remove the top CRT support bar from the oscilloscope. The CRT support bar is unattached once the four Torx head screws securing the top of the CRT are removed.

☐ Step 15: Remove the four Torx head screws that secure the CRT to the bottom of the oscilloscope chassis. Two of the screws are removed from the front of the fron panel chassis, and two of the screws are removed from behind the front panel casting.

☐ Step 16: Remove the bottom CRT support bar from the oscilloscope.

CAUTION

Once the four Torx head screws are removed from the bottom of the CRT, the CRT is unattached to the oscilloscope. Use care not to damage the CRT while it is loose in the oscilloscope.

☐ Step 17: Slowly pull the CRT out of the front panel chassis.

To replace the CRT, perform the previous steps using the reverse process.

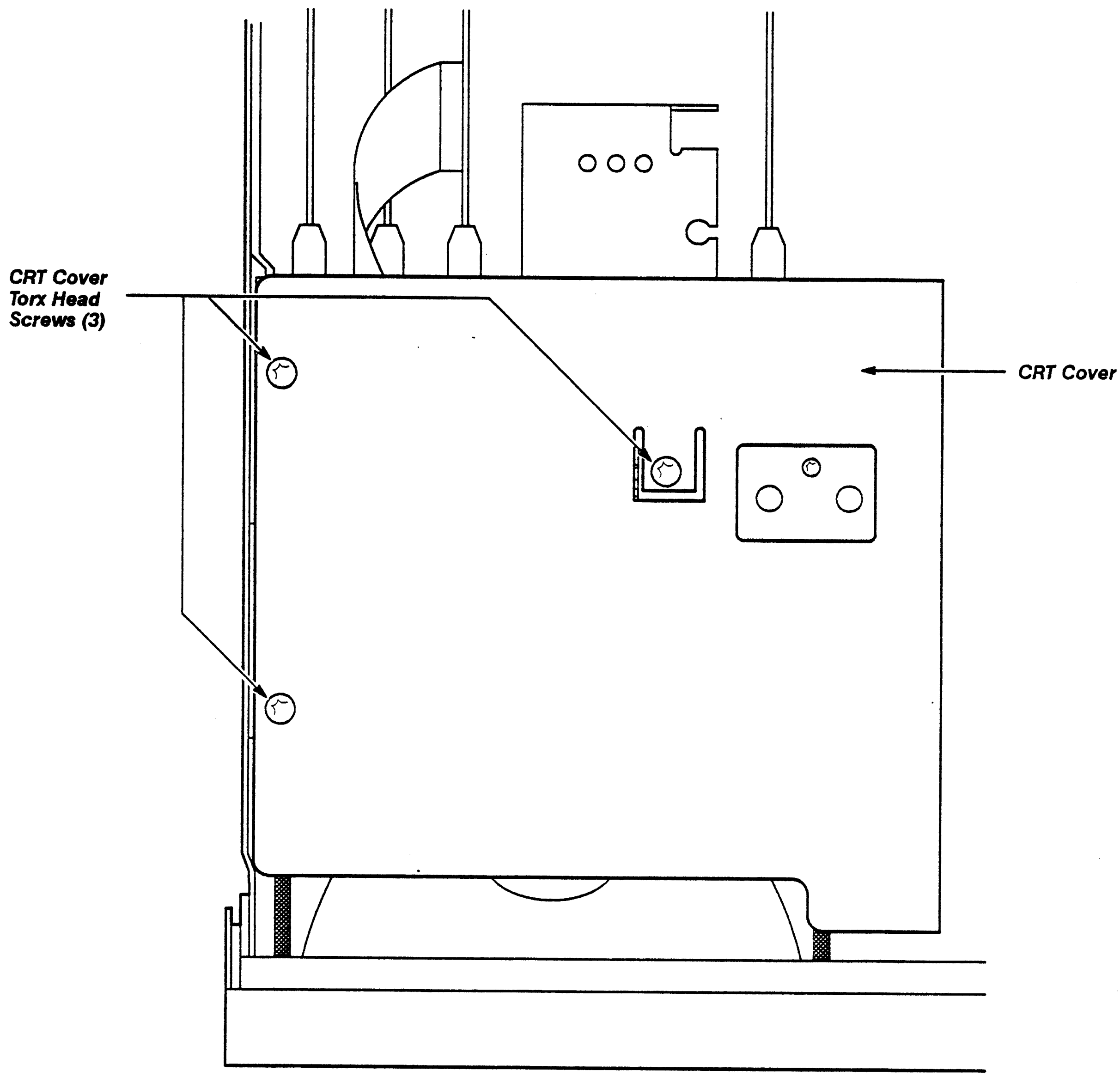


Figure 3-2 — *Removing/Replacing the CRT Cover*

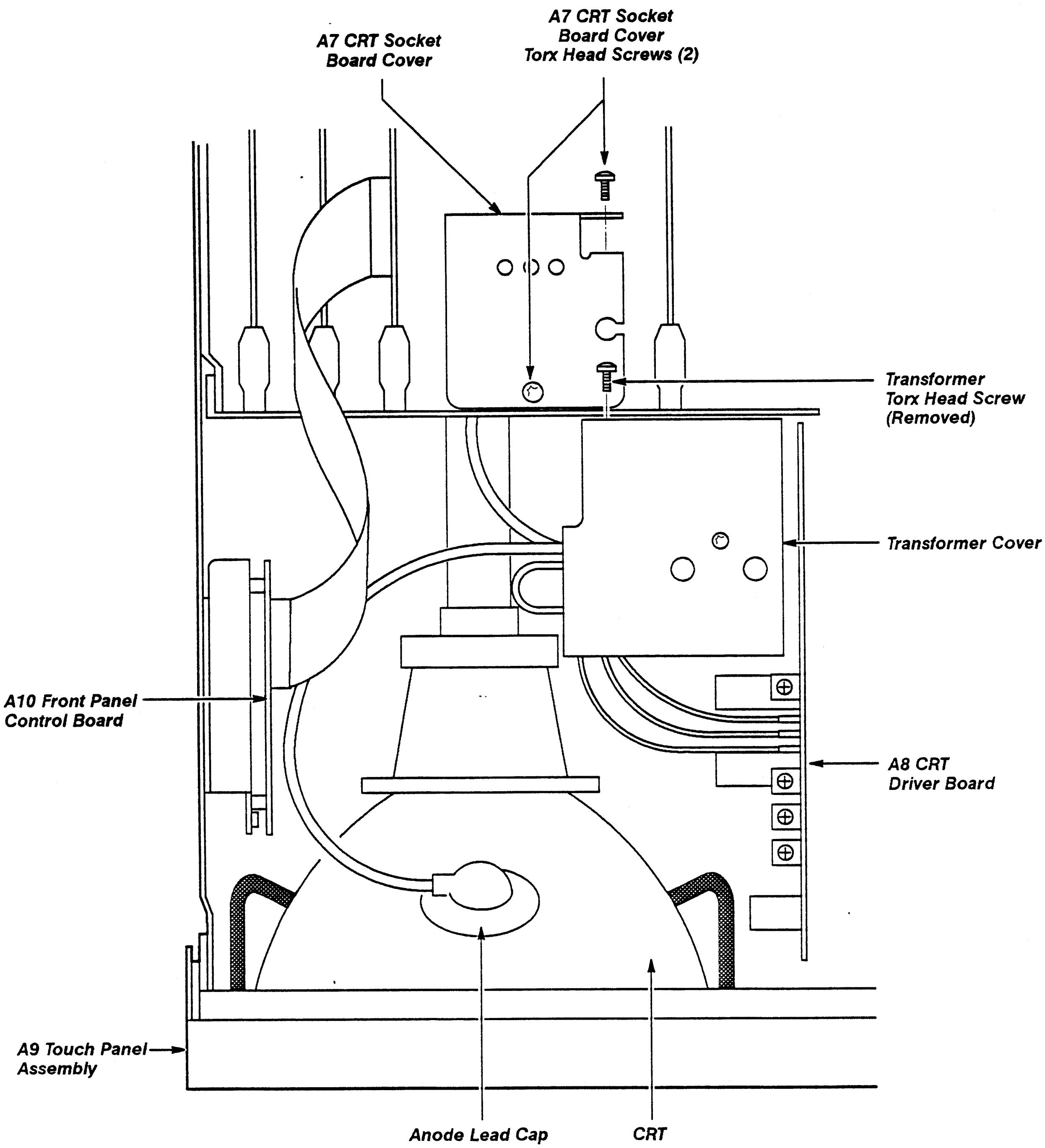


Figure 3-3 – *Removing/Replacing the Cathode Ray Tube*

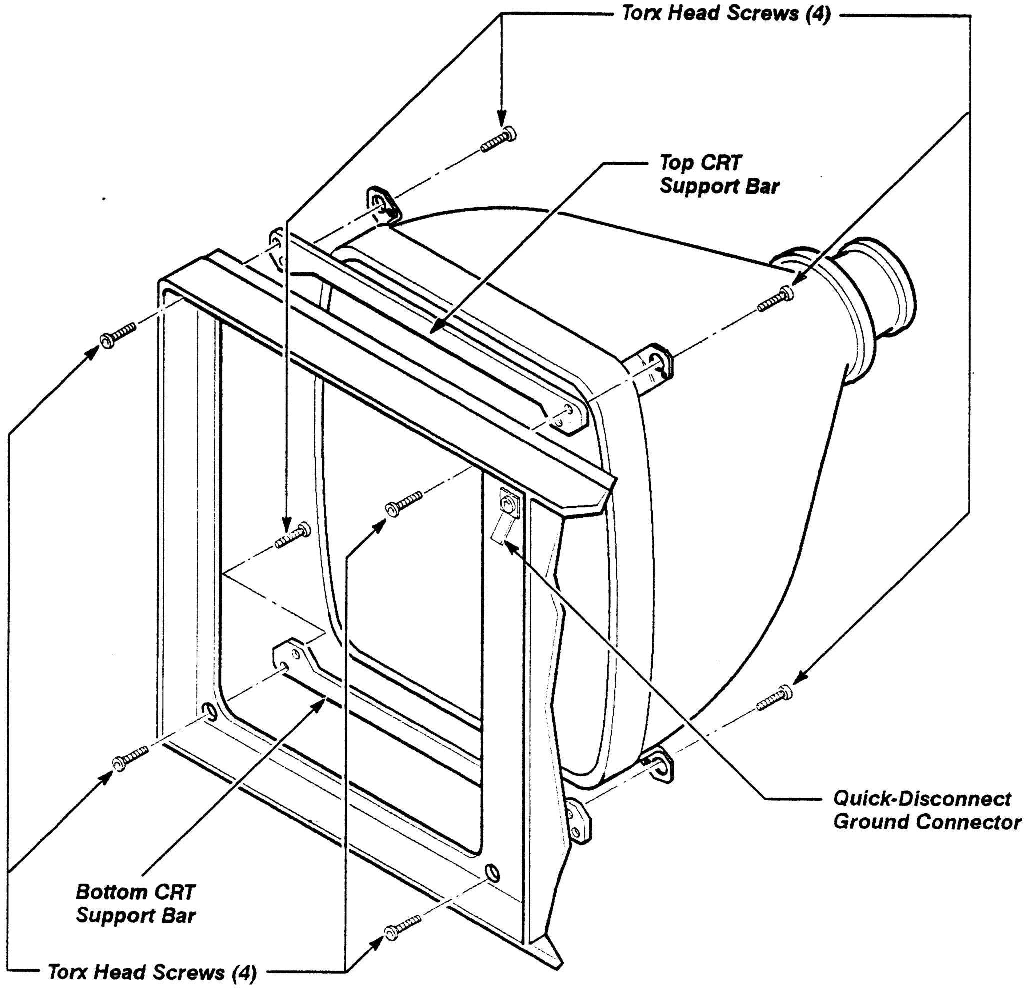


Figure 3-4 — *Removing/Replacing the CRT Torx Head Screws*

Fan Motor Removal/Replacement

See Figures 3-1 and 3-5 for module and screw locations.

Remove and replace the fan motor as follows:

☐ Step 1: Using a pencil or tape, mark the top of the fan motor housing for later use in the positioning the motor. Remove the four screws securing the housing to the rear of the oscilloscope. Support the housing as you remove the last screws.

☐ Step 2: Separate the grill and the housing from the motor.

☐ Step 3: Remove the two wires at their motor connections. Note that the red wire is plus (+) and the brown wire is minus (-).

☐ Step 4: Remove the fan motor.

Note: *Observe the position in which the motor was mounted. Ensure that the motor is remounted in its original position, or the fan wires may not reach.*

To replace the fan motor, perform the previous steps using the reverse process, and note the following additional points while replacing the motor:

- use the mark from Step 1 to determine the original position of the motor
- tighten the screws securely
- remove the mark from the top of the housing
- ensure that no wires contact the fan blades

CAUTION

Be careful not to pinch the wires under the fan housing.

Power Supply Module Removal/Replacement

The Power Supply module slides out of the rear of the oscilloscope for maintenance and troubleshooting. It may also be removed to gain better access to the A1 Plug-in Interface board or the A4 Regulator board.

See Figures 3-1, 3-5, 3-6, and 3-30 for module, connector, screw, and index locations.

Remove and replace the Power Supply module as follows:

- ☐ Step 1: Turn the oscilloscope on its left side (as viewed facing the rear panel). The Power Supply module will now be at the bottom of the oscilloscope.
- ☐ Step 2: Remove the eight Torx head screws that secure the power supply module.
- ☐ Step 3: Carefully pull the Power Supply module partially out of the oscilloscope (stop short of stretching taut or binding the wires connecting to the A2A2 Control Rectifier board connectors).

CAUTION

Pulling the Power Supply module any further, than partially out of the oscilloscope, may damage connector pins.

- ☐ Step 4: Disconnect connectors J62, J63, J64, J65, J66, J70 and J81 from the A2A2 Control Rectifier board. Note the position of the multi-pin connector's index triangles to ensure that you can correctly replace these connector.
- ☐ Step 5: Remove the chassis ground (green-yellow) wire that is connected from the chassis of the oscilloscope to the Power Supply module.
- ☐ Step 6: Remove the Power Supply module.

To replace the Power Supply module, perform the previous steps using the reverse process.

Note: *Align the metal guides on the top of the Power Supply module with the grooves inside the upper portion of the opening in the oscilloscope.*

Be careful not to pinch any wires or interconnecting cables while installing the Power Supply module.

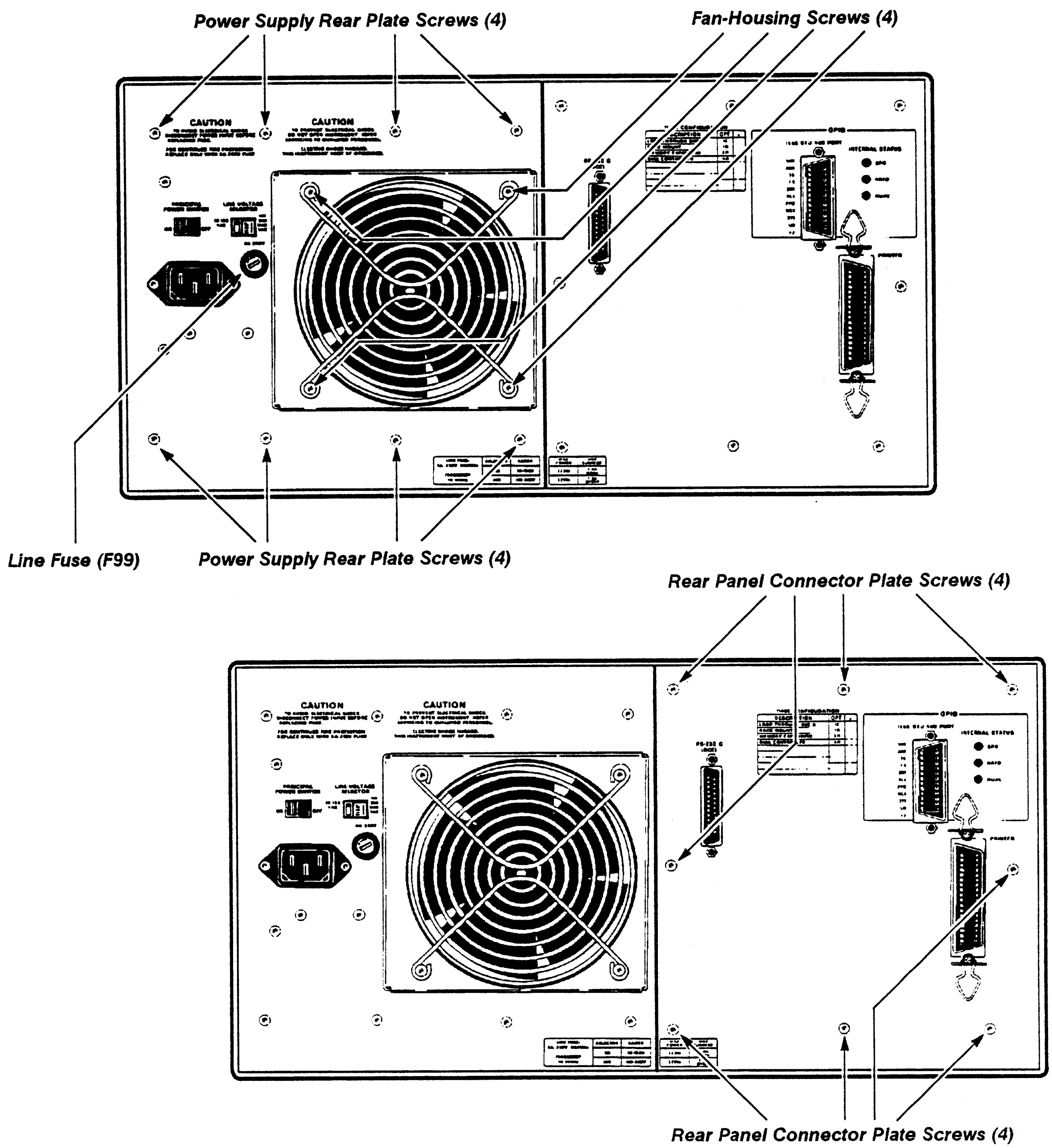


Figure 3-5 — Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector Plate

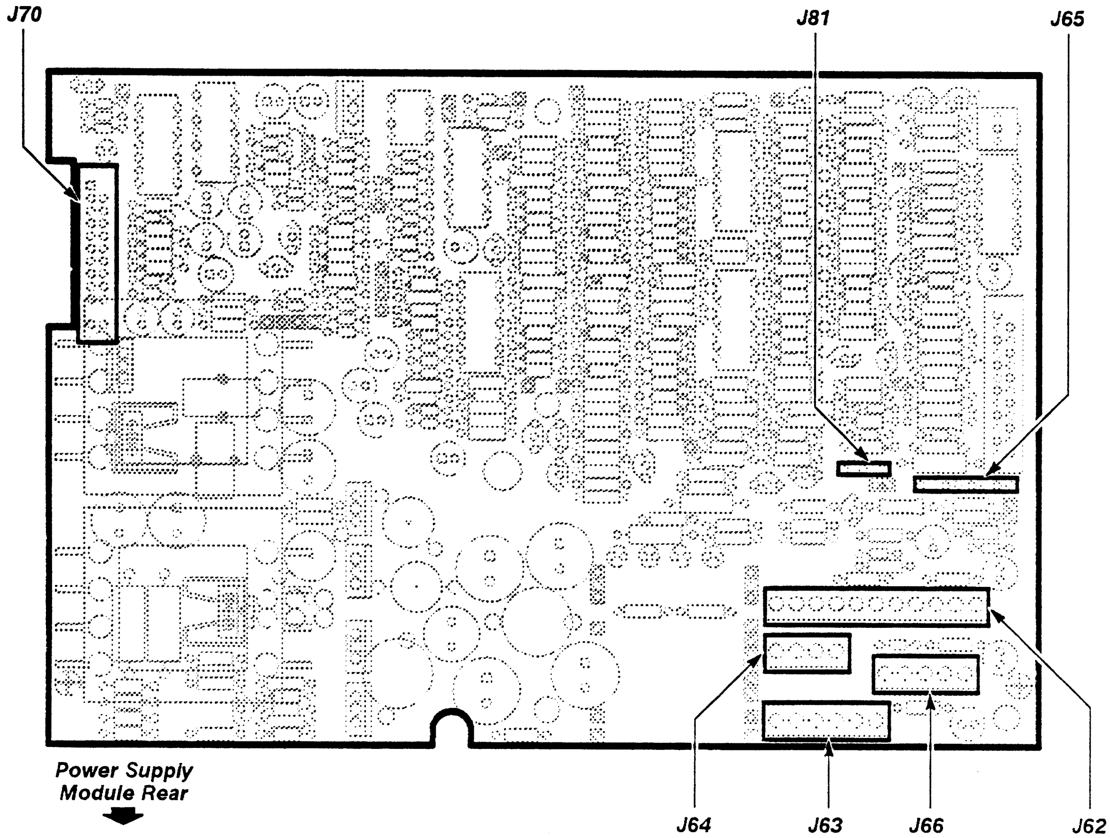


Figure 3-6 — A2A2 Control Rectifier Board Connector Locations

FRU Board and Assembly Removal

Pin connectors are for electrical interconnection with chassis-mounted components and other boards. Most boards/assemblies in the oscilloscope are mounted on the chassis. The following four boards plug onto the top of the A13 Mother board (see Fig. 3-7 for the location of these boards in the card cage):

- A14 Input/Output (I/O)
- A15 Memory Management Unit (MMU)
- A17 Executive Processor (EXP)
- A18 Memory

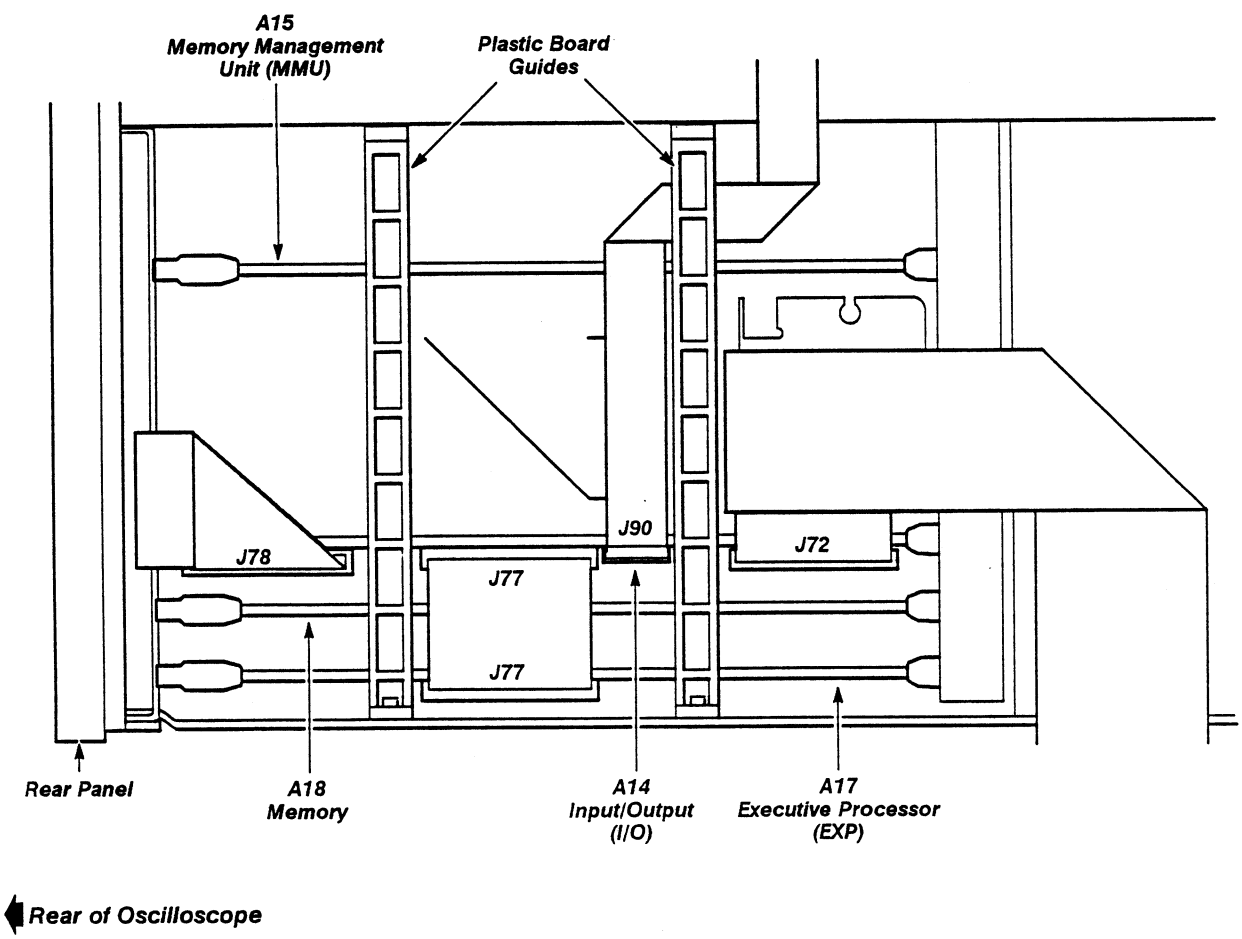


Figure 3-7 *— Top View of the Card Cage*

Feed-through connectors join the plug-on boards to the A13 Mother board.

CAUTION

After removing a board from the oscilloscope, place it on a grounded antistatic surface. This will minimize the chance of static charge damage to the integrated circuits and/or related circuitry.

Some components mounted on a board must be retained for use with the new assembly. These components would include interconnecting plugs, support posts, and some wiring.

A1 Plug-in Interface Board—See Figures 3-1, 3-5, 3-6, 3-7, 3-8, 3-9, 3-10, 3-11, 3-13, and 3-30 for board, connector, screw, and index locations.

Remove and replace the A1 Plug-in Interface board as follows:

☐ Step 1: Remove the nine Torx head screws that secure the three interface connector receptacles to the chassis.

☐ Step 2: Partially remove the Power Supply module (that is, do not disconnect connectors J70 and J81 from the A2A2 Control Rectifier board.

Note: *The chassis ground (green-yellow) wire may be removed from the Power Supply module for this operation only.*

Record the positions of all connectors for correct replacement.

Set the oscilloscope in the upright position (if the oscilloscope is on its side).

☐ Step 3: Disconnect connectors J57 and J60 from the A4 Regulator board.

☐ Step 4: Remove the two Torx head screws from the metal heat sink at the rear of the A4 Regulator board.

Note: *The A4 Regulator board is now unfastened from the chassis. However, it still remains connected to the A1 Plug-in Interface board.*

☐ Step 5: Pull the A4 Regulator board towards the rear to carefully disconnect the J95 and J96 interconnecting pins from the A1 Plug-in Interface board.

☐ Step 6: Remove the A4 Regulator board.

☐ Step 7: Disconnect connector J90 from the A14 I/O board.

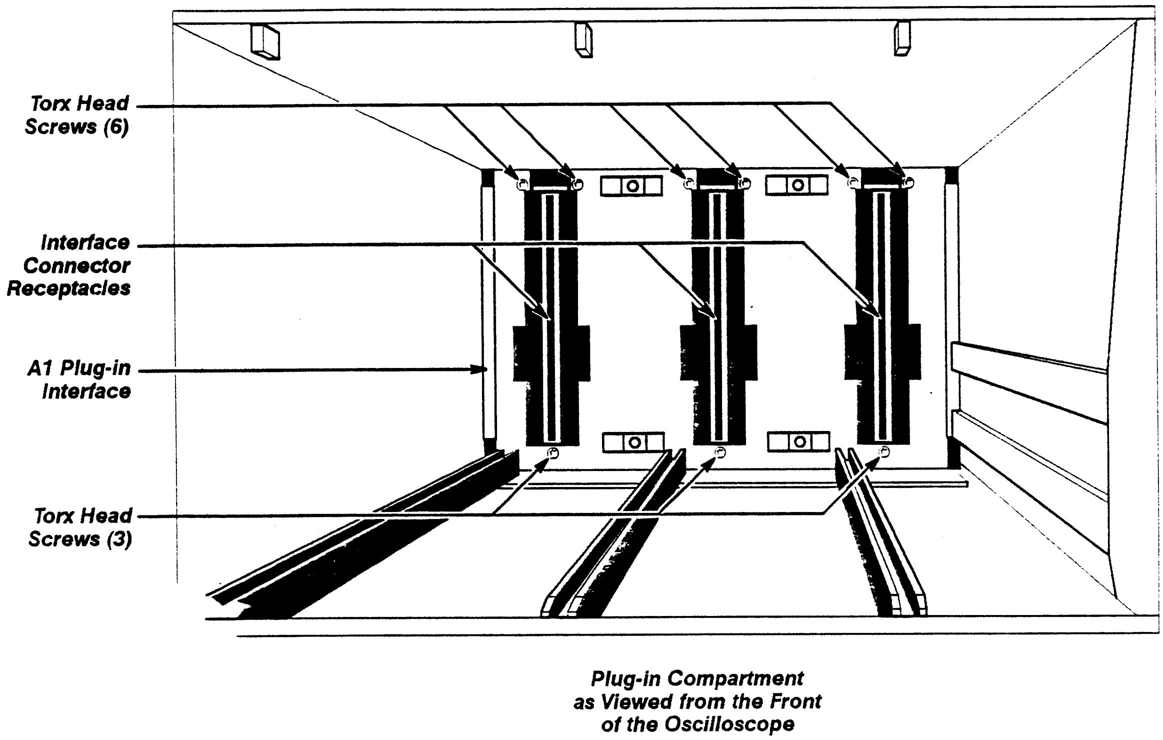


Figure 3-8 – Removing/Replacing the Plug-in Compartment Torx Head Screws

☐ Step 8: Remove the A5 Acquisition board.

☐ Step 9: Disconnect connector J91B from the A6 Time Base board.

Note: *The A1 Plug-in Interface board is no longer attached to the oscilloscope. Although, you must still be careful when removing the board and attached wire assemblies.*

☐ Step 10: Position the oscilloscope so that the A1 Plug-in Interface board can be removed through the top of the oscilloscope chassis.

☐ Step 11: Remove the A1 Plug-in Interface board.

☐ Step 12: Disconnect connector J91 from the A1 Plug-in Interface board.

Note: *The J91 Ribbon cable assembly is not part of the FRU. Retain this cable for use when installing a replacement A1 Plug-in Interface board. All wires remaining attached to the board are part of the FRU and should remain attached to the FRU.*

To replace the A1 Plug-in Interface board, perform the previous steps using the reverse process.

Reconnect the J91 connector on the A1 Plug-in Interface board before reinstalling this board in the oscilloscope.

CAUTION *Ensure that the chassis ground wire is replaced on the Power Supply module.*

Note: *To replace the nine Torx head screws in the A1 Plug-in Interface connector receptacles, start the screws, reinstall the A1 Plug-in Interface board in the oscilloscope, and then tighten all nine Torx head screws into the connector receptacles.*

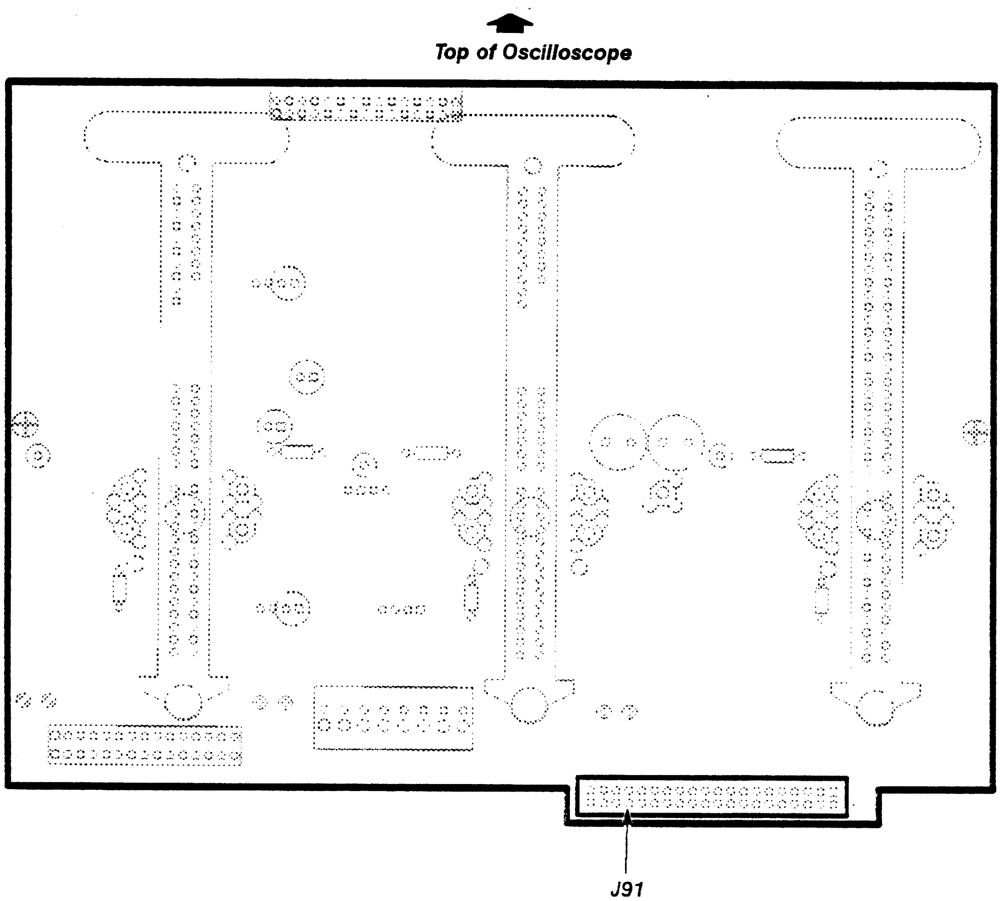


Figure 3-9 *— Removing/Replacing the A1 Plug-in Interface Board*

A4 Regulator Board—See Figures 3-1, 3-5, 3-6, 3-10, and 3-30 for board, connector, screw, and index locations.

Remove and replace the A4 Regulator board as follows:

☐ Step 1: Remove the Power Supply module.

☐ Step 2: Set the oscilloscope in the upright position (if it is not already in this position).

☐ Step 3: Disconnect connectors J57 and J60 from the A4 Regulator board. Note the position of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.

☐ Step 4: Remove the two Torx head screws from the metal heat sink attached to the rear of this board.

Note: *The A4 Regulator board is now unfastened from the chassis. However, it remains connected to the A1 Plug-in Interface board through inter-connecting pins.*

☐ Step 5: Pull the A4 Regulator board toward the rear of the oscilloscope to carefully disconnect the J95 and J96 pins from the A4 Regulator board.

☐ Step 6: Remove the A4 Regulator board.

To replace the A4 Regulator board, perform the previous steps using the reverse process.

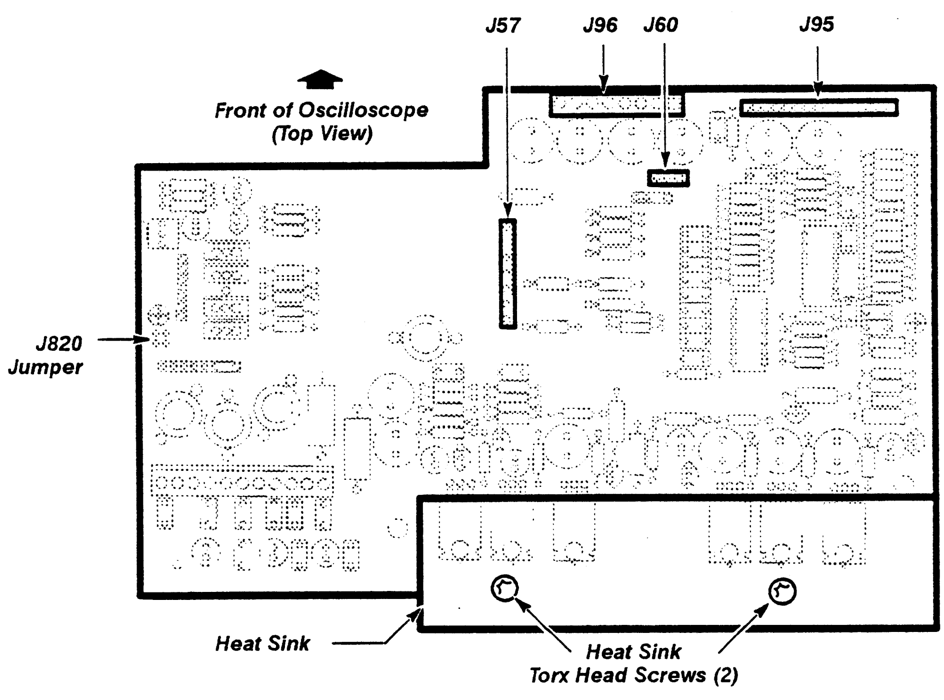


Figure 3-10 — Removing/Replacing the A4 Regulator Board

A5 Acquisition Board—See Figures 3-1, 3-11, and 3-30 for board, connector, screw, and index locations.

Remove and replace the A5 Acquisition board as follows:

☐ Step 1: Turn the oscilloscope on its right side (as viewed facing the front of the oscilloscope). The board is located beneath the card cage and the Power Supply module and beside the A6 Time Base board.

☐ Step 2: Remove the seven Torx head screws from the A6 Time Base board.

☐ Step 3: Remove the two long Torx head screws from the support pivots at the front edges of the board.

☐ Step 4: Grasp the rear-most edge of the board, and pivot the board on its hinges approximately 90° (so that the board is nearly perpendicular to the bottom of the oscilloscope). Do not stress the wire bundles.

☐ Step 5: Disconnect the Peltola connectors J01, J02, J03, J04, J05, J06, J26, J30, J31, J32, J33, J34 and J36 from the center and edges of the A5 Acquisition board. Tag all Peltola connectors that you remove with the corresponding J number to ensure that you can correctly replace these connectors.

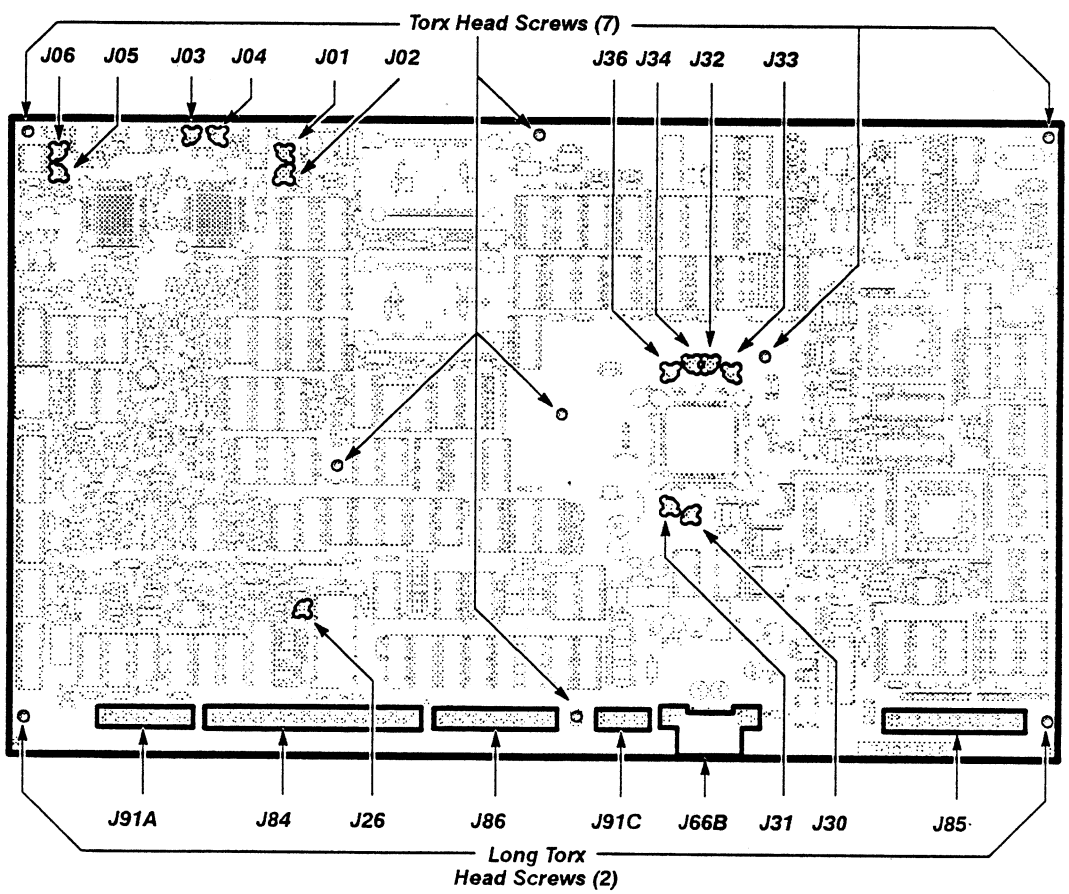


Figure 3-11 — Removing/Replacing the A5 Acquisition Board

☐ Step 6: Disconnect connectors J66B, J84, J85, J86, J91A and J91C from along the inside edge of the A5 Acquisition board. Note the position of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.

☐ Step 7: Remove the A5 Acquisition board.

To replace the A5 Acquisition board, perform the previous steps using the reverse process.

CAUTION

Do not pinch any of the interconnecting wires while replacing this board. And, arrange the wires away from the posts so that these wires will not interfere while you are replacing the Torx head screws.

A5A2 Trigger Enhancement Board—See Figures 3-1, 3-11, 3-12, and 3-30 for board, connector, and screw locations. The A5A2 Trigger Enhancement board is located on the A5 Acquisition board.

Remove and replace the A5A2 Trigger Enhancement board as follows:

☐ Step 1: Remove the A5 Acquisition board.

☐ Step 2: Remove the two hex nuts that secure the A5A2 Trigger Enhancement board.

Note: *The A5A2 Trigger Enhancement board is still secured to the A5 Acquisition board through connector J88.*

☐ Step 3: Disconnect the A5A2 Trigger Enhancement board from the J88 connector on the A5 Acquisition board.

To replace the A5A2 Trigger Enhancement board, perform the previous steps using the reverse process.

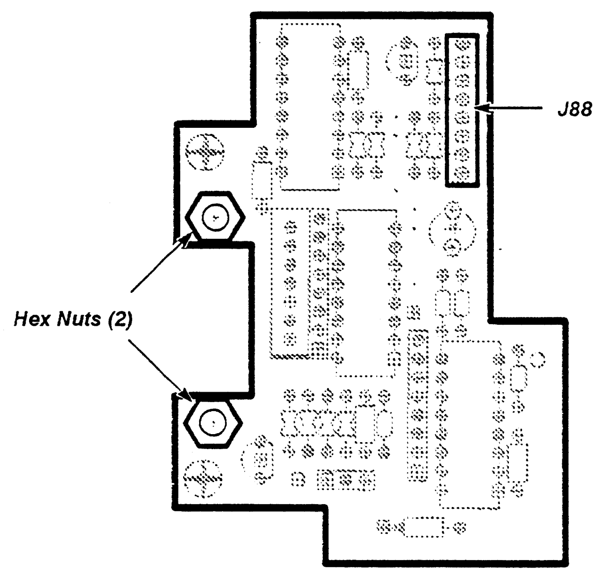


***Figure 3-12** — Removing/Replacing the A5A2 Trigger Enhancement Board*

A6 Time Base Board—See Figures 3-1, 3-11, 3-13, and 3-30 for board, connector, screw, and index locations.

Remove and replace the A6 Time Base board as follows:

☐ Step 1: Turn the oscilloscope on its right side (as viewed facing the front of the oscilloscope). This board is located next to the CRT and the A5 Acquisition board. The A5 Acquisition board overlaps the rear edge of the A6 Time Base board.

☐ Step 2: Remove the seven Torx head screws and the two long Torx head screws at the support pivots from the A5 Acquisition board. **Do not remove the board's connectors.**

☐ Step 3: Move the A5 Acquisition board, so that it no longer overlaps the A6 Time Base board.

☐ Step 4: Remove connectors J66A, J83, J84, J85, J86, and J91B, from the A6 Time Base board. Note the position of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.

☐ Step 5: Remove the spacer post and the five Torx head screws from the A6 Time Base board.

☐ Step 6: Remove the A6 Time Base board.

To replace the A6 Time Base board, perform the previous steps using the reverse process.

CAUTION

Do not pinch any interconnecting wires.

ATTENTION

*If an FRU (field replacement unit) being replaced contains firmware, the **firmware must be removed from the old FRU and installed on the new FRU**. The replacement assemblies (FRUs) will not have any firmware installed from the factory or Module Repair station.*

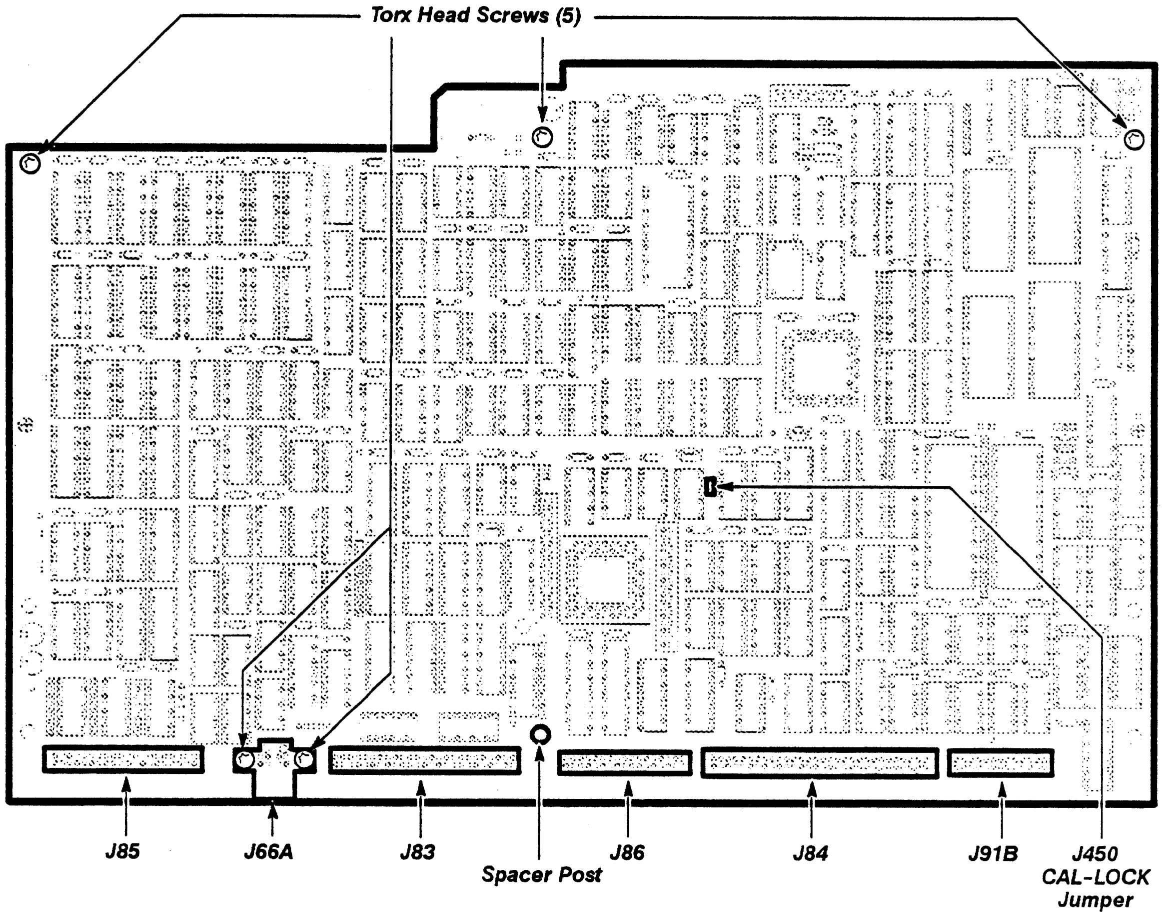


Figure 3-13 – Removing/Replacing the A6 Time Base Board

A7 CRT Socket Board and A8 CRT Driver Board—See Figures 3-1, 3-2, 3-3, 3-7, 3-14, 3-15, 3-18, 3-19, and 3-30 for board, connector, screw, and index locations.

Remove and replace the A7 CRT Socket board and the A8 CRT Driver board as follows:

☐ Step 1: Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover.

☐ Step 2: Remove the two plastic circuit board guides on top of the card cage.

☐ Step 3: Remove the two Torx head screws that secure the A7 CRT Socket board cover, and then remove the A7 CRT Socket board cover.

☐ Step 4: Slowly pull the A7 CRT Socket board toward the rear of the oscilloscope to unplug the A7 CRT Socket board from the CRT.

☐ Step 5: Disconnect connectors J53 and J56 on the A7 CRT Socket board. Note the positions of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.

WARNING

The CRT anode voltage is 16 kV. Ground the anode lead from the CRT to the chassis to short any stored charge remaining in the CRT. Wait approximately ten minutes, then ground the anode lead to the chassis again (refer to Step 6).

☐ Step 6: Use a non-conducting tool to pry up the anode lead cap. This rubber cap is located on the upper part of the CRT, behind the front casting. Release the spring clip inside the cap and remove the anode. Insert one blade of a pair of needle-nose pliers against the anode, and touch the other blade to the top of the front casting to ground the anode to the chassis.

☐ Step 7: Remove the single Torx head screw that secures the A8 CRT Driver board to the oscilloscope chassis. Use either of the following methods to remove the Torx head screw:

- Remove the Torx head screw with a very short handled T-15 Torx head screwdriver. Ensure that you do not strike the CRT while removing the screw.
- Remove the A10 Front Panel Control board. Then, use a Torx head screwdriver that has an extension length inserted in it to remove the Torx head screw. Access the screw from the hole in the left side of the oscilloscope chassis. Ensure that you do not strike the CRT while removing the screw.

☐ Step 8: Remove the single Torx head screws that secures the transformer, on the A8 CRT Driver board, to the oscilloscope chasis. This screw is located at the rear of the transformer. The A8 CRT Driver board is now unattached to the oscilloscope chasis.

☐ Step 9: Disconnect connectors J52, J56, and J57 from the A8 CRT Driver board. Note the position of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.

☐ Step 10: Lift the A8 CRT Driver board partially out of the oscilloscope chassis.

☐ Step 11: Disconnect connectors J54 and J55 from the A8 CRT Driver board. Note the position of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.

☐ Step 12: Remove the A8 CRT Driver board and the A7 CRT Socket board.

☐ Step 13: Unsolder the two wires that connect the A8 CRT Driver board to the A7 CRT Socket board (the two boards are now separated).

To replace the A8 CRT Driver board and the A7 CRT Socket board, perform the previous steps using the reverse process.

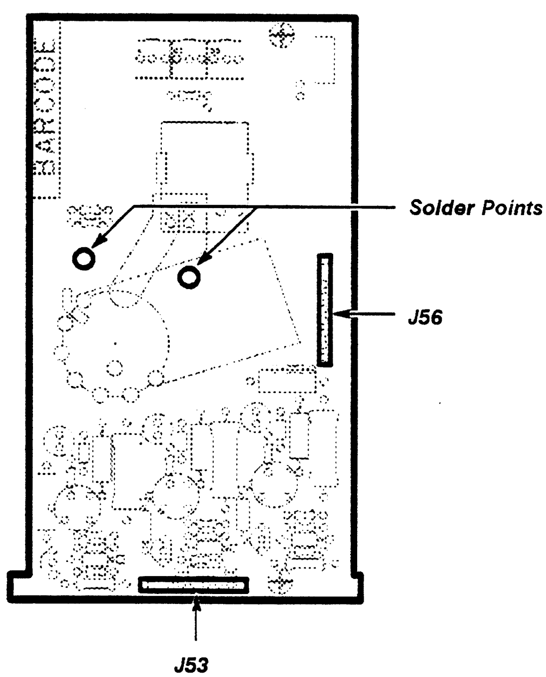


***Figure 3-14** – Removing/Replacing the A7 CRT Socket Board*

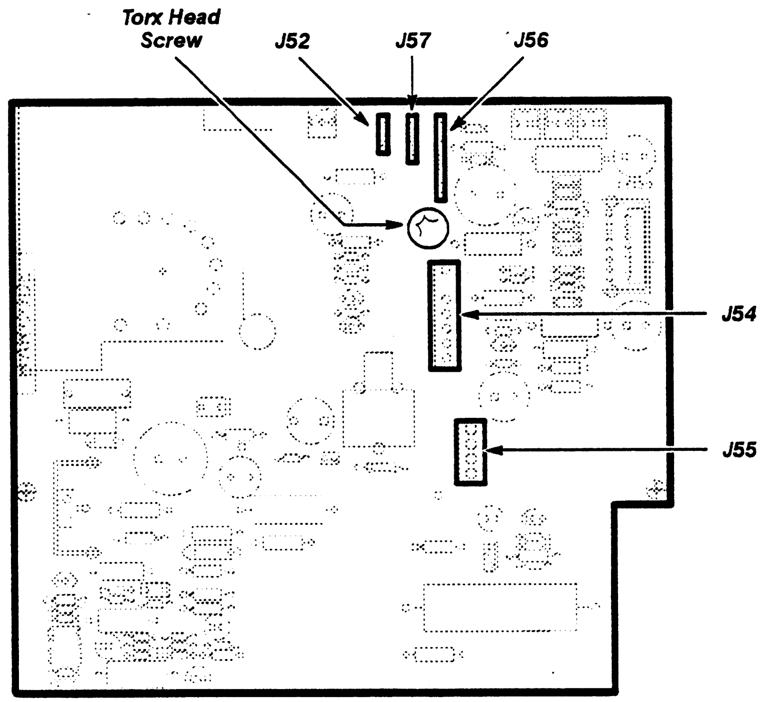


Figure 3-15 — Removing/Replacing the A8 CRT Driver Board

A9 Touch Panel Assembly—See Figures 3-1, 3-16, 3-17, 3-19, and 3-30 for connector, screw, and index locations.

Remove and replace the A9 Touch Panel assembly as follows:

☐ Step 1: Set the oscilloscope on its right side. (The CRT will now be at the top.)

☐ Step 2: Use a $^1/_{16}$-inch allen wrench to loosen the small allen screws in each of the two control knobs.

☐ Step 3: Slowly remove the two control knobs so that you do not lose the small allen screws inside the knobs.

☐ Step 4: Remove the two Torx head screws at the bottom of the A9 Touch Panel Assembly.

☐ Step 5: Lift up on the bottom of the A9 Touch Panel Assembly, and swing the assembly outward.

Note: *The top of the A9 Front Panel Assembly is held by two tabs. These tabs fit into two slots in the front-panel chassis.*

☐ Step 6: Disconnect the back ground wire from the quick-disconnect ground connector on the front panel casting.

☐ Step 7: Disconnect connector J73 from the A10 Front Panel Control board. Note the position of multi-pin connector's index triangles to ensure that you can correctly replace this connector. Carefully remove the wire cable through the slot provided in the front casting.

Cover the A9 Touch Panel Assembly with protective material once it is removed, since the plastic exterior may scratch.

To replace the A9 Touch Panel Assembly board, perform the previous steps using the reverse process.

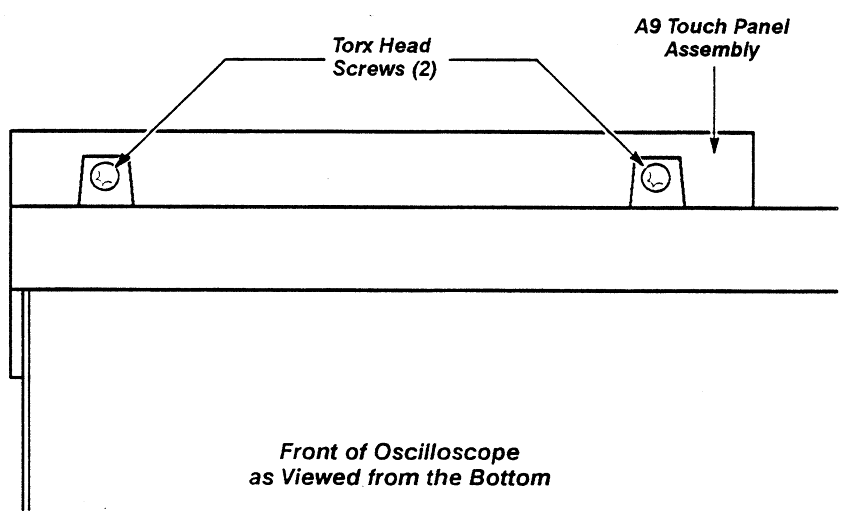


***Figure 3-16** — A9 Touch Panel Assembly Torx Head Screws*

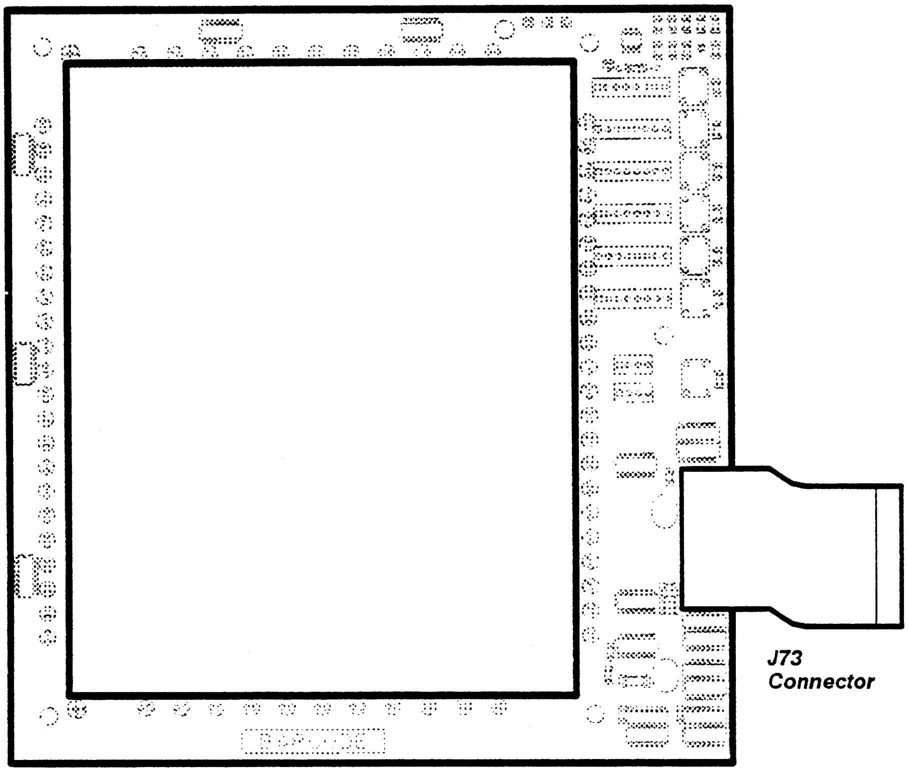


Figure 3-17 — Removing/Replacing the A9 Touch Panel Assembly

A10 Front Panel Control Board—See Figures 3-1, 3-2, 3-18, 3-19, and 3-30 for board, connector, screw, and index locations.

Remove and replace the A10 Front Panel Control board as follows:

☐ Step 1: Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover.

☐ Step 2: Remove the two Torx head screws that secure the support bracket attached to the upper, left side of the oscilloscope chassis. This support bracket secures the A10 Front Panel Control board to the oscilloscope chassis, and also provides support to the left-most Degauss coil.

☐ Step 3: Remove the single Torx head screw that secures the plastic clamp from the left-most Degauss coil to the support bracket.

☐ Step 4: Disconnect connector J72 from the A10 Front Panel Control board. Note the position of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.

☐ Step 5: Lift the A10 Front Panel Control board and the connected support bracket partially out of the oscilloscope chassis.

☐ Step 6: Disconnect connectors J73, J74 and J75 from the A10 Front Panel Control board. Note the position of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.

☐ Step 7: Remove the A10 Front Panel Control board and the connected support bracket from the plastic board guide at the bottom of the chassis.

☐ Step 8: Remove the two Torx head screws that secure the A10 Front Panel Control board to the support bracket.

☐ Step 9: Remove the A10 Front Panel Control board from the support bracket.

To replace the A10 Front Panel Control board, perform the previous steps using the reverse process.

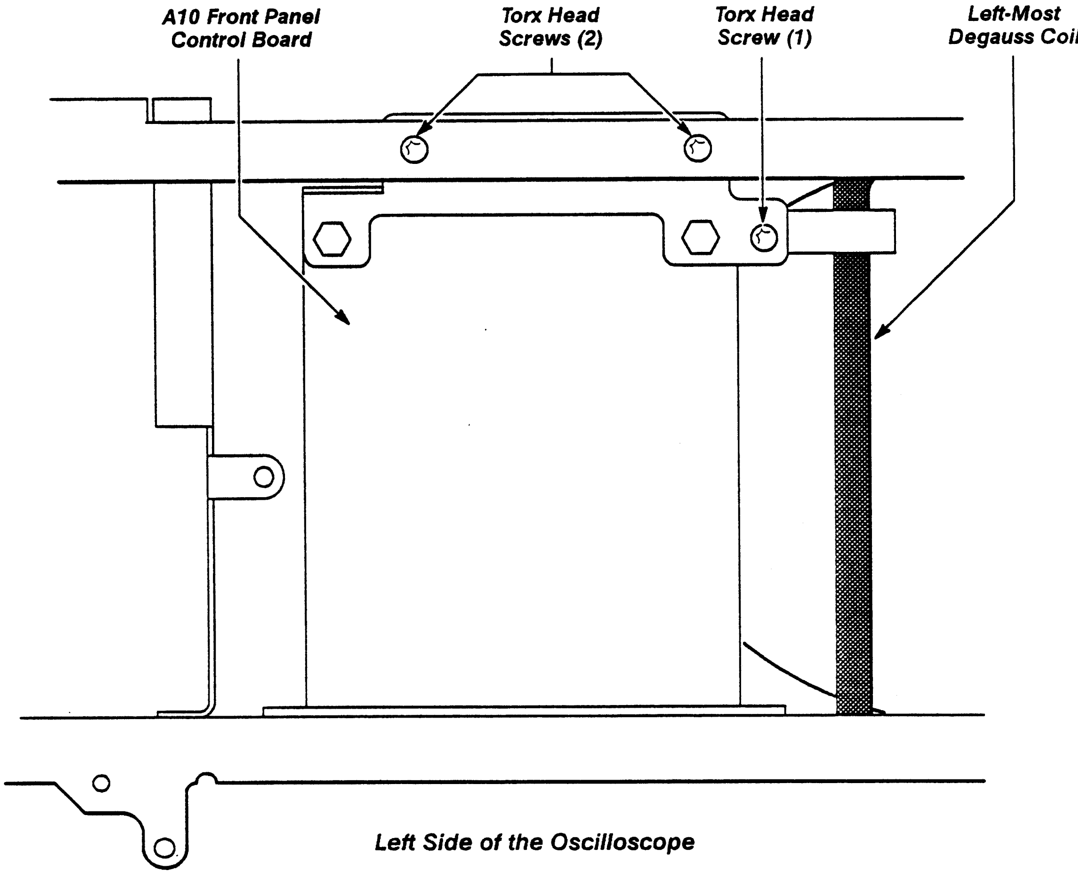


Figure 3-18 — *Removing/Replacing the A10 Front Panel Control Board Torx Head Screws*

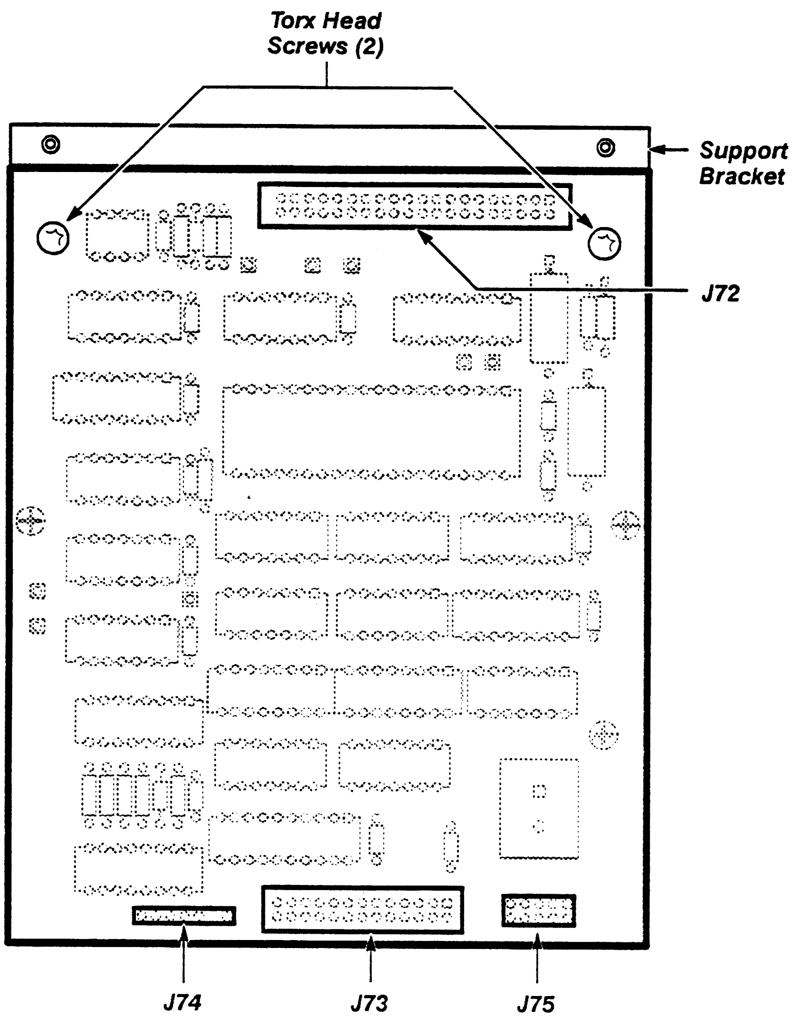


Figure 3-19 — Removing/Replacing the A10 Front Panel Control Board

A11 Front Panel Button Board—See Figures 3-1, 3-2, 3-18, 3-19, 3-20, and 3-30 for board, connector, screw, and index locations.

Remove and replace the A11 Front Panel Button board as follows:

☐ Step 1: Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover.

☐ Step 2: Remove the two Torx head screws that secure the support bracket attached to the upper, left side of the oscilloscope. This support bracket secures the A10 Front Panel Control board to the oscilloscope chassis, and also provides support to the left-most Degauss coil.

☐ Step 3: Remove the single Torx head screw that secures the plastic clamp from the left-most Degauss coil to the support bracket.

☐ Step 4: Disconnect connector J72 from the A10 Front Panel Control board. Note the position of multi-pin connector's index triangles to ensure that you can correctly replace this connector.

☐ Step 5: Lift the A10 Front Panel Control board partially out of the oscilloscope chassis, and then disconnect connector J75 from the A10 Front Panel Control board. Note the position of multi-pin connector's index triangles to ensure that you can correctly replace this connector.

☐ Step 6: Route the J75 connector and cable under the CRT and out of the oscilloscope chassis.

CAUTION

Ensure that you do not strike or damage the CRT when routing the J75 connector out of, or into the oscilloscope chassis.

☐ Step 7: Remove the two Torx head screws from the A11 Front Panel Button board; which are located at the top and near the inside center of the front casting.

☐ Step 8: Remove the A11 Front Panel Button board.

To replace the A11 Front Panel Button board, perform the previous steps using the reverse process.

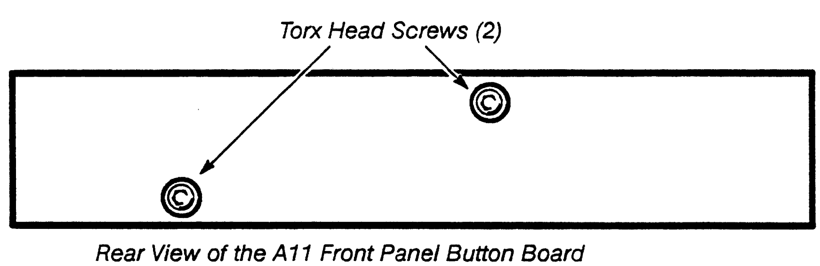


***Figure 3-20** — Removing/Replacing the A11 Front Panel Button Board*

A12 Rear Panel Assembly—See Figures 3-1, 3-5, 3-21, 3-23, and 3-30 for assembly, connector, screw, and index locations.

Remove and replace the A12 Rear Panel assembly as follows:

- [ ] Step 1: Remove any connectors from the RS-232-C, the GPIB, and the PRINTER connector holders.
- [ ] Step 2: Disconnect connector J78 from the A14 I/O board. Note the position of multi-pin connector's index triangles to ensure that you can correctly replace these connectors.
- [ ] Step 3: Remove the eight Torx head screws from the outer edges of the rear panel connector plate.
- [ ] Step 4: Tilt the plate away from the oscilloscope. Remove connector J78 from the top of the A12 Rear Panel assembly. Note the position of multi-pin connector's index triangles to ensure that you can correctly replace this connector. The J78 cable is now unattached from all boards in the oscilloscope. Save this cable for replacing the A12 Rear Panel Assembly.
- [ ] Step 5: Pull out the rear panel connector plate and the attached A12 Rear Panel Assembly from the oscilloscope.
- [ ] Step 6: Remove the black ground wire screw from the card cage chassis.
- [ ] Step 7: Remove the following items from the rear panel connector plate:
  - two bail brackets, screws, and washers from the PRINTER connector
  - two posts from the GPIB connector
  - posts, lock washers, and flat washers from the RS-232-C connector(s)
  - Torx head screw and washer (at the lower left of the connector plate, if present)
- [ ] Step 8: Remove the A12 Rear Panel assembly from the rear panel connector plate.

CAUTION

The metal covers on the PRINTER and the GPIB connectors are loose. If the board is inverted, these covers will drop from the board.

To replace the A12 Rear Panel assembly, perform the previous steps using the reverse process.

Note: *Replacement of connector J78 will be simplified if you replace the connector before reinstalling the rear panel connector plate on the rear of the chassis.*

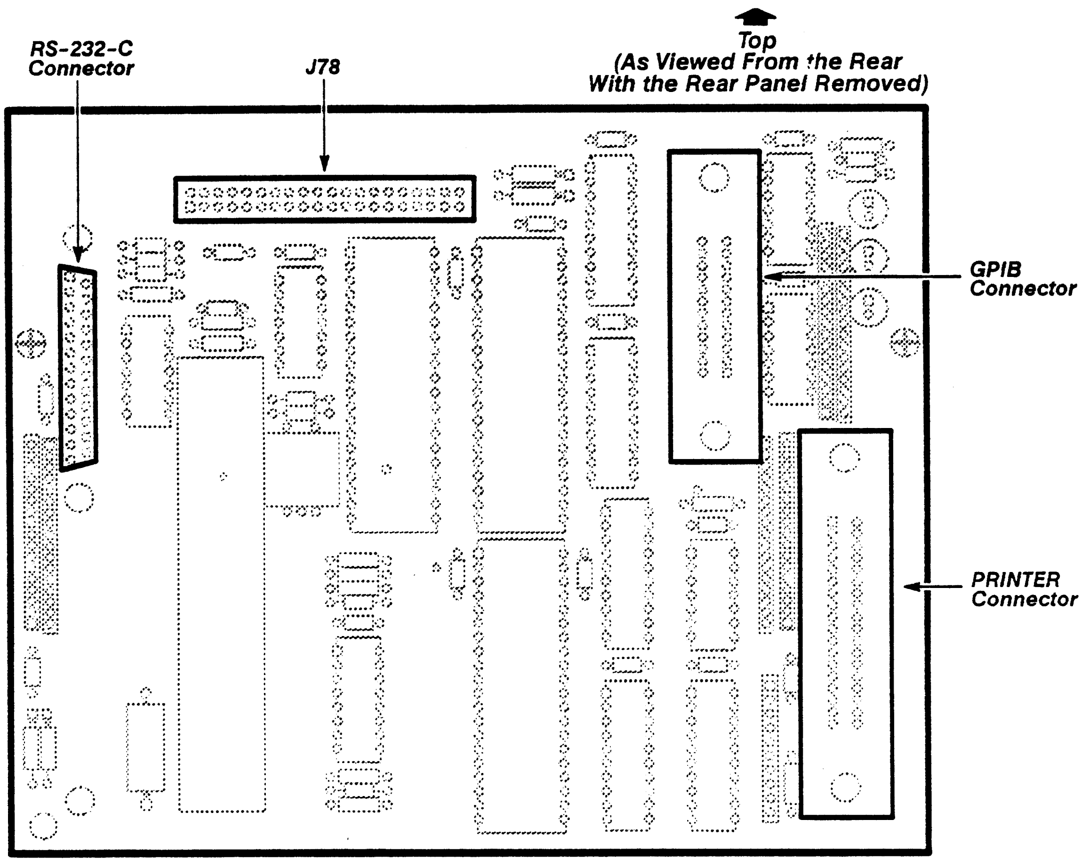


Figure 3-21 — Removing/Replacing the A12 Rear Panel Assembly

A13 Mother Board—See Figures 3-1, 3-2, 3-7, 3-22, 3-23, 3-24, 3-25, 3-26, and 3-30 for board, connector, screw, and index locations.

Remove and replace the A13 Mother board as follows:

☐ Step 1: Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover.

☐ Step 2: Remove both of the plastic board guides from the top of the card cage. The guides are retained by two small catches, located in two holes in the left side bracket of the card cage. The other ends of the guides contain slots which attach to the edge of a metal bracket. Both ends of the guides can be pried loose.

☐ Step 3: Remove the A14 I/O, A15 MMU, A17 Main Processor, and A18 Memory boards. Note the position of the multi-pin connector's index triangles to ensure that the connectors can be correctly replaced.

Note: *Tag the interconnecting plugs and mark the board locations to ensure that the plugs can be correctly replaced.*

☐ Step 4: Remove connector J63A from the A13 Mother board.

☐ Step 5: Remove the six Torx head screws from the A13 Mother board.

☐ Step 6: Remove the A13 Mother board.

To replace the A13 Mother board, perform the previous steps using the reverse process.

CAUTION

Be careful not to pinch the wires along the inside edge while replacing this board.

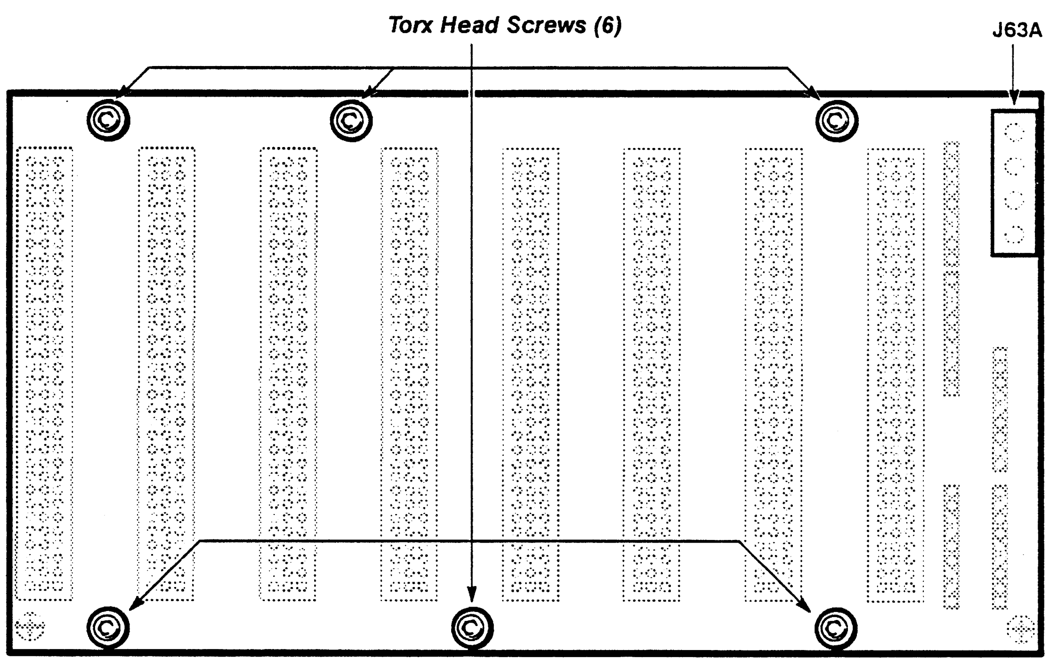


***Figure 3-22** — Removing/Replacing the A13 Mother Board*

A14 Input/Output (I/O) Board—See Figures 3-2, 3-7, 3-23, and 3-30 for board, connector, screw, and index locations.

Remove and replace the A14 I/O board as follows:

- ☐ Step 1: Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover.
- ☐ Step 2: Remove both of the plastic board guides from the top of the card cage. These guides are retained by two small catches located in two holes in the left bracket of the card cage. The other ends of the guides contain slots which attach to the edge of a metal bracket. Both ends of the guides can be pried loose.
- ☐ Step 3: Disconnect connectors J72, J77, J78, and J90 from the A14 I/O board. Note the position of multi-pin connector's index triangles to ensure that you can be correctly replace these connectors.
- ☐ Step 4: Lift the white, hinged tab at the upper, front edge of the board. Pull the tab upward until the A14 I/O board separates from the A13 Mother board.
- ☐ Step 5: Remove the A14 I/O board.

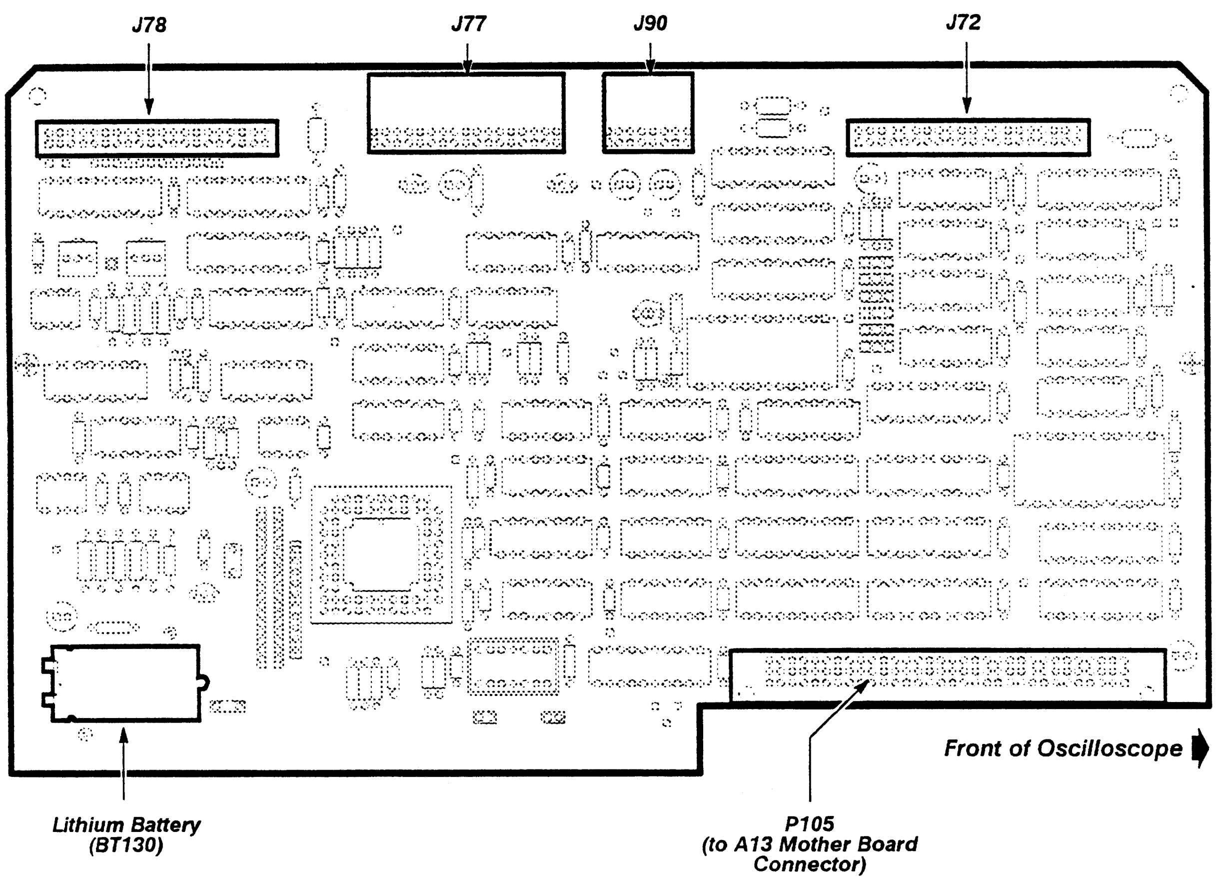


Figure 3-23 — Removing/Replacing the A14 I/O Board

To replace the A14 I/O board, perform the previous steps using the reverse process.

Note: *Insert the board edges into the plastic guides at each end of the card cage. Lower the board into position.*

Ensure that connector P105 is seated on the A13 Mother board connector. Push down firmly on the A14 I/O board to connect this connector to the A13 Mother board.

WARNING

A lithium battery (BT130) is mounted on the A14 I/O board. ***This battery requires special handling for disposal.*** *Refer to the instructions on Lithium Battery Disposal and First Aid earlier in this section. Care is required when placing the A14 I/O board on metal surfaces. If some IC or battery leads are shorted, the battery may discharge or overheat and vent. (You can use plastic standoffs to prevent short circuits.)*

A15 Memory Management Unit (MMU) Board—See Figures 3-2, 3-7, 3-23, 3-24, and 3-30 for board, connector, screw, and index locations.

Remove and replace the A15 MMU board as follows:

☐ Step 1: Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover.

☐ Step 2: Remove both of the plastic board guides from the top of the card cage. The guides are retained by two small catches located in two holes in the left bracket of the card cage. The other ends of the guides contain slots which attach to the edge of a metal bracket. Both ends of the guides can be pried loose.

☐ Step 3: Disconnect connectors J52, J57, and J83 from the A15 MMU board. Note the position of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.

☐ Step 4: Disconnect connector J90 from the A14 I/O board.

☐ Step 5: Lift the white, hinged tabs at the front and rear edges of the A15 MMU board. Pull the tabs upward until the A15 MMU board separates from the A13 Mother board.

☐ Step 6: Remove the A15 MMU board.

ATTENTION

If an FRU (field replacement unit) being replaced contains firmware, the ***firmware must be removed from the old FRU and installed on the new FRU.*** *The replacement assemblies (FRUs) will not have any firmware installed from the factory or Module Repair station.*

To replace the A15 MMU board, perform the previous steps in the reverse order.

Note: *Insert the board edges into the plastic guides at each end of the card cage. Lower the board into position.*

Ensure that connector P101 is seated onto the A13 Mother board connector. Push down firmly on the A15 MMU board to connect this connector to the A13 Mother board.

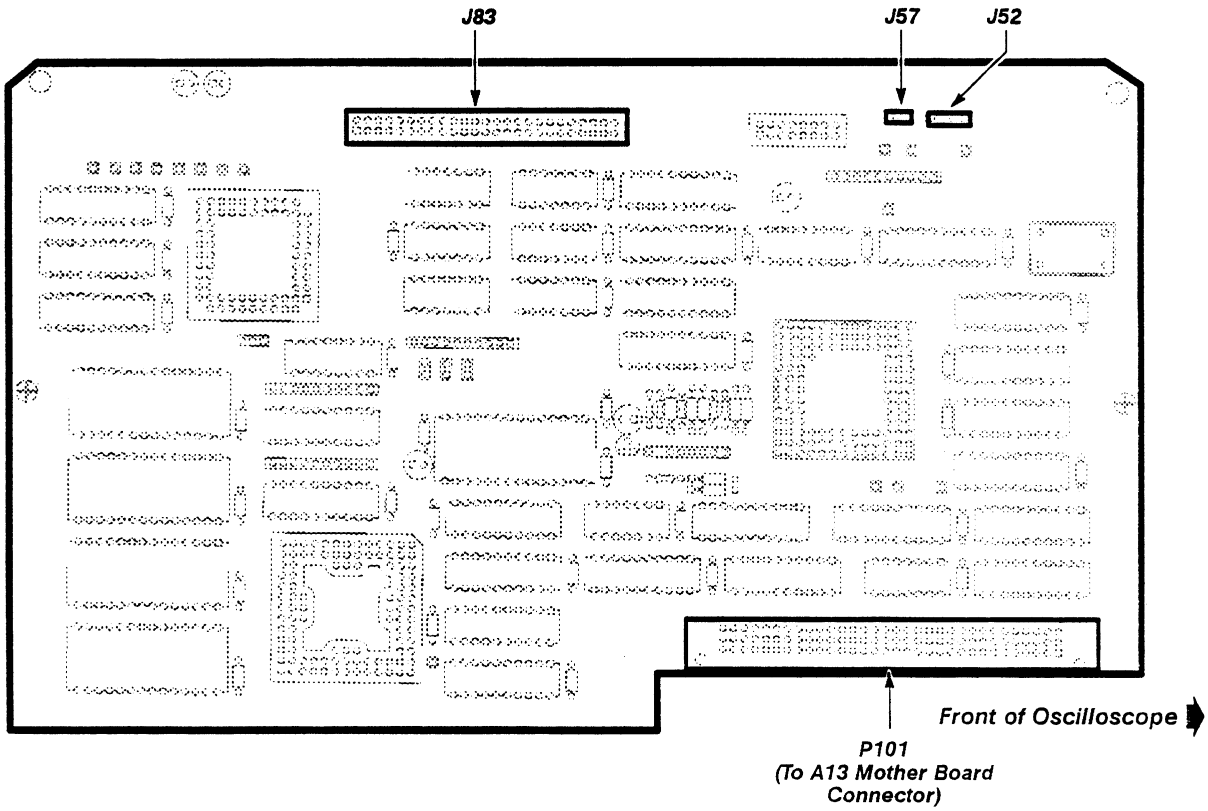


Figure 3-24 *— Removing/Replacing the A15 MMU Board*

A17 Executive Processor (EXP) Board—See Figures 3-2, 3-7, 3-25, and 3-30 for board, connector, screw, and index locations.

Remove and replace the A17 Executive Processor board as follows:

- ☐ Step 1: Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover.
- ☐ Step 2: Remove both of the plastic board guides from the top of the card cage. The guides are retained by two small catches located in two holes in the left bracket of the card cage. The other ends of the guides contain slots which attach to the edge of a metal bracket. Both ends of the guides can be pried loose.
- ☐ Step 3: Disconnect connector J77 from the A17 Executive Processor board. Note the position of the multi-pin connector's index triangle to ensure that you can correctly replace this connector.
- ☐ Step 4: Lift the white, hinged tabs at the front and rear edges of the board. Pull the tabs upward until the A17 Executive Processor board separates from the A13 Mother board.
- ☐ Step 5: Remove the A17 Executive Processor board.

To replace the A17 Executive Processor board, perform the previous steps using the reverse process.

Note: *Insert the board edges into the plastic guides at each end of the card cage. Lower the board into position.*

Ensure that connector P104 on the A17 Executive Processor board is seated onto the of A13 Mother board connector. Push down firmly on the A17 Executive Processor board to connect this connector to the A13 Mother board.

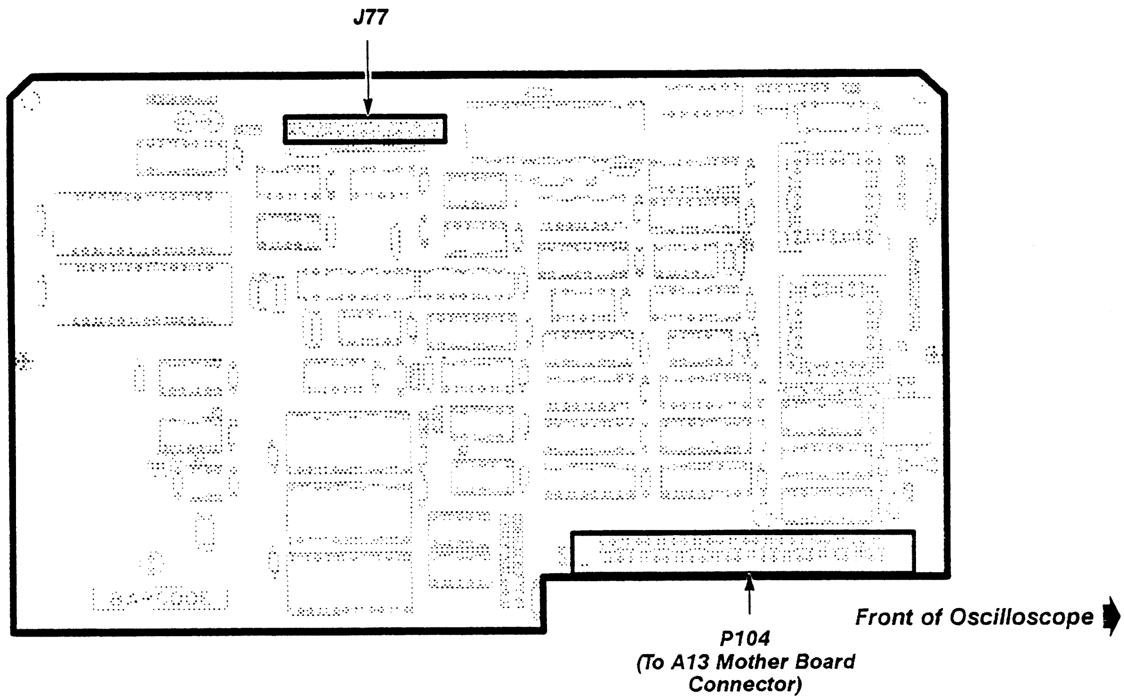


Figure 3-25 — Removing/Replacing the A17 Executive Processor Board

A18 Memory Board—See Figures 3-2, 3-7, 3-25, 3-26, and 3-30 for board, connector, screw, and index locations.

Remove and replace the A18 Memory board as follows:

☐ Step 1: Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover.

☐ Step 2: Remove both of the plastic board guides from the top of the card cage. The guides are retained by two small catches located in two holes in the left bracket of the card cage. The other ends of the guides contain slots which attach to the edge of a metal bracket. Both ends of the guides can be pried loose.

☐ Step 3: Disconnect connector J77 from the A17 Executive Processor board. Note the position of the multi-pin connector's index triangle to ensure that you can correctly replace this connectors.

☐ Step 4: Lift the white, hinged tabs at the front and rear edges of the board. Pull the tabs upward until the A18 Memory board separates from the A13 Mother board.

☐ Step 5: Remove the A18 Memory board.

ATTENTION *If an FRU (field replacement unit) being replaced contains firmware, the* ***firmware must be removed from the old FRU and installed on the new FRU****. The replacement assemblies (FRUs) will not have any firmware installed from the factory or Module Repair station.*

To replace the A18 Memory board, perform the previous steps using the reverse process.

Note: *Insert the edges of the board into the plastic guides at each end of the card cage. Lower the board into position.*

Ensure that connector P106 is seated onto the A13 Mother board connector. Push down firmly on the A18 Memory board to connect this connector to the A13 Mother board.

WARNING *A lithium battery (BT150) is mounted on the A18 Memory board.* ***The battery requires special handling for disposal****. Refer to the instructions on Lithium Battery Disposal and First Aid earlier in this section. Care is required when placing the A18 Memory board on metal surfaces. If some IC or battery leads are shorted, the battery may discharge or overheat and vent. (You can use plastic standoffs to prevent short circuits.)*

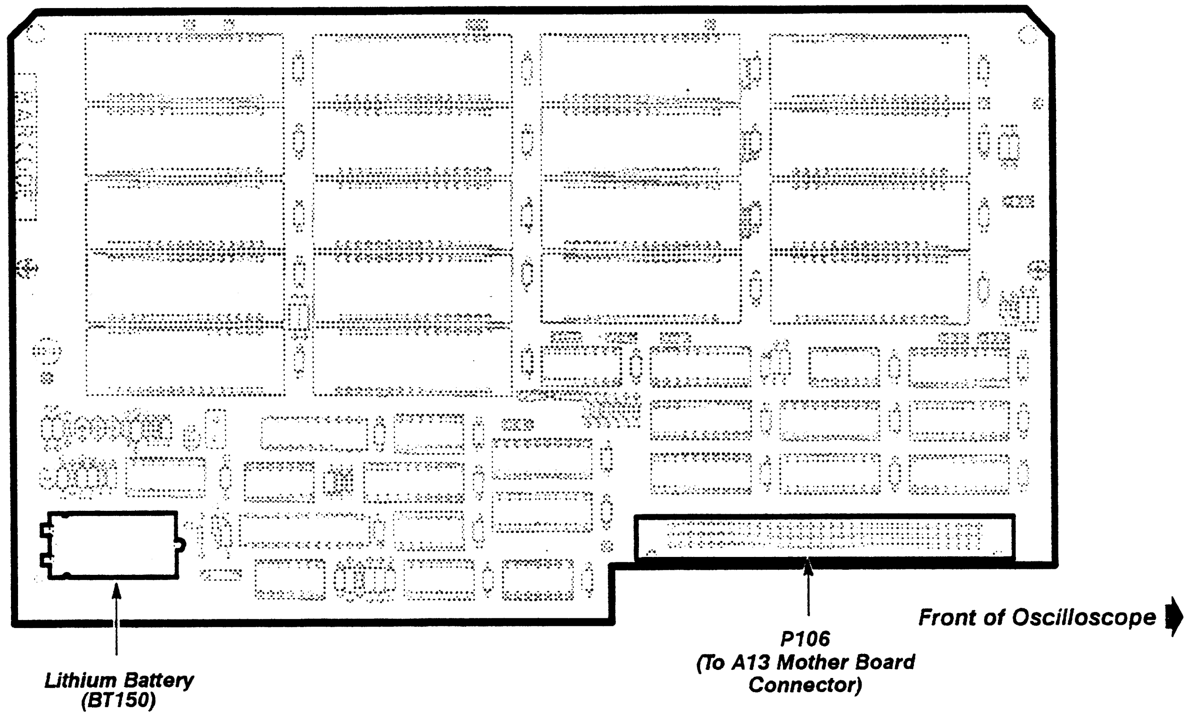
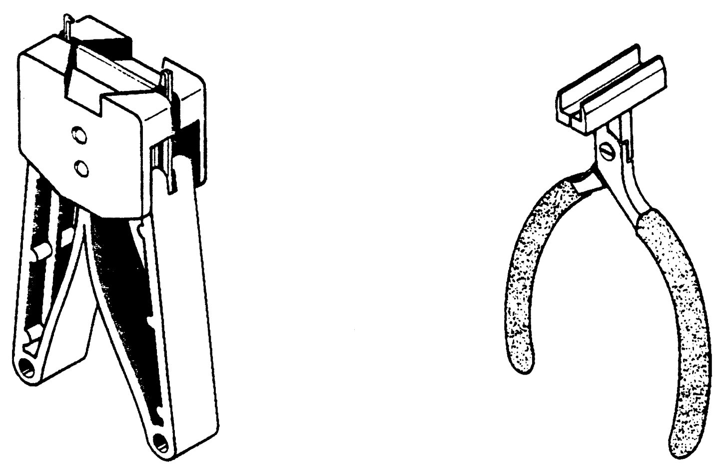


Figure 3-26 — Removing/Replacing the A18 Memory Board

FRU IC Removal

This section lists the procedures for removing and replacing the FRU ICs in the oscilloscope. See Figures 3-1, 3-27, 3-28, and 3-29 for board locations, IC locations, index information, and the proper tools for removing/replacing these ICs.

Destination Address Generator Integrated Circuits (DAG IC) and Direct Memory Address Integrated Circuit (DMA IC)—The DAG IC (U166) is located on the A6 Time Base board and the DMA IC is located on the A17 Executive Processor board. These ICs is seated in sockets soldered onto the boards. These ICs are oriented to their sockets by a beveled corner. (One IC corner is beveled while the other three are notched.) This beveled corner aligns with a beveled corner on the outer edge of the IC socket.



DAG and DMA IC Extraction Pliers ***DIP IC Extraction Tool***

***Figure 3-27** — IC Extraction Tools*

Remove the DAG IC or DMA IC as follows:

CAUTION

Observe all the special precautions described under Static-Sensitive Device Classification earlier in this section.

☐ Step 1: Insert the hook-shaped, plier tips of the DAG IC and DMA IC extraction pliers (see Fig. 3-27) into the slots in the opposite corners of the IC socket.

☐ Step 2: Squeeze the handles of the pliers to lift the IC from the socket.

☐ Step 3: Carefully remove the IC so that you do not damage any IC pins.

CAUTION

Avoid touching the IC or its socket contacts with your fingers. Finger oils can degrade reliability.

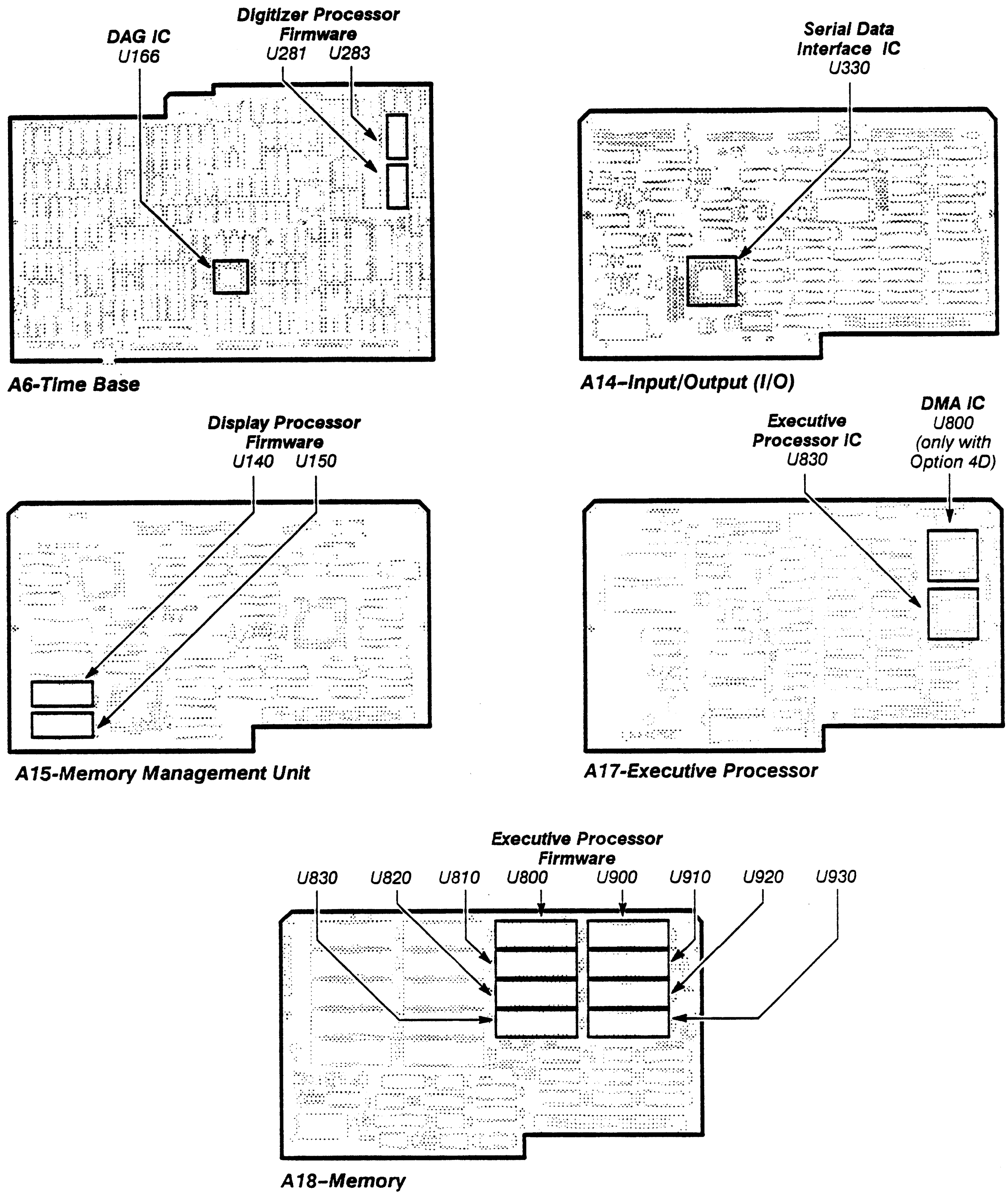


Figure 3-28 — *FRU IC Detail*

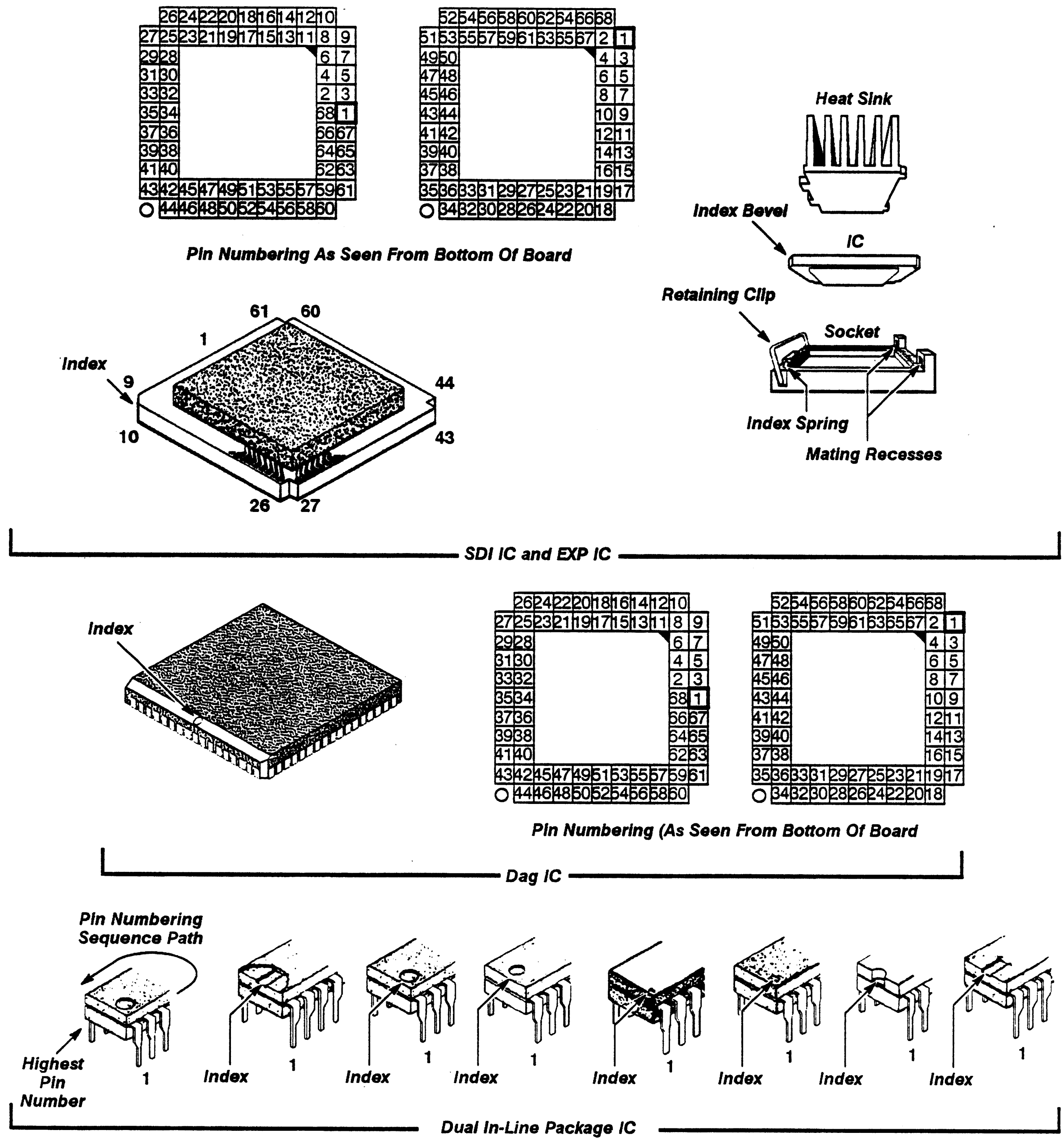


Figure 3-29 — Semiconductor Indexing Diagram

Replace the DAG IC or DMA IC as follows:

Note: *One of the upper sides of the IC is also beveled. This side has a dot that aligns with an arrow is marked on the bottom of the IC socket.*

☐ Step 1: Align the beveled corner of the IC to the side of the socket to which the arrow points.

☐ Step 2: Ensure that the beveled IC corner also aligns with the outer beveled corner of the socket, and that the IC is flat against the socket.

☐ Step 3: Ensure that all IC pins align correctly with their respective socket contacts.

☐ Step 4: Push down carefully on the IC to seat the IC in its socket.

Serial Data Interface Integrated Circuit (SDI IC) and Executive Processor Integrated Circuit (EXP IC)—The SDI IC (U330) is mounted on the A14 I/O board and the EXP IC (U830) is located on the A17 Executive Processor board. These ICs have a raised, ridged, heat sink, cover. The ICs are oriented to their sockets by a beveled corner. The other corners are notched to fit the edges of the socket. The beveled corner aligns with a spring (small metal tab) at one corner of the socket.

Remove the SDI IC or the EXP IC as follows:

☐ Step 1: Remove the board containing the IC you are removing (either the A14 I/O board or the A17 Executive Processor board) from the card cage.

☐ Step 2: Hold the cover in place (while simultaneously pushing down slightly on the cover), and move the retaining clip across the tabs to unfasten the clip.

CAUTION

Observe all the special precautions mentioned under Static-Sensitive Classification earlier in this section.

☐ Step 3: Remove the cover slowly to prevent the IC from falling out.

Note: *Observe the index of the IC before removing it.*

☐ Step 4: Remove the IC with tweezers.

CAUTION

Avoid touching the IC or the socket contacts with your fingers. Skin oils can degrade reliability.

Replace the SDI IC or the EXP IC as follows:

☐ Step 5: Using tweezers, place the beveled corner of the replacement IC against the index spring.

CAUTION

Do not damage the spring with the beveled corner. Shorting of the two corner contacts could result.

- [ ] Step 6: Using the tweezers, arrange the other corners to fit evenly at the edges of the socket.
- [ ] Step 7:. Set the cover flat on the IC with its end tabs properly aligned with, but not in, the mating recesses in the socket.
- [ ] Step 8: Push down on the cover, keeping it flat on the IC, and slide the cover end tabs into place. Hold the cover in this position while moving the retaining clip over the tabs at the other end of the cover.
- [ ] Step 9: Check that the cover is secure.
- [ ] Step 10: Replace the board removed earlier, either the A14 I/O board or the A17 Executive Processor board.

Firmware Integrated Circuits ("Dual In-Line Package" ICs) – The firmware integrated circuits (FW ICs) are located on six separate boards. The boards and their respective FW are as follows:

- **A6 Time Base board** Digitizer FW (U281 and U283)
- **A15 MMU board** Display Processor FW (U140 and U150)
- **A18 Memory board** Executive Processor FW (U800, U810, U820, U830, U900, U910, U920, and U930)

All of the ICs listed above are ordered by a single Tektronix Part Number. (Each IC cannot be ordered separately.) For the 11403 Oscilloscope, the total firmware kit number is 020-1778-00.

To remove and replace the FW ICs, proceed as follows:

WARNING

Dangerous shock hazards may be exposed when the oscilloscope covers are removed. Before proceeding, ensure that the PRINCIPAL POWER SWITCH is in the OFF position. Then, disconnect the oscilloscope from the power source. Disassembly should only be attempted by qualified service personnel.

CAUTION

Observe all the special precautions described under Static-Sensitive Device Classification earlier in this section.

Firmware Upgrade Procedure – is outlined in the following steps:

- [ ] Step 1: Prepare the oscilloscope for the firmware upgrade procedure as follows:
  - Set the PRINCIPAL POWER SWITCH to OFF, and remove the power cord.
  - Place the oscilloscope on its right side (if not already in this position) to provide access to the boards upgraded in the firmware upgrade procedure that follows.

☐ Step 2: Access boards within the card cage as follows:

- Ensure that the PRINCIPAL POWER SWITCH is set to OFF and the power cord is disconnected.
- Remove the oscilloscope's top panel cover.
- Remove the two plastic board guides from the top of the card cage (at the left rear of the oscilloscope).
- Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover (see Fig. 3-2).

☐ Step 3: Upgrade the A15 MMU board firmware as follows:

- Remove the A15 MMU board from the card cage. The A15 MMU board is typically located farthest from the outside (left side) of the oscilloscope.
- Locate the two firmware ICs, U140 and U150.

CAUTION *Ensure that pin 1 is positioned correctly when replacing components.*

Note: *Use the DIP IC extraction tool for removing and replacing the ICs.*

Do not use the label on the IC for an index because it may have been applied incorrectly.

- Remove U140 and replace it with the upgraded IC. The last two-digit portion of the part number on the replacement IC should be the same as, or higher than, that on the removed IC. Ensure that pin 1 is oriented correctly.
- Similarly replace U150 with the upgraded IC.

☐ Step 4: Upgrade the A18 Memory board firmware as follows:

- Remove the A18 Memory board from the card cage. The A18 Memory board is typically located one slot from the outside (left side) of the oscilloscope.
- On the A18 Memory board, replace the following ICs:

U800	U900
U812	U910
U820	U920
U830	U930

  In each case, the last two-digits of the part number on the replacement IC should be the same as, or higher than, that on the removed IC. Again, ensure that pin 1 is oriented correctly.

- Return the A18 Memory board to its former location in the card cage.

☐ Step 5: Upgrade the A6 Time Base board firmware as follows:

- Locate U281 and U283 on the A6 Time Base board. These components are found near the bottom front of the oscilloscope when the oscilloscope is positioned on its right side.
- Replace U281 and U283.

  The last two digits of the part number on the replacement IC should be the same as, or higher than, that on the removed IC. Ensure that pin 1 is oriented correctly.

☐ Step 6: Verify the oscilloscope serial number as follows:

- Locate the CAL-LOCK pins, J450, on the A6 Time Base board (see Fig. 3-13), and install the terminal connector link.
- Connect a power cord to the oscilloscope.
- Connect a terminal or controller to the oscilloscope. Refer to the *11403 User Reference* manual for more information on this connection.
- Set the PRINCIPAL POWER SWITCH and ON/STANDBY switch to ON.
- Set necessary communication parameters; for example, baud rate.
- After the oscilloscope is powered-on, to establish communication from the terminal or controller, enter the following commands (<CR> is the return key):

  e<CR>
  v<CR>

- Verify that the serial number on the oscilloscope's front panel matches the oscilloscope serial number in the **Ident** pop-up menu in the UTILITY major menu.
- If the numbers do not match, then enter the command:

  uid main:"**BXXXXXX**"<CR>

  where **XXXX** corresponds to the serial number digits found on the front panel serial number marker.

- Verify that the proper ID is now displayed in the **Ident** pop-up menu.

☐ Step 7: Remove the procedure setup as follows:

- Set the PRINCIPAL POWER SWITCH to OFF.
- Remove the J450 CAL-LOCK jumper on the A6 Time Base board.
- Replace the bottom oscilloscope cover, and set the oscilloscope upright.

☐ Step 8: Perform the final power-on and verification as follows:

Note: *You must now perform the power-on sequence again for the oscilloscope to recognize the new CAL-LOCK strap configuration.*

- Set the PRINCIPAL POWER SWITCH and ON/STANDBY switch to ON.
- Verify that the oscilloscope powers-on and successfully completes the Self-Test diagnostics.
- Press the ENHANCED ACCURACY button, and verify that the oscilloscope successfully completes the sequence.

Note: *If problems are encountered, then check for the following:*

- *Proper orientation of components in the sockets*
- *All component pins are properly seated*
- *Components are installed in the correct location*

Cables and Connectors

A cabling diagram (see Fig. 4-2) is provided to show the interconnecting cables between the various boards, modules, and assemblies. Use this diagram for a reference when you are removing and replacing cables on these units.

Interconnecting Pins – Two methods of interconnection are used to electrically connect a board with other boards and components. When the interconnection is made with a coaxial cable, a special end-lead connector plugs into a socket on the board. Other interconnections are made with a pin soldered into the board.

These interconnecting pins use two types of connectors. If the connector is mounted on a plug-on board, a special socket is soldered into the board. If the connector is on the end of a lead, an end-lead pin connector mates with the interconnecting pin. The following information provides the removal and replacement procedure for the various types of interconnecting methods.

Coaxial-type End Lead Connectors (Peltolas) – Color coding of wires may be helpful to connect a Peltola connector to its socket on a board. The wire insulation's color, or its colored stripe, is the same as the color represented by the last digit of the JXX component number. (for example, a green wire would connect to a J05 socket.) Other Peltola connectors may have labels which designate their JXX component number.

Multi-Pin Connectors – Multi-pin connectors are the pin connectors that connect the wires to interconnecting pins. These pin connectors are clamped to the ends of the associated leads, and some of these pin connectors are grouped together and mounted in a plastic holder. See Figure 3-30 for an example of a multi-pin connector.

Arrangement of Pins in Multi-Pin Connectors – Pin 1 on multi-pin connectors is designated with a triangle (or arrowhead). Pin 1 on a board is denoted by a triangle, dot, or square. Most board-mounted connectors have a square pad for pin 1.

Note: *Some multi-pin connectors are keyed by a gap between the pin 1 and 3 positions in the holder. A small plastic plug covers the pin 2 position on the end of the holder. There is a corresponding gap between pins 1 and 3 on the board.*

Align the plug, in the multi-pin holder, with the gap between the board pins. The connector is then ready to be installed.

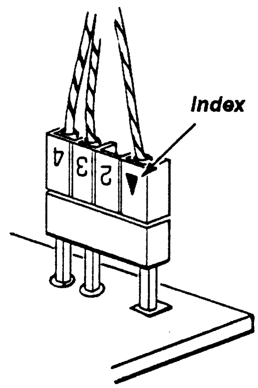


***Figure 3-30** — Multi-Pin Connector Orientation*

Many of the larger, multi-pin ribbon connectors have a red, blue, or other contrasting color line along one side of their attached wire cables. This line indicates the location of pins 1 and 2 and also the location of the corresponding triangle index mark on the connector.

Some of the gray ribbon cables may have the number of their connectors stamped on itself.

The ribbon connectors have two functions:

The first is to provide a strain release for the wire connections. The wire ribbon is wrapped around a bar in between the wire connections and the top of the connector; producing strain between the wires and the top of the connector, and thereby releasing most of the strain which would otherwise exist on the wire connections.

The second function of the ribbon connectors is to provide a pull-tab to ease disconnection. The pull-tab is attached inside the connector. When the tab is pulled, even pressure is applied across the connector. Then, the connector separates from its holder easily.

Note: *To remove these ribbon connectors, grasp the pull-tab (fastened into the connector, if there) and pull it loose from the holder.*

If there is not a pull-tab present in the connector, then grasp the ends of the connector, and pull the connector straight out from the connector socket.

Checks After FRU Replacement

After any FRU is replaced, it is recommended that you perform the Checks and Adjustments parts listed in Table 3-4, Checks Required After FRU Replacement.

***Table 3-4** – Checks Required After FRU Replacement*

FRU Replaced	Checks Required
CRT (Cathode Ray Tube)	Part 4 – Display
Power Supply Module	Part 1 – Power-On Diagnostics Part 2 – Extended Diagnostics Part 3 – Power Supply Part 5 – Enhanced Accuracy Part 6 – Calibration Output Accuracy Part 7 – Probe Compensation Voltage Part 8 – Acquisition Part 9 – Vertical Input Offset Part 10a – Sampler & Digitizer Performance Verification Procedure Part 11 – ADC Linearity Part 12 – Equivalent Time Step Response Part 13a – Bandwidth Performance Verification Procedure Part 14 – ADC RMS Noise Part 17a – Time Base Performance Verification Procedure
A1 Plug-In Interface board	Part 5 – Enhanced Accuracy (with a plug-in installed in each compartment)
A4 Regulator board	Part 1 – Power-On Diagnostics Part 2 – Extended Diagnostics Part 3 – Power Supply Part 5 – Enhanced Accuracy Part 6 – Calibration Output Accuracy Part 7 – Probe Compensation Voltage Part 8 – Acquisition Part 9 – Vertical Input Offset Part 10a – Sampler & Digitizer Performance Verification Procedure Part 11 – ADC Linearity Part 12 – Equivalent Time Step Response Part 13a – Bandwidth Performance Verification Procedure Part 14 – ADC RMS Noise Part 17a – Time Base Performance Verification Procedure

Table 3-4 — Checks Required After FRU Replacement (cont)

FRU Replaced	Checks Required
A5 Acquisition board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics Part 5 — Enhanced Accuracy Part 6 — Calibration Output Accuracy Part 7 — Probe Compensation Voltage Part 8 — Acquisition Part 9 — Vertical Input Offset Part 10a — Sampler & Digitizer Performance Verification Procedure Part 11 — ADC Linearity Part 12 — Equivalent Time Step Response Part 13a — Bandwidth Performance Verification Procedure Part 14 — ADC RMS Noise Part 15 — Trigger Sensitivity Part 16 — Trigger Enhancement Part 17a — Time Base Performance Verification Procedure Part 20 — Triggering
A5A2 Trigger Enhancement	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics Part 5 — Enhanced Accuracy Part 16 — Trigger Enhancement
A6 Time Base board	Part 17a — Time Base Performance Verification Procedure
A7 CRT Socket board	Part 4 — Display
A8 CRT Driver board	Part 4 — Display
A9 Touch Panel board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics Part 5 — Enhanced Accuracy
A10 Front Panel Control board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics Part 5 — Enhanced Accuracy
A12 Rear Panel board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics Part 5 — Enhanced Accuracy
A13 Mother board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics Part 5 — Enhanced Accuracy
A14 Input/Output board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics Part 5 — Enhanced Accuracy Part 19 — Input/Output

***Table 3-4** – Checks Required After FRU Replacement (cont)*

FRU Replaced	**Checks Required**
A15 Memory Management Unit board	Part 1 – Power-On Diagnostics Part 2 – Extended Diagnostics Part 5 – Enhanced Accuracy
A17 Executive Processor board	Part 1 – Power-On Diagnostics Part 2 – Extended Diagnostics Part 5 – Enhanced Accuracy
A18 Memory board	Part 1 – Power-On Diagnostics Part 2 – Extended Diagnostics Part 5 – Enhanced Accuracy
SDI IC, DMA IC, and EXP IC	Part 1 – Power-On Diagnostics Part 2 – Extended Diagnostics Part 5 – Enhanced Accuracy (with a plug-in amplifier installed in each compartment)
DAG IC	Part 1 – Power-On Diagnostics Part 2 – Extended Diagnostics Part 5 – Enhanced Accuracy (with a plug-in amplifier installed in each compartment)
Firmware ICs	Part 1 – Power-On Diagnostics Part 2 – Extended Diagnostics Part 5 – Enhanced Accuracy (with a plug-in amplifier installed in each compartment)

Diagnostic Troubleshooting

This section provides the information necessary to troubleshoot a faulty oscilloscope to the Field Replaceable Unit (FRU) level. In most cases an FRU is a board. Two FRUs are an exception: the Cathode Ray Tube (CRT) and the Power Supply Module. The primary means for troubleshooting is to use the error index code output from the Kernel diagnostics or the Self-Test/Extended Diagnostics and to cross-reference these error codes to the suspect boards in Tables 3-10, 3-13, and 3-15, or to use the built-in FRU **(?)Help** function available in the **EXTENDED DIAGNOSTICS** menu structure. After the faulty FRU is replaced, some recalibration of the oscilloscope is normally required. In addition, conventional troubleshooting techniques are described at the end of this section to help identify a faulty Power Supply module, A4 Regulator board, CRT, A7 CRT Socket board, A8 CRT Driver board, A13 Mother board, or fuses.

Diagnostics Overview

Each subsystem (Executive, Display and Digitizer) processor executes a set of Kernel diagnostics prior to the Self-Test diagnostics. After the Display and Digitizer processors verify their support circuitry, these processors attempt to establish communication with the Executive processor. If this link is successful, then the Self-Test diagnostics execute to verify the functionality of each of the subsystems. After all the Self-Test diagnostics are executed, any failures cause the oscilloscope to enter Extended Diagnostics and to display the error index codes in the **EXTENDED DIAGNOSTICS** menu structure. Extended Diagnostics tests are a superset of the Self-Test diagnostics.

The Kernel diagnostics (low-level Self-Test diagnostics) and Self-Test/Extended Diagnostics produce and format error index codes differently, so these two sets of diagnostics are covered separately.

Note that some of these tests that may indicate faulty FRU(s) are not executed automatically during the Self-Test diagnostics (that is, some errors codes are only generated by manually selecting tests in the **EXTENDED DIAGNOSTICS** menu structure). Also, some tests may only indicate a faulty FRU(s) after achieving Enhanced Accuracy.

The following flowchart provides an overview of Kernel, Self-Test, and Extended Diagnostics.

Notes:

1. *If the Executive processor has a kernel failure, no other processors can enter Self-Test diagnostics.*
2. *If the Display processor does not successfully communicate with the Executive processor, the Digitizer processor or the plug-in units can not enter Self-Test diagnostics.*
3. *If the Digitizer processor does not successfully communicate with the Executive processor, the plug-in units cannot enter Self-Test diagnostics.*
4. *Normal operation cannot be entered from Extended Diagnostics unless both the Display and Digitizer processors have successfully communicated with the Executive processor.*

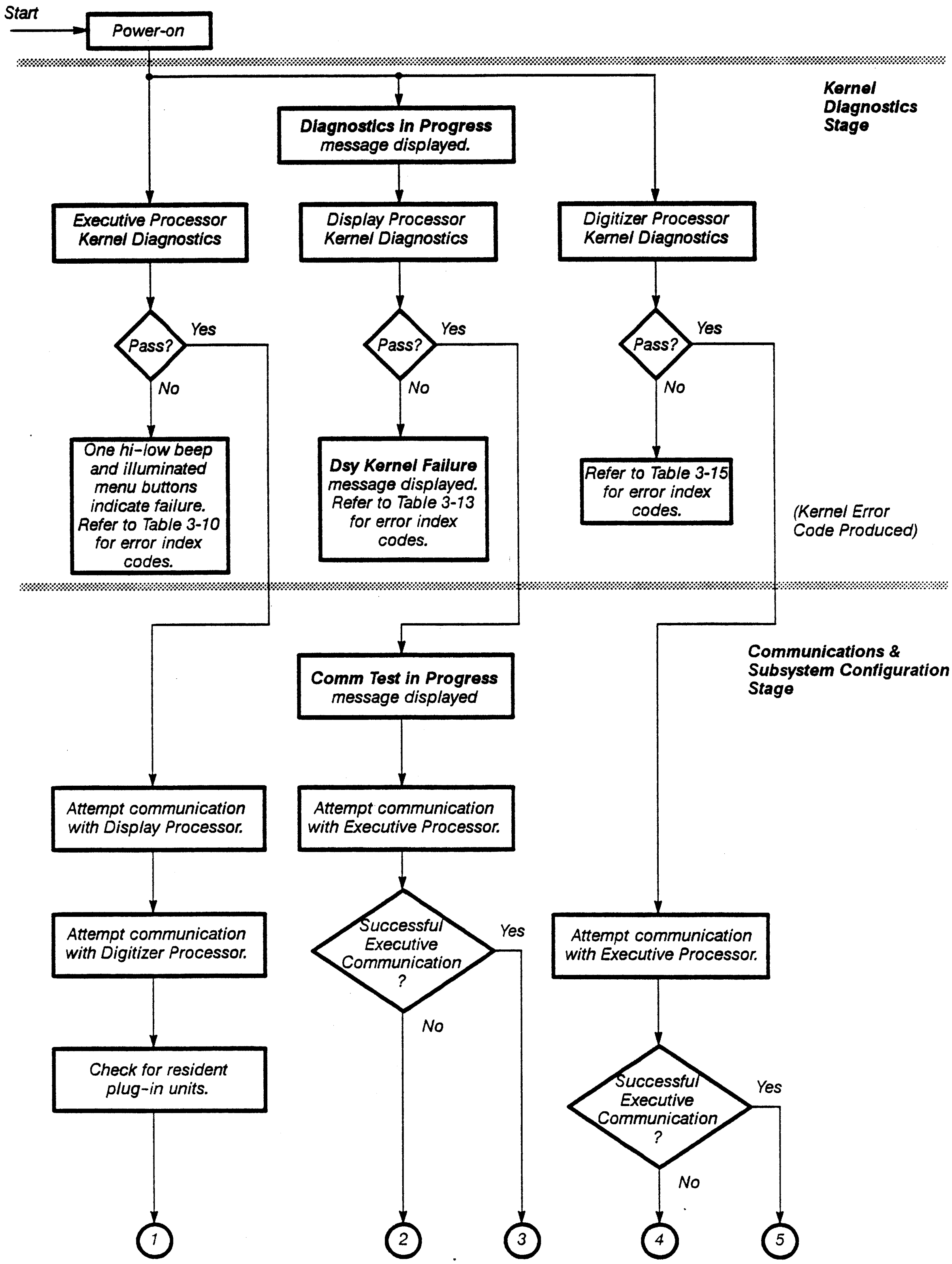


Figure 3-31 — *Diagnostics Flowchart*

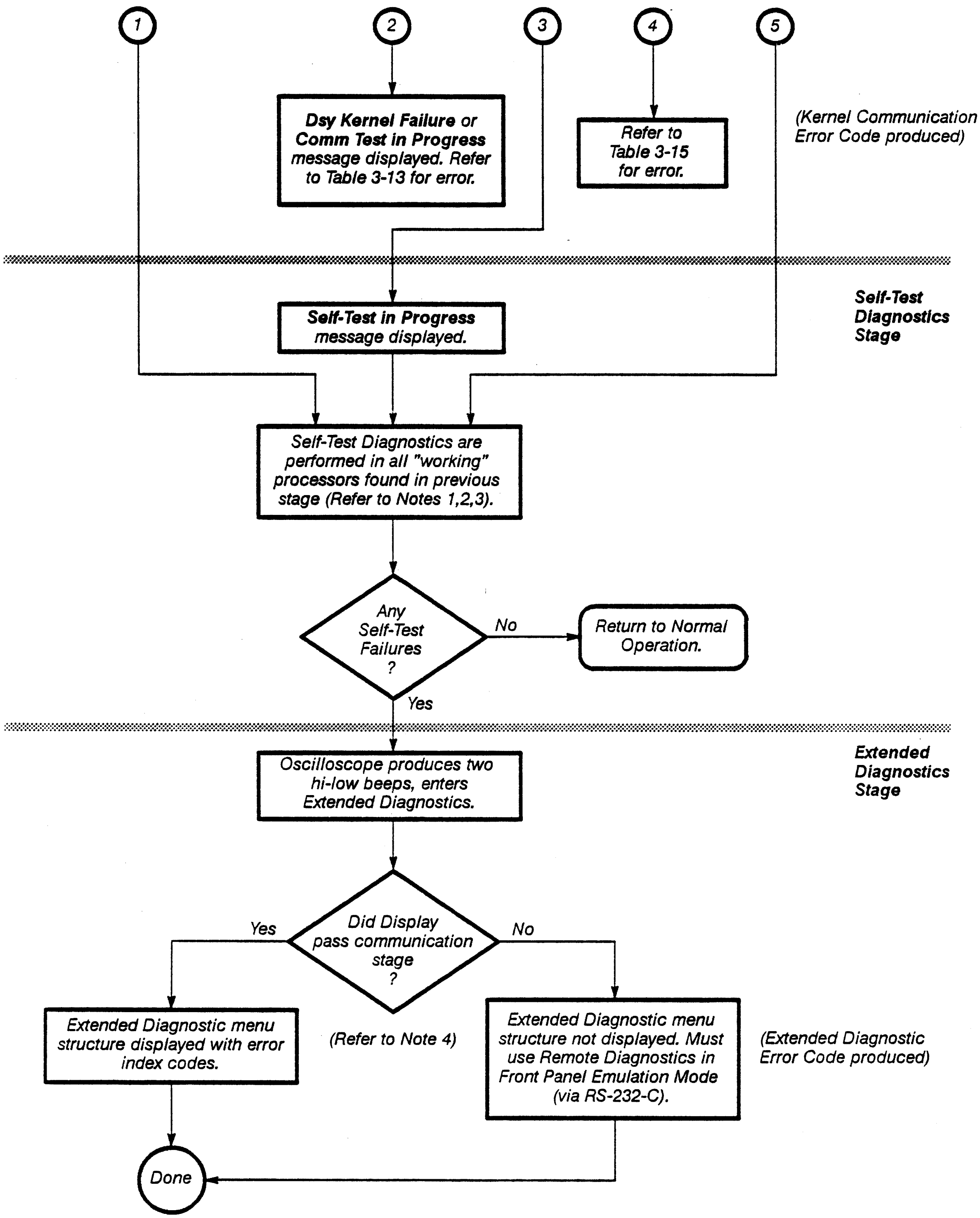


Figure 3-31 — *Diagnostics Flowchart (Cont.)*

The EXTENDED DIAGNOSTICS Menu Structure

The **EXTENDED DIAGNOSTICS** menu structure determines the format of the error index codes. The **EXTENDED DIAGNOSTICS** menu structure is in a four-level hierarchy with the **Subsys** (that is, the Subsystem) pop-up menu at the highest level. This four-level **Subsys**, **Block**, **Area**, and **Routine** menu hierarchy generates the error index codes. Each subsystem in the **Subsys** pop-up menu can be selected and tested if there are functional processor(s) and communication paths. Each subsystem is broken into a number of parts or circuit blocks in the **Block** pop-up menu for the selected subsystem. In a similar manner each block is broken into a number of circuit areas in the **Area** pop-up menu, the third level. The fourth and lowest menu level is the **Routine** pop-up menu, which contains the smallest test unit that can be selected and executed.

The Extended Diagnostics error index codes – are five digit codes whose first character indicates the subsystem tested. The last four digits are hexadecimal (*hex*) numbers that indicate the **Block**, **Area**, **Routine**, and specific failure mode. For example, E2321 is decoded as follows:

E Subsystem – Executive

2 Block name – Front Panel

3 Area name – Soft Keys

2 Routine name – Column Open

1 Failure Identity – specific failure mode

Table 3-5 lists the subsystem character of an Extended Diagnostic error index code:

***Table 3-5** – Extended Diagnostics Error Index Code Descriptions*

Code	Meaning
E	Executive
D	Display
G	Digitizer
L	Left Plug-in Unit
C	Center Plug-in Unit
R	Right Plug-in Unit

Front panel controls are active during the Self-Test diagnostics sequence and any disturbance may cause a test failure; forcing the oscilloscope into the Extended Diagnostics mode. Touch the **(E)Exit** label twice in succession to remove the **EXTENDED DIAGNOSTICS** menu structure and resume normal operation. In situations where the Display or Digitizer processors have failed their Kernel diagnostics, exiting diagnostics to normal operation will not be possible.

After the Self-Test/Extended Diagnostic programs have executed, any resultant error index codes appear on the display next to the associated subsystem name in the **EXTENDED DIAGNOSTICS** menu structure. Each subsystem that had a failure gives the first error encountered and the number of failures in the subsystem.

To get a more complete list of the error index codes in a subsystem, touch the selector of a failed subsystem (if the failed subsystem is not already selected) and then touch the **Block** selector. Touching the **Area** and then **Routine** selectors shows the lowest level test routines in the selected **Block**. The currently selected **Subsys**, **Block**, **Area**, and **Routine** are shown below their labels at the bottom of the **EXTENDED DIAGNOSTICS** menu structure. Several function and operating mode selectors are also available at the bottom of the screen. When certain test routines are selected some of these operating modes are non-selectable. And, when some of the operating modes are set to certain states, some of the test routines may become non-selectable.

The function and mode operators are as follows:

- **(?)Help** – displays a list of FRUs for the currently selected routine. If the routine had a failure, then the error index code for that routine is also displayed. The FRUs are normally listed as the most-to-least probable cause for errors in the routine. In some cases, the FRUs are listed according to their ease-of-replaceability to minimize the time required to identify the faulty FRU.
- Within this menu you can scan forward to the next routine or to the next failure to touch the appropriate selectors in the lower portion of the screen (which functions like a simple keypad). Scanning continues circularly through all available subsystems.

  Upon exiting this menu, the oscilloscope returns to the same menu level (that is, **Subsys**, **Block**, **Area** and **Routine**) that it was displaying before the **(?)Help** function was invoked. However, the displayed menu may be different if any scanning was performed.
- **(–)Delete** – places an execution mark on the currently selected menu name (in the upper menu area) and all items beneath it, down to the **Routine** level. This process inhibits the actual execution of these routines when **Run** is invoked.

  Visually, execution marks are displayed on the screen as an asterisk (*) immediately to the left of the menu name (in the upper menu area). If one, but not all, menu names in a menu are marked with an asterisk, then the name of the menu at the next highest level (that is, from **Area** to **Block**) is preceded by an execution mark or a minus (–).
- **(+)Add** – removes the execution mark, if present, on the currently selected menu name and all execution marks on items (that is, blocks, areas, or routines) below the currently selected menu name, down to the **Routine** level. The execution mark, if present, will change from an asterisk (*) or minus (–) to a space.
- **(D)Debugger** – normally can not be selected and is used by qualified service personnel only.

- **E(Exit)**—terminates Extended Diagnostics and returns the oscilloscope to normal operating mode, when this selector is touched twice in succession. The first touch causes a confirmation prompt to appear at the top of the screen; the second touch causes the actual termination of Extended Diagnostics.
- **(p)Loop**—toggles **On** and **Off**. When **On**, the selected test(s) is executed continuously with the number of iterations displayed.
- **(t)Terse**—toggles **On** and **Off**. When **On**, tests in the loop mode execute at the fastest rate, but the iteration (i.e. Loop) readout is not updated until the test is stopped (by touching the screen or a button).
- **(x)All**—toggles **On** and **Off**. When **On**, all tests in the current menu are selected to execute when started.
- **(s)Stop on Err**—toggles **On** and **Off**. When **On**, testing stops after the first failed test completes.
- **(r)Run/(q)Quit**—starts or stops the currently selected tests.

Note: *If you touch the screen or any front panel button while a test is operating, the test will terminate when the current routine ends.*

Diagnostic Menus

The upper portion of the display screen displays diagnostic menus. Menus are composed of menu items and menu fields. Menu items are rows of items that can be selected, while menu fields are columns of status information.

There are four tiers of menus which may appear in the menu area (only one is present at any given time): the **Subsys**, **Block**, **Area**, and the **Routine** pop-up menus. Upon entry into any menu, there is always one menu item which is selected. And, only one menu item can be selected at any given time.

The following field descriptions apply for **Subsys**, **Block, Area,** and **Routine** menus.

Subsys, **Block** and **Area** menus are divided into the following four fields: execution mark, title, error index code, and failure count.

Execution mark field—is a one character field preceding the title field and succeeding the keystroke selector identification. The three values of this field and their meanings are as follows:

' ' All routines in this **Subsys**, **Block**, or **Area** menus are available for execution.

'*' No routines in the **Subsys**, **Block**, or **Area** menus are available for execution.

'-' One or more routines in the **Subsys**, **Block**, or **Area** menus are available for execution.

Refer to the (–) Delete and (+) Add descriptions earlier in this section, for more information.

Title field—contains the name of individual hardware **Subsys**, **Blocks**, or **Areas**, and may contain a maximum of ten ASCII characters (up to twelve are allowed for **Block** and **Area** titles).

Error index code field—contains an index code. This index field may contain one of six types of status (indicating one of four types of tests), providing the following information:

"pass" — An automatic test has executed and did not fail.

"Yxxxx" — A test has failed and the failure encountered in subsystem **Y** is **xxxx**. This index code contains one digit each for **Subsys** identification, **Block** identification, **Area** identification, **Routine** identification, and a Test identification that gives some specific information about the failure.

"*****" — An automatic test has not yet been executed. When the test does execute, the test will provide **pass** or **Yxxxx** failure status.

"- - - -" — The test requires you to perform some type of test set up using the RS-232-C loopback connector. When executed, this status provides **pass** or **Yxxxx** failure status. To execute this test, you must select it.

" " (blank) — This status indicates that the test requires action from you user (such as the front panel verification tests), or that the test is for stimulus only (such as the manual calibration tests). This status does not provide failure status. To execute this test, select it individually.

"????" — This status indicates that an option was found that was not present in the current oscilloscope configuration or that a subsystem was found that did not have a working communication path.

Failure count field—indicates the total number of routine failures, (one per routine), currently encountered in the **Subsys**, **Block**, or **Area**. Thus, the Failure Count will never be more than the total number of routines in the subsystem. If no tests have been executed or no failures have occurred, then this field is blank. Since the failure count field is an indication of all routines that have failures, it is possible to have a failure field count greater than the loop count (for example, there may be five routine failures after the first loop).

A field display of **65535+** indicates that the lfailure count field has gone beyond 65534 and that an overflow condition has occurred.

In addition to these four fields (execution mark, title, error index code, and failure count), the **Routine** pop-up menu contains three test result fields.

The three test results fields—contain information useful for troubleshooting and are in one of the following formats:

- test address, expected data, and actual data
- expected data lower bound (minimum), expected data upper bound (maximum), and actual data

Hardcopy

Hardcopy of a menu is created when the hardcopy button on the front panel is pressed. The hardcopy is sent to the printer attached to the PRINTER port. Screen hardcopies can also be obtained from other menus (for example, help menus, interactive test menus, and hardware debugger menus).

After a hardcopy is output, a Form Feed is issued to the printer. If no printer is attached or the printer can not print (for example, if the printer is off line or if the printer is out of paper) then the following warning is shown in the Input/Prompt area:

Hardcopy absent or off line.

The hardcopy function may be unavailable for some tests requiring human interaction, such as touch panel interactive tests, various display tests, and CRT/touch panel calibration patterns.

The knobs control the screen intensity during the four main diagnostic menu levels. The touch panel on/off button enables/disables the touch panel from responding to touches.

Diagnostic Terminal Mode (RS-232-C)

The RS-232-C port drives a terminal which conforms to the ANSI 3.64 standard. In this mode, the terminal provides a screen-driven, interactive human interface.

This mode is useful when either the display or touch panel is not functioning properly, or when it is desired to remotely use the diagnostics with a modem and phone link.

There are several single terminal keystroke commands which are equivalent to front panel buttons or are terminal-only commands; all of which do not appear on any of the display screens. The following terminal keystrokes do appear on the screen and are shown in quotes:

- **'B' <baud rate> <cr>** —this keystroke, followed by the baud rate and carriage return), allows you to change the default baud rate to any one of the allowable product baud rates. The default power-on baud rate is determined from the position of two internal jumpers located on the A14 I/O board (300, 1200, 9600, 19200). (The Default setting is 9600 baud.)
- 'T'—this keystroke toggles the screen output between the current screen display and an ANSI compatible terminal. The terminal should initially be set in its ANSI mode.
- 'K'—this keystroke toggles the screen output between the current screen display and a Tektronix 4x05 terminal (for example, the 4105 or 4205).

- **'L'** – this keystroke toggles the screen output between the current screen display and a Tektronix 4x07 terminal (for example, the 4107 or 4207).
- **'H'** – this keystroke produces a hardcopy of the current diagnostic menu as described earlier in this section under Hardcopy.
- **'O'** – this keystroke disables/enables the touch panel from responding to touches. Pressing this key is equivalent to using the TOUCH PANEL ON/OFF button.
- **'Q'** – this keystroke, when used in interactive test menus, stops and starts the display information in the keypad prompt area. Pressing this key is equivalent to the using the DIGITIZER RUN/ARMED–STOP button in these menus.

To gain access to the terminal mode diagnostics, the oscilloscope must be in the Extended Diagnostic mode.

To exit the terminal mode, cycle the power (turn the ON/STANDBY switch STANDBY, and then to ON), and then either enter the (Exit) keystroke twice to begin normal operation, or enter the appropriate L keystroke.

System Mode (GPIB & RS-232-C)

The Self-Tests diagnostics and Extended Diagnostics are accessible using the two commands listed in Table 3-6.

***Table 3-6** – System Mode Commands*

Header	Argument	Notes
TEST		Set-only
TEST	**[XTND]**	Set-only
TEST	**[MAN]**	Set-only
DIAG?		Query-only

The **TEST** command invokes Self-Test diagnostics or Extended Diagnostics. The **TEST** command without arguments initiates Self-Tests diagnostics. The **TEST** command with argument **XTND** initiates Extended Diagnostics.

Refer to the *11403 Programmer Reference* manual for more information on TEST and DIAG command syntax and usage.

The return of one of two event codes listed in Table 3-7, Event Code Descriptions, to the GPIB and RS-232-C ports, signals that diagnostic testing is complete.

***Table 3-7** – Event Code Descriptions*

Event Code	Explanation
460	Self-Test or Extended Diagnostics were completed successfully
394	Self-Test or Extended Diagnostics were completed and failed

In either case, a GPIB/RS-232-C controller may obtain pass/fail information through the **DIAG?** query.

The **TEST** command with argument **MAN** initiates the Extended Diagnostics similarly to entering Extended Diagnostics through the front panel UTILITY menu. The primary use of this command is to provide the remote operator a convenient way of accessing the diagnostics through the RS-232-C interface so that the operator can use the diagnostic terminal mode to perform remote testing.

WARNING

*The **TEST** command with argument **MAN** violates normal GPIB protocols in that, when used, the oscilloscope becomes non-responsive to further GPIB commands until normal operation is resumed.*

The **DIAG?** query returns pass/fail information from the most recent invocation of Self-Test diagnostics or Extended Diagnostics. Examples of possible responses and explanations, are as follows:

DIAG PASSED: C????,C????,R????,d????

This response indicates that the Self-Test diagnostics or Extended Diagnostic operation did not detect any faults and there were no 11000-Series plug-in units installed. If there actually was one or more 11000-Series plug-in units installed, then there is an oscilloscope-to-amplifier hardware communication problem.

DIAG PASSED: NONE

This response indicates that the Self-Test diagnostics or Extended Diagnostic operation did not detect any test faults and that all plug-in compartments contained functional 11000-Series plug-in units.

DIAG FAILED: E1311, R????, E1711, E1721, E1731

This response indicates that the Extended Diagnostic operation detected test faults and that there was no 11000-Series plug-in unit installed in the right plug-in compartment.

DIAG FAILED: E1311, D1211, G1431, R????

This response indicates that the Self-Test diagnostics or Extended Diagnostic operation detected test faults.

DIAG BYPASSED

This response indicates that a power-on has occurred and that Self-Test diagnostics were bypassed through a jumper on the A14 I/O board.

Battery Testing

The oscilloscope contains two lithium batteries to provide power when the oscilloscope is turned off. The following discussions provide criteria for determining if a battery has exceeded its lifetime and if it is causing the oscilloscope to operate incorrectly. (A battery's lifetime will typically exceed five years.) If the battery voltage measures (at 20°C) equal to or greater than the voltages given, then the circuit should operate correctly from 0°C to 50°C. (These voltage measurements are taken with the oscilloscope power off.)

Battery BT130 provides power for the real time clock on the A14 I/O board. If the clock begins to lose time rapidly when the oscilloscope is turned off, the diagnostics report that the **Real Time Clk (E42XX)** has failed or then the battery should be tested. If the battery voltage measures less than 2.7 V, then the most likely source of the problem is the battery and you should follow the instructions for battery disposal earlier in this section.

Battery BT150 provides power for the nonvolatile RAM (NVRAM) on the A18 Memory board. If the diagnostics consistently reports an **NVRAM Battery (E141X)** failure over multiple power-ons, then the battery should be tested. If the battery voltage measures less than 2.7 V, then the most likely source of the problem is the battery and you should follow the instructions for battery disposal earlier in this section.

Note: *Turning the oscilloscope off while the Extended Diagnostics is executing one of the NVRAM memory tests may cause a failure of the NVRAM battery test. If the diagnostics report an NVRAM battery failure, then exit the diagnostics. This will rewrite the confidence words into the NVRAM. Turn off the oscilloscope for at least one hour. Then, turn the oscilloscope back on. If the diagnostics still indicate an NVRAM battery failure, then the battery should be tested.*

Clearing NVRAM

Before the power-on Self-Test diagnostics begin – and after the Executive processor has performed its Kernel diagnostics – the front panel buttons are scanned by the Executive processor. If the Executive processor senses that the WAVEFORM and TRIGGER buttons, and only these two buttons, are pressed (that is, closed) simultaneously, then the Executive processor resets its NVRAM to a default state. This essentially destroys all stored settings and stored waveforms. When this occurs, the NVRAM is initialized by filling virtually all but a few of the memory locations with a default value. The following items are left intact after the NVRAM is reset:

- Number of oscilloscope power-ons (POWERON?)
- Oscilloscope power-on time (UP TIME?)
- Oscilloscope serial number (UID? MAIN)
- Digitizer calibration constants

Field Replaceable Unit (FRU) Guide

This section correlates Kernel Diagnostic error index codes with the components or boards suspected of causing each error. Suspect FRU(s) for Self-Test/Extended Diagnostics error index codes are identified by using the built-in FRU help function **(?)Help**, described under Self-Test/Extended Diagnostics earlier in this section.

The FRU(s) in the Suspect board category in the following error index tables are listed in most-to-least probable cause order. If any diagnostic errors occur, inspect the suspect FRU for loose connections and components. Then, repeat the diagnostic test. If any diagnostic errors reoccur again, replace the suspect FRU(s) with a known good FRU or FRUs. Ensure that the new FRU is configured exactly like the old FRU and that any installed firmware is the same version as, or a newer version than the old firmware.

The error index codes and tests are divided into three groups based on the three oscilloscope subsystems: Executive, Display, and Digitizer processors. Each subsystem group has a table of kernel diagnostic error index codes. And, the Executive and Digitizer processors have a table of manual test error index codes. These tables extend the confidence level of oscilloscope's functionality. Amplifier (plug-in unit) error index codes are covered in the appropriate plug-in unit *Service Reference* manual.

If necessary, kernel error index codes can be read as TTL logic levels on circuit board pins using a logic probe.

Abbreviations of FRU Names

All active boards are listed in Table 3-8 with their respective abbreviations.

Table 3-8 – Board FRUs

Title	Title	Title
CRT	Cathode Ray Tube	
PIINT	Plug-In Interface board	(A1)
REG	Regulator board	(A4)
ACQ	Acquisition board	(A5)
TB	Time Base board	(A6)
CRTSOC	CRT Socket board	(A7)
CRTDR	CRT Driver board	(A8)
TOUCH	Touch Panel board	(A9)
FPCTRL	Front Panel Control board	(A10)
FPBUT	Front Panel Button board	(A11)
REAR	Rear Panel board	(A12)
MOTHER	Mother board	(A13)
IO	Input/Output board	(A14)
MMU	Memory Management Unit board	(A15)
EXP	Executive Processor board	(A17)
MEM	Memory board	(A18)

Abbreviations of Component and Module Names

All active components and modules are listed in Table 3-9 with their respective abbreviations.

Table 3-9 *— Component Module FRUs*

Title	Title
FW	Executive Processor Firmware
FW	Display Processor Firmware
FW	Digitizer Processor Firmware
SDI	Serial Data Interface IC
DAG	DAG IC
PS	Power Supply Module

The Executive, Display, and Digitizer processor Firmware are not separate components. These three components are packaged in a single firmware (FW) kit.

Executive Subsystem Error Index Codes—are listed in Table 3-10 along with the suspected FRUs.

Table 3-10 *— Executive Processor Kernel Error Index Codes*

Error Index$_{hex}$	**Hybrid/IC FRUs**	**Suspect Board FRUs**
1F - 1D		MEM, EXP
1C - 19	FW	MEM
18 - 16		IO, EXP
15		EXP
14		EXP, MEM
13		FPCTRL, IO, MPU
12		IO, EXP
11		IO, EXP
10 - 0E		REAR, IO, MPU
0D		MMU, EXP
0C		EXP, MEM
0B		REAR, IO, EXP

Bit patterns for the above hexadecimal error index codes are displayed with the front panel MENUS LEDs in bottom-to-top bit order. The UTILITY label represents the MSB (most significant bit) and the WAVEFORM label represents the LSB (least significant bit). When lit, the LEDs represent a one.

For example: Error index code 12_{hex} causes the UTILITY and TRIGGER LEDs to light.

The status LEDs (DS306 and DS307) on the A17 Executive Processor board will flash while the Kernel diagnostic tests are executing. If a kernel failure is detected, then one or both LEDs will remain on. Table 3-11 lists the various LED configurations and their significance.

Reading the Executive processor subsystem error bits from the A17 Executive Processor board test points TP201 (MSB) to TP205 (LSB) is also possible. See Figure 3-32 for the location of these test points and status LEDs. The bits are high (+5 V) true.

Table 3-11 – Executive Processor Status LED Configuration

DS307	DS306	Significance
ON	ON	Power-On
ON	OFF	Kernel Tests Executing
OFF	ON	Kernel Tests Failed
OFF	OFF	Kernel Tests Finished

Table 3-12 lists the Executive processor manual tests and verification procedures. If the conditions specified in the verification procedure listed are not met, then the suspect FRUs can be found using the **(?) Help** function.

These tests are performed manually and produce no error index code displays. They are included to help you locate faulty boards that possibly the Kernel or Self-Test diagnostics did not locate. Interconnections, such as the A13 Mother boards cables and the power supply boards are not listed; however, these interconnections are considered as possible problem sources.

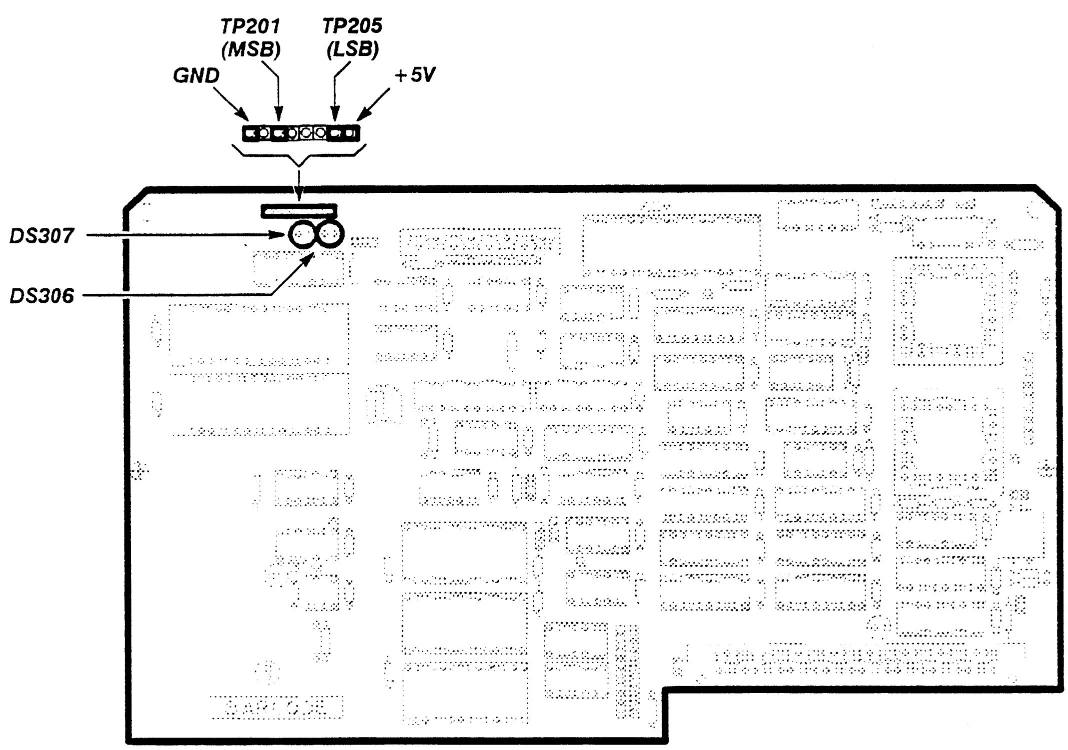


***Figure 3-32** – A17 Executive Processor Board Test Point and Status LED Locations*

***Table 3-12** – Executive Processor Manual Tests*

Test	Verification Procedure
Front Panel	
Verify	
Hard Keys	This test allows you to interactively press the hard keys to verify their operation. This test verifies the operation of a key with both visual and audio feedback. This test requires operator interaction and can be executed only in the **Routine** pop-up menu with the **All** and **Loop** modes set to **Off**. Once this test is invoked, you can press any of the hard keys on the oscilloscope and verify that the corresponding image of the key on the screen is highlighted, that the associated LED is turned on, and that an audio click is generated.
Soft Keys	This test allows you to interactively touch any of the soft keys and verify their operation. This test verifies the operation of a key with both visual and audio feedback. This test requires operator interaction and can be executed only in the **Routine** pop-up menu with the **All** and **Loop** modes set to **Off**. Once this test is invoked, you can touch any of the soft keys in the oscilloscope and verify that a touch box is drawn around the soft key on the screen and that an audio click is generated.
Knobs	This test allows you to turn either of the knobs and verify their operation. This test verifies knob movement with visual feedback. This test requires operator interaction and can be executed only in the **Routine** pop-up menu with the **All** and **Loop** modes set to **Off**. Once this test is invoked, you can turn either of the knobs on the oscilloscope and verify that the corresponding knob pointer on the screen rotates and that the associated counter value changes.
Front Panel	
Test Pattern	
Gray Scale Green Grid White Grid Red Display Green Display Blue Display HV Reg Dsply	These tests allow you to examine and adjust the CRT adjustments pertaining to color. These tests require operator interaction and are only executable in the **Routine** pop-up menu with the **All** and **Loop** modes set to **Off**. Once one of the tests is invoked, the operator can examine/adjust the CRT by following the procedure outlined in Section 2, Checks and Adjustments.

Table 3-12 – *Executive Processor Manual Tests (cont)*

Test	Verification Procedure
Internal I/O	
Tone Gen	
Ramp Tone	This test verifies the capability of the oscilloscope to generate tones through its internal speaker. This test requires operator interaction and can be executed only in the **Routine** pop-up menu with the **Loop** mode set to **On** and the **Terse** and **All** mode set to **Off**. After invoking this test, you should verify that a high-speed clicking sound occurs.
Real Time Clk	
Calibrate	This test allows you to check and adjust the Real Time Clock period. This test requires operator interaction and can be executed only in the **Routine** pop-up menu with the **All** and **Loop** modes set to **Off**. Once this test is invoked, you can examine/adjust the real time clock period following the procedure outlined in Part 19, Input/Output in Section 2, Checks and Adjustments.
External I/O	
Printer	
Pattern	This test prints a set of patterns (all printable ASCII characters) to help you verify the external printer interface. This test requires operator interaction and can be executed only in the **Routine** pop-up menu with the **All** mode set to **Off**. Before executing this test, you should connect a Centronics-compatible printer to the PRINTER connector on the rear panel of the oscilloscope.
RS-232	
Extern Loop	This test verifies parts of the external RS-232-C interface. This test requires operator interaction and can be executed only in the **Routine** pop-up menu with the **All** mode set to **Off**. Before executing this test, you should connect an external loopback connector to the RS-232-C connector on the rear panel of the oscilloscope.
GPIB	
Inrpt Reset Reset Status Data Lines Interrupt	These tests verify the Executive processor interface to the internal GPIB circuitry. The major external GPIB functions are not tested. This test requires operator interaction and can be executed only in the **Routine** pop-up menu with the **All** and **Loop** modes set to **Off**. Before executing this test, you should disconnect the oscilloscope from the GPIB connector.

Display subsystem error index codes—are listed in Table 3-13 along with the suspect FRUs.

Table 3-13 *– Display Processor Kernel Error Index Codes*

Error Index*hex*	Suspect Hybrid/ IC FRUs	Suspect Board FRUs
1 - 4	FW	MMU
5 - 7		MMU

The name of the first Display kernel test that fails is displayed on the screen. The Display processor error index codes is read from the A15 MMU board test points DIAG0 (LSB) to DIAG2 (MSB). The bits are high (+5 V) true.

The status LEDs (DS201 and DS200) on the A15 MMU boardwill flash while the Kernel diagnostic tests are executing. If a kernel failure is detected, then one or both LEDs will remain on. Table 3-14 lists the various LED configurations and their significance. See Figure 3-33 for the location of these test points and status LEDs.

Table 3-14 *– Display Processor Status LED Configuration*

DS200	DS201	Significance
ON	ON	Power-On
ON	OFF	Kernel Tests Executing
OFF	ON	Kernel Tests Failed
OFF	OFF	Kernel Tests Finished

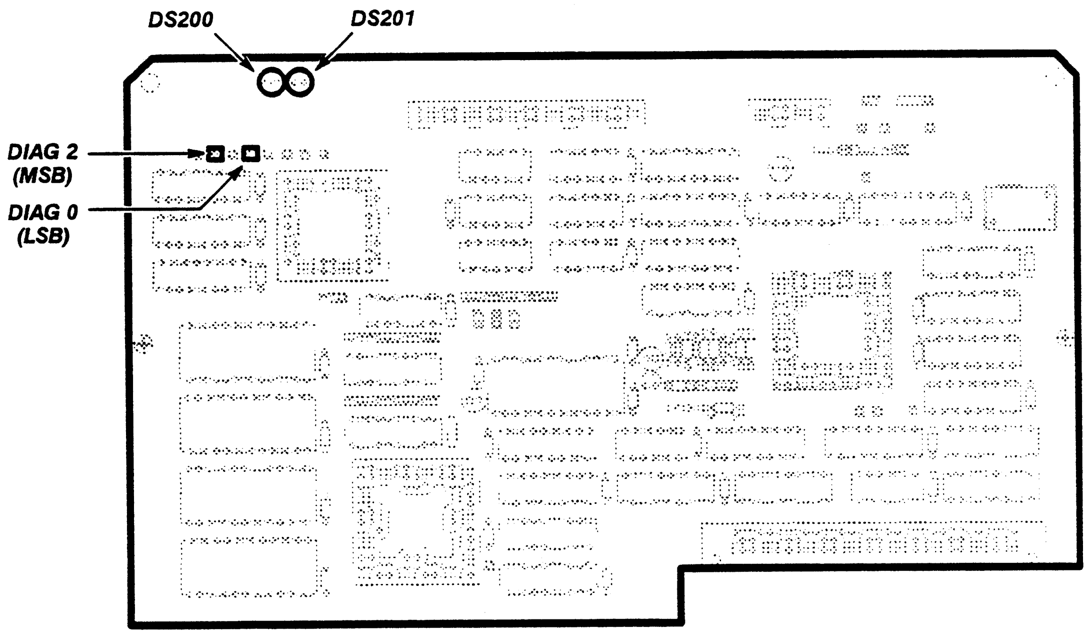


Figure 3-33 – A15 MMU Board Test Point and Status LED Locations

Digitizer Subsystem Error Index Codes—are listed in Table 3-15 along with the suspect FRUs.

Table 3-15 – Digitizer Processor Kernel Error Index Codes

Error Index*hex*	Suspect Hybrid/ IC FRUs	Suspect Board FRUs
1F - 1E		TB
1D - 1A	FW	TB
19 - 17		TB
16		TB, MMU

The error index code bits of the first Digitizer Kernel test that fails are read from the A6 Time Base board test connector J290, pins 2 (LSB) to 6 (MSB). See Figure 3-34 for the location of these status pins. The bits are high (+5 V) true.

The status LEDs (DS90 and DS92) on the A6 Time Base board will flash while the Kernel diagnostic tests are executing. If a kernel failure is detected, then one or both LEDs will remain on. Table 3-16 lists the various LED configurations and their significance. See Figure 3-34 for the location of this test connector and these status LEDs.

Table 3-16 — *Digitizer Processor Status LED Configuration*

DS90	DS92	Significance
ON	ON	Power-On
ON	OFF	Kernel Tests Executing
OFF	ON	Kernel Tests Failed
OFF	OFF	Kernel Tests Finished

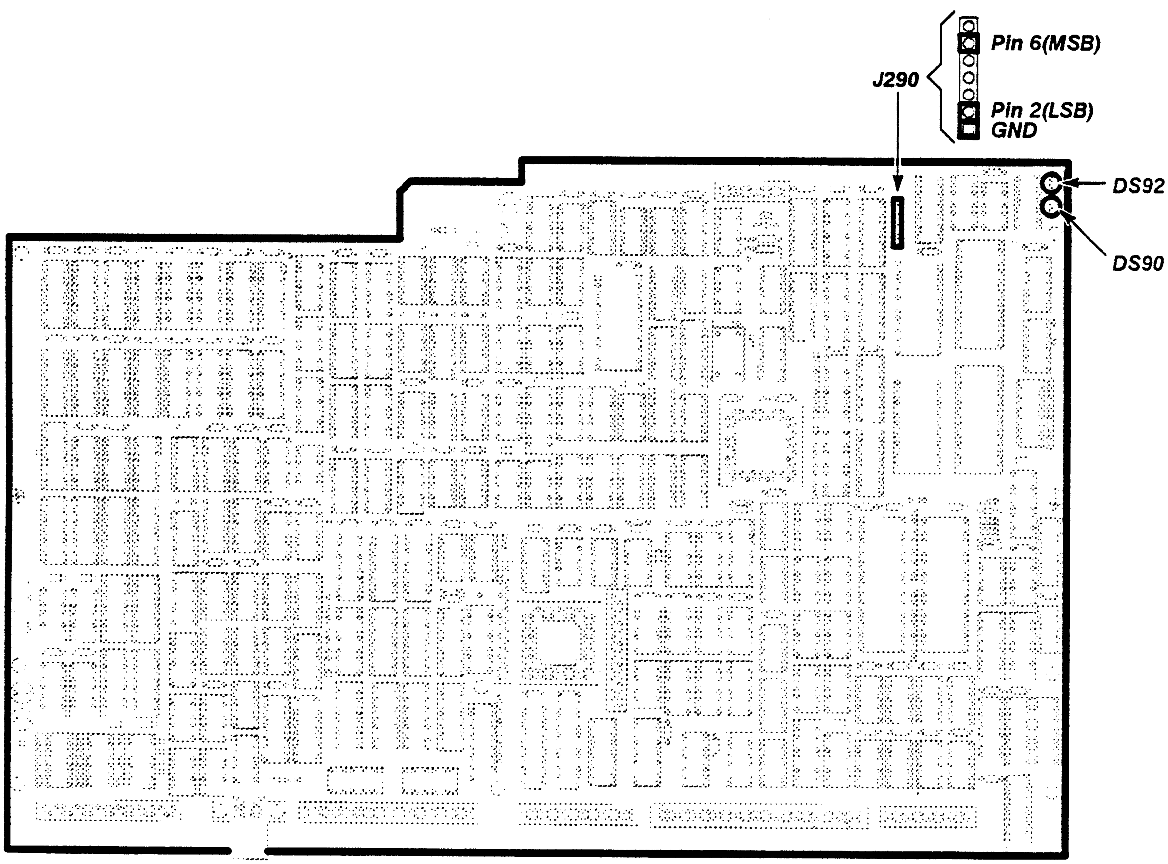


Figure 3-34 — *A6 Time Base Board Test Connector and Status LED Locations*

Table 3-17 lists the Digitizer Processor Manual Test, the verification procedures, and the suspect board FRUs. If the conditions specified in the verification procedure listed are not met, then the board FRUs listed are suspect.

These tests are performed manually by selecting them individually and may produce no error index code displays. They are included to help you locate faulty boards that possibly the Kernel or Self-Tests diagnostics did not locate. Interconnections, such as A13 Mother board, cable, and the Power Supply module interconnections, are not listed, but are considered as possible problem sources.

Table 3-17 *— Digitizer Processor Manual Tests*

Error Index	Verification Procedure
Points Acq	
FP Cal Refs	
FP 1 KHz	This test verifies that the front panel CALIBRATOR is capable of generating a 6 V peak-to-peak, 1 kHz square wave, centered around 0 V. Once this test is invoked, you can use a Test Oscilloscope to verify the waveform present on the front panel CALIBRATOR BNC. Refer to Table 2-2 for a complete description of the test oscilloscope required.
FP 1 MHz	This test verifies that the front panel CALIBRATOR is capable of generating a 6 V peak-to-peak, 1 MHz square wave, centered around 0 V. Once this test is invoked, you can use a Test Oscilloscope to verify the waveform present on the front panel CALIBRATOR BNC. Refer to Table 2-2 for a complete description of the test oscilloscope required.
FP −10.000 V FP −5.000 V FP −2.5000 V FP −1.000 V FP −100.00 mV FP 0.0000 V FP +99.951 mV FP +999.51 mV FP +2.4988 V FP +4.9976 V FP +9.9951 V	These tests allow you to check and adjust the output of the front panel CALIBRATOR. Once this test is invoked, you can use a digital multimeter to check and adjust the voltage present on the front panel CALIBRATOR BNC. Refer to Part 6, Calibration Output Accuracy, in Section 2, Checks and Adjustments.

Note: *In Table 3-17, Points Acq denotes points acquired, Cal Refs denotes calibrator references, and FP denotes the Front Panel.*

Enhanced Accuracy Mode Troubleshooting

Table 3-18 lists the error messages that are possible in the Enhanced Accuracy state and the troubleshooting technique to use to eliminate this error. Enhanced Accuracy of the system is available after a 20-minute warmup period.

***Table 3-18** – Enhanced Accuracy Mode Error Messages and Troubleshooting*

Error Message	Suggested Troubleshooting
A/D Out of Specification	Replace the A5 Acquisition board
A/D Quantizer 1	Replace the A5 Acquisition board
A/D D/A Converter	Replace the A5 Acquisition board
A/D Quantizer 2 Positive	Replace the A5 Acquisition board
A/D Quantizer 2 Negative	Replace the A5 Acquisition board
Main Time Interpolator	Replace the A5 Acquisition board
Window Time Interpolator	Replace the A5 Acquisition board
Main Fine Holdoff	Replace the A5 Acquisition board
Window Fine Holdoff	Replace the A5 Acquisition board
Main Trigger Level	Replace the A5 Acquisition board and/or the A1 Plug-in Interface board
Window Trigger Level	Replace the A5 Acquisition board and/or the A1 Plug-in Interface board

Note: *In Table 3-18, A/D denotes an analog-to-digital converter, and D/A denotes a digital-to-analog converter.*

Other Troubleshooting

Power Supply Module

This procedure requires an Extended Diagnostics power supplies troubleshooting fixture. Refer to Table 2-2 for a complete description of the equipment required.

Module Troubleshooting–If any Power Supply module problems are present, they appear when the ON/STANDBY switch is set to ON. If the green light beside the ON label fails to light, then check for the following:

- The PRINCIPAL POWER SWITCH located on the back panel is in the ON position.
- The line cord is connected to a functional power source with the same output voltage set as the LINE VOLTAGE SELECTOR on the back panel.
- The fuse is good. If the fuse is blown, then replace the fuse.
- The fan is exhausting air from the oscilloscope when the ON/STANDBY switch is ON. A defective fan causes an over-temperature shutdown in the power supply.

If these checks fail to correct the problem, connect the Extended Diagnostics 11000-Series Power Supplies Test Fixture to the Power Supply module (refer to the documentation accompanying the test fixture for troubleshooting techniques). The test fixture indicates which power supply voltage source is at fault. To help isolate the source of the problem, set the oscilloscopes ON/STANDBY switch to STANDBY, and disconnect the suspected faulty power supply voltage source from the Power Supply module. Set the ON/STANDBY switch to ON. If the test fixture does not record a fault, then you have verified the suspected faulty power source. This procedure is only effective for externally shorted power supplies. Once again, refer to the documentation accompanying the test fixture for more troubleshooting information.

A4 Regulator Board

This board is implicitly verified; that is, if all the other FRUs pass diagnostic testing, then you can assume that the A4 Regulator board is operating correctly as well.

CRT, A7 CRT Socket board, or A8 CRT Driver Board

This procedure requires a test terminal and a compatible RS-232-C serial interface cable. Refer to Table 2-2 for a complete description of the equipment required.

Module Troubleshooting—If the oscilloscope powers-on (the ON/STANDBY light is on), but the display gives scrambled information or none at all, then the CRT and A8 CRT Driver board are suspect. The following two procedures help you determine whether the A15 MMU board or one of the CRT units, (either the CRT, the A7 CRT Socket board or the A8 CRT Driver board) is at fault.

- With the power off (ON/STANDBY switch to STANDBY), remove the top cover, then turn the power on. Observe the two LEDs on the A15 MMU board and those on the A17 Executive Processor board in the card cage. These LEDs should flicker on and off until the diagnostic tests are complete and then all turn off. If any of these LEDs remain lit, it indicates a problem with the board on which the LED resides. If all LEDs turn off, then the CRT, A7 CRT Socket board, or the A8 CRT Driver board is suspect.
- With the power off, connect a test terminal (ANSI 3.64-compatible) to the oscilloscope using an RS-232-C cable. Touch the screen through the full power-on cycle to force a diagnostic error so the oscilloscope enters Extended Diagnostics. On the test terminal type **T** to display the **EXTENDED DIAGNOSTICS** menu on the terminal display. If the displayed errors are only for the front panel touch screen, then the CRT, the A7 CRT Socket board or the A8 CRT Driver board is at fault. Note any other errors, and use Table 3-5, earlier in this section, to identify the suspect subsystem.

A13 Mother Board

This board is implicitly verified; that is, if all the other FRUs pass diagnostic testing, then you can assume that the A13 Mother board is operating correctly as well.

Fuse Testing

The A14 I/O board has four fuses (see Fig. 3-35). F200 supplies +5V to the A12 Rear Panel board. F800 supplies +5V to the A10 Front Panel Control board and the A9 Touch Panel board. F600 supplies +15V to the A14 I/O board, card cage, A10 Front Panel Control board, A9 Touch Panel board, A11 Front Panel Button board, and A12 Rear Panel board (reduced to +12V). F602 supplies -15V to the A14 I/O board, card cage, A10 Front Panel Control board (reduced to -5V), and A12 Rear Panel board (reduced to -12V).

- F200 supplies +5 V to the A12 Rear Panel board. If diagnostics report failure of all three ports (RS-232-C, GPIB, and PRINTER), then this fuse is the probable suspect (assuming that the ribbon cable to the A12 Rear Panel board is connected). When tested with a multimeter, this fuse should measure less than 1.5 V.
- F800 supplies +5 V to the A10 Front Panel Control board and the A11 Front Panel board. If the diagnostics report both an A9 Touch Panel board failure and knob failures, then this fuse is one possible source of this problem. When tested with an multimeter, this fuse should measure less than 1 Ω.
- F600 supplies +15 V to the A14 I/O board temperature sensor and tone generator, the lights of the A11 Front Panel Button board, the A9 Touch Panel board, the A12 Rear Panel board's RS-232 output line drivers, the card cage, and the A17 Executive Processor board's NVRAM. If the NVRAM battery test and the **RS-232 External Loop Back** test fail (but the **Internal Loop Back** test passes), and the A11 Front Panel Button board's lights, temperature sensor, and tone generator are all off, then this fuse is the probable suspect. When tested with an multimeter, this fuse should measure less than 1 Ω.
- F602 supplies -15 V to the A14 I/O board temperature sensor and tone generator, A12 Rear Panel board's RS-232 output line drivers, the A9 Touch Panel board, and the card cage. If the temperature sensor, tone generator, and **RS-232 External Loop Back** test fail (but the **Internal Loop Back** test passes), then this fuse is the probable suspect. When tested with an multimeter, this fuse should measure less than 1Ω.

The A14 I/O board uses the +15 V and -15 V supplies on board to operate the temperature sensor and the tone generator. Of the other card cage boards, the A18 Memory board uses the +15 V supply to operate the NVRAM circuitry. The information above and Table 3-19 will help you to identify a failure of one of these fuses. If a test fails, then check the fuses.

CAUTION *Using a replacement fuse with an incorrect current rating may cause the ribbon cables to melt and create fire danger during a component fault.*

See Figures 3-5 and 3-35 for the location of the line fuse and the A14 I/O board fuses, respectively.

When a fuse must be replaced, unsolder the fuse from the board. Be careful not to damage the solder pads on the board. (It may be helpful to straighten the fuse leads on the rear of the board before removing the leads from their holes in the circuit board.) Refer to Section 5, Replaceable Parts, for the correct value and part number of each fuse.

***Table 3-19** – A14 I/O Board Fuse Failures*

Fuse	Executive Kernel Test Failure (refer to Table 3-5, Executive Subsystem Error Index Codes)	Self-Test/Extended Test Failure	
F200 open	10*hex* (GPIB Interrupt)		
F800 open	13*hex* (Front Panel Inter) **Note:** *The front panel lights do not work so the code must be read from the error status test points (TP200–TP205) on the A17 Main Processor board.*		
F600 open	Passes the Kernel diagnostic tests, but the front panel lights are not lit.	Executive Control	E1411 3
		NVRAM	E1411 3
		Battery	E1411 1
		*Data Lines	E1421 1
		*Addr/Data	E1431 1
		Internal I/O	E3111 1
		Temp Sensor	E3111 1
		Comparator	E3111 1
		*Tone Gen	– –
		*Ramp Tone (works)	
		Note: *The front panel lights, soft keys, and hard keys do not work.*	
F602 open	OE*hex* (Front Panel Inter) **Note:** *The tone generator has a very different tone.*		

**indicates a Manual Test forced by the operator. The test is not automatically executed by Self-Test diagnostics.*

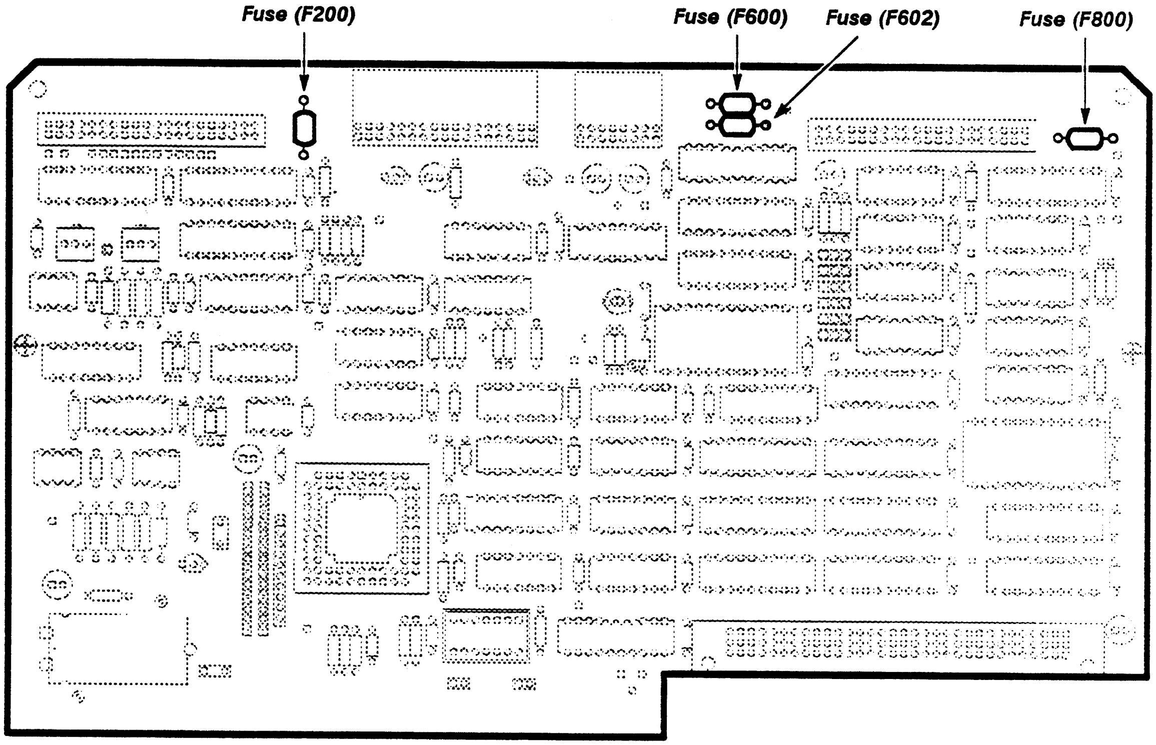


Figure 3-35 — A14 I/O Board Fuse Locator Diagram

Theory of Operation

The 11403 Digitizing Oscilloscope is a high-resolution digitizing oscilloscope that provides three plug-in unit compartments, accommodating up to 12 input channels. The features of this oscilloscope include:

- Sweep rates ranging from 100 s/division to 1 ns/division
- Autoset to provide a suitably adjusted display for viewing and further manual adjustment
- Windows for viewing expanded sections of a trace
- Self-Test diagnostics to assure continuous accuracy of waveform data and measurements
- Digital waveform storage and display
- On-board measurement capabilities
- Menu driven touch-screen operation
- RS-232-C, GPIB, and PRINTER interfaces
- Color display

System Functional Overview

This section describes and illustrates the major functional blocks of the 11403 Oscilloscope (see Fig. 4-1).

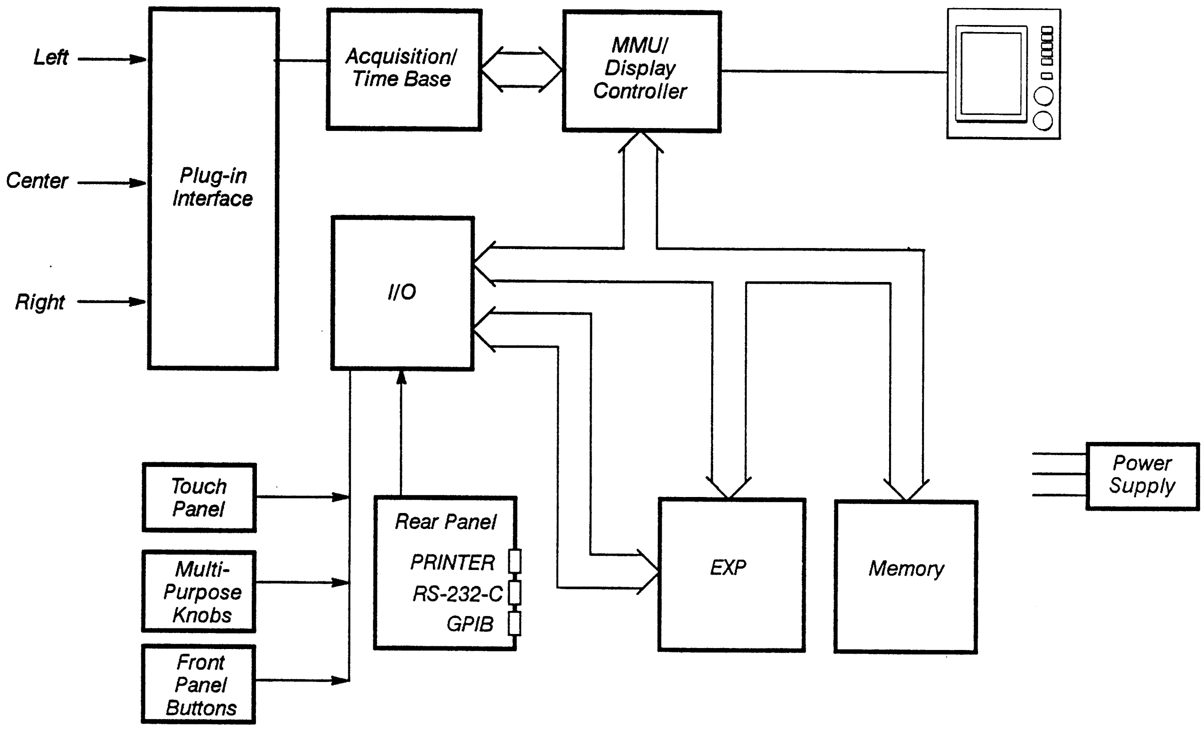


Figure 4-1 — 11403 Oscilloscope System Functional Block Diagram

Plug-in Interface Block

The Plug-in Interface block is the interface between the plug-in amplifiers input signals and the Acquisition/Time Base block of the oscilloscope. The Plug-in Interface block accommodates up to four input channels for the left, center, and right plug-in compartments, for a total of up to twelve input channels.

Acquisition/Time Base Block

The Acquisition/Time Base block comprises four systems:

- Digitizer
- Microprocessor with local RAM and ROM
- Time base and trigger circuits
- Interface to the Memory Management Unit (MMU) and the Plug-in Interface

Memory Management Unit (MMU)/Display Controller Block

The Memory Management Unit arbitrates requests for access to the Memory block from the Display processor, Digitizer processor and Executive processor. This arbitration allows all three processors transparent access to the memory.

The Display Controller provides all visual output to the user. This includes not only data output such as waveform traces, graticules, axes, and annotation, but displays supporting the human interface as well (menus, labeling for touch panel input, and current mode-setting information).

Input/Output (I/O) Block

The Input/Output (I/O) block provides an interface to the Rear Panel block, and also to the front panel buttons, touch panel and multi-purpose knobs.

Front Panel Controls

You control the oscilloscope by three primary methods:

- Front panel (major menu) buttons
- Display touch panel
- Multi-purpose knobs

The major menu buttons are the top-level menu selections for the oscilloscope. Touching an icon, menu item, or waveform on the display touch panel selects that particular icon, menu item, or waveform. The multi-purpose knobs control the function of the particular item that is selected.

Rear Panel Block

The Rear Panel block provides GPIB, RS-232-C, and PRINTER ports for interfacing various peripheral devices.

Executive Processor (EXP) Block

After you request an operation (with a front panel control for instance), the Executive processor (EXP) directs the oscilloscope to perform this operation. Another primary function of the EXP is to execute Self-Test diagnostics on the oscilloscope when powering-on or at your request. To control operations, the EXP controls and monitors the other boards sharing the Executive system bus. Thus, through the Executive bus boards, the EXP also indirectly controls all other oscilloscope boards; that is, the EXP generates commands and status signals to control on-board devices and I/O devices, such as GPIB and RS-232-C interfaces, that help process data and control the remainder of the oscilloscope.

Memory Block

The main function of the Memory block is to provide the EXP with static RAM and EPROM for waveform storage (waveform memory) and most oscilloscope operations. All accesses to RAM and ROM are initiated by the EXP. Support circuitry for the memories and diagnostic circuitry for troubleshooting are also contained in this block.

Power Supply

The oscilloscope operates from either a 115 V or 230 V nominal line voltage source at a line frequency between 48 and 440 Hz. The LINE VOLTAGE SELECTOR switch allows selection of AC line inputs of 90 to 132 V rms or 180 to 250 V rms.

To apply power to the oscilloscope:

- Set the rear panel PRINCIPAL POWER switch to ON
- Set the front panel ON/STANDBY switch to ON

A small green indicator lamp will light to indicate that the power is on.

Typical Waveform Processing Cycle

The following sequence is a brief overview of how the oscilloscope acquires, processes, and displays a waveform from the input channels:

1. Analog input signals are connected to the channel inputs.
2. The Acquisition/Time Base block converts these signals to digital signals.
3. The digitized signals are then stored in the waveform memory in the MMU/Display Controller block.
4. The EXP processes information from the human interfaces (the menus, icons, buttons, and knobs that you interact with to control the oscilloscope).
5. The EXP sends commands to the Memory Management Unit/Display Controller block so that the function that you selected is displayed.
6. When instructed by the EXP, the Memory Management Unit/Display Controller block receives the waveform data from waveform memory and converts it to a unique vertical, raster-scan format for a display based on your settings.

Detailed Block Diagram

This section describes the 11403 Oscilloscope block diagram (see Fig. 4-2).

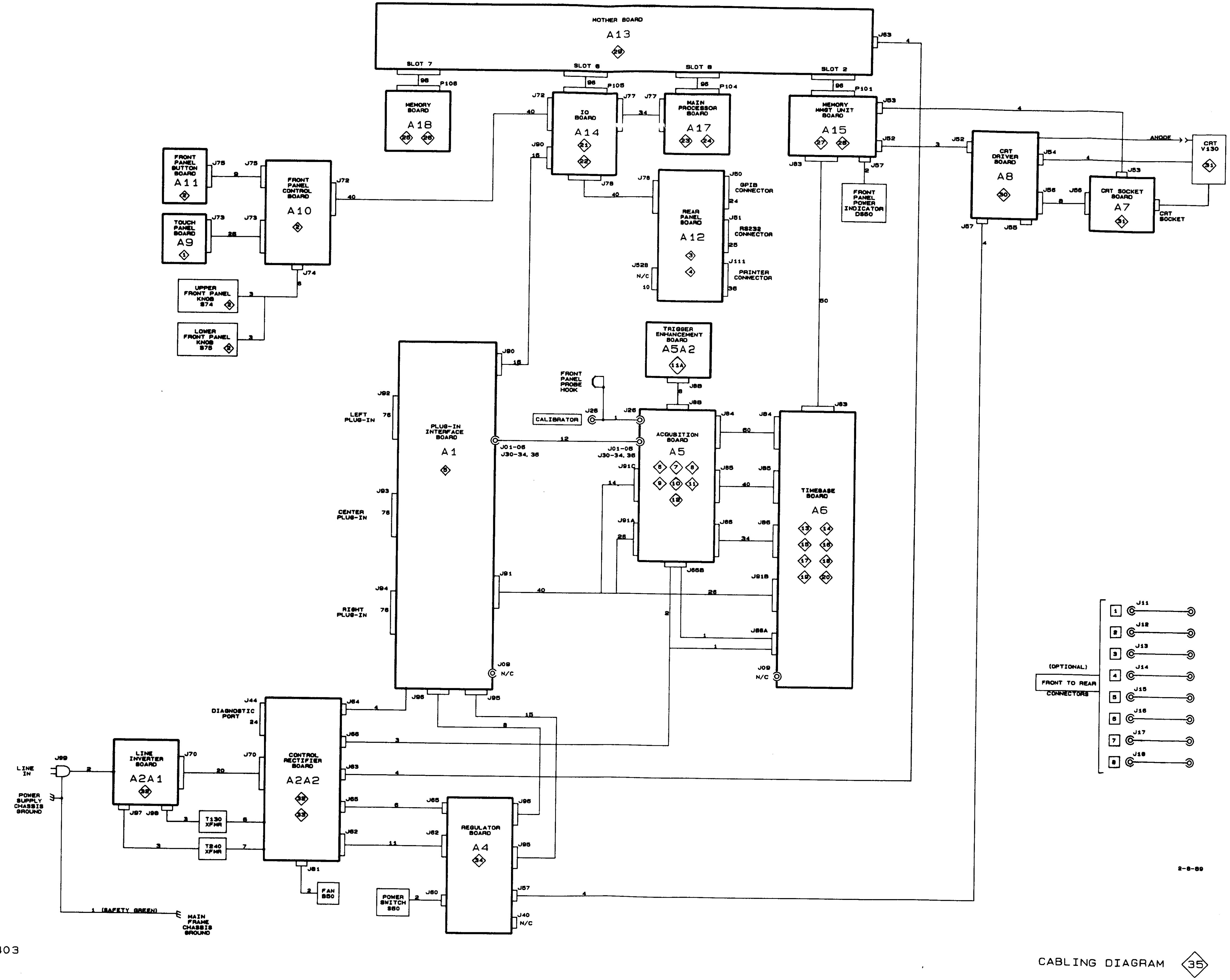


Figure 4-2 – 11403 Oscilloscope Detailed Block (Cabling) Diagram

A1 Plug-in Interface Board

The A1 Plug-in Interface board is the interface between the plug-in units and the the other oscilloscope subsystems (Executive, Display, and Digitizer). This board performs the following functions:

- Routes signals and voltages within the oscilloscope through the A1 Plug-in Interface board
- Busses power supply voltages from the Power Supply module

There are no active components on the A1 Plug-in Interface board.

A4 Regulator Board

The regulators convert semi-regulated voltages into stabilized low-ripple output voltages. The A4 Regulator board consists of the following regulators and the voltage fault detect circuitry:

- +50 V
- -50 V
- +15 V
- -15 V
- +5 V
- -5 V

The operational amplifiers for the +50 V, +15 V, +5 V, -50 V, -15 V and -5 V regulators require that the following special voltages be generated for their operation:

- the semi-regulated +54 V supply generates the +20 V supply
- the semi-regulated -54 V supply generates the -20 V supply
- the semi-regulated +54 V supply generates the +10 V supply
- the semi-regulated -54 supply generates the -10 V supply
- the +10.0 V REF is a reference voltage.

See Figure 4-3 for a block diagram of this board.

The voltage fault detect circuitry—consists of two window comparators and associated resistors. This circuitry detects whether any regulated supply is over-voltage or under-voltage. The associated resistors set a hysteresis window that is 5% of the regulator sense line voltages.

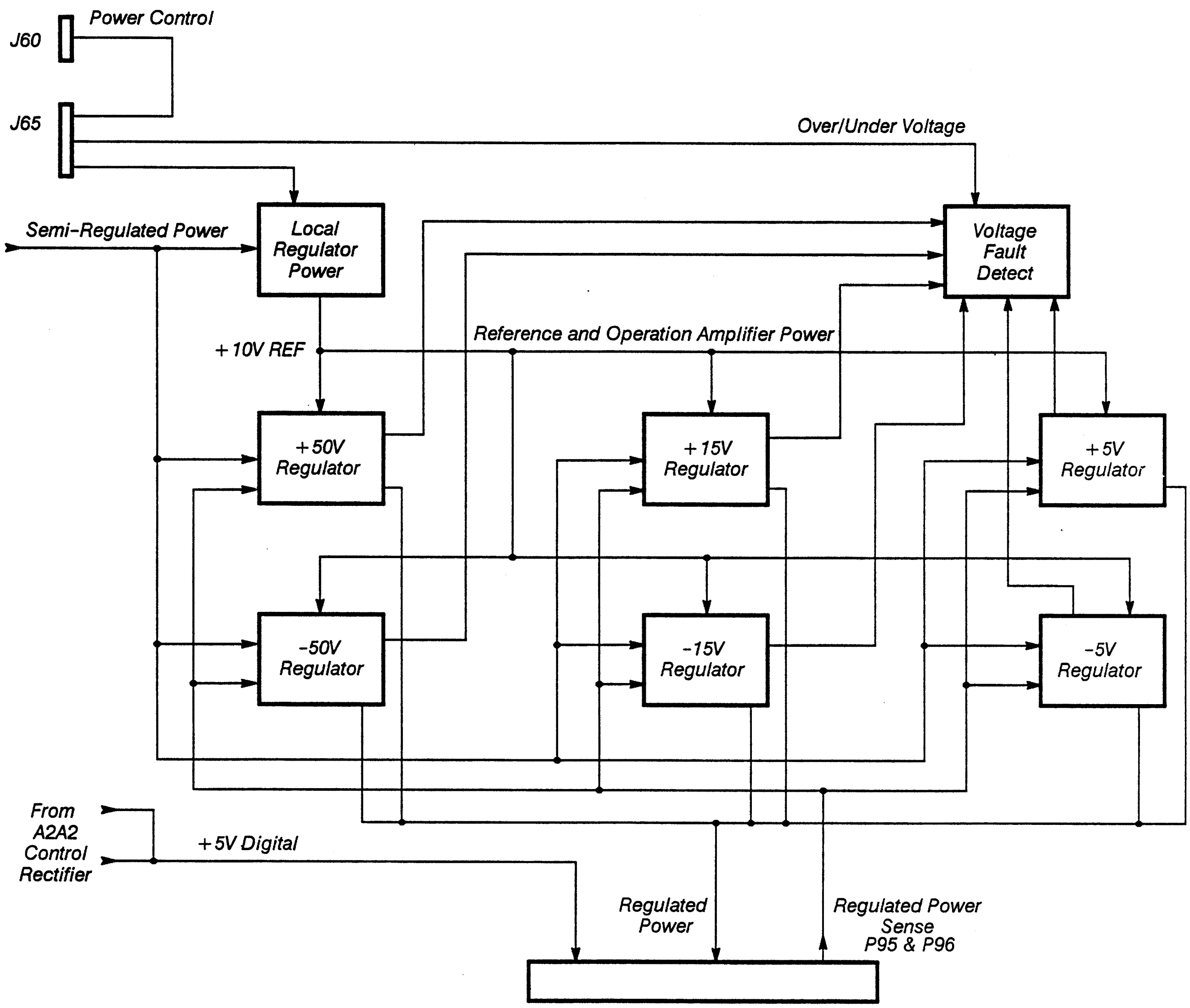


Figure 4-3 — A4 Regulator Board Block Diagram

A5 Acquisition Board

The A5 Acquisition board consists of the following systems:

- Sample/hold (S/H) circuits and the channel switch
- Sample strobe generators
- Analog-to-digital converter (ADC)
- Clock generator
- Main and Window triggers circuits
- Holdoff control
- Main and Window time interpolators
- Holdoff by events counters
- Programmable control voltages
- Scope calibrator

See Figure 4-4 for a block diagram of this board.

The sample/hold (S/H) circuits and the channel switch – collect input signals from the plug-in amplifiers in the left, center, and right plug-in compartments. Each plug-in compartment has a S/H circuit dedicated to it. The voltage that is present at the time of the sample is stored in a capacitor that is connected to a buffer amplifier. The buffer amplifier from each S/H is fed to a channel switch. The ADC selects one of these input signals during its conversion cycle.

The sample strobe generators – generate the sampling strobe signals that drive the S/H circuits. The strobe signal is a narrow pulse that sets the S/H circuit into the hold state very quickly, capturing the high frequency components of the input signals. All S/H circuits are driven simultaneously, however the analog-to-digital conversion is performed one sample at a time.

The analog-to-digital converter (ADC) – is a 10-bit, two-stage flash converter with error correction.

The clock generator – consists of two asynchronous oscillators. The first oscillator supplies signals to the strobe generators, ADC, time interpolators, and time base circuits. The second oscillator provides a clock for the main and window holdoff control circuits.

Main and Window trigger circuits – provide very similar features. An input channel switch selects the input signal sources. The channel switch provides a signal to the trigger latch. The holdoff control circuit resets and enables this latch.

Holdoff control – determines triggering. This circuitry allows you to trigger on specific portions of a complex signal. It also allows the system to prevent triggering when other operations are in progress.

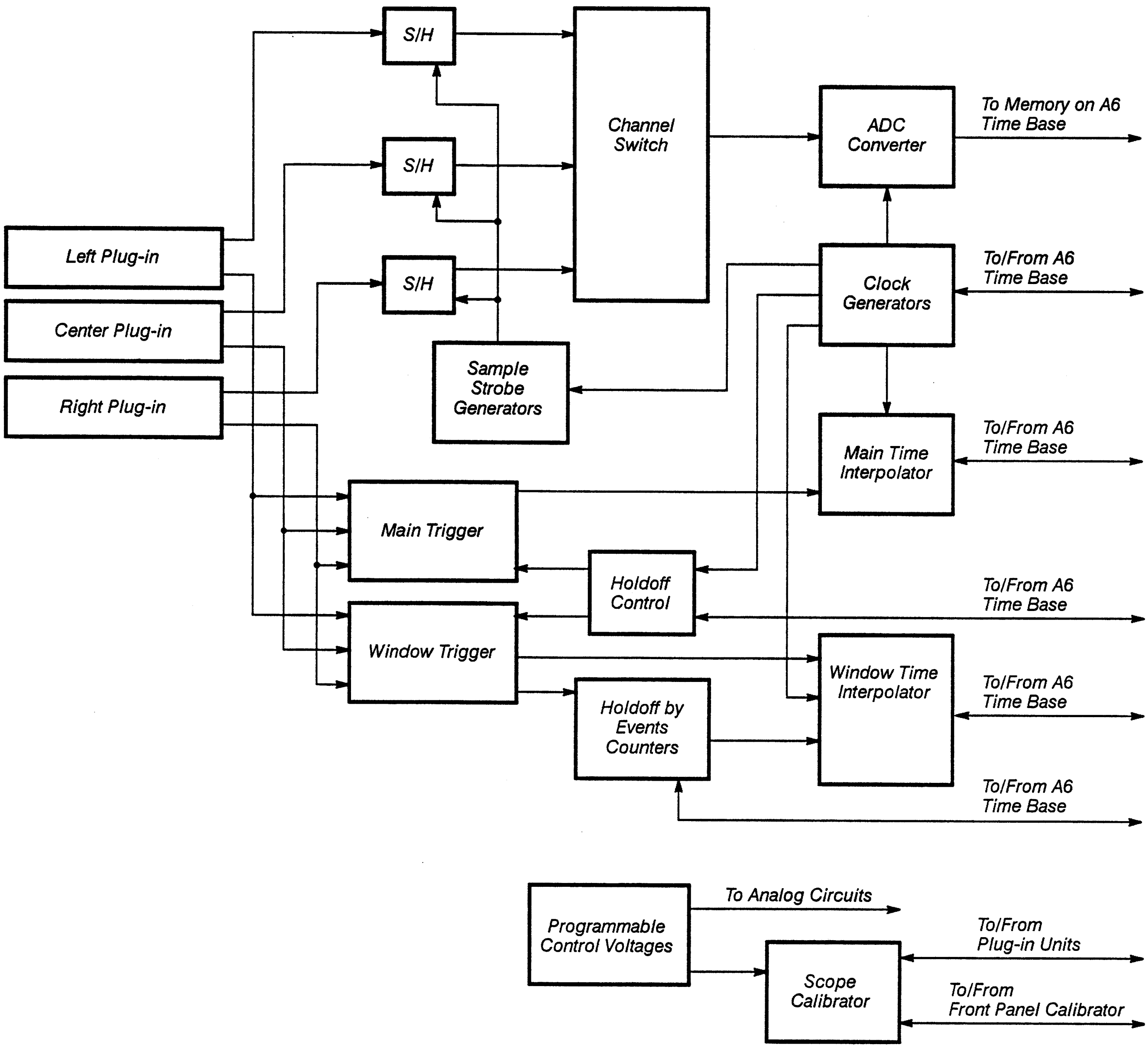


***Figure 4-4** — A5 Acquisition Board Block Diagram*

Independent holdoff controls are provided for main and window triggers. Each circuit consists of fine and coarse sections. The coarse section consists of counters for relatively long periods of delay. The fine section uses analog-ramp circuits for smaller delay increments than possible with the counters.

Main and Window time interpolators – measure the time between the trigger event and the sample strobe. This measurement allows high-resolution placement of the input signal samples in the waveform record. Counters, in conjunction with the time interpolators, provide both coarse and fine time placement of the samples.

Holdoff by events counters – consists of slow-speed and high-speed counters. The high-speed counters are on the A5 Acquisition board and the slowe-speed counters are on the A6 Time Base board. After the main trigger has occurred, these counters inhibit window triggers until a user-selected number of events has occurred.

Programmable control voltages – are voltages for the Enhanced Accuracy feature of the oscilloscope. The circuit that provides these programmable control voltages uses one precision DAC and numerous S/H circuits with output buffer amplifiers.

Scope calibrator – provides a precision voltage reference signal that the input channels or probes use during Enhanced Accuracy. A square wave signal is also provided for compensating and deskewing probes.

A6 Time Base Board

The A6 Time Base board receives waveform data, organizes the data in its proper sequence, assigns the data a specific address in waveform memory, and then relays the data to waveform memory through the MMU interface. The hardware consists of the following systems:

- input data latches
- main record circuitry
- window record circuitry
- chop sequencer
- acquisition memory
- end-detect circuitry
- destination Address Generator (DAG)
- MMU interface
- MPU (main processing unit) system

See Figure 4-5 for a block diagram of this board.

Input data latches – temporarily store incoming data points from the A5 Acquisition board.

Main record circuitry – consists of counters and logic circuitry. This hardware provides the sampling rates for each record that the oscilloscope is acquiring. The counters count the number of samples taken to determine the position of each record in time.

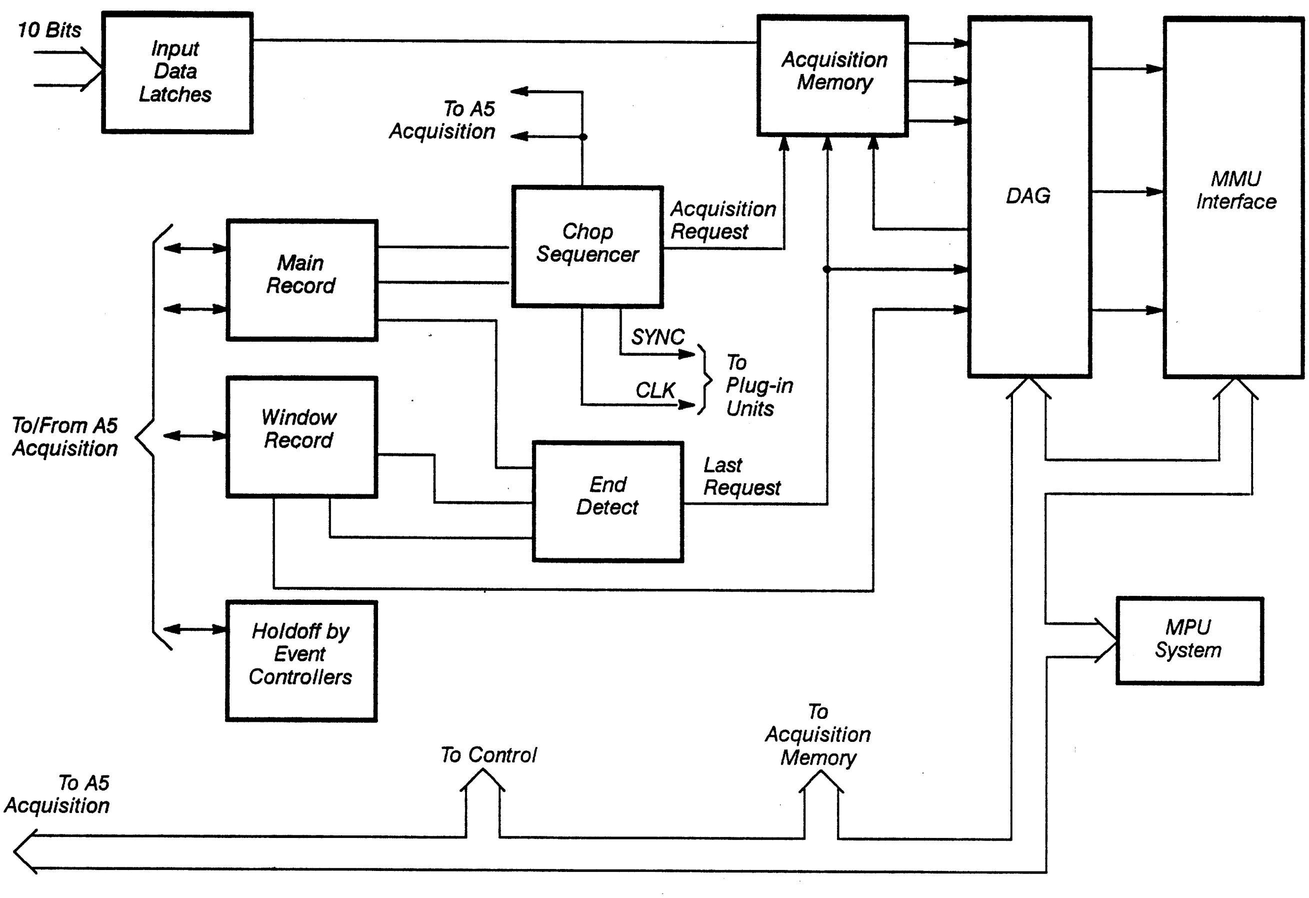


Figure 4-5 — A6 Time Base Board Block Diagram

Window record circuitry—consists of the same hardware as the Main record logic circuitry. The Window record logic circuitry supports two windows: Window 1 and Window 2.

Chop sequencer—coordinates the timing among the various input signals through two clock signals, SYNC and CLK. The chop sequencer also tags the waveform data with record identification information for storing the data in the acquisition memory.

Acquisition memory—holds the digitized waveform data and record identification tag until the A6 Time Base board is prepared to transfer the data through the MMU interface.

End-detect circuitry—detects the end of the sweep for each record.

Destination Address Generator (DAG)—assigns each waveform data point an address in the waveform memory. The memory location assigned depends on which input channel the data point was acquired from and when it was acquired during the sweep.

MMU interface – interfaces the Digitizer subsystem (the A5 Acquisition board and the A6 Time Base board) to the Executive subsystem (specifically, the EXP and waveform memory). The MMU interface is the path through which the waveform data is transferred from the A6 Time Base board to the waveform memory. The MMU interface also serves as the communication path between the MPU system (the Digitizer processor) and the Executive processor.

The MPU system – is based on a microprocessor that operates at 8 MHz. This microprocessor addresses several different blocks of memory and various I/O devices. A possible 256 Kbytes of EPROM and 16 Kbytes of RAM can be addressed by the microprocessor.

A7 CRT Socket Board

The A7 CRT Socket board is an interface from the A15 MMU board to the CRT. The A7 CRT Socket board consists of the following circuits:

- red, green, and blue video amplifiers
- RED, GREEN, and BLUE cutoff adjustments
- CONVERGENCE adjustment

See Figure 4-6 for a block diagram of this board.

Red, green, and blue video amplifiers – are three identical high speed video amplifiers that drive the three cathodes (R, G, and B; red, green, and blue, respectively) of the CRT. Each of the three colors can be programmed to display 64 different levels. This yields a possible 262,144 colors, of which eight can be displayed on the screen at any time.

Red, green, and blue adjustments – control the cutoff point; that is, the point at which a certain color becomes invisible of each color.

Convergence adjustment – controls the vertical convergence of the red, green, and blue deflection beams.

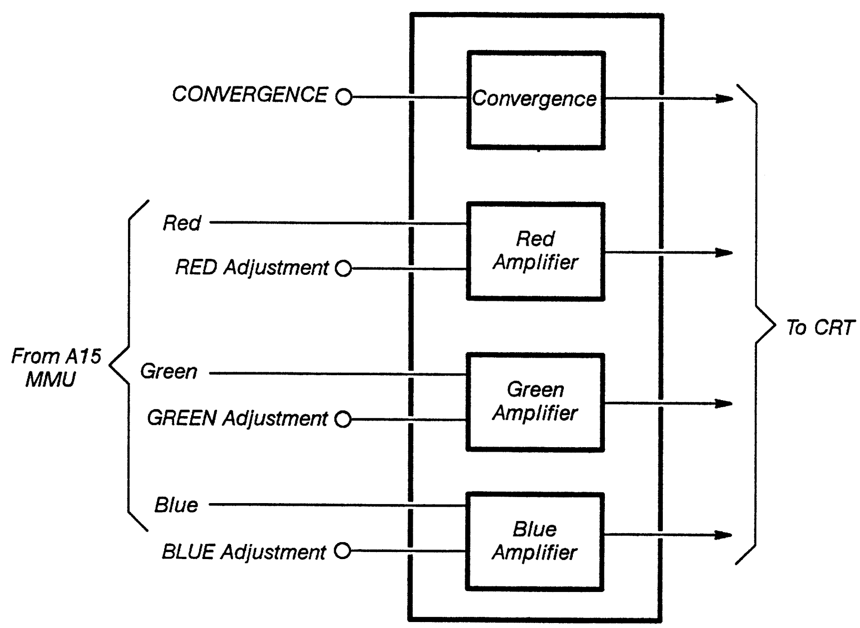


***Figure 4-6** – A7 CRT Socket Board Block Diagram*

A8 CRT Driver Board

The A8 CRT Driver board consists of the following circuits:

- Horizontal sweep circuitry
- Vertical sweep circuitry
- High voltage and grid voltage generator circuitry
- Degauss circuit
- Beam current limit circuit
- Grid bias circuit

The A8 CRT Driver board circuitry drives the raster scan CRT. The VIDEO and SYNC signals from the A15 MMU board generate the Z-axis signal, sweep signals, and grid bias voltages for the CRT.

See Figure 4-7 for a block diagram of this board.

Horizontal sweep circuitry—generates the sweep current for the horizontal deflection yoke. The horizontal driver includes an oscillator, a voltage ramp generator, a high-gain amplifier, and a flyback generator. These components provide sweep synchronization, horizontal deflection, and linearity.

The horizontal adjustments, H-SIZE, H-POS, and H-LIN, allow you to optimize the appearance of the display.

Vertical sweep circuitry—produces a deflection current that sweeps the video beam from the bottom to the top of the CRT. This circuit also produces a flyback signal to the flyback transformer that is in parallel with the deflection yoke.

The vertical adjustments, VERT SIZE and VERT POS, set the vertical size and position of the display.

High voltage and grid voltage generator circuitry—consists of the flyback transformer from the flyback waveform, which generates the 16 kV CRT anode potential and other bias voltages. This transformer is in parallel with the yoke and also supplies some of the sweep current for the yoke winding.

The SCREEN adjustment provides the cutoff point; that is, the point where no information is visible on the display screen. The FOCUS adjustment provides manual focusing of the display image.

Degauss circuit—removes magnetic fields, that are induced by magnetic sources from the color steel aperture grille at each power-on.

The Degauss circuit produces an exponentially decaying sine wave with a frequency of approximately 3.7 kHz. This waveform is applied to the degauss coils that are located on both sides of the CRT. The decayed oscillation through the coils causes a magnetic field to be induced in the CRT steel aperture grille. This magnetic field saturates the steel, and then forces the stored magnetic field down to zero; as the steel is driven around its hysteresis curve.

Beam current limit circuit—limits the average power to the CRT to below 15 W. An amplifier circuit compares the sum of the anode current and the FOCUS adjustment current to a reference current of 0.72 mA. If the sum of the two currents exceed the reference current, then the three video amplifiers on the A7 CRT Socket board are disabled.

Grid bias circuit—provides −40 V of grid bias to the A7 CRT Socket board. At power-off, the grid is supplied with −90 V until the focus circuit discharges a high voltage. This prevents a bright spot from appearing at the center of the screen at power-off.

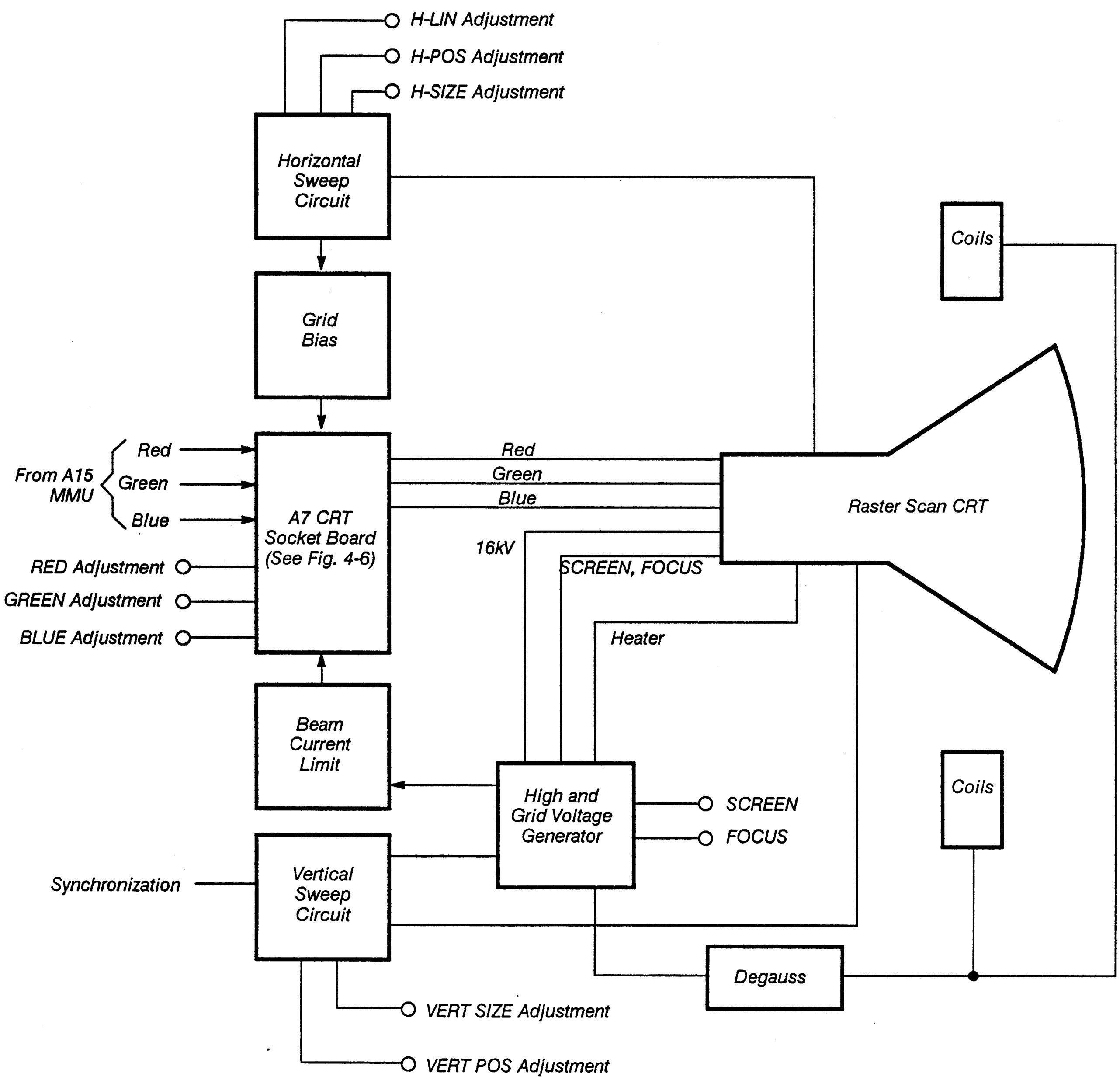


***Figure 4-7** — A8 CRT Driver Board Block Diagram*

A9, A10, and A11 Front Panel Boards

There are three Front Panel boards:

- A9 Touch Panel assembly
- A10 Front Panel Control board
- A11 Front Panel Button board

The touch panel, major menu buttons (hard keys), and menu status LEDs interface to the EXP through a general purpose programmable keyboard and display controller IC on the A10 Front Panel Controller board. The keyboard function of this IC controls the touch matrix and hard keys. The display function drives the menu LED light bars.

The A9 Touch Panel assembly—is composed of infrared LEDs that produce a matrix of light beams. When you touch a particular touch zone on the display, the light beams are interrupted by your finger. The touch panel and hard key matrix are scanned continuously until such an interruption (a shadow or keypress) is detected. When a keypress is detected, that scan is complete, and the keyboard display controller IC asserts the respective interrupt line. While the interrupt is active no new data is written into the sensor RAM from the touch panel or hard keys. The data will remain stable in the sensor RAM while the micro- processor is reading this data.

During scanning, only one infrared LED is turned on at a time, and only the phototransistor directly opposite is selected to receive light. This prevents any crosstalk between emitter/detector pairs.

The A10 Front Panel Control board—generates the 6-bit address that selects an infrared LED and its corresponding phototransistor on the A9 Touch Panel board. The A10 Front Panel Control board also reads the A9 Touch Panel Assembly.

The A11 Front Panel Button board—is composed of the LED light bars; which the display refresh register output of the keyboard and display controller IC drives. Internally, the light bars are an 8-bit by 8-bit matrix of display RAM. This display RAM is scanned column by column (automatically) lighting the appropriate LED bar(s) when a high bit is encountered.

A12 Rear Panel Assembly

The A12 Rear Panel assembly links the oscilloscope to other devices. This assembly contains connectors for the following:

- GPIB port
- RS-232-C port
- PRINTER port (Centronix style)

The A12 Rear Panel assembly is controlled from the A14 Input/Output (I/O) board through a 40-wire cable. This cable contains the following:

- 8-bit bidirectional data bus
- Four-bit address bus
- Interrupt lines (4)
- GPIB DMA request and grant lines
- Device control lines (4)
- Assorted power supply and ground lines

See Figure 4-8 for a block diagram of this assembly.

The GPIB port – drives the GPIB controller directly. The GPIB controller determines if the microprocessor is attempting a read or write. The interrupt controllers in the A17 Executive Processor board monitor an interrupt line from the GPIB controller and signal the microprocessor to service the GPIB controller if an interrupt occurs. A GPIB controller interrupt indicates the following:

- The receiver register of the GPIB controller contains a byte of data from the GPIB bus that the microprocessor must read
- The empty transmitter register of the GPIB controller is ready to receive another byte of data
- A microprocessor notification if the status of the GPIB bus or the GPIB controller has changed

On the other side of the GPIB controller is another bus system. This bus system includes an 8-bit data bus that accesses a directional GPIB data buffer; and an eight-bit control bus that accesses a GPIB control driver. The GPIB bus is connected to the opposite side of the buffer and control driver. These two devices are specially designed to be TTL signal-level compatible on the bus side of one side and GPIB bus compatible on the other.

The state of three control signals from the GPIB controller are monitored and displayed on LEDs located on the rear panel of the oscilloscope. These LEDs show the state of the GPIB controller, not the state of the GPIB bus.

Two other significant signals are GPIB REQ and GPIB GR. The DMA controller on the A17 Executive Processor board uses these signals to communicate with the GPIB controller (if the DMA controller is installed). The microprocessor can program the DMA to service either the receiver section or the transmitter section.

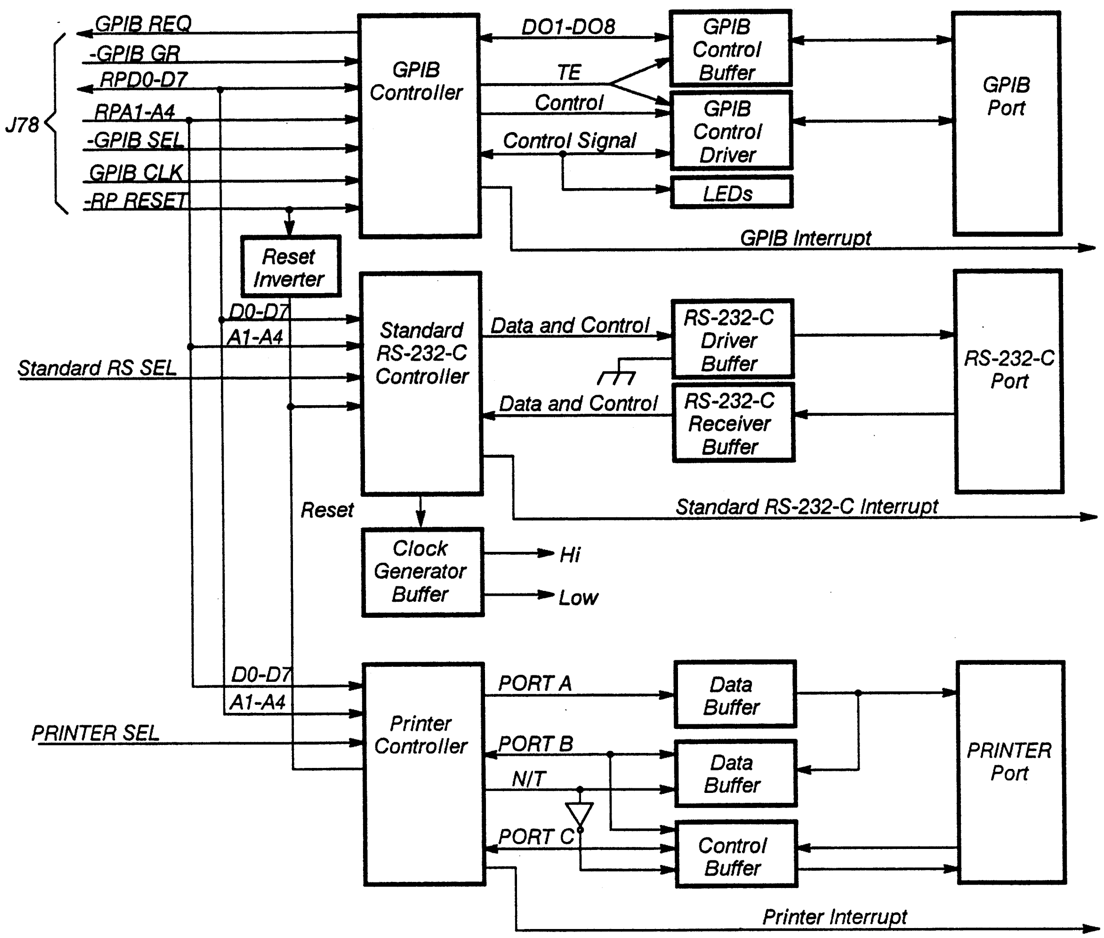


Figure 4-8 — *A12 Rear Panel Assembly Block Diagram*

Note: *DMA controller is present only if your oscilloscope is equipped with Option 4D. The DMA controller shortens the GPIB transfer time and also the transmission time of waveforms.*

The standard RS-232-C controller — is connected to the same data bus and address bus as the GPIB controller. The RPD0-D7 address lines transfer data to and from the microprocessor. The microprocessor uses the RPA1-A4 address lines to select individual registers in the RS-232-C controller. The Standard RS SEL (STD RS SEL) line becomes low when the microprocessor is attempting to communicate with the RS-232-C controller. This line also drives the chip enable.

The microprocessor drives the WR and RD signals if the RS-232-C controller is to be written into or read. The standard RS-232-C controller sets the Standard RS-232-C Interrupt (STD RS INTR) line low to request service from the microprocessor. The microprocessor writes a byte into the transmit buffer of the controller to transmit data on the RS-232-C bus. The microprocessor reads a byte from the receiver buffer to receive data from the RS-232-C bus. The microprocessor can also read the status of the controller. The RS-232-C controller translates the parallel data from the microprocessor to serial data for the RS-232-C bus, and converts serial data from the RS-232-C bus to parallel data for the microprocessor.

The PRINTER port – is controlled by a programmable peripheral interface IC. This IC has the control lines for connecting the port to a microprocessor. It also has two general purpose eight-bit ports and the control signals necessary to use these two ports. The A12 Rear Panel Assembly data bus and address bus connect to the IC and have the same function as described for the GPIB and RS-232-C controllers. The microprocessor sets the PRINTER SEL line low when it is communicating with this port. The RD and WR lines allow the microprocessor to either read or write to the registers in the programmable peripheral interface IC. The microprocessor must initialize this IC for PORT A to be a strobed output port and PORT B to be a strobed input port. PORT C provides the control signals for these ports. This IC sets the Printer Interrupt line low when its output buffer is empty (the printer is ready for the next byte). The microprocessor then writes the next data byte to the IC.

A13 Mother Board

Provides the interconnection for the microprocessor signals and the +5 V digital power between the following boards:

- A14 I/O board
- A15 MMU board
- A17 Executive Processor board
- A18 Memory board

A14 Input/Output (I/O) Board

The A14 I/O board contains the following:

- Data buffers
- Timer configuration circuitry
- Real time clock
- Serial data interface (SDI)
- Temp/tone readback buffer
- Tone generator

The A14 I/O board is an interface between the Executive Processor (EXP) and devices on the A9, A10, and A11 Front Panel boards, the A12 Rear Panel assembly, and on-board I/O devices. The EXP reads and writes to these I/O devices at specific I/O addresses. These I/O addresses are decoded to produce device select signals which enable the addressed device. Each I/O device is located on I/O address boundaries of at least 100_{hex}.

The lower eight bits of the Executive data bus transmit data to and from the various I/O devices. Note that only one I/O device can be accessed at a time.

When the DMA controller is installed on the A17 Executive Processor board, the A14 I/O board alters how it controls GPIB operations.

See Figure 4-9 for a block diagram of this board.

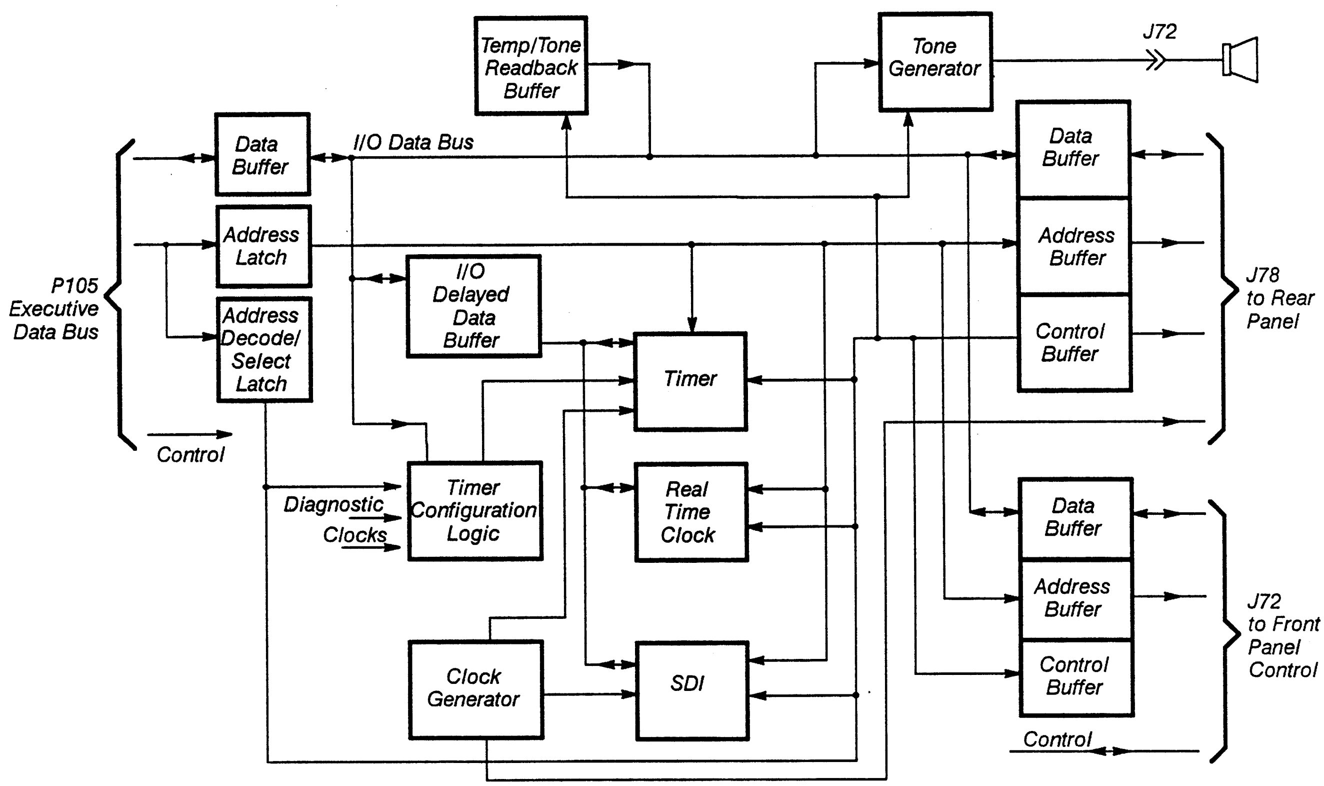


Figure 4-9 — A14 I/O Board Block Diagram

The I/O data buffer—buffers the lower eight bits of the Executive data bus from P105. The output of the I/O data bus drives data to the following six on-board devices:

- I/O delayed data buffer
- Rear panel data buffer
- Front panel data buffer
- Tone generator
- Tone/temp readback buffer
- Timer configuration circuitry

The I/O delayed data buffer—interfaces between the I/O data bus and the Write Delayed data bus.

The timer configuration—is composed of a latch and three two-input data multiplexers built with discrete gates. When a byte of data on the I/O data bus, is latched some of the data bits individually configure counters 1 and 2; allowing the timer to accept different inputs for different system tasks. The operating system uses counter 0 as a real-time clock based on the 2 MHz CLK input from the clock generator; which is always operating at 8 MHz.

The real time clock—and its oscillator circuit maintain the current time of day. The EXP sets the real time clock and also interrupts the Executive processor (EXP) every one second to request the EXP to read the time.

The serial data interface (SDI)—is a custom IC that interfaces the EXP to the three plug-in compartments and with both the front panel knobs. The EXP controls this IC, and this IC interrupts the EXP when a device requires service.

The tone generator—utilizes a DAC and a timer. The timer is equipped with a special current switch and capacitor to set the timer's frequency. The timer outputs a square wave whose frequency is inversely proportional to the digital value written to the temp/tone DAC. Thus, if a zero value is inputted into the DAC, the tone generator produces the highest tone.

The temp/tone readback buffer—is an eight-line buffer connected to the I/O data bus, and the EXP uses this buffer to monitor the tone generator.

A15 Memory Management Unit (MMU) Board

The A15 MMU board consists of the following:

- MMU IC
- Waveform RAM
- Display interface
- Digitizer interface
- Execution processor (EXP) interface
- Display IC
- Microprocessor
- Bit map RAM
- Waveform display RAM circuitry
- Video DAC

The A15 MMU board coordinates communications among the following three oscilloscope subsystems:

- Display
- Digitizer
- Executive

See Figure 4-10 for a block diagram of this board.

The MMU IC—controls all data transfers to and from waveform RAM. The MMU gate array controls high-speed transfers of waveform data and communication messages between waveform RAM and the three subsystem interfaces the: Display, Digitizer and Executive processors. A set of handshaking lines designed to the DMA facilities of each particular subsystem coordinates each subsystem interface.

The waveform RAM—consists of 512 K of RAM. The RAM holds waveform data and messages that are read and written by the Digitizer, Display, and Executive subsystems.

Through the Display Interface—data is transferred to and from the Display subsystem and to and from the MMU IC. The data is buffered with the bidirectional display data buffers.

Through the Digitizer Interface—data is transferred to and from the digitizer subsystem and to and from the MMU IC.

The Executive Processor (EXP) Interface—consists of bidirectional buffers, address mapping programmable array logic (PAL), and interface timing control PALs. This circuitry directs data flow to the EXP from the MMU IC and vice versa.

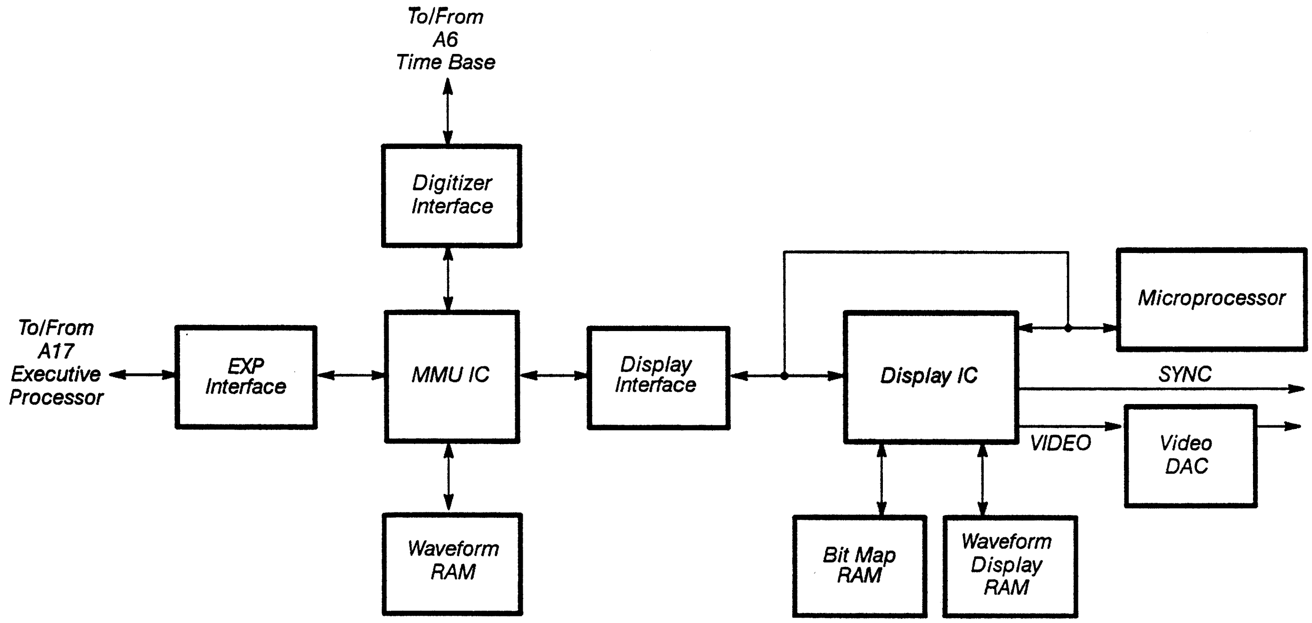


Figure 4-10 — A15 MMU Board Block Diagram

The Display IC—consists of the following functional circuits:

- CRT controller
- Video output circuitry
- Compressor circuit

The basic function of the CRT Controller is to produce VIDEO and SYNC signals that indicate to the CRT where to position video information. The controller is virtually automatic in operation and invisible to the firmware programmer; with the exception of several internal registers that must be initialized at power-on.

The video output circuitry is where the hardware recognizes and displays specific data structures, while the raster-scan CRT displays the contents of the bit map.

During the refresh of the screen, the hardware acquires bit map data along with waveform display data to yield a final color index.

The compressor circuit receives a waveform composed of any possible number of data points, and outputs 512 pairs (one minimum and one maximm) to the display.

The microprocessor—transforms the entire Display subsystem into an intelligent peripheral dedicated to operating the display. The firmware that controls the Display subsystem executes from ROM in the microprocessor's address space. The clock for this microprocessor operates at a frequency of 8 MHz.

The bit map RAM – consists of 256 Kbytes of RAM, divided into 4-bit planes of 65,536 bytes each. Three of the bit planes are for text and the remaining bit plane is for XY, point accumulate waveforms. Each bit in a plane represents a single pixel of the display. Setting the representative pixel bit in each of the planes controls the color or intensity.

The waveform display RAM – consists of 65,536 bytes. These bytes contain the minimum/maximum pairs of values, along with color index information and overrange/underrange settings.

The video digital-to-analog converter (DAC) – converts the digital data from the Display IC into analog data for the A7 CRT Socket board.

A17 Executive Processor Board

The A17 Executive Processor board consists of the:

- Executive processor (EXP)
- Numeric co-processor circuitry
- Bus buffer circuitry
- Rreset circuitry
- Wait state circuitry
- Auxiliary EPROMS
- Interrupt controllers
- DMA Controller (option 4D only)

See Figure 4-11 for a block diagram of this board.

The Executive processor (EXP) – executes firmware routines stored in EPROMS located on the A18 Memory board to control the operation of the oscilloscope. Along with the numeric co-processor, the EXP does all data processing not directly related to generating the display or digitizing the waveform. When power is first applied to the oscilloscope, the EXP executes local and system diagnostic tests, which are located in the EPROMs on the A18 Memory board.

The EXP performs these functions with three main circuits:

- The clock generator generates the timing signals and synchronized reset signals for the microprocessor
- The microprocessor reads and writes data, generates addresses for I/O and memory devices, and also generates status signals for the bus controller
- The bus controller interprets the microprocessor's status signals and generates the necessary bus control signals for the Executive bus

Address decoders, address latches, and data buffers are all support circuits for I/O operations.

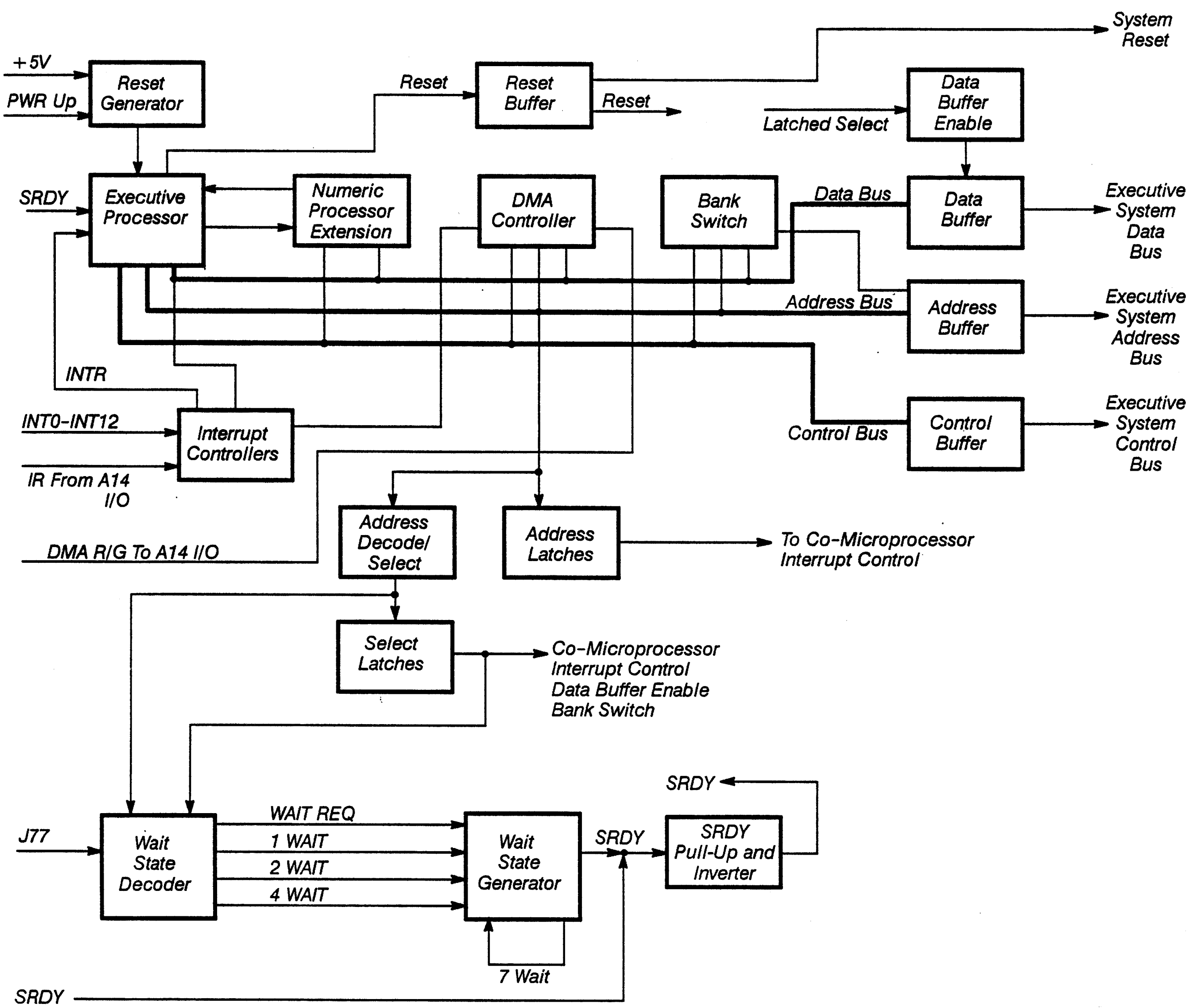


***Figure 4-11** — A17 Executive Processor Board Block Diagram*

The numeric co-processor circuitry—is a high-speed floating-point processor that executes instructions in parallel with the EXP. The EXP programs and controls the numeric co-processor as an I/O device at addresses 0F8*hex* to 0FF*hex*.

The bus controller circuitry—consists of a data buffer, an address buffer, and a control buffer that provide command and control signals from the microprocessor to the three Executive busses. The Executive busses consist of the following:

- **The system data bus**—is a bidirectional bus. It allows the microprocessor to fetch instructions from memory, and also to write data to memory and read data from memory. The memory that the microprocessor uses is located on the A18 Memory board.

- **The system address bus**—contains the address of a device when the microprocessor is requesting access to that device. Once the microprocessor has access, the addressed device can then respond to the microprocessor.
- **The system control bus**—contains control signals sent by the microprocessor. These control signals are sent to the devices that the microprocessor addresses, so that the devices can respond at the proper moment in the bus cycle.

The reset circuitry—generates synchronized ready and reset control signals.

The wait state circuitry—extends the bus cycle so that slower devices have sufficient time to read or write data.

The interrupt controllers—constantly monitor the EXP's interrupt lines to ensure that the highest priority interrupt gets serviced first. The Interrupt controllers provide the ability to assign priority levels to all the system's interrupt lines; and conversely, to ignore (mask) any of the interrupt lines as well.

Note: *DMA controller is present only if your oscilloscope is equipped with Option 4D. The DMA controller shortens the GPIB transfer time and also the transmission time of waveforms*

A18 Memory Board

The 18 Memory Board provides the Executive processor (EXP) with system RAM (SRAM) and EPROM for most operations. Support circuitry for the memories and diagnostic circuitry for troubleshooting are located on-board. All accesses to SRAM or EPROMs are initiated by the A17 Executive Processor board (specifically by the EXP or the DMA controller). Refer to the discussion of the A17 Executive Processor board, earlier in this section, for bus cycle timing information.

The A18 Memory board consists of the following:

- Address latches
- Address decode and memory select circuitry
- EPROM and system RAM
- Memory data buffers
- Wait state generator
- Wait state diagnostics
- Memory configuration readback
- Waveform storage RAM and battery backup (optional)

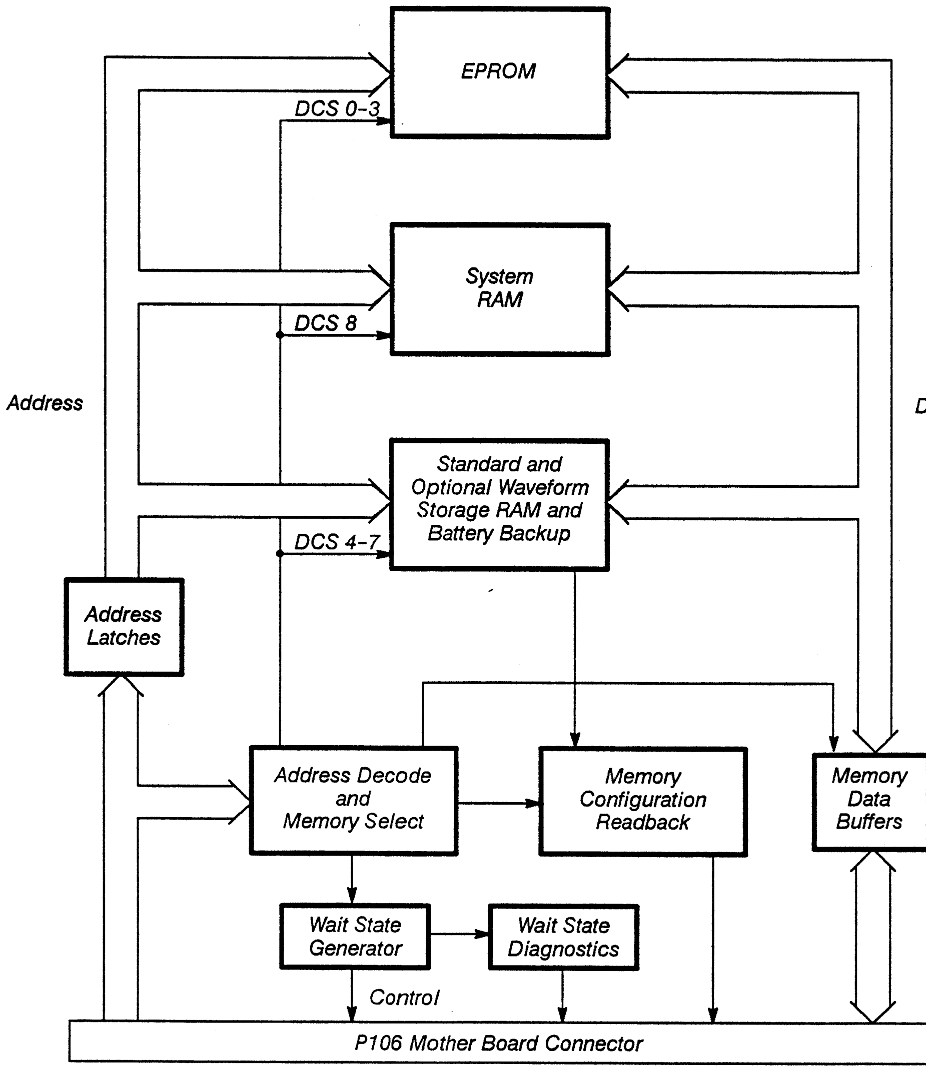


***Figure 4-12** — A18 Memory Board Block Diagram*

Address latches—buffer and hold the address lines for the EPROMs, SRAMs and other on-board devices until the end of the bus cycle.

The address decode and memory select circuitry—consists of a programmable array logic (PAL) device that decodes the address lines to produce five RAM select signals (DCS4-8) and four EPROM select signals (DCS0-3). DCS8 enables the SRAM. All EPROM and RAM select lines are latched, and the latch outputs are normally enabled. While the latch enable signal is high, the latch outputs are responsive to changes on the inputs; and while the latch enable signal is low, the select lines are latched.

The EXP on the A17 Executive Processor board generates the address line inputs, A14-A19. Depending upon the position of a jumper on the A17 Executive Processor board, address lines A20-A23 can be memory bank-select lines or micro- processor address lines.

The memory select circuitry provides latched memory select lines and an enable signal for the memory data buffers.

The EPROM and system RAM (SRAM) – The EPROMs contain all of the operating system code and diagnostics code for the EXP. All the memories share the latched address bus. The SRAM stores miscellaneous constants that the operating system code uses and produces. The memories are organized into high and low-byte pairs. The address decode PAL generates latched chip-select signals. A separate latched chip-select signal selects each of these pair. The memory data buffers buffer the data lines to the Executive data bus.

The memory data buffers – drive data between the memories and Executive data bus. Both 8-bit buffers are enabled when all of their inputs are high.

The wait state generator – allows the EXP to access memory devices when the EXP is operating at faster clock frequencies. When the EXP is operating at frequencies greater than 8 MHz, the bus cycle time is too short to allow reads or writes to the present memory devices. The wait state generator sets the SRDY line (see Fig. 4-11) on the Executive bus low to signal the EXP to lengthen the bus cycles.

The wait state generator also contains a circuit to generate control signals (similar to those on the Executive bus). These control signals are: early address latch (ELATCH), early memory write control (EMWTC), and early memory read control (EMRDC).

The wait state diagnostics – measure the time interval that the wait state generator generates when a one (1) is written to I/O address 8020*hex*. This causes the wait state diagnostics to connect the SRDY signal to the DIAGNSIG line on the Executive bus. A timer on the A14 I/O board can then measure the length of the wait.

Memory configuration readback – allows the diagnostics to read the position of the memory configuration straps and the bank address lines. One bit of the readback data byte also indicates if the battery is at 2.5 V (an early warning of a low battery). The EXP performs an I/O read at address 8040*hex* to read this information.

The waveform storage RAM and battery backup (optional) – provide standby power to the waveform storage RAM during the powered-off periods of the oscilloscope.

Replaceable Parts

This section contains a list of the components that are replaceable for the 11403 Digitizing Oscilloscope. As described below, use this list to identify and order replacement parts.

Parts Ordering Information

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

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

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

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

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

Module Replacement

The 11403 Digitizing Oscilloscope are 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. BVJ5799.
- **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
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
01536	TEXTRON INC CAMCAR DIV SEMS PRODUCTS UNIT	1818 CHRISTINA ST	ROCKFORD IL 61108
04348	LAWRENCE ENGINEERING AND SUPPLY INC	500 S FLOWER ST P O BOX 30	BURBANK CA 91503
06383	PANDUIT CORP	17301 RIDGELAND	TINLEY PARK IL 07094-2917
06915	RICHCO PLASTIC CO	5825 N TRIPP AVE	CHICAGO IL 60646-6013
09772	WEST COAST LOCKWASHER CO INC	16730 E JOHNSON DRIVE P O BOX 3588	CITY OF INDUSTRY CA 91744
11897	PLASTIGLIDE MFG CORP	2701 W EL SEGUNDO BLVD	HAWTHORNE CA 90250-3318
16428	COOPER BELDEN ELECTRONIC WIRE AND CA SUB OF COOPER INDUSTRIES INC	NW N ST	RICHMOND IN 47374
28520	HEYCO MOLDED PRODUCTS	750 BOULEVARD P O BOX 160	KENILWORTH NJ 07033-1721
30010	BICC-VERO ELECTRONICS INC	40 LINDEMAN DR	TRUMBULL CT 06611-4739
53387	MINNESOTA MINING AND MFG CO ELECTRONIC PRODUCTS DIV	3M CENTER	ST PAUL MN 55101-1428
70903	COOPER BELDEN ELECTRONICS WIRE AND C SUB OF COOPER INDUSTRIES INC	2000 S BATAVIA AVE	GENEVA IL 60134-3325
71400	BUSSMANN DIV OF COOPER INDUSTRIES INC	114 OLD STATE RD PO BOX 14460	ST LOUIS MO 63178
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076-9749
74445	HOLO-KROME CO	31 BROOK ST	ELMWOOD CT 06110-2350
75915	LITTELFUSE INC SUB TRACOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016-3049
77900	ILLINOIS TOOL WORKS SHAKEPROOF DIV	ST CHARLES RD	ELGIN IL 60120
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
81041	HOWARD INDUSTRIES DIV OF MSL INDUSTRIES INC	1 NORTH DIXIE HWY PO BOX 287	MILFORD IL 60953
83486	ELCO INDUSTRIES INC	1101 SAMUELSON RD	ROCKFORD IL 61101
83553	ASSOCIATED SPRING BARNES GROUP INC	15001 S BROADWAY P O BOX 231	GARDENA CA 90248-1819
85480	BRADY W H CO CORP H Q INDUSTRIAL PRODUCTS DIV	2221 W CAMDEN RD PO BOX 2131	MILWAUKEE WI 53209
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61108-5181
S3109	FELLER	ASA ADOLF AG STOTZWEID CH8810	HORGEN SWITZERLAND
S3629	SCHURTER AG H C/O PANEL COMPONENTS CORP	2015 SECOND STREET	BERKELEY CA 94170
TK0510	PANASONIC COMPANY DIV OF MATSUSHITA ELECTRIC CORP	ONE PANASONIC WAY	SECAUCUS NJ 07094
TK0861	H SCHURTER AG DIST PANEL COMPONENTS	2015 SECOND STREET	BERKELEY CA 94170
TK1262	MURPHY ELECTRONICS INC (DIST)	14933 NE 40TH ST	REDMOND WA 98052-5326
TK1373	PATELEC-CEM (ITALY)	10156 TORINO	VAICENTALLO 62/45S ITALY
TK1456	PAPST MECHATRONIC CORP	AQUIDNECK INDUSTRIAL PK	NEWPORT RI 02840
TK1543	CAMCAR/TEXTRON	600 18TH AVE	ROCKFORD IL 61108-5181
TK1546	DTM PRODUCTS INC	4725 NAUTILUS COURT S	BOULDER CO 80301
TK1869	ALPS	100 N CNTRE AVE	ROCKVILLE CENTRE NY 11570
TK2165	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER WA 98661-2999
TK2278	COMTEK MANUFACTURING OF OREGON (METALS)	PO BOX 4200	BEAVERTON OR 97076-4200
TK6020	DAINICHI-NIPPON CABLES	NEW KOKUSAI BLDG 4-1 MARUNOUCHI 3-CHOME CHIYODA-KU	TOKYO 100 JAPAN

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-1	200-3759-00			1	COVER,CABINET:TOP,LIFT OFF	80009	200-3759-00
-2	214-0603-02			4	.PIN ASSY,SECRG:W/SPRING WASHER	80009	214-0603-02
-3	386-1151-00			4	.CLAMP,RIM CLENC:SPG STL CD PL	83553	ORDER BY DESCR
-4	386-0227-00			4	.STOP,CLP,RIM CL:	80009	386-0227-00
-5	200-3758-00			1	COVER,CABINET:BOTTOM,LIFT OFF	80009	200-3758-00
-6	214-0603-02			4	.PIN ASSY,SECRG:W/SPRING WASHER	80009	214-0603-02
-7	386-1151-00			4	.CLAMP,RIM CLENC:SPG STL CD PL	83553	ORDER BY DESCR
-8	386-0227-00			4	.STOP,CLP,RIM CL:	80009	386-0227-00
-9	348-0596-00			4	PAD,CAB.FOOT:0.69 X 0.255 X 0.06,PU	80009	348-0596-00
-10	348-0879-00			4	FOOT,CABINET:BOTTOM,BLUE,POLYCARBONATE	80009	348-0879-00
					(ATTACHING PARTS)		
-11	211-0711-00			4	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-12	348-0875-00			1	FLIPSTAND,CAB.:	80009	348-0875-00

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-1	366-0582-00			2	KNOB:ENCODER	TK1546	ORDER BY DESCR
-2	213-0022-00			2	SETSCREW:4-40 X 0.188,STL	74445	ORDER BY DESCR
-3	614-0848-00			1	FRONT PNL ASSY:	80009	614-0848-00
					(SEE A9, EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-4	211-0373-00			2	SCREW,MACHINE:4-40 X 0.25,PNH,STL	80009	211-0373-00
					(END ATTACHING PARTS)		
					TOUCH PANEL ASSEMBLY INCLUDES:		
-5	200-3143-01			1	.COVER,CRT SCALE:BEZEL	80009	200-3143-01
-6	333-3693-00			1	.PANEL,FRONT:BEZEL	80009	333-3693-00
					(ATTACHING PARTS)		
-7	210-0586-00			3	.NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
					(END ATTACHING PARTS)		
-8	386-5806-00			1	.FRAME,LENS:TOUCH PANEL	80009	386-5806-00
					(ATTACHING PARTS)		
-9	211-0372-00			4	.SCREW,MACHINE:4-40 X 0.312,PNH,STL	TK1543	B80-00020-003
					(END ATTACHING PARTS)		
-10	----- -----			1	.CKT BOARD ASSY:TOUCH PANEL		
					.(NOT REPLACEABLE, ORDER 614-0898-XX)		
					(ATTACHING PARTS)		
-11	211-0378-00			1	.SCR,ASSEM WSHR:4-40 X 0.375.PNH,STL,CD PL	80009	211-0378-00
					(END ATTACHING PARTS)		
-12	366-0600-00			6	.PUSH BUTTON:0.269 X 0.409,ABS	80009	366-0600-00
-13	154-0946-00			1	ELECTRON TUBE:CRT,COLOR	80009	154-0946-00
					(ATTACHING PARTS)		
-14	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-15	131-4763-00			1	CONTACT,ELEC:GROUND,CU BE	80009	131-4763-00
					(ATTACHING PARTS)		
-16	211-0711-00			1	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-17	384-1682-00			2	EXTENSION SHAFT:2.375 L,POLYCARBONATE	80009	384-1682-00
-18	366-0600-00			4	PUSH BUTTON:0.269 X 0.409,ABS	80009	366-0600-00
-19	333-3691-00			1	PANEL,FRONT:UPPER	80009	333-3691-00
					(ATTACHING PARTS)		
-20	210-0586-00			4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
					(END ATTACHING PARTS)		
-21	131-1688-00			1	TERM,QIK DISC.:MALE,0.032 X 0.25 BL	00779	42577-4
					(ATTACHING PARTS)		
-22	211-0721-00			1	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
-23	210-0006-00			1	WASHER,LOCK:#6 INTL,0.018 THK,STL	77900	1206-00-00-0541C
					(END ATTACHING PARTS)		
-24	311-2320-00			2	ENCODER,DIGITAL:INCREMENTAL,50PPR,50 DETENT	TK1869	LA22661
					,QUAD OUTPUT,LOC LUG AT 9 O'CLOCK		
-25	129-0103-00			1	POST,BDG,ELEC:ASSEMBLY	80009	129-0103-00
					(ATTACHING PARTS)		
-26	210-0455-00			1	NUT,PLAIN,HEX:0.25-28 X 0.375,BRS NP	73743	3089-402
-27	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,STL	77900	1214-05-00-0541C
					(END ATTACHING PARTS)		
-28	348-0876-00			2	SHLD GSKT,ELEK:SOLID TYPE,2.480 L	80009	348-0876-00
-29	131-1768-00			1	CONTACT,ELEC:DELAY LINE,BRS CU-SN-ZN PL	80009	131-1768-00
-30	131-3767-00			1	CONN ASSY,ELEC:CAL TERMINAL	80009	131-3767-00
					(ATTACHING PARTS)		
-31	103-0268-00			1	ADAPTER,CONN:PELTOLA TO BNC	80009	103-0268-00
-32	210-0012-00			1	WASHER,LOCK:0.384 ID,INTL,0.022 THK,STL	09772	ORDER BY DESCR
					(END ATTACHING PARTS)		
-33	150-0121-13			1	LIGHT,INDICATOR:5V,GREEN,INCANDECENT	80009	150-0121-13
-34	348-0877-00			1	SHLD GSKT,ELEK:SOLID TYPE,1.860 L	80009	348-0877-00
-35	260-2275-00			1	SWITCH,ROCKER:SPST,30MA,12V	TK1262	ME010-D
-36	333-3231-00			1	PANEL,FRONT:LOWER(STANDARD)	80009	333-3231-00
	333-3215-00			1	PANEL,FRONT:LOWER,(OPTION)	80009	333-3215-00
					(OPTION 1C ONLY)		
					(ATTACHING PARTS)		
-37	210-0586-00			4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
					(END ATTACHING PARTS)		
	174-0178-01			1	CABLE ASSY,RF:4,50 OHM COAX,31.25 L	80009	174-0178-01
					(FRONT BNC'S TO REAR BNC'S, OPTION 1C ONLY)		
	174-0252-01			1	CABLE ASSY,RF:4,50 OHM COAX,31.25 L	80009	174-0252-01

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-					(FRONT BNC'S TO REAR BNC'S, OPTION 1C ONLY)		
	131-1315-01			16	CONN,RCPT,ELEC:BNC,FEMALE	80009	131-1315-01
					(J11 THRU J18 FRONT AND BACK, OPT. 1C ONLY)		
-38	348-0878-00			1	SHLD GSKT,ELEK:SOLID TYPE,7.646 L	80009	348-0878-00
-39	386-5268-04			1	SUBPANEL,FRONT:FINISHED	80009	386-5268-04
					(ATTACHING PARTS)		
-40	211-0718-00			5	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-41	348-0886-00			4	SHLD GSKT,ELEK:FINGER TYPE,18.310 L	80009	348-0886-00
-42	101-0107-00			2	TRIM,DECORATIVE:RIGHT SIDE,FRONT CASTING	80009	101-0107-00
					(ATTACHING PARTS)		
-43	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-44	426-2099-01			1	FRAME SECT,CAB.:RIGHT SIDE	80009	426-2099-01
					(ATTACHING PARTS)		
-45	212-0681-00			2	SCREW,MACHINE:10-32 X 0.25,PNH,STL	83486	ORDER BY DESCR
-46	211-0718-00			1	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-47	351-0744-00			3	GUIDE,PLUG-IN:POLYAMIDE	80009	351-0744-00
					(ATTACHING PARTS)		
-48	211-0711-00			3	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-49	131-0800-03			2	CONTACT,ELEC:PLUG-IN GND,BE NI HT TR	80009	131-0800-03
					(ATTACHING PARTS)		
-50	211-0408-00			4	SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-51	131-0799-00			4	CONTACT,ELEC:PLUG-IN GND,BE NI CD PL	80009	131-0799-00
					(ATTACHING PARTS)		
-52	211-0408-00			4	SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-53	671-1130-00			1	CIRCUIT BD ASSY:FRONT PANEL BUTTON	80009	671-1130-00
					(SEE A11)		
					(ATTACHING PARTS)		
-54	211-0410-00			2	SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-55	343-0004-00			3	CLAMP,LOOP:0.312 ID,PLASTIC	06915	ORDER BY DESCR
					(ATTACHING PARTS)		
-56	211-0720-00			3	SCR,ASSEM WSHR:6-32 X 0.50,PNH,STL,TORX,T15	01536	829-09487
-57	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	78189	511-061800-00
					(END ATTACHING PARTS)		
-58	381-0469-00			2	BAR,SUPPORT:CRT	80009	381-0469-00
					(ATTACHING PARTS)		
-59	211-0722-00			4	SCREW,MACHINE:6-32 X 0.25,PNH,STL	80009	211-0722-00
					(END ATTACHING PARTS)		
-60	108-1462-00			2	COIL,RF:FXD	80009	108-1462-00
-61	346-0143-00			1	STRAP,TIEDOWN,E:14.5 X 0.14,PLASTIC	06383	PLT4I
-62	351-0765-00			11	GUIDE,CKT BOARD:NYLON	30010	29-0124D
-63	200-2191-00			2	CAP,RETAINER:PLASTIC	80009	200-2191-00
-64	367-0248-01			1	HANDLE,CARRYING:16.341 L,W/CLIP	80009	367-0248-01
-65	426-2098-01			1	FRAME SECT,CAB.:LEFT SIDE	80009	426-2098-01
					(ATTACHING PARTS)		
-66	212-0681-00			2	SCREW,MACHINE:10-32 X 0.25,PNH,STL	83486	ORDER BY DESCR
-67	211-0718-00			1	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-68	200-3690-00			1	COVER,HV:ALUMINUM	80009	200-3690-00
					(ATTACHING PARTS)		
-69	211-0722-00			1	SCREW,MACHINE:6-32 X 0.25,PNH,STL	80009	211-0722-00
-70	211-0718-00			2	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-71	670-8847-01			1	CIRCUIT BD ASSY:FRONT PANEL CONTROL	80009	670-8847-01
					(SEE A10)		
					(ATTACHING PARTS)		
-72	211-0711-00			2	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-73	407-3840-00			1	BRACKET,SPRT:	TK2278	ORDER BY DESCR
					(ATTACHING PARTS)		
-74	211-0718-00			2	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-75	351-0746-00			2	GUIDE,CKT BOARD:NYLON 6.803 L	80009	351-0746-00
-76	407-3438-02			1	BRACKET,CHASSIS:ALUMINUM	80009	407-3438-02
					(ATTACHING PARTS)		
-77	211-0718-00			3	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-78	200-3708-00			1	COVER,CKT BD:11403	80009	200-3708-00
					(ATTACHING PARTS)		
-79	211-0711-00			2	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-80	386-1559-00			1	SPACER,CKT BD:0.47 H,ACETAL	80009	386-1559-00
-81	671-1028-00			1	CIRCUIT BD ASSY:CRT SOCKET	80009	671-1028-00
					(SEE A7)		
-82	348-0253-00			1	GROMMET,PLASTIC:BLACK,OBLONG,3.0 X 0.925	TK2165	ORDER BY DESCR
-83	348-0532-00			1	GROMMET,PLASTIC:BLACK,ROUND,0.625 ID	28520	SB-750-10
-84	343-0081-00			1	STRAP,RETAINING:0.125 DIA,NYLON	85480	CPNY-172BK
					(ATTACHING PARTS)		
-85	211-0711-00			1	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-86	351-0746-00			1	GUIDE,CKT BOARD:NYLON 6.803 L	80009	351-0746-00
					(ATTACHING PARTS)		
-87	211-0711-00			1	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-88	255-0334-00			1	PLASTIC CHANNEL:12.75 X 0.175 X 0.155,NYLON	11897	122-37-2500
-89	342-0313-00			1	GROMMET,PLASTIC:0.437 ID X 0.562 OD,NYLON	28520	2066
-90	211-0711-00			1	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(ATTACHING PART TO REAR PANEL GROUND WIRE)		
-91	386-5369-01			1	PLATE,CONN:ALUMINUM	80009	386-5369-01
	386-5336-00			1	PLATE,CONNECTOR:ALUMINUM	80009	386-5336-00
					(OPTION 1C ONLY)		
	334-6776-00			1	MARKER,IDENT:MKD GPIB	80009	334-6776-00
					(ATTACHING PARTS)		
-92	211-0721-00			8	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-93	671-0013-00			1	CIRCUIT BD ASSY:REAR PANEL	80009	671-0013-00
					(SEE A12, EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-94	129-0744-00			2	SPACER,POST:0.875 L,4-40 BOTH ENDS,AL	80009	129-0744-00
-95	214-3106-00			2	HARDWARE KIT:JACK SOCKET	53387	3341-1S
-96	211-0410-00			1	SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-97	214-2476-01			2	HDW ASSY KIT:BAIL LOCK,ELEC CONN RCPT MTG	80009	214-2476-01
					(ATTACHING PARTS)		
-98	211-0410-00			2	SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-99	101-0106-00			2	TRIM,DECORATIVE:LEFT SIDE,FRONT CASTING	80009	101-0106-00
					(ATTACHING PARTS)		
-100	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-101	386-5269-02			1	SUBPANEL,REAR:PLATED	80009	386-5269-02
					(ATTACHING PARTS)		
-102	211-0718-00			5	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-103	386-5283-00			2	SUPPORT,CHASSIS:POWER SUPPLY,POLYCARBONATE	80009	386-5283-00
-104	211-0722-00			1	SCREW,MACHINE:6-32 X 0.25,PNH,STL	80009	211-0722-00
					(ATTACHING PART TO PWR SPLY GROUND WIRE)		
-105	610-0751-04			1	CHASSIS ASSY:WELDED	80009	610-0751-04

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-1	671-1026-00			1	CIRCUIT BD ASSY:TIMEBASE	80009	671-1026-00
					(SEE A6, EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-2	211-0711-00			6	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
					TIMEBASE BOARD ASSEMBLY INCLUDES:		
-3	156-2624-00			1	.MICROCKT,DGTL:HMOS,SEMI CUSTOM,STANDARD	80009	156-2624-00
					.CELL,DISPLAY CONTROLLER		
					.(U166)		
-4	129-0591-00			1	SPACER,POST:0.937 L,6-32 INT-EXT,STL	80009	129-0591-00
-5	386-1559-00			3	SPACER,CKT BD:0.47 H,ACETAL	80009	386-1559-00
-6	671-1027-00			1	CIRCUIT BD ASSY:CRT DRIVER	80009	671-1027-00
					(SEE A8, EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-7	211-0711-00			1	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
-8	211-0722-00			1	SCREW,MACHINE:6-32 X 0.25,PNH,STL	80009	211-0722-00
					(END ATTACHING PARTS)		
					CRT DRIVER BOARD ASSEMBLY INCLUDES:		
-9	159-0235-00			1	.FUSE,WIRE LEAD:0.75A,125V,FAST	80009	159-0235-00
					.(F330)		
-10	407-3824-00			1	.BRACKET,SPRT:HV XFMR,0.062 ALUMINUM	80009	407-3824-00
					(ATTACHING PARTS)		
-11	213-0992-00			1	.SCREW,TPG,TF:4-24 X 0.375,PNH,STL	93907	B80-70000-003
-12	211-0711-00			1	.SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-13	671-1129-00			1	CIRCUIT BD ASSY:MOTHER	80009	671-1129-00
					(SEE A13)		
					(ATTACHING PARTS)		
-14	211-0711-00			6	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-15	671-1024-00			1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	671-1024-00
					(SEE A17, EXCHANGE ITEM)		
	671-1024-50			1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	671-1024-50
					(SEE A17, OPTION 4D ONLY, EXCHANGE ITEM)		
-16	156-3812-00			1	.MICROCKT,DGTL:HMOS,MICROPROCESSOR,16 BIT	80009	156-3812-00
					.(U830)		
	156-3821-00			1	.MICROCKT,DGTL:NMOS,PRPHL,DMA CONT,10MHZ	80009	156-3821-00
					.(U800, OPTION 4D ONLY)		
-17	671-1025-00			1	CIRCUIT BD ASSY:MEMORY	80009	671-1025-00
					(SEE A18, EXCHANGE ITEM)		
	671-1025-50			1	CIRCUIT BD ASSY:MEMORY	80009	671-1025-50
					(SEE A18, OPTION 2D ONLY, EXCHANGE ITEM)		
-18	146-0055-00			1	.BATTERY,DRY:3.0V,1200 MAH,LITHIUM	TK0510	BR-2/3A-E2P
					.(BT150)		
-19	670-8854-01			1	CIRCUIT BD ASSY:INPUT/OUTPUT	80009	670-8854-01
					(SEE A14, EXCHANGE ITEM)		
-20	146-0055-00			1	.BATTERY,DRY:3.0V,1200 MAH,LITHIUM	TK0510	BR-2/3A-E2P
					.(BT130)		
-21	159-0245-00			4	.FUSE,WIRE LEAD:1A,125V,FAST	75915	R251001T1
					.(F200,F600,F602,F800)		
-22	156-2622-00			1	.MICROCKT,DGTL:HMOS,SEMI CUSTOM,STANDARD	80009	156-2622-00
					.CELL,SERIAL DATA INTERFACE		
					.(U330)		
-23	671-1023-00			1	CIRCUIT BD ASSY:MEMORY MANAGEMENT UNIT	80009	671-1023-00
					(SEE A15, EXCHANGE ITEM)		
-24	670-8852-00			1	CIRCUIT BD ASSY:PL-IN INTERFACE	80009	670-8852-00
					(SEE A1)		
					(ATTACHING PARTS)		
-25	211-0410-00			9	SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-26	670-8840-01			1	CIRCUIT BD ASSY:REGULATOR	80009	670-8840-01
					(SEE A4, EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-27	211-0721-00			2	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
					REGULATOR BOARD ASSEMBLY INCLUDES:		
-28	159-0220-00			1	.FUSE,WIRE LEAD:3A,125V,FAST	71400	TRA3
					.(F430)		

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-29	671-1021-00			1	CIRCUIT BD ASSY:ACQUISITION V2 (SEE A5, EXCHANGE ITEM)	80009	671-1021-00
					(ATTACHING PARTS)		
-30	211-0711-00			7	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
-31	211-0754-00			2	SCR,ASSEM WSHR:6-32 X 1.375,PNH,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
					ACQUISITION BOARD ASSEMBLY INCLUDES:		
-32	671-1022-00			1	.CIRCUIT BD ASSY:TRIGGER ENHANCEMENT .(SEE A5A2)	80009	671-1022-00
					(ATTACHING PARTS)		
-33	210-0407-00			2	.NUT,PLAIN,HEX:6-32 X 0.25,BRS CD PL	73743	3038-402
					(END ATTACHING PARTS)		
-34	386-5429-01			1	SUPPORT,PIVOT:ECB,RIGHT SIDE	80009	386-5429-01
					(ATTACHING PARTS)		
-35	213-0992-00			1	SCREW,TPG,TF:4-24 X 0.375,PNH,STL	93907	B80-70000-003
					(END ATTACHING PARTS)		
-36	386-5428-01			1	SUPPORT,PIVOT:ECB,LEFT SIDE	80009	386-5428-01
					(ATTACHING PARTS)		
-37	213-0992-00			1	SCREW,TPG,TF:4-24 X 0.375,PNH,STL	93907	B80-70000-003
					(END ATTACHING PARTS)		
	020-1778-00			1	COMPONENT KIT:11403 FIRMWARE	80009	020-1778-00
					WIRE ASSEMBLIES		
	174-0287-00			1	CABLE ASSY,RF:50 OHM COAX,29.0 L,W/PELTALAS (FROM A5J26 TO FRONT PANEL)	80009	174-0287-00
	174-0580-00			1	CA ASSY,SP,ELEC:50,28 AWG,14.0 L,RIBBON (FROM A5J83 TO A6J83)	80009	174-0580-00
	174-1557-00			1	CA ASSY,SP,ELEC:8,22 AWG,(4)12.5 L, (4)11.125 L (FROM A10J74 TO ENCODERS S74 AND S75)	80009	174-1557-00
	174-1559-00			1	CA ASSY,SP,ELEC:8,26 AWG,12.0 L (FROM A7J56 TO A8J56)	80009	174-1559-00
	174-1560-00			1	CA ASSY,SP,ELEC:4,26 AWG,21.0 L,RIBBON (FROM A4J57 TO A8J57)	80009	174-1560-00
	174-1561-00			1	CA ASSY,SP,ELEC:3,26 AWG,9.0 L (FROM A8J52 TO A15J52)	80009	174-1561-00
	174-1743-00			1	CA ASSY,SP,ELEC:4,18 AWG,18.5 L (FROM A2A2J63 TO A13J63)	80009	174-1743-00
	174-1744-00			1	CA ASSY,SP,ELEC:50,28 AWG (FROM A10J72 TO A14J72)	80009	174-1744-00
	174-1748-00			1	CABLE ASSY,RF:50 OHM COAX,17.5 L (FROM A1J30,J31,J32,J33,J34,J36 TO A5J30, J31,J32,J33,J34,J36)	80009	174-1748-00
	175-9798-00			1	CA ASSY,SP,ELEC:18.0 L (FROM A2A2J66 TO A5J66,A6J66)	80009	175-9798-00
	175-9803-00			2	CA ASSY,SP,ELEC:7,26 AWG,7.5 L,RIBBON (FROM A2A2J65 TO A4J65) (FROM A7J53 TO A15J53)	80009	175-9803-00
	175-9804-00			1	CA ASSY,SP,ELEC:34,4.0 L (FROM A5J86 TO A6J86)	80009	175-9804-00
	175-9805-00			1	CA ASSY,SP,ELEC:40,4.0 L (FROM A5J85 TO A6J85)	80009	175-9805-00
	175-9806-00			1	CA ASSY,SP,ELEC:60,4.0 L (FROM A5J84 TO A6J84)	80009	175-9806-00
	175-9812-00			1	CA ASSY,SP,ELEC:26,7.0 L (FROM A1J91 TO A5J91,A6J91)	80009	175-9812-00
	175-9814-00			1	CA ASSY,SP,ELEC:34,3.0 L (FROM A14J77 TO A17J77)	80009	175-9814-00
	175-9815-00			1	CA ASSY,SP,ELEC:34,12.0 L (FROM A14J78 TO A12J78)	80009	175-9815-00
	175-9857-00			1	CA ASSY,SP,ELEC:11,18 AWG,7.25 L,RIBBON (FROM A4J62 TO A2A2J62)	80009	175-9857-00
	175-9905-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-1 (FROM A1J01 TO A5J01)	80009	175-9905-00
	175-9906-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-2 (FROM A1J02 TO A5J02)	80009	175-9906-00
	175-9907-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-3	80009	175-9907-00

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-					(FROM A1J03 TO A5J03)		
	175-9908-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-4 (FROM A1J04 TO A5J04)	80009	175-9908-00
	175-9909-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-5 (FROM A1J05 TO A5J05)	80009	175-9909-00
	175-9910-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-6 (FROM A1J06 TO A5J06)	80009	175-9910-00

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
4-1	620-0022-03			1	POWER SUPPLY:ET,RT HLRES MAINFRAME	80009	620-0022-03
					(SEE A2, EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-2	211-0721-00			8	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
					POWER SUPPLY ASSEMBLY INCLUDES:		
-3	200-2222-00			1	.GUARD,FAN:	81041	6-182-033
					(ATTACHING PARTS)		
-4	211-0744-00			4	.SCREW,MACHINE:6-32 X 2.0,PNH,TORX,STL,CD	04348	ORDER BY DESCR
					(END ATTACHING PARTS)		
-5	407-3362-00			1	.BRACKET,FAN:0.050 5005 H-34	80009	407-3362-00
-6	200-2264-00			1	.CAP,FUSEHOLDER:3AG FUSES	S3629	FEK 031 1666
-7	159-0013-00			1	.FUSE,CARTRIDGE:3AG,6A,250V,FAST BLOW	71400	MTH-CW-6
					.(F99, USED IN FUSE HOLDER)		
	159-0021-00			1	.FUSE,CARTRIDGE:3AG,2A,250V,FAST BLOW	71400	AGC-CW-2
					.(F410, PART OF LINE INVERTER BOARD)		
	159-0248-00			1	.FUSE,WIRE LEAD:1.5 A,AXIAL LEAD	75915	R25101.5 T1
					.(F650, PART OF LINE INVERTER BOARD)		
	159-0220-00			1	.FUSE,WIRE LEAD:3A,125V,FAST	71400	TRA3
					.(F740, PART OF CONTROL RECTIFIER BOARD)		
-8	204-0832-00			1	.BODY,FUSEHOLDER:3AG & 5 X 20MM FUSES	TK0861	031 1673
-9	119-1725-01			1	.FAN,TUBEAXIAL:8 14.5VDC,6W,3200RPM,106CFM	TK1456	4112 KX

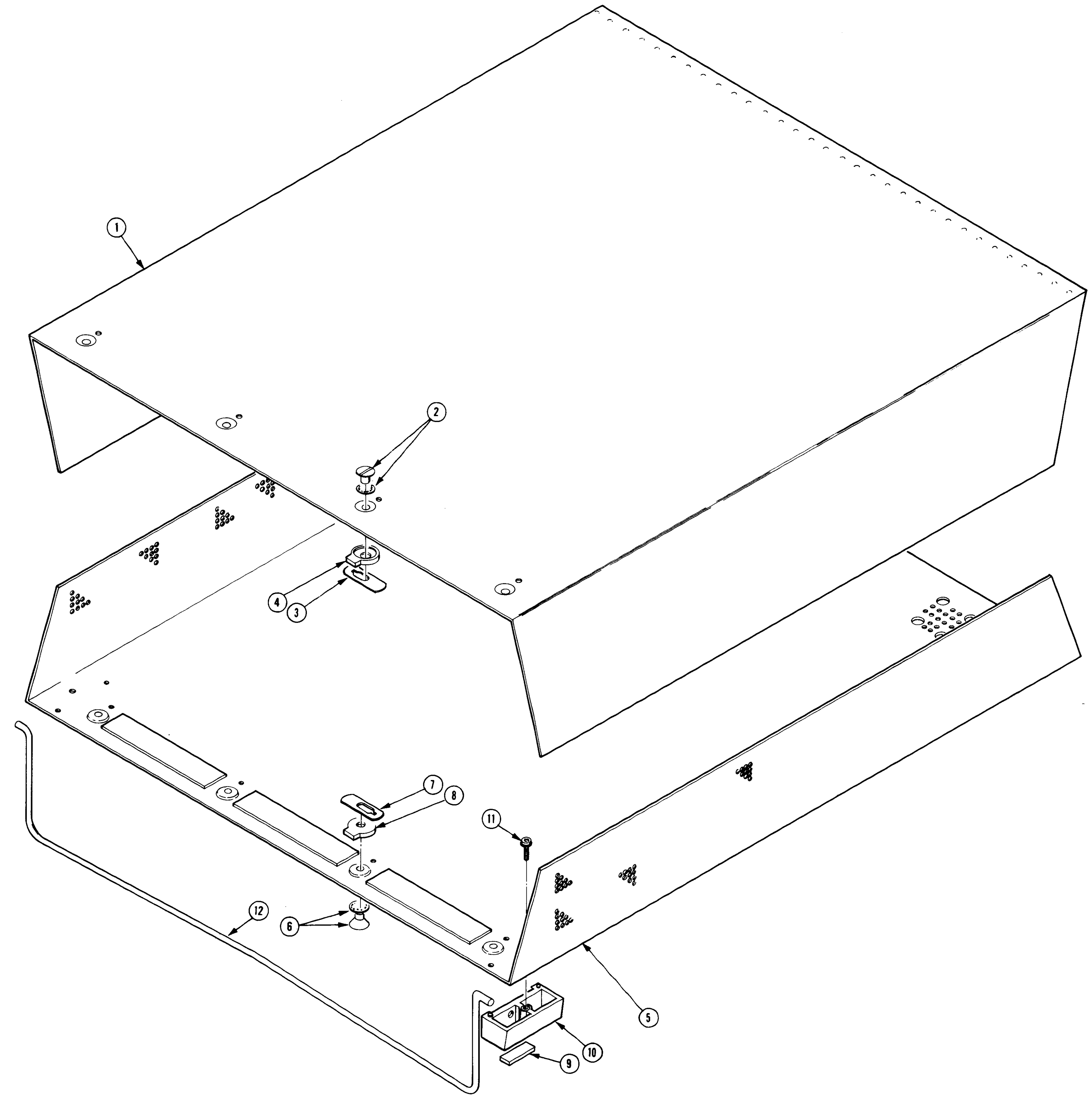
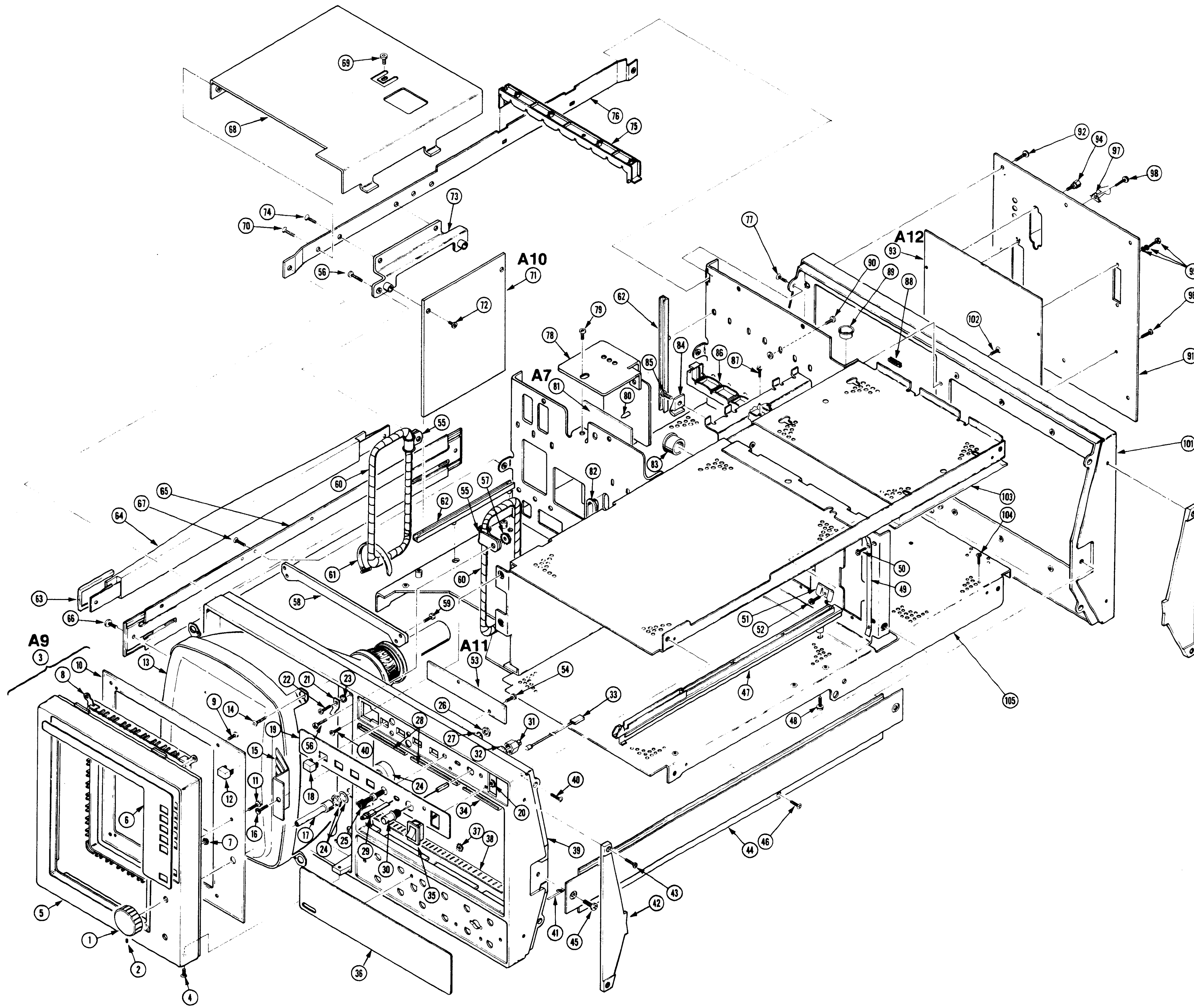
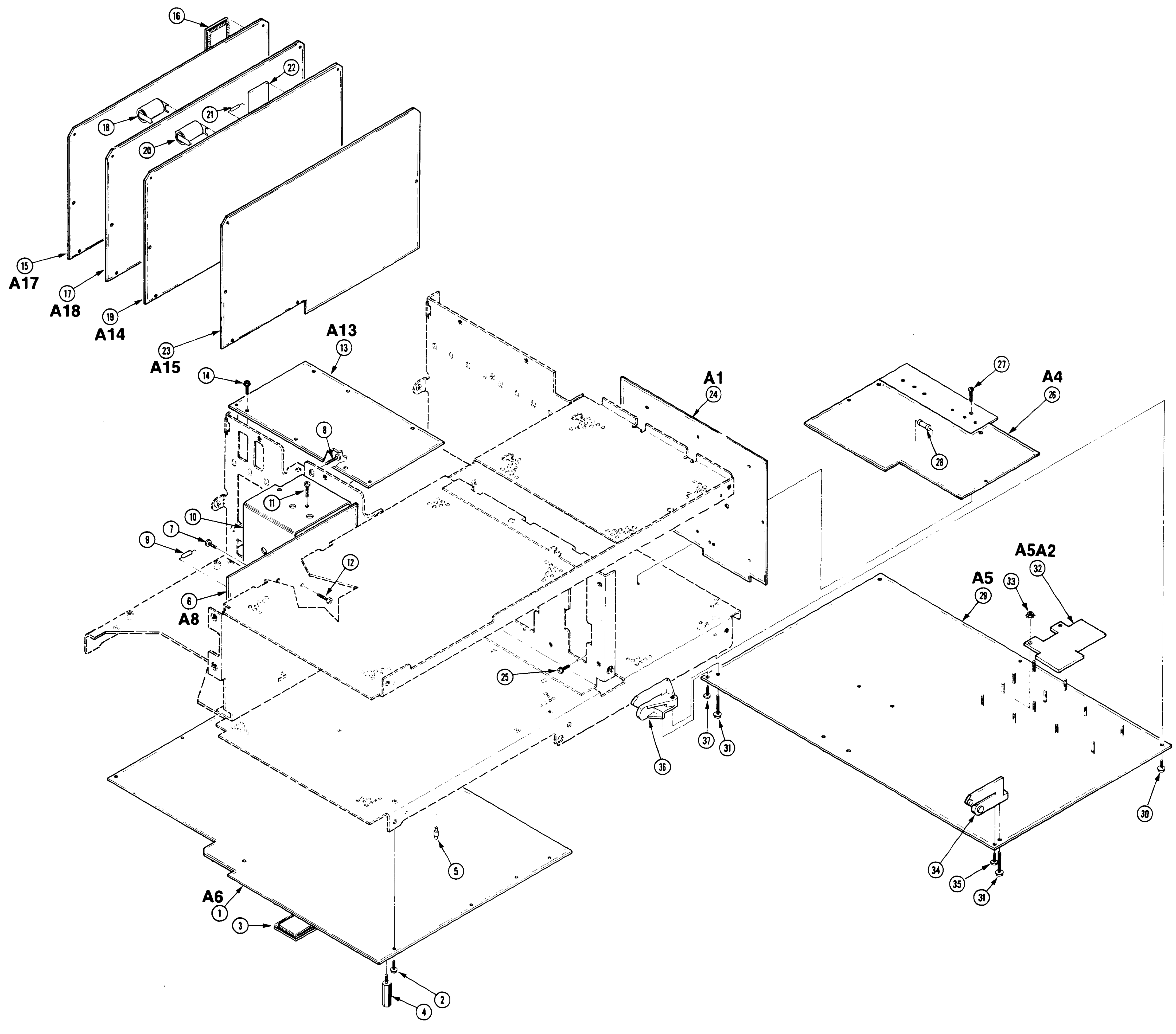


Fig. 1 Cabinet

Fig. 2 Front, Chassis, Rear

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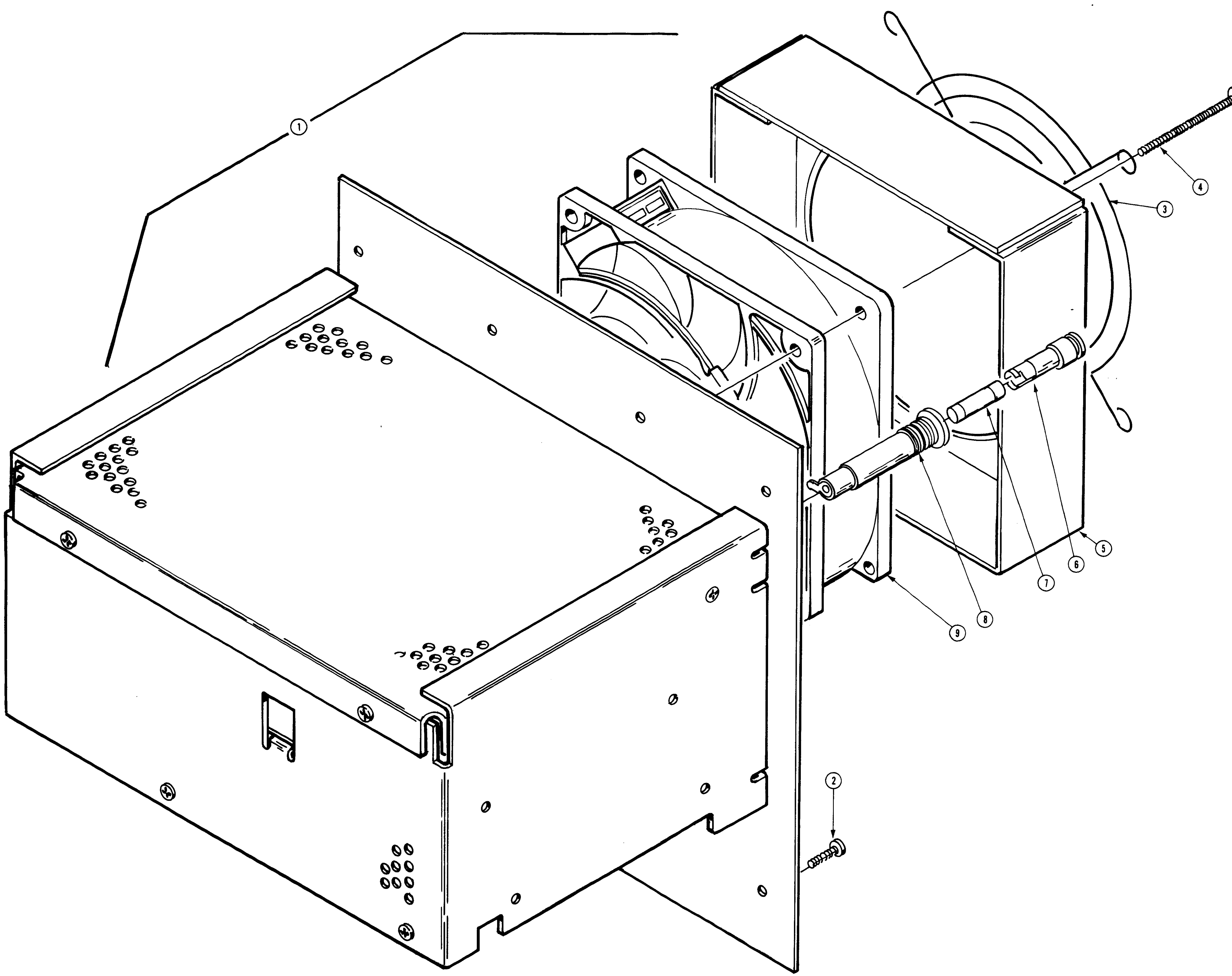
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