TEK **Service Reference Manual**

Part No. 070-7279-00
Product Group 47

THE 11201 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, 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.).

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

 

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General Information

The *11201 Digitizing Oscilloscope Service Reference* manual is designed for use by qualified service personnel. It contains information necessary to check, troubleshoot, and maintain the 11201 Digitizing Oscilloscope.

Troubleshooting is primarily based upon internal power-on diagnostics. These diagnostics isolate problems to the field replaceable unit (FRU) level. If the diagnostics can not detect the defective FRU, then this difective FRU can be isolated using other methods. Once the faulty FRU is identified, use the instructions provided in this manual to remove and replace this FRU. The removal and immediate replacement of the faulty FRU allows a minimum of downtime for the user. Section 5, Replaceable Parts, provides a complete list of the FRUs in this oscilloscope.

The 11201 Oscilloscope is a four channel digitizing oscilloscope. The input impedance of each channel is set independently to either 1 MΩ or 50 Ω. The Bandwidth can be limited to 20 MHz or 100 MHz. Each channel provides display and trigger signals that are comprised of any combination of the input signals.

Each channel has a TEKPROBE® input connector. The TEKPROBE® input connector accepts a Level 1 or Level 2 TEKPROBE®, a probe with a BNC connector, or a BNC connector. The channel detects the probe-encoding information, and uses this information to automatically achieve the desired settings.

The 11201 Oscilloscope also provides an external trigger input for triggering a waveform with a time-related, external signal. The external trigger input has a BNC connector.

First-time users are encouraged to read *Introducing the 11201 Digitizing Oscilloscope*. This is a tutorial manual that will familiarize you with the basic functions of the oscilloscope.

This section gives safety information, information about 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 product 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 product is grounded through the grounding conductor of the oscilloscope's power cord. To avoid electric shock, plug the power cord into a properly wired receptacle before connecting it to the product 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 product in an atmosphere of explosive gasses.

Do Not Service Alone

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

Use Care When Servicing with Power On

Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections 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 fuses which are identical in type, voltage rating, and current rating to the fuses specified in Section 5, Replaceable Parts.

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. The 6 A, 250 V line fuse is used for both 115 V and 230 V operation.

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, 250 V.

WARNING

Before making connection to the power source, check 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's 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*

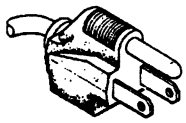
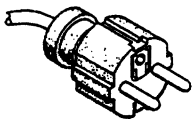
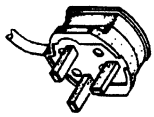
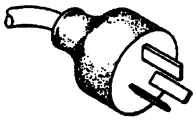
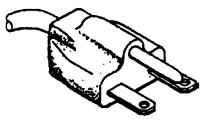
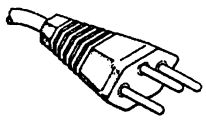
Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Light Blue	White
Grounded (Earthing)	Green/Yellow	Green

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 are not retained. The 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-up sequences.

The self-contained power-source has a nominal shelf life of approximately five years. Partial or total loss of stored settings upon power-on may indicate that the power source needs to be replaced.

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	[4]CEE (7),II, IV, VII [3]IEC 83 [8]VDE [9]SEMKO	A1
	United Kingdom 240 V/6 A	[5]BSI 1363 [3]IEC 83	A2
	Australian 240 V/6 A	[6]AS C112 [12]ETSA	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*

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 not-enhanced 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 power supply of the oscilloscope may temporarily shut down.

Packaging for Shipment

If the oscilloscope is shipped long distances by commercial transportation, it should be packaged in the original manner. The carton and packaging material in which your oscilloscope was shipped should be saved and used for this purpose.

Also, if the oscilloscope is to be shipped 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 **Instr Options** 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: Cushion the oscilloscope on all sides by tightly packing dunnage or urethane foam between the carton and the oscilloscope, allowing three inches of cushion on each side of the oscilloscope.

☐ 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. For further information and prices of instrument options, see your *Tektronix Products Catalog* or contact your local Tektronix Service Center.

WARNING

To avoid electric shock hazard, operating personnel must not remove the protective oscilloscope covers. Component replacement and internal adjustments must be made by qualified service personnel only.

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—expands total waveform memory from 64 K to 128 K points for storage of waveform records. This option can be added at any time.

Option 4D—increases 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 type power cord.

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

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

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

Option A5—replaces the standard power cord with the Switzerland 240 V type 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. Refer to the *11201 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 for more information concerning test equipment used in the setups.

Table 2-1 *– Measurement Limits, Specifications, and Adjustments*

Part and Description	**Measurement Limits *(Examine)***	**Specifications *(Check)***	**Adjustments *(Adjust)***
Part 1 Power-On Diagnostics	none	none	none
Part 2 Extended Diagnostics	none	none	none
Part 3 Voltage Reference			
Voltage Supply	+4.85 V to +5.25 V	none	none
Voltage Reference	+5.15 V to +5.25 V	none	R800 +5.20 V Ref for +5.20 V
Regular Reference	+9.95 V to +10.05 V	none	R730 +10 V Ref for +10.00 V
Part 4 Display			
Vertical Size	±0.050 inch	none	■ R202 Main Brite until raster appears, and then until the retrace lines just disappear ■ R620 Horiz Hold and R530 Vert Hold for stable display ■ R530 Vert Hold so bottom line at bottom of raster ■ R520 Vert Pos and L120 Vert Size to align grid with index bumps along inside vertical edge of front panel bezel; within 0.05 inches ■ R541 Horiz Lin, R621 Horiz Size, and R540 Horiz Pos for optimum overall linearity and position ■ R100 Focus for optimum overall focus
Horizontal Size	±0.050 inch	none	
Vertical Linearity	3.7 ±0.4 lines/inch	none	
Horizontal Linearity	5.6 ±0.6 lines/half inch	none	

Table 2-1 (cont) *– Measurement Limits, Specifications, and Adjustments*

Part and Description	Measurement Limits *(Examine)*	Specifications *(Check)*	Adjustments *(Adjust)*
Part 5 Enhanced Accuracy	successful execution		none
Part 6 Calibration Output Accuracy			
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	±0.04%		none
Calibrator DAC Linearity	±0.75 of LSB		none
Part 7 High Frequency Response			
Aberrations	9% peak-peak (2.25 div) and 18% peak-peak (4.5 div)		HF1 and HF2 for aberrations with 9% and 18%
Bandwidth	400 MHz for ≥10 mV/div		none
	350 MHz for 5 mV/div to 9.99 mV/div		none
	250 MHz for 2 mV/div to 4.99 mV/div		none
	200 MHz for 1 mV/div to 1.99 mV/div		none
Part 8 DC Balance	±0.110 div for 10 V/div ±0.120 div for 5 V/div, 0.5 V/div, and 50 mV/div ±0.150 div for 2 V/div, 0.2 V/div, and 20 mV/div ±0.200 div for 1 V/div, 0.1 V/div, and 10 mV/div ±0.300 div for 5 mV/div ±0.600 div for 2 mV/div ±1.100 div for 1 mV/div		none
Part 9 ΔV DC Accuracy		±1.4%	none
Part 10 DC Offset Accuracy		±0.20% of Vert Offset + 0.5 mV for 1 mV/div	none
		±0.50% of Vert Offset + 0.5 mV for 0.1 V/div	none
		±0.50% of Vert Offset + 50 mV for 1.0 V/div	none
Part 11 Trigger Sensitivity at 400 MHz	2.0 division triggered display at 400 MHz		none
Part 12 RMS Noise	≤0.06 divs for 10mV/div to 10V/div		none

Table 2-1 (cont) *– Measurement Limits, Specifications, and Adjustments*

Part and Description	**Measurement Limits *(Examine)***	**Specifications *(Check)***	**Adjustments *(Adjust)***
Part 13 Time Base	100 ps ±0.002% of measurement interval		none
Part 14 Events Window Position Accuracy	150 MHz Maximum Event Frequency		none
Part 15 Input/Output			
Real Time Clock	1,000,000 µs +50 µs or -5 µs		C 510 Real Time Clock for1,000,000 µs
Temperature Sensor Voltage Reference	+6.500 V ± 5 mV		R112 Temp Sensor Voltage Ref for 6.500 V
Part 16 Trigger Enhacement	Delay Limit of 400 ps ± 80 ps		C200 for most transitions between high and low levels of L2 signal
Part 17 Triggering	Trigger level DC Accuracy within 2.2% of full scale (20 LSBs)		none
	Noise Reject Coupled of 1.2 div or less from DC to 50 MHz, increasing to 3.5 div at 400 MHz		none
	AC Coupled of 1.0 div from 60 Hz to 50 MHz, increasing to 2.0 div at 400 MHz		none
	DC Coupled of 1 division from DC to 50 MHz, increasing to 2 divisions at 400 MHz.		none
	HF Reject Coupled functional		none
	LF Reject Coupled functional		none
Part 18 External Trigger Input Resistance	1 MΩ ± 0.05 mΩ		none
Part 19 External Trigger Input Calibration			
Balance	0 V ± 0.500 mV		R21 balance for ≃ 0 V
Input Capacitance	15 pF±10 %		C2 input capacitance for a flat response
Gain	Unity ± 1%		R39 gain for 2 V peak-peak reading (unity gain)

Table 2-1 (cont) *– Measurement Limits, Specifications, and Adjustments*

Part and Description	Measurement Limits *(Examine)*	Specifications *(Check)*	Adjustments *(Adjust)*
Part 20 External Trigger Performance			
Low Frequency Trigger Performance	Obtain a stable display		none
Medium Frequency Trigger Performance	Obtain a stable display		none
High Frequency Trigger Performance	Obtain a stable display		none

Test Equipment

Table 2-2, Test Equipment, contains suggested test equipment used in this manual. 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 Applicable Test Equipment
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 with SG504 Output Head
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

Table 2-2 (cont) *– Test Equipment*

Description	Minimum Specification	Examples of Applicable Test Equipment
Low Frequency Sine Wave Generator	60 Hz to 80 kHz, Variable amplitude	TEKTRONIX SG 502 Oscillator with a TM 500-Series Power Module
Calibration Generator	Period, 0.1 ms, Amplitude, -60 V	TEKTRONIX PG 506 Calibration 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
Frequency Counter	1 part in 10^6 accuracy	TEKTRONIX DC 503A Universal Counter/Timer with a TM 500-Series Power Module
Power Supply	Continuously variable from 0-40 V; current limit, adjustable from 0-400 mA	TEKTRONIX PS 503A Dual Power Supply with a TM 500-Series Power Module
Pulser	Amplitude; 250 mV Rise time; $\leq$125 ps Aberrations $<$1%	TEKTRONIX 067-0681-01 Tunnel Diode Calibration Fixture Pulser
Signal Pickoff	Provides output signal access.	TEKTRONIX 067-1262-00 Signal Pickoff
RC Normalizer	Impedance, 1 MΩ and 15 pF	TEKTRONIX 067-0537-00 RC Normalizer
Flexible Plug-in Extender		TEKTRONIX 067-1261-00 Flexible Plug-in Extender
Digital Multimeter (w/test leads)	Accuracy $\leq$0.01%	Fluke 8842A Digital Multimeter
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
Test Oscilloscope	$\geq$80 MHz bandwidth	TEKTRONIX SC 504 Oscilloscope
CT-3 Signal Pickoff	10% sensitivity into a 50 Ω load	Tektronix Part 017-0061-00

Table 2-2 (cont) — *Test Equipment*

Description	Minimum Specification	Examples of Applicable Test Equipment
Coaxial Cable (3 required)	50 Ω, 36-inch, male BNC connectors	Tektronix Part 012-0482-00
Adapters	BNC Female to Dual Banana (2 required)	Tektronix Part 103-0090-00
	BNC Female to Alligator Clips	Tektronix Part 013-0076-00
	Male BNC to GR	Tektronix Part 017-0064-00
	Female BNC to GR	Tektronix Part 017-0063-00
Connector, T	Two female and one male BNC connector	Tektronix Part 103-0030-00
50 Ω Termination	Impedance, 50 Ω; accuracy, within 2 %; connectors, BNC	Tektronix Part 011-0049-01
Attenuator, 10X (2 required)	Impedance, 50 Ω; one male and one female BNC connector	Tektronix Part 011-0059-02
Attenuator, 5X	Impedance, 50 Ω; one male and one female BNC connector	Tektronix Part 011-0060-02
Resistor	430Ω, 10 % tolerance; power rating, 1 W	Tektronix Part 303-0431-00
Capacitor	0.1 μF minimum capacitance	
Probe, 10X	Probe capacitance of ≤ pF, DC to 150 MHz, 10X, w/ground lead	TEKTRONIX P6106A
Logic Probe		TEKTRONIX P6401 Logic Probe
Power Supplies Troubleshooting Fixture		TEKTRONIX 067-1264-00 Extended Diagnostics 11000-Series Power Supplies troubleshooting fixture
Adapter, Probe-Tip to Ground	Used on Probe Bayonet Ground assembly	Tektronix Part 013-0085-00
Term Conn Link	Shorting strap	Tektronix Part 013-0993-00

Table 2-2 (cont) *— Test Equipment*

Description	Minimum Specification	Examples of Applicable Test Equipment
External Loopback Connector	RS-232-C connector	Tektronix Part 013-0198-00
Alignment Tool (plastic hex)	Plastic hex	Tektronix Part 003-0301-00
Alignment Tool (insulated slot)	Insulated slot	Tektronix Part 003-0675-01
Alignment Tool (square-tip ceramic)	Square-Tip (ceramic)	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	003-0966-00
	#20 tip	003-0866-00
Shorting Strap	Two alligator clips on a short pigtail conductor	
Integrated Circuit Extracting Tools	IC Extraction Pliers	General Tool P/N 821566-1 or equivalent
	IC Insertion-Extraction Pliers 28-pin type	General Tool P/N U505BG or equivalent
Circuit Board Removal Tools	Straight-slot screw-driver, 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

In these procedures, the following conventions are used:

- CAPITAL letters within the body of text identify front panel controls, indicators, and connectors on the oscilloscope (for example, MEASURE).
- **Bold** letters identify menu labels and display messages.
- Initial Capital letters identify connectors, controls, and indicators (for example, On) on associated test equipment.
- In some steps, the first word is italicized to identify a step that contains a performance verification 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 indicate whether the oscilloscope is operating properly; 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 procedure. Comprehensive descriptions of menus and oscilloscope features are provided in the *11201 Digitizing Oscilloscope User Reference* manual.

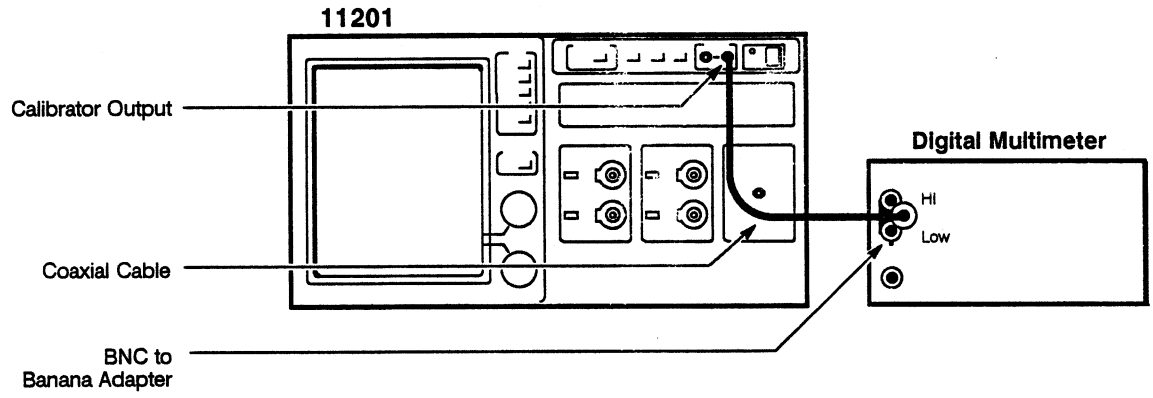
Tutorial Manual

The tutorial manual, *Introducing the 11201 Digitizing Oscilloscope*, is strongly recommended to familiarize the first-time user with 11201 Oscilloscope controls and features.

Characterizing the Oscilloscope

For parts 9 and 10 the oscilloscope must be characterized in order to obtain the calibration voltage reference characterization. Prior to performing parts 9 or 10 perform the following procedure, and then record the calibration voltage reference characterization for use in these parts.

Setup to Characterize Oscilloscope



Setup to Characterize Oscilloscope

Procedure to Characterize Oscilloscope

☐ Step 1: Perform the following settings:

11201 Oscilloscope

UTILITY button ..... press
UTILITY major menu ..... **Extended Diagnostics**
Block ..... **Points Acq**
Area ..... **Cal Refs**
Routine ..... **FP -10.000 V**
..... **Run**

Digital multimeter

Mode ..... DC

☐ Step 2: Record the absolute value of the reading on the digital multimeter as V_2.

☐ Step 3: Press **Exit.**

☐ Step 4: Press **FP +9.9951 V.**

☐ Step 5: Press **Run.**

☐ Step 6: Record the digital multimeter reading as V_6.

☐ Step 7: Press **Exit.**

☐ Step 8: Press **Exit Diagnostics.**

☐ Step 9: Add the digital multimeter absolute values of the readings obtained in steps 2 (V_2) and 6 (V_6). Divide the result by 19.9951 V to obtain the calibration voltage reference characterization factor. Record this result for use in parts 9 and 10.

☐ Step 10: Press **Exit** twice to leave Extended Diagnostics.

Part 1 Power-On Diagnostics

The following part must be performed within the ambient temperature range of +18° and +28° C to assure proper oscilloscope operation.

Setup to Power-On Diagnostics

☐ Step 1: Remove the top and bottom covers from the 11201 oscilloscope.

☐ Step 2: With the rear-panel PRINCIPAL POWER SWITCH set to OFF, connect the oscilloscope to a suitable power source.

☐ Step 3: Set the rear panel PRINCIPAL POWER SWITCH to ON and then the front panel 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 do all power switching.

☐ Step 4: 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
- Low frequency sine wave generator
- Medium frequency sine wave generator
- High frequency sine wave generator
- Time mark generator

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. If corruption occurs, refer to Restoring Data under Diagnostic Troubleshooting in Section 3.

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, Digitizer and Signal Input.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-Test 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-in 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 Self-Test Diagnostics. Any failures cause the oscilloscope to execute the remaining tests, and then display the Extended Diagnostics menu. 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 sequence and any disturbance will cause a test failure. If such a failure occurs, the oscilloscope will automatically enter the Extended Diagnostics mode and display the **Extended Diagnostics** menu. Touch the **Exit** selector to remove the menu and resume normal operation . However, if a fatal Digitizer fault is detected by the diagnostics, exiting the menu to normal operation will not be possible.

Self-Test diagnostics verify the following circuits:

- Executive Control
- Front Panel
- Internal I/O
- External I/O
- Subsystem Communication
- Display Control
- Video Generator
- Digitizer
- Timebases
- Points Acquisition
- Internal Triggers
- Points/Address Generator
- Left Input Channels
- Center Input Channels

Completion of Power-on Diagnostics

When the graticule is displayed and the front panel settings in effect at the last power-down 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** mode and execute the indicated tests.

- ☐ Step 1: Press the UTILITY button.
- ☐ Step 2: Touch **Extended Diagnostics**.
- ☐ Step 3: Touch **All** and then **Run** to start the tests.
- ☐ Step 4: *Check* that all tests have executed and have a **Pass** status.
- ☐ Step 5: Touch the following selectors in order:

  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: *Check* that all four tests executed and passed.
- ☐ Step 11: Touch **Exit** to leave Extended Diagnostics.

Part 3 Voltage Reference

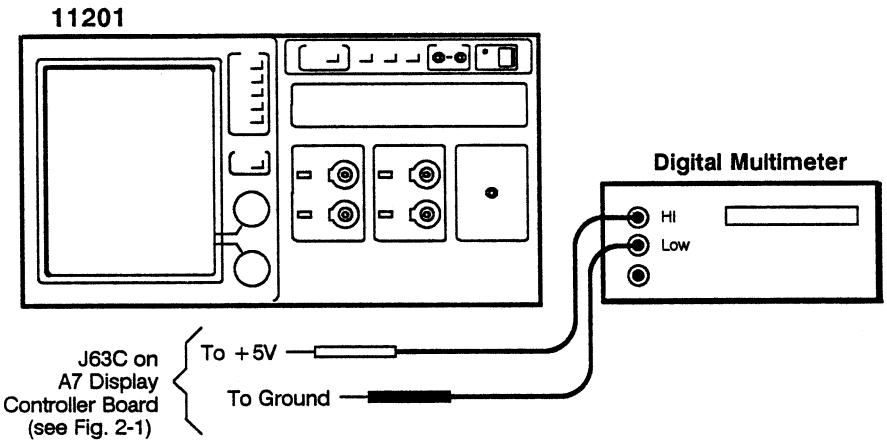
This part shows the setup and lists the procedure to check the measured voltage supply, the voltage reference, and the regulator reference (see Figs. 2-1, 2-2, and 2-3).

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 Voltage Supply



Setup to Examine Voltage Supply

Procedure to Examine Voltage Supply

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

11201 Oscilloscope ..... No settings required
Digital multimeter
Mode ..... DC Voltage

☐ Step 2: *Examine* that the digital multimeter reads within the limits of +4.85 V and +5.25 V.

STOP

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

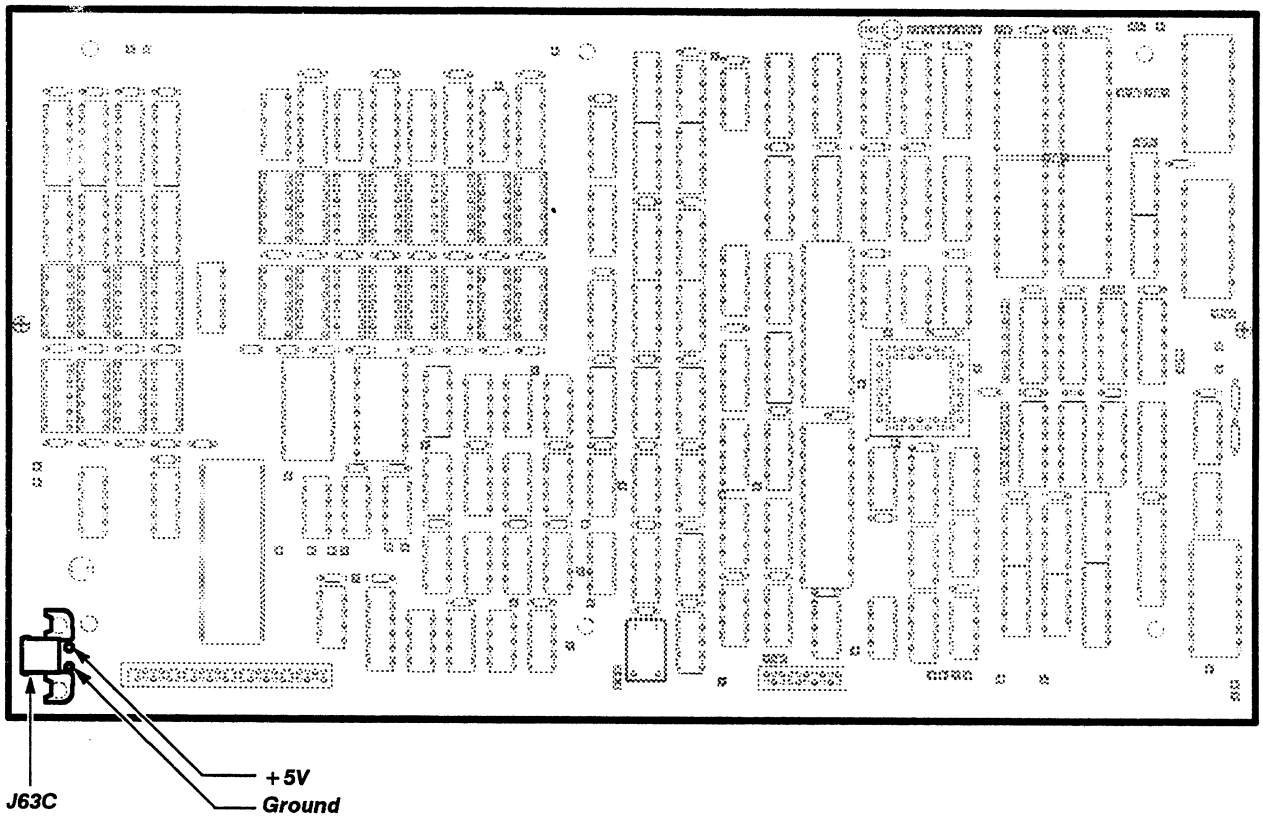
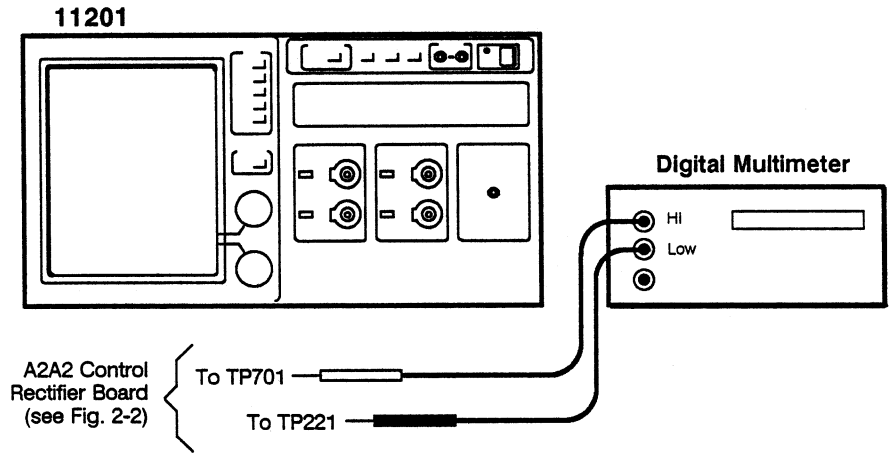


Figure 2-1 *— A7 Display Controller Board Test Point Locations*

Setup to Examine/ Adjust Voltage Reference



Setup to Examine/Adjust Voltage Reference

Procedure to Examine/Adjust Voltage Reference

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

11201 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

WARNING

Extreme caution must be used when performing the following adjustment.

☐ 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 +5.2 V Ref adjustment, if the reading is within the stated limits. Proceed to Step 4.

☐ 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.

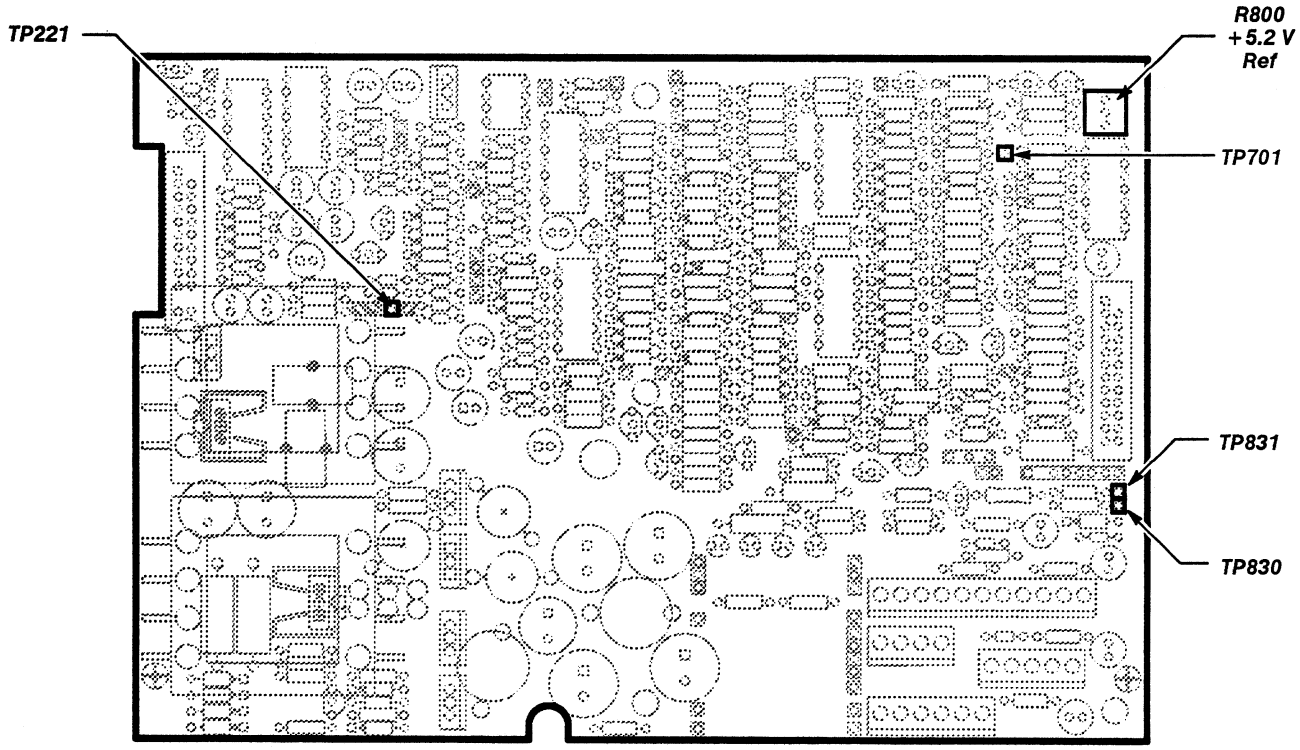
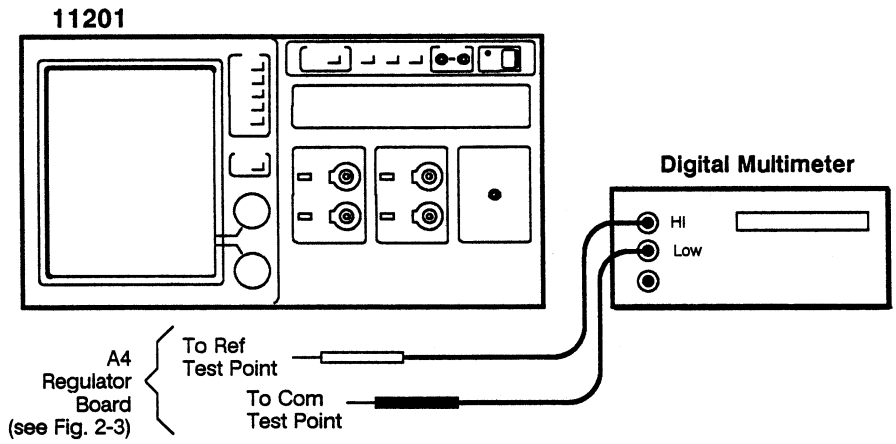


Figure 2-2 *— A2A2 Control Rectifier Board Test Point and Adjustment Locations*

Setup to Examine/ Adjust Regulator Reference



Setup to Examine/Adjust Regulator Reference

Procedure to Examine/Adjust Regulator Reference

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

11201 Oscilloscope . . . . . No settings required
Digital multimeter
Mode . . . . . DC Voltage

WARNING

Extreme caution must be used when making the following adjustment. (Access the test points from the right side of the oscilloscope.)

☐ 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 +10 V Ref adjustment R730, if the reading is within the stated limits. Proceed to step 4.

☐ Step 3: *Adjust* +10 V Ref adjustment R730 on the A4 Regulator board for +10.00 V.

☐ Step 4: Remove the test leads.

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

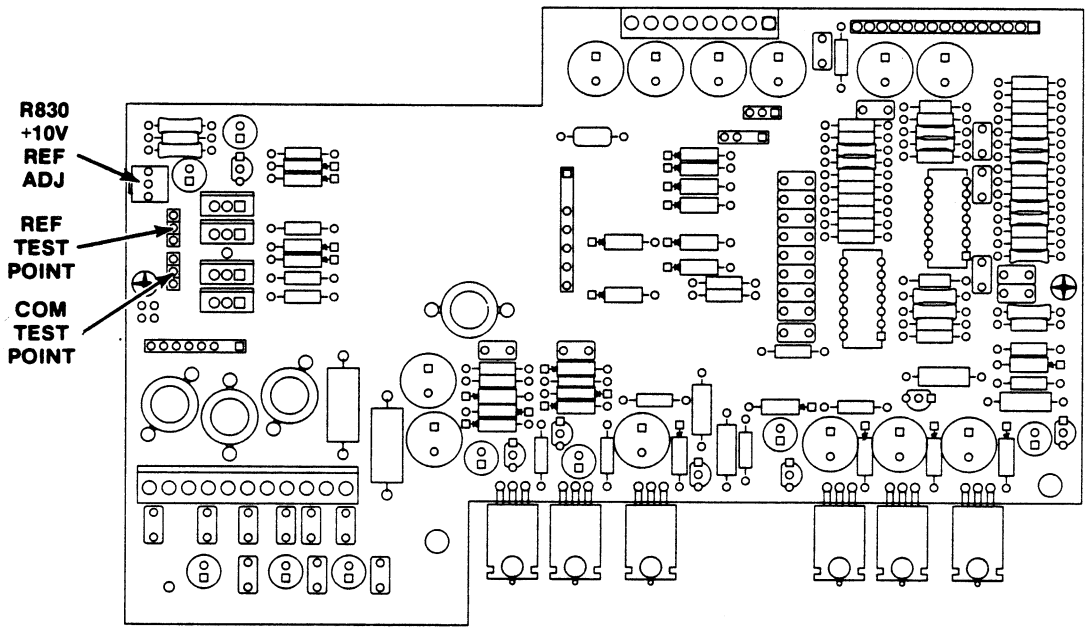


Figure 2-3 — A4 Regulator Board Test Point and Adjustment Locations

Part 4 Display

This part shows the setup and lists the procedure to Examine/Adjust the A8 CRT Driver board (see Fig. 2-4).

STOP

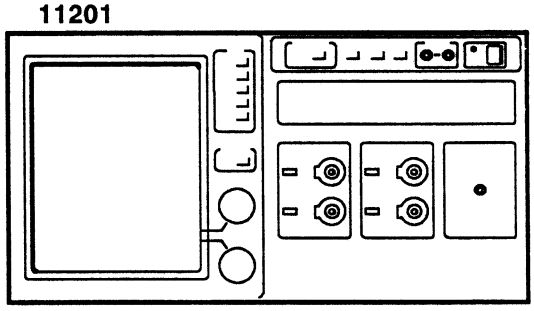
The adjustments in this part only affects the visual aspects of the CRT display and are to be made only when the CRT or A8 CRT Driver board components are replaced. These adjustments do not affect oscilloscope accuracy since all measurements are made on the acquired data, not the displayed data. Unless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

Measurement Limits

The measurement limits are set on the CRT as follows:

- Vertical size is adjusted within ±0.050 inch of tic marks on the edges of the front panel bezel.
- Horizontal size is adjusted within ±0.050 inch of the tic marks on the top and bottom edges of the front panel bezel.
- Vertical linearity is 3.7 ±0.4 lines/inch, using internally-generated horizontal lines.
- Horizontal linearity is 5.6 ±0.6 lines/half-inch and is adjusted for optimum appearance using internally generated vertical lines.

Setup to Examine/ Adjust A8 CRT Driver Board



Setup to Examine/Adjust A8 CRT Driver Board

WARNING

Extreme caution must be used when making the following adjustment.

Procedure to Examine/Adjust A8 CRT Driver Board

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

11201 Oscilloscope ..... No settings required

☐ Step 2: Remove the two screws in the CRT protector shield and then the shield.

☐ Step 3: Set the ON/STANDBY switch to ON.

☐ Step 4: *Adjust* Main Brite adjustment R202 on the A8 CRT Driver board clockwise until the raster appears, then turn the adjustments counterclockwise until the retrace lines just disappear.

☐ Step 5: *Adjust* Horiz Hold adjustment R620 and Vert Hold adjustment R530 on the A8 CRT Driver board so that a stable display appears on the screen.

☐ Step 6: Press the UTILITY button.

☐ Step 7: Touch **Extended Diagnostics** in the UTILITY major menu.

☐ Step 8: Touch **Block** and then **Front Panel** in the **Extended Diagnostics** pop-up menu.

☐ Step 9: Touch **Area** and then **Verify**.

☐ Step 10: Touch **Routine** and then **Soft Keys**.

☐ Step 11: Touch **Run** (a grid pattern will fill the display area).

☐ Step 12: *Adjust* Vert Hold adjustment R530 so that the bottom line is at (or near) the bottom of the raster.

☐ Step 13: *Examine* that the grid is aligned with the index bumps along the inside vertical edge of the front panel bezel within ±0.05 inches. There are three indexes along each side: one at each of the two corners and one in the center. To eliminate any parallax error, look directly into the CRT, align the top of the grid display with the top vertical index, the bottom of the grid with the bottom index, and the grid centerline with the center index. Optimize the settings of R520 Vert Pos and L120 Vert Size for the optimum overall alignment.

Do not attempt to optimize the adjustments if the grid is aligned within the stated limits. Proceed to Step 15.

☐ Step 14: *Adjust* Vert Pos adjustment R520 and Vert Size adjustment L120 on the A8 CRT Driver board to align the grid with the index bumps along the inside vertical edge of the front panel bezel; within ±0.05 inches.

☐ Step 15: Touch **Exit** once to remove the grid pattern.

☐ Step 16: Touch **Exit** in the menu/status area.

☐ Step 17: Touch **Extended Diagnostics** in the UTILITY major menu.

☐ Step 18: Touch **Block** and then **Front Panel**.

☐ Step 19: Touch **Area** and then **Verify**.

☐ Step 20: Touch **Routine** and then **Soft Keys**.

☐ Step 21: Touch **Run** in the UTILITY major menu.

☐ Step 22: Use a small ruler (or piece of paper with a one inch increment marked on the edges) to measure the number of horizontal lines within one inch of the top, center, and bottom of the screen. (Count the heavy lines only.)

☐ Step 23: *Examine* the number of horizontal lines within a one-inch increment, of the left, center, and right of the screen (do not count the first line) to be from 3.3 to 4.1 lines.

☐ Step 24: *Examine* that the grid is aligned with the horizontal indexes along the top and bottom of the front panel bezel within 0.05 inches.

Do not attempt to optimize the adjustments if the grid is aligned within the stated limits. Proceed to Step 26.

☐ Step 25: *Adjust* Horiz Lin adjustment R541, Horiz Size adjustment R621, and Horiz Pos adjustment R540 on the A8 CRT Driver board for optimum overall linearity and position. Use the horizontal indexes along the top and bottom of the front panel bezel to align the grid within 0.05 inches of the tic marks by the same method used in Step 12.

☐ Step 26: *Examine* the number of vertical lines per half-inch at the left, center, and right of the screen to be 5.6 ±0.6 lines. (Count both the light and heavy lines, but do not count the first vertical line.)

☐ Step 27: R621 Horiz Size, R541 Horiz Lin, and R540 Horiz Pos interact and therefore you may need to repeat Step 25 until R621, R541, and R540 are adjusted properly.

☐ Step 28: Touch **Exit** once to remove the grid pattern.

☐ Step 29: Touch **Exit** in the menu/status area.

☐ Step 30: Touch **Instr Options** in the UTILITY major menu and then **Display Intensity** in the **Instrument Options** pop-up menu.

☐ Step 31: Use either control knob to set the **Dsy Intensity** to 100%.

☐ Step 32: *Adjust* Focus adjustment R100 on the A8 CRT Driver board for optimum overall focus.

☐ Step 33: Set the control knob for normal intensity (approximately 70%).

☐ Step 34: Set the ON/STANDBY switch to STANDBY.

☐ Step 35: Replace the CRT protective shield.

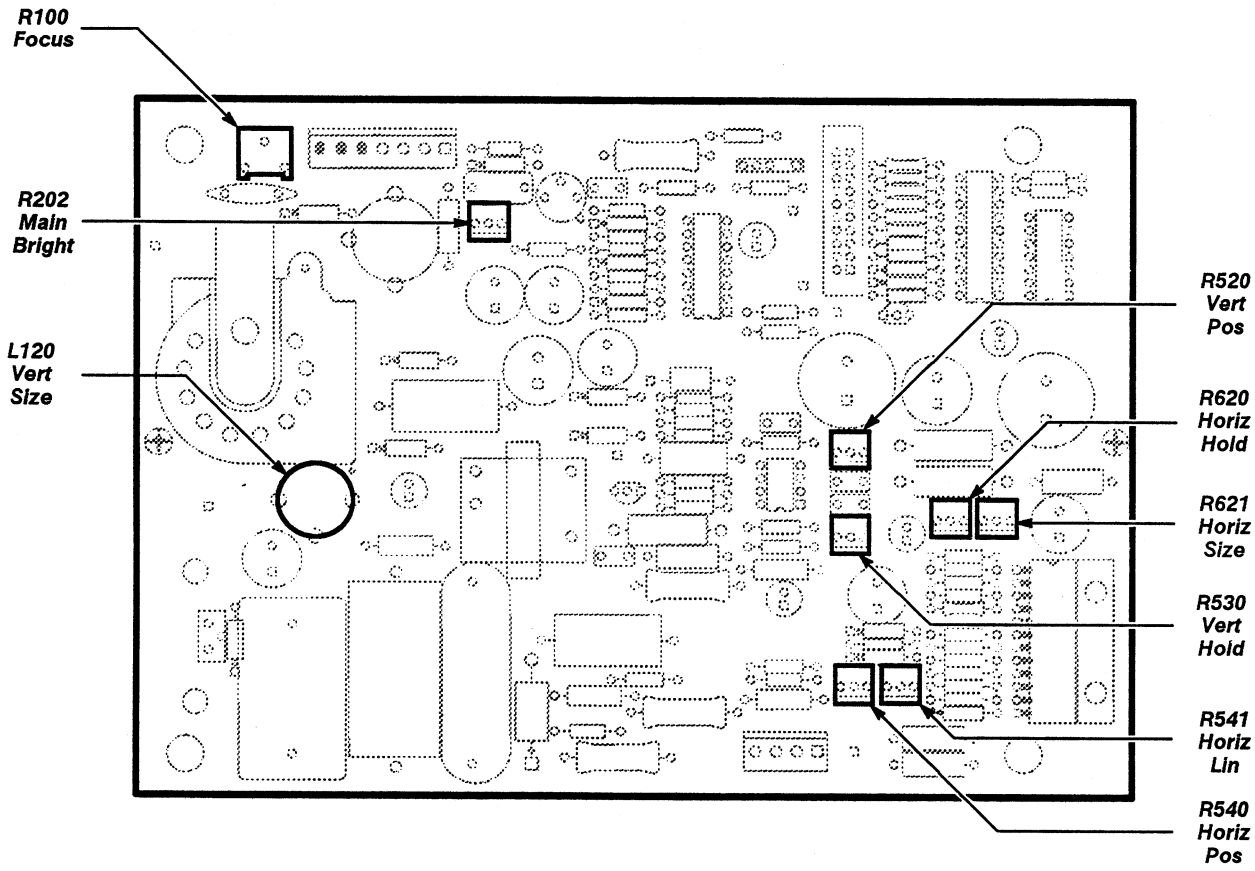


Figure 2-4 *— A8 CRT Driver Board Adjustment Locations*

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.

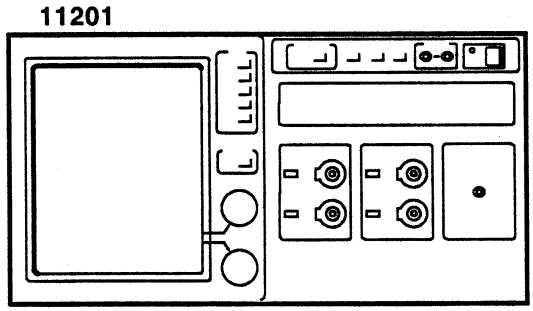
For more information about the Enhanced Accuracy state, refer to *Enhanced Measurement Accuracy* in Section 3 of the *11201 Digitizing Oscilloscope User Reference* manual.

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

Measurement Limits

When invoked, Enhanced Accuracy is achieved.

Setup to Examine Enhanced Accuracy



Setup to Examine Enhanced Accuracy

Procedure to Examine Enhanced Accuracy

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

11201 Oscilloscope . . . . . No settings required

☐ 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. The Enhanced Accuracy process lasts for a couple of minutes.

CAUTION

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

☐ Step 4: *Examine* for the message, **Enhanced Accuracy in Progress Please Leave Instrument on Until Complete** indicating that the oscilloscope has began the Enhanced Accuracy process.

☐ Step 5: *Examine* the display for the message, **Enhanced Accuracy completed and passed** indicating successful self-calibration. The **EA** indicator appears on the display when Enhanced Accuracy is achieved.

Part 6 Calibration Output Accuracy

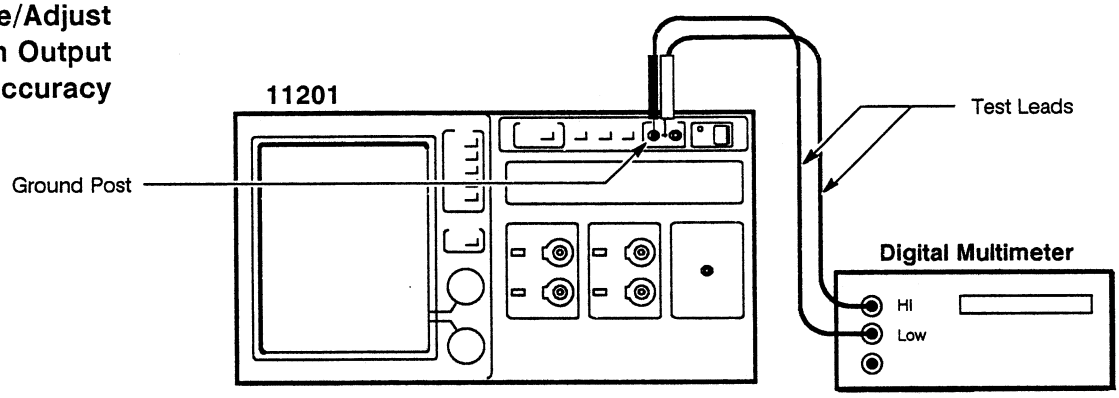
The Extended Diagnostics are set to apply specific voltages to the front panel connector, these voltages are then measured with a digital multimeter (see Fig. 2-5).

Measurement Limits

The measurement limits for this part are as follows:

- Probe calibration output voltage accuracy ±0.06% (or ±6 mV).
- Attenuator Ratios ±0.04%.
- Calibrator DAC Linearity of ±0.75 LSB.

Setup to Examine/Adjust Calibration Output Accuracy



Setup to Examine/Adjust Calibration Output Accuracy

Procedure to Examine/ Adjust Calibration Output Accuracy

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

11201 Oscilloscope
- UTILITY button ..... press
- UTILITY major menu ..... **Extended Diagnostic**
- **Block** pop-up menu ..... **Points Acq**
- **Area** pop-up menu ..... **Cal Refs**
- **Routine** pop-up menu ..... **FP -10.0000 V**
- ..... **Run**

Digital multimeter
- Set to measure ..... 10.0000 Vs DC

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

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

☐ Step 3: *Adjust* offset adjustment R1576 on the A5 Acquisition board for −10.000 V, within the limits of −9.998 V and −10.002 V. (see Fig. 2-5.)

☐ Step 4: Touch **Exit**.

☐ Step 5: Touch **FP +9.9951 V** in the **Routine** pop-up menu and then **Run** in the menu/status area.

☐ Step 6: *Examine* 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 adjustment setting if the digital multimeter reading is within the stated limits. Proceed to Step 8.

☐ Step 7: *Adjust* 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** to clear the **Extended Diagnostics** menu.

☐ Step 10: If Step 3 or 7 was performed, press the front panel ENHANCED ACCURACY button.

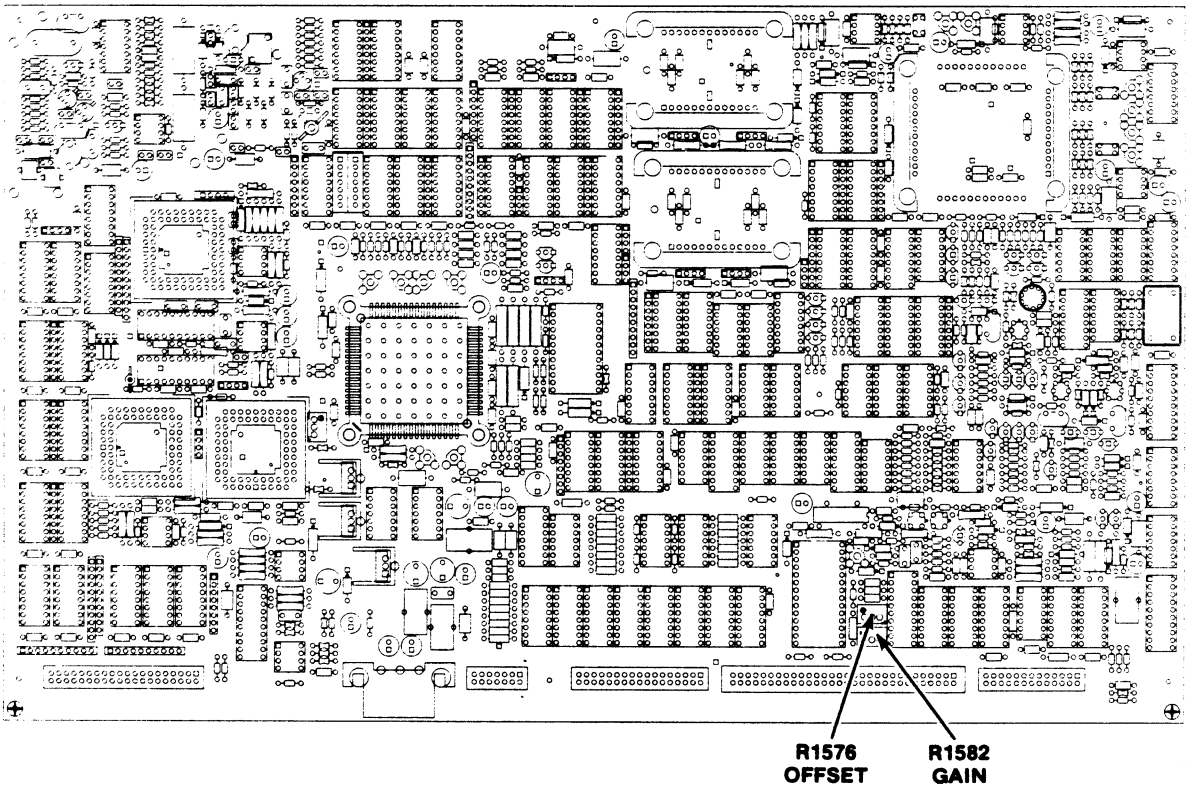
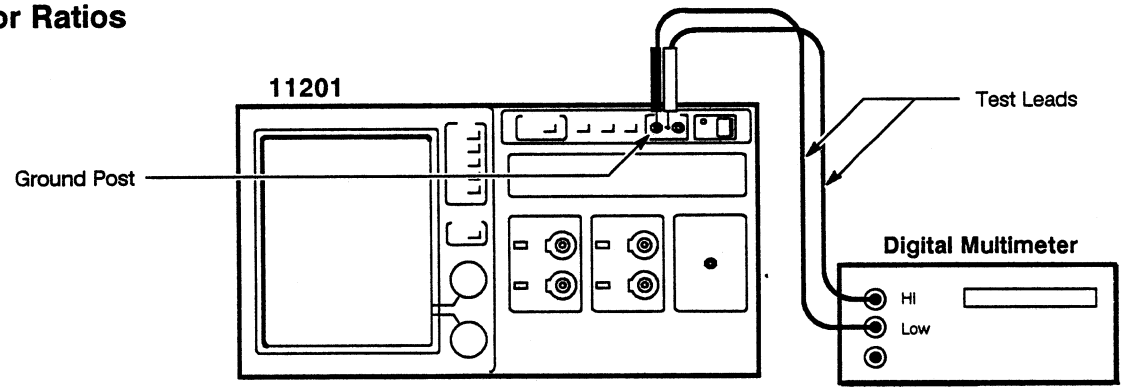


Figure 2-5 — A5 Acquisition Board Adjustment Locations

Setup to Examine Attenuator Ratios



Setup to Examine Attenuator Ratios

Procedure to Examine Attenuator Ratios

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

11201 Oscilloscope
- UTILITY button ..... press
- UTILITY major menu ..... **Extended Diagnostic**
- **Block** pop-up menu ..... **Points Acq**
- **Area** pop-up menu ..... **Cal Refs**
- **Routine** pop-up menu ..... **FP −10.0000 V**
- ..... **Run**

Digital multimeter
- Set to measure ..... 10.0000 volts DC

☐ 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** in the menu/status area, 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** (refer to Table 2-3 for the correct selector for successive tests) in the **Routine** pop-up menu.

☐ Step 9: Touch **Run** in in the menu/status area.

☐ Step 10: Push the offset button on the digital multimeter.

☐ Step 11: Touch **Exit.**

☐ Step 12: Touch **FP +4.9976 V** in the **Routine** pop-up menu.

☐ Step 13: Touch **Run** in the menu/status area.

☐ Step 14: Record the voltage reading on the digital multimeter and multiply this reading by 2. (Refer to Step 14 Selector in Table 2-3 for selecting voltages for the 2nd, 3rd, and 4th repetitions.) 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 $\leq \pm 0.008$ V.

☐ Step 16: Push the offset button on the digital multimeter so that the offset is turned off.

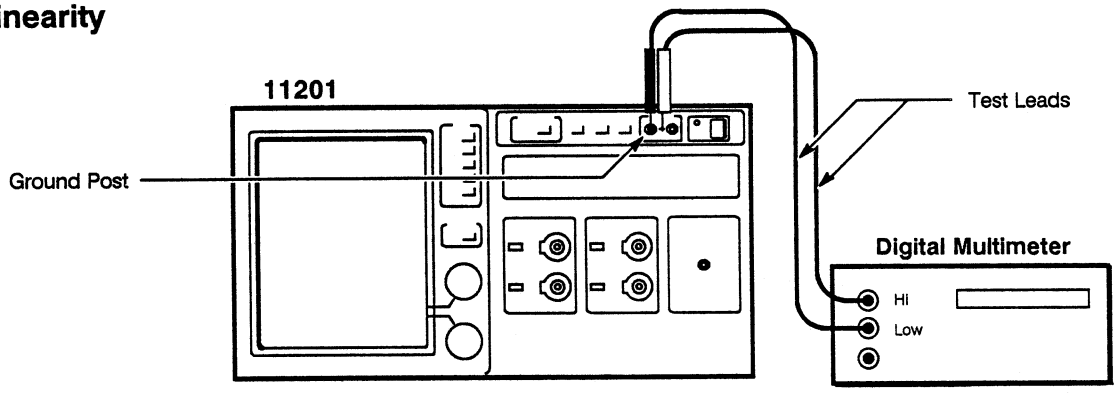
☐ Step 17: Repeat Steps 8 through 16 three times (that is, repetitions 2, 3, and 4) using the selectors supplied in Table 2-3 for Steps 8, 12, and 14.

☐ Step 18: Press **Exit** twice to leave the **Extended Diagnostics** menu.

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

Repetition	Step 8 Selector	Step 12 Selector	Step 14 Selector	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	——

Setup to Examine Linearity



Setup to Examine Linearity

Procedure to Examine Linearity

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

11201 Oscilloscope
- UTILITY button ..... press
- UTILITY major menu ..... **Extended Diagnostic**
  - **Block** pop-up menu ..... **Points Acq**
  - **Area** pop-up menu ..... **Cal Refs**
  - **Routine** pop-up menu ..... **FP -10.0000 V**
  - ..... **Run**

Digital multimeter
- Set to measure ..... 10.0000 V DC

☐ Step 2: Record the voltage reading on the digital multimeter as V_2 for later use. (The reading should be approximately −10.0000 V.)

☐ Step 3: Touch **Exit.**

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

☐ Step 5: Touch **Run** in the menu/status area.

☐ Step 6: Record the voltage reading on the digital multimeter as V_6 for later use. (The reading should be approximately +9.9951 V.)

☐ Step 7: Touch **Exit.**

☐ Step 8: Touch **FP 0.0000 V** in the **Routine** pop-up menu.

☐ Step 9: Touch **Run** in the menu/status area.

☐ Step 10: Record the voltage reading on the digital multimeter as V_{10}.

☐ Step 11: *Examine* that the voltage recorded in Step 10 (V_{10}) is within ±3.7 mV of the sum of the voltages recorded in Step 2(V_2) and Step 6(V_6) plus +4.9 mV (that is, $V_{10} \pm 3.7\ mV = V_2 + V_6 + 4.9\ mV$).

Part 7 High Frequency Response

The high frequency peaking is adjusted so that the bandwidth is adequate and the aberrations are not excessive (see Fig. 2-6).

The displayed amplitude is checked at the specification frequencies to determine the bandwidth.

Measurement Limits

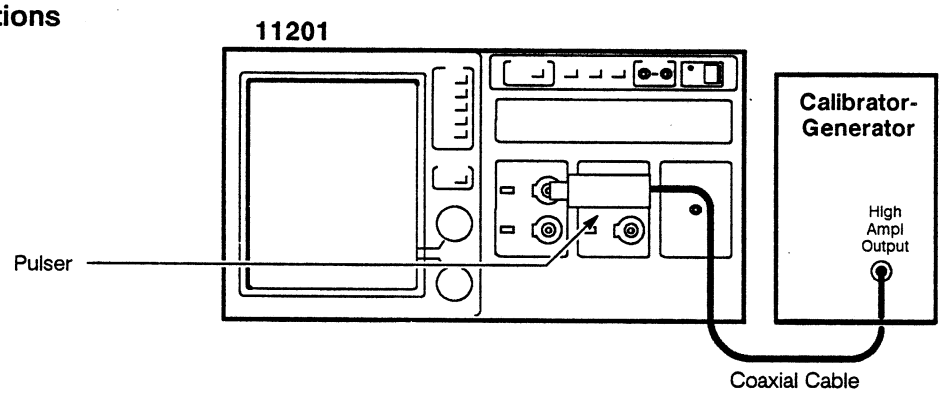
The waveform aberrations should not exceed 9% peak (2.25 divisions) and 18% (4.5 divisions) peak-to-peak. One major graticule division = 4%.

Specification

The bandwidth specifications are as follows:

- 400 MHz for **Vert Size** settings of ≥10 mV/div
- 350 MHz for **Vert Size** settings of 5 mV/div to 9.95 mV/div
- 250 MHz for **Vert Size** settings of 2 mV/div to 4.98 mV/div
- 200 MHz for **Vert Size** settings of 1 mV/div to 1.99 mV/div

Setup to Examine/ Adjust Aberrations



Setup to Examine/Adjust Aberrations

Procedure to Examine/ Adjust Aberrations

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

a. Connect the pulser to the L1 input connector.

b. Connect a 50 Ω coaxial cable from the calibration generator High Ampl Output connector to the pulser.

Calibration generator

Function switch ..... High Ampl
Period ..... 0.1 ms
Pulse amplitude ..... Max

Pulser
TD Triggered Level ..... fully clockwise
11201 Oscilloscope
ON/STANDBY switch ..... ON
Wait for calibration cycle to complete
UTILITY button ..... press
Initialize .....
UTILITY button ..... press
Instr Options pop-up menu
Waveform Scaling ..... **Forced**
L1 display on/off ..... on
Vert Size ..... 50 mV/div
WAVEFORM button ..... press
Impedance ..... 50 Ω
Main Size ..... 1 μs/div
Main Pos ..... position positive-going edge to first graticule line from left edge of graticule
Pulser
TD Triggered Level ..... rotate control counterclockwise until the step disappears, then rotate clockwise just enough to obtain a step
11201 Oscilloscope
Main Size ..... 2 ns/div
Main Pos ..... position positive-going edge between the first and second graticule lines from the left edge of the graticule
Vert Offset ..... position top of step 2.5 divisions above the center horizontal graticule line
WAVEFORM button ..... press
Acquire Description ..... **Average N** to **On**
Set Avg N 8

☐ Step 2: Touch the vertical icon and then **Vert Size**.

☐ Step 3: Touch **Fine** in the **Numeric Entry & Knob Res** pop-up menu.

☐ Step 4: Set the **Vert Size** (top knob) so that the displayed step amplitude is five vertical divisions.

☐ Step 5: Set the **Vert Offset** so that the right-most part of the trace is on the horizontal centerline.

☐ Step 6: Set the **Vert Size** so that the screen will display only 20% of the step amplitude (~8 mV/div).

☐ Step 7: Set the **Vert Offset** so that the right-most part of the trace is on the horizontal centerline.

☐ Step 8: *Examine* that the aberrations are within 9% peak (2.25 divisions) and 18% peak-to-peak (4.5 divisions).

DO NOT attempt to optimize the aberrations if they are within the stated limits. Proceed to Step 10.

☐ Step 9: *Adjust* HF1 on the A20A1 Main board, so that the L1 aberrations are within 9% peak (2.25 divisions) and 18% peak-to-peak (4.5 divisions).

Note: *The Signal Input module must be removed to gain access to the A20A1 Main board. Refer to Signal Input Module Removal/Replacement in the Corrective Maintenance section of this manual.*

☐ Step 10: Remove the displayed waveform.

☐ Step 11: Repeat Steps 1 through 10 for channels L2, C1, and C2. When testing channels C1 and C2 the adjustment locations are located on the A21A1 Main board. Both adjustment locations, HF1 and HF2, are located in the same position as they are on the A20A1 Main board. Refer to *A21A1 Main Board* in the Corrective Maintenance section of this manual for instructions on removing the A21A1 Main board in order to gain access to the adjustments on this board.

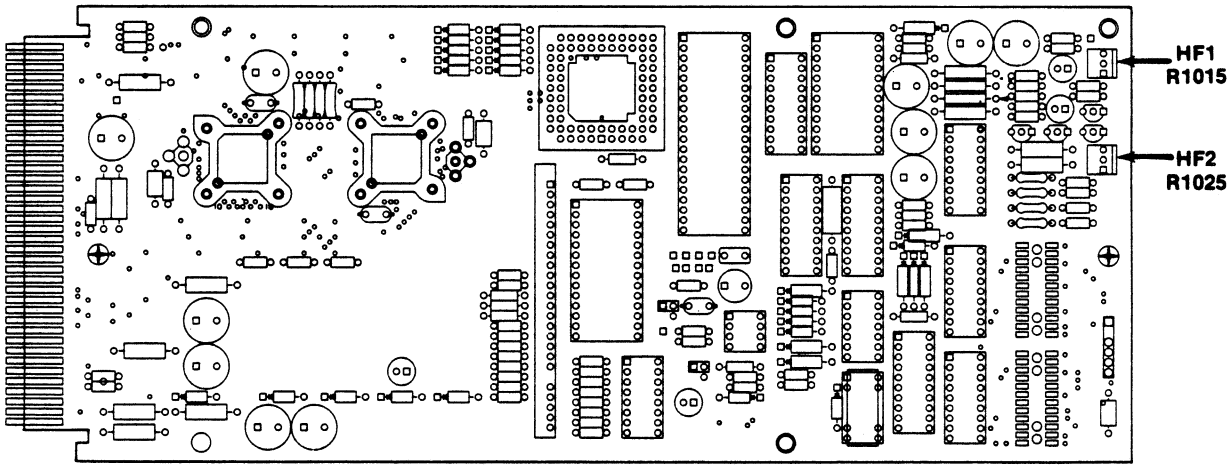
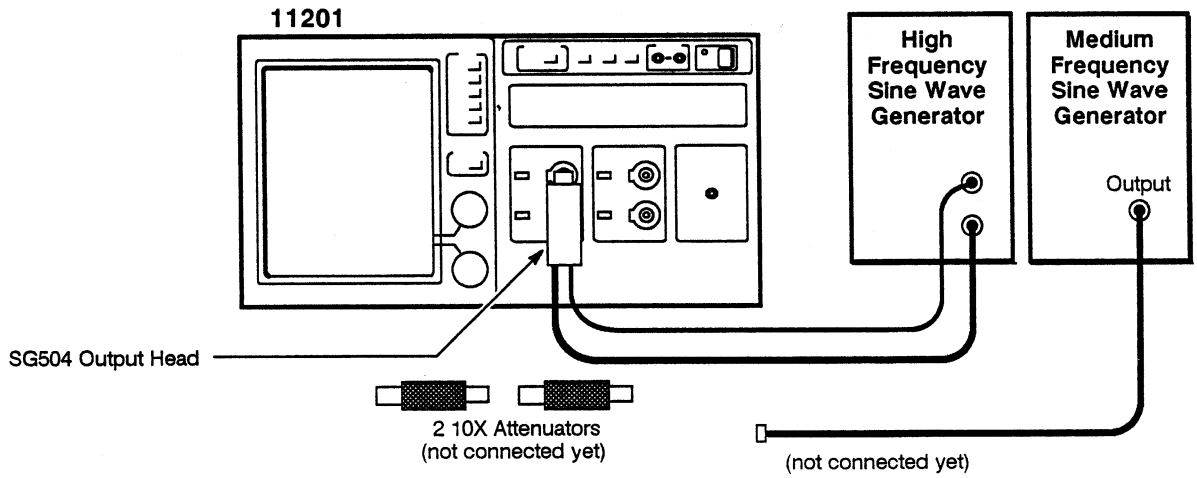


***Figure 2-6** — A20A1/A21A1 Main Boards Adjustment Locations*

Setup to Check Bandwidth



Setup to Check Bandwidth

Procedure to Check Bandwidth

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

11201 Oscilloscope
- L1 display on/off ..... on
- WAVEFORM button ..... press
  - **Impedance** ..... **50 Ω**
- **Main Size** ..... 10 µs/div

High frequency sine wave generator
- Amplitude ..... 4 V p-p
- Frequency ..... reference

Medium frequency sine wave generator ..... not used yet

If the High frequency sine wave generator has a remote leveling head, then you must connect it to the channel input connector without additional coaxial cables.

The reference frequency must be between 50 kHz and 6 MHz.

Perform this procedure for each **Vert Size** listed in Table 2-4; then repeat for CH 2.

This procedure may require the use of more than one sine wave generator to test all the frequencies listed in Table 2-4.

If the sine wave generator is not equipped with internal attenuators, then use the 10X Attenuators at the channel input when setting amplitude.

To measure the amplitude, either count the divisions, or use the **ΔV** cursors.

☐ Step 2: Set the sine wave generator amplitude as listed in the Reference Amplitude column of Table 2-4.

☐ Step 3: Set the sine wave generator frequency as listed in the Test Frequency column of Table 2-4.

☐ Step 4: Record the Displayed Amplitude in the Displayed Amplitude column of Table 2-4.

☐ Step 5: *Check* that the amplitude is at least the value listed in the Amplitude Specified column of Table 2-4.

☐ Step 6: Set the sine wave generator to the reference frequency.

Table 2-4 *— Bandwidth*

(1) Test Frequency MHz	(2) Vertical Size	(3) Reference Amplitude: div	(4) Displayed Amplitude: div				(5) Amplitude Specified div
			L1	L2	C1	C2	L1, L2, C1, C2
400	1 V/div	4	____	____	____	____	≥2.828
400	500 mV/div	6	____	____	____	____	≥4.242
400	50 mV/div	6	____	____	____	____	≥4.242
400	20 mV/div	6	____	____	____	____	≥4.242
400	10 mV/div	6	____	____	____	____	≥4.242
350	5 mV/div	6	____	____	____	____	≥4.242
250	2 mV/div	6	____	____	____	____	≥4.242
200	1 mV/div	6	____	____	____	____	≥4.242

If there are any failures, then the step response must be readjusted for the appropriate deflection factors so that the Measurement Limits for step response aberrations and the Specifications for bandwidth can both be achieved.

Part 8 DC Balance

The position of the displayed trace with no input signal applied is examined.

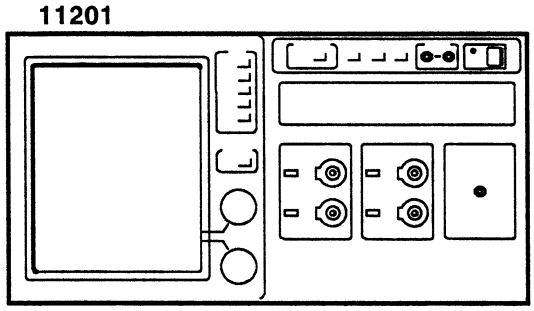
The purpose of this part is to confirm that DC balance can be accomplished accurately. This procedure does not test for drift over time or temperature, therefore, this part must be performed immediately after entry into the Enhanced Accuracy state. Refer to *Part 5 Enhanced Accuracy* earlier in this section.

Measurement Limits

Table 2-5 *— DC Balance*

Vertical Size	11201 Shift (± div)	11201 Shift (± mV)
10 V/div	0.110	1100
5 V/div	0.120	600
2 V/div	0.150	300
1 V/div	0.200	200
0.5 V/div	0.120	60
0.2 V/div	0.150	30
0.1 V/div	0.200	20
50 mV/div	0.120	6
20 mV/div	0.150	3
10 mV/div	0.200	2
5 mV/div	0.300	1.5
2 mV/div	0.600	1.2
1 mV/div	1.100	1.1

Setup to Examine DC Balance



Setup to Examine DC Balance

Procedure to Examine DC Balance

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

11201 Oscilloscope
- L1 Display on/off ..... on
- **Vert Size** ..... 10 V/div
  - **BW Limit** ..... **20 MHz**
  - **Impedance** ..... **50 Ω**
  - **Acquire Description** pop-up menu ..... **Average N** to **On**
- MEASURE button ..... press
  - **Measurements** pop-up menu ..... **Mean**
  - **Mean** pop-up menu ..... **Data Internal** to **whole zone**

☐ Step 2: *Examine* that the **Mean** is ≤ the Shift value (in mV) for each Verttical Size listed in Table 2-5.

☐ Step 3: Perform this procedure for each channel.

Part 9 ΔV DC Accuracy

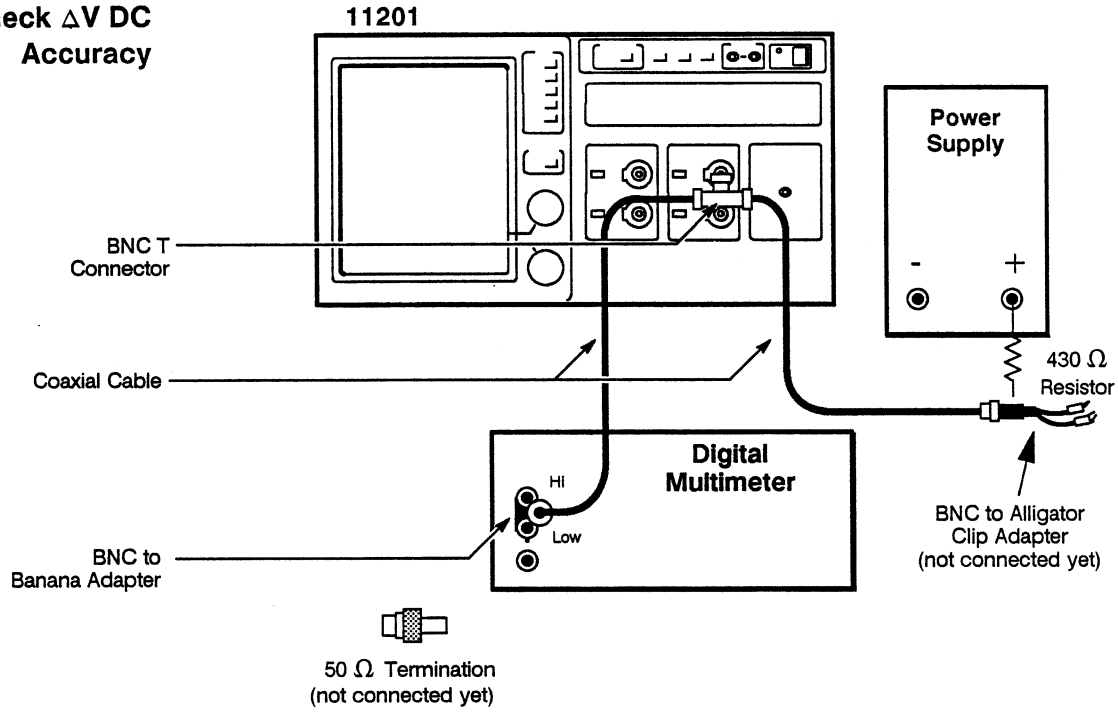
The system ΔV DC Accuracy is checked using a digital multimeter and power supply.

The purpose of this part is to confirm that the oscilloscope can be accurately calibrated. This part does not test for calibration voltage reference accuracy or long term stability. Therefore, tests must be performed immediately after entry into the Enhanced Accuracy state. Refer to *Part 5 Enhanced Accuracy* earlier in this section.

Specification

ΔV DC Accuracy within ±1.4%.

Setup to Check ΔV DC Accuracy



Setup to Check ΔV DC Accuracy

If the environment is electrically noisy, then connect a capacitor (at least 0.1 μF) across the input terminals of the DMM.

Press the Enhanced Accuracy button twice. Immediately after Enhanced Accuracy has completed and passed, repeat this part for each channel.

It is helpful if you use a pocket calculator to do the calculations required for evaluating the data in this part. If your DMM is equipped with a comparison or relative reference feature, use this feature for the readings and calculations required in Steps 3 and 5.

When connecting the alligator clips, connect one clip directly to the power supply's negative terminal and the other clip to the 430 Ω resistor (not the power supply's positive terminal).

Procedure to Check ΔV DC Accuracy

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

11201 Oscilloscope
- C1 Display on/off ..... on
- **Vert Size** ..... 2 V/div
  - **BW Limit** or **HF Limit** ..... **20 MHz**

Power supply
- Output ..... on

Digital multimeter
- Mode ..... DC
- Range ..... Auto

☐ Step 2: Press the WAVEFORM button, and then set **Average N** to **On**.

☐ Step 3: Press the MEASURE button.

☐ Step 4: Touch **Measurements** and then **Mean** in the **Measurements** pop-up menu.

☐ Step 5: Touch **Mean**, and then set **Data Interval** to **whole zone** in the **Mean** pop-up menu.

☐ Step 6: Touch **Compare and References** in the MEASURE major menu, and then set **Compare** to **On**.

☐ Step 7: Connect the alligator clips to the power supply and set the voltage so that the trace is within ±0.2 division of the first graticule line above the bottom of the screen. Read the digital multimeter and record the absolute value (that is, ignore the polarity) as V_7.

☐ Step 8: Touch **Compare and References** in the MEASURE major menu and then **Save Current Meas Values as References** in the **Compare and Reference values** pop-up menu.

☐ Step 9: Connect the alligator clips to the power supply and set the voltage so that the trace is within ±0.2 division of the first graticule line below the top of the screen. Read the digital multimeter and add the absolute value (again, ignore the polarity) to the reading obtained in Step 7 (V_7). Record this value as V_9.

☐ Step 10: Read and record the **ΔMean** value in the MEASURE major menu as V_{10}.

☐ Step 11: Divide the sum obtained in Step 9 V_9 by the **ΔMean** readout obtained in Step 10 (V_{10}). Then, divide this result by the calibration voltage characterization factor (obtained in the Characterizing the Oscilloscope procedure at the beginning of the section).

☐ Step 12: *Check* that the result obtained in Step 11 is ≥0.9860 and ≤1.014.

☐ Step 13: Repeat Steps 7 through 12 for the vertical size settings listed below. When testing with small voltages, it may help to install a 50 Ω termination and attenuators in series between the BNC to alligator clip adapter and the coaxial cable so that you can set the voltages with better resolution. You can also use a DC Voltage Calibrator to achieve better resolution (when testing with small voltages).

1 V/div
0.5 V/div
0.2 V/div
0.1 V/div
50 mV/div
49.8 mV/div
23 mV/div
20 mV/div
10 mV/div
5 mV/div
2 mV/div
1 mV/div

Part 10 DC Offset Accuracy

The DC Offset is checked using a digital multimeter and a power supply.

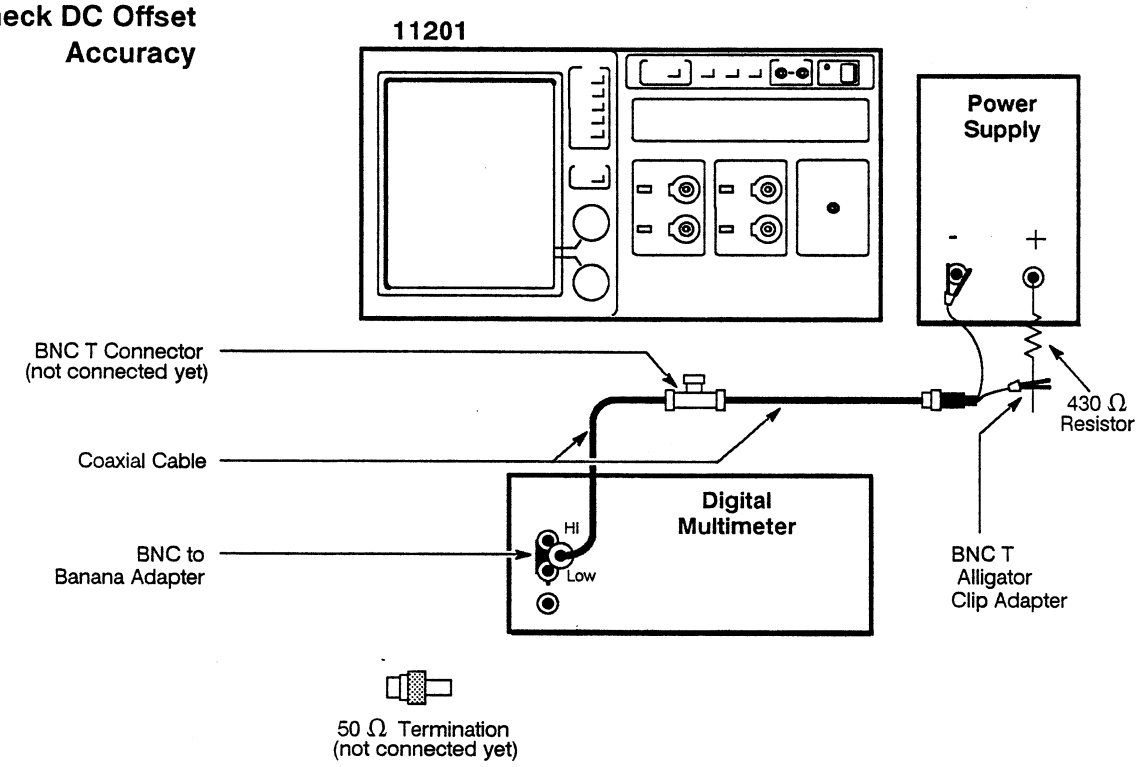
The purpose of this procedure is to confirm that the oscilloscope can be accurately calibrated. This procedure does not test for calibration voltage reference accuracy or long term stability. Therefore, the oscillsocope is characterized and tests must be performed immediately after entry into the Enhanced Accuracy state.

Specification

The DC offset accuracy specifications are as follows:

- ±0.20% of Vert Offset +0.5 mV for 1 mV/div
- ±0.50% of Vert Offset +0.5 mV for 0.1 V/div
- ±0.50% of Vert Offset +50 mV for 1.0 V/div

Setup to Check DC Offset Accuracy



Setup to Check DC Offset Accuracy

Procedure to Check DC Offset Accuracy

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

11201 Oscilloscope
- C1 Display on/off ..... on
- WAVEFORM button ..... press
- **BW Limit** or **HF Limit** ..... **20 MHz**

Power supply
- Voltage ..... + 40 V

Digital multimeter
- Mode ..... DC
- Range ..... Auto

If the environment is electrically noisy, then connect a capacitor (at least 0.1 μF) across the input terminals of the digital multimeter (DMM).

Press the Enhanced Accuracy button twice. Immediately after Enhanced Accuracy has completed and passed, repeat this part for each channel.

When connecting the alligator clips, connect one clip directly to the power supply's negative terminal and the other clip to the 430 Ω resistor (not the power supply's positive terminal).

☐ Step 2: Note the position of the displayed trace (it should be near the center of the graticule).

☐ Step 3: Press the WAVEFORM button, and then touch **Acquire Desc.**

☐ Step 4: Set **Average N** to **On** and then press the MEASURE button.

☐ Step 5: Touch **Measurements** and then **Mean** in the **Measurements** pop-up menu.

☐ Step 6: Touch **Mean** in the MEASURE major menu, and then set **Data Interval** to **whole zone** in the **Mean** pop-up menu.

☐ Step 7: Connect the BNC T Connector to the L1 input connector, with the DMM connected.

☐ Step 8: Touch the vertical icon and then **Vert Offset**.

☐ Step 9: Set the **Vert Offset** to 40 V. Set the power supply voltage so that the displayed trace returns to the position noted in Step 2. Divide the digital multimeter's reading by the calibration voltage reference characterization factor (obtained in Step 9 under Characterize the Oscilloscope earlier in this section) and subtract the **Vert Offset** reading.

☐ Step 10: *Check* that the result obtained in Step 9 is less than the Error Limit shown in Table 2-6.

☐ Step 11: Disconnect the BNC T connector at the L1 input connector and set **Vert Offset** to 0.

☐ Step 12: Repeat Steps 2 through 11 for each Vertical Size and Offset shown in Table 2-6. When testing with small voltages, it may help to install a 50 Ω

termination and attenuators in series between the BNC to alligator clip adapter and the coaxial cable so that you can set the voltages with better resolution. You can also use a DC voltage calibrator to achieve better resolution (when testing with small voltages).

Table 2-6 *– DC Offset Accuracy*

Vertical Size	Vertical Offset	Error Limit (± mV)
1 V/div	40 V	250 mV
0.1 V/div	10 V	55 mV
1 mV/div	1 V	2.5 mV
1 mV/div	800 mV	2.1 mV
1 mV/div	600 mV	1.7 mV
1 mV/div	400 mV	1.3 mV
1 mV/div	200 mV	0.9 mV

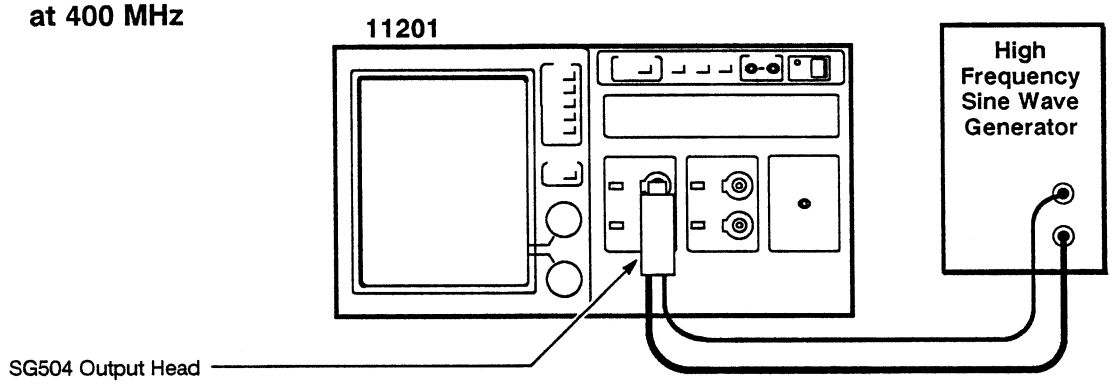
Part 11 Trigger Sensitivity at 400 MHz

Trigger sensitivity is verified using the specified output frequency and amplitude of a high frequency (HF) sine wave generator into a Signal Standardizer and checking for a screen-displayed trigger indicator.

Measurement Limits

Trigger Sensitivity—1.0 division from dc to 50 MHz, increasing to 2.0 division at 400 MHz.

Setup to Examine Trigger Sensitivity at 400 MHz



Setup to Examine Trigger Sensitivity at 400 MHz

Procedure to Examine Trigger Sensitivity at 400 MHz

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

11201 Oscilloscope
L1 Display On/Off ..... On
High frequency sine wave generator
Output Frequency ..... 400 MHz

☐ Step 2: Set the high frequency sine wave generator output amplitude control for a 2 division peak-peak screen display.

☐ Step 3: *Examine* that the **not** display above the **trig'd** icon can be extinguished if you adjust the **Trig Level**.

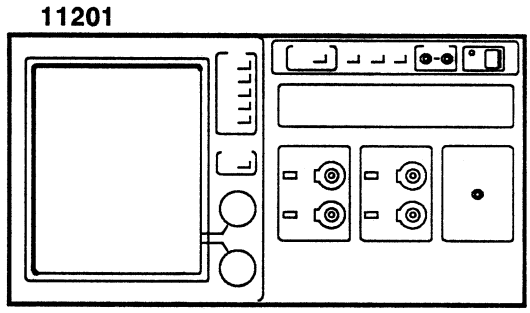
Part 12 RMS Noise

RMS noise is measured using the RMS measurement function. This function measures the noise on the trace.

Specification

The RMS noise must be ≤0.06 divisions for vertical size settings of 10 mV/division to 10V/division

Setup to Check RMS Noise



Setup to Check RMS Noise

Procedure to Check RMS Noise

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

11201 Oscilloscope

Def Wfm ..... **L1 – Avg (L1)**
MEASURE button ..... press
Measurements pop-up menu ..... **RMS**
RMS selector ..... touch
Data Interval ..... **whole zone**

☐ Step 2: *Check* that the **RMS** readout on the screen is ≤60 mV (0.06 divisions).

☐ Step 3: Repeat this part for channels L2, C1, and C2.

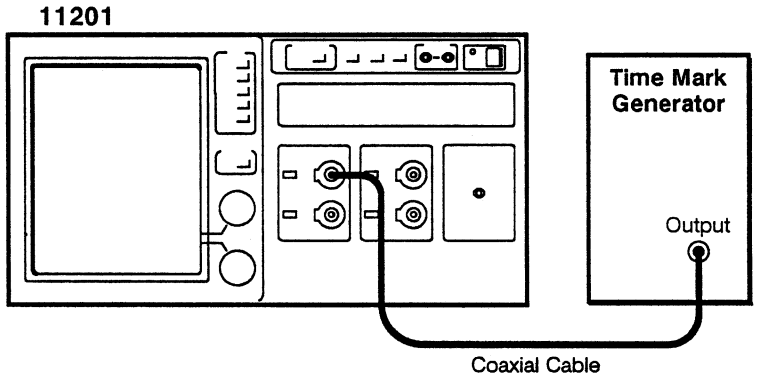
Part 13 Time Base

In this part, the horizontal size/marker generator is set to 1 ns/5 μs, and then the Period readout is checked to determine if it is within the stated limits.

Measurement Limits

Time Base accuracy = 100 ps, +0.002% of measurement interval. Trigger window position accuracy within 0.002% of position, +100 ps.

Setup to Examine Time Base Accuracy



Setup to Examine Time Base Accuracy

Procedure to Examine Time Base Accuracy

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

11201 Oscilloscope
- L1 Display on/off ..... on
- **Main Size** ..... 1 ns/division
- **Vert Size** ..... 200 mV/division
- **Impedance** ..... **50 Ω**

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

1 ns/Division Accuracy

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

☐ Step 3: Adjust the **Trig Level** 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: *Examine* that the **Period** result is 5 ns ±100 ps.

☐ 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 1: 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 2: Touch **Window 1**.

☐ Step 3: Set the **Window1 Pos** to 0 s.

☐ Step 4: Touch a portion of the main waveform.

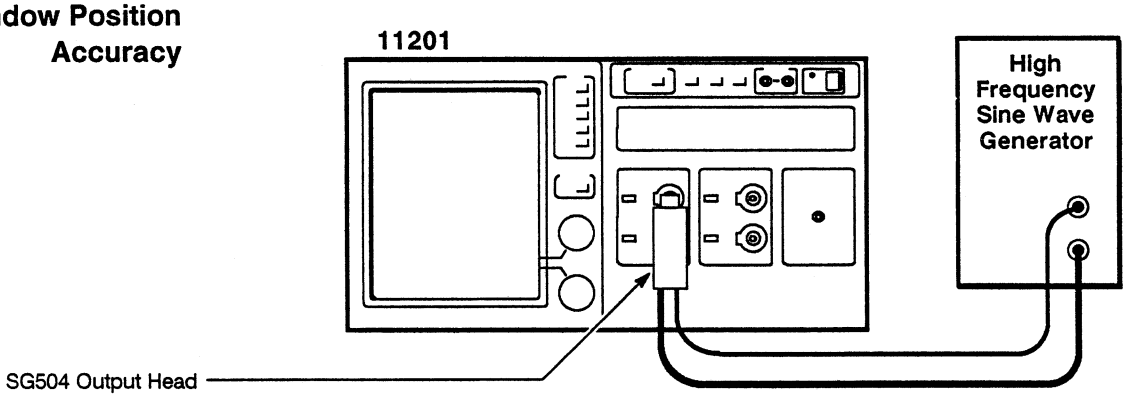
☐ Step 5: Touch **Window 2**.

☐ Step 6: Set the **Window2 Pos** to 50 μs.

☐ Step 7: Set the **Window Size** to 1 ns/division.

☐ Step 8: *Examine* that the horizontal positions of the two waveforms match within 1 ns. 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 Window Position Accuracy



Setup to Check Window Position Accuracy

Procedure to Check Window Position Accuracy

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

11201 Oscilloscope

L1 display on/off ..... on
Main Size ..... 2 ns/div
Vert Size ..... 200 mV/div
Impedance **50Ω**

TRIGGER button ..... press
Slope ..... - (negative)

High frequency sine wave generator

Frequency ..... 333 MHz (approx)

☐ Step 2: Set the high frequency (HF) sine wave generator controls for ≈6 division signal centered on the screen.

☐ Step 3: Set the **Average N** to **On** in the **Acquire Description** pop-up menu.

☐ Step 4: Press the MEASURE button, and then touch **Measurements**.

☐ Step 5: Touch **Delay** in the **Measurements** pop-up menu, and then touch **Delay** in the MEASURE major menu.

☐ Step 6: 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 7: Set the **Right Limit** knob to position the limit line on the signals sixth positive peak (with an intensified zone of 5 complete cycles).

☐ Step 8: 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 9: Set the **Right Limit** knob to display an intensified zone of 6 complete cycles.

☐ Step 10: *Examine* that the **Delay** readout on the screen is within the limits of 17.9 ns and 18.1 ns.

☐ Step 11: *Examine* that the **Delay** readout (in the Delay Readout column) for each **Right Limit** setting in the Set Right Limit Line to Display column is as listed in Table 2-7.

***Table 2-7** — 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 12: Touch **Window 1**.

☐ Step 13: Set the **Window Size** knob to **2 ns/div**.

☐ Step 14: Touch **Delay** in the MEASURE major menu, and then touch **Left Limit** in the **Delay** pop-up menu.

☐ Step 15: Set the **Left Limit** and **Right Limit** to display an intensified zone of 6 complete cycles.

☐ Step 16: *Examine* that the **Delay** readout on the screen is within the limits of 17.9 ns and 18.1 ns.

☐ Step 17: *Examine* the **Delay** readout as shown in Table 2-8.

***Table 2-8** — 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

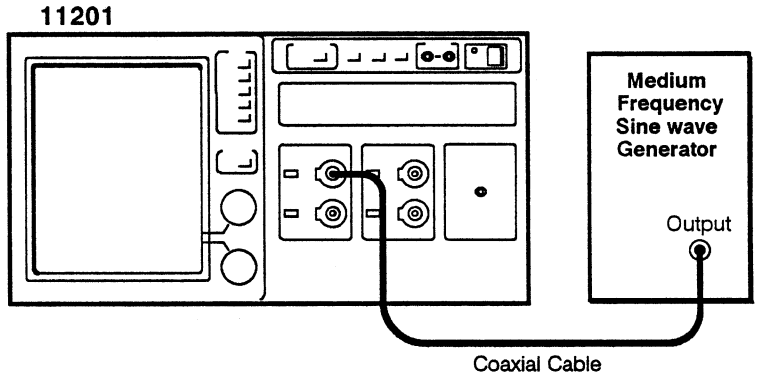
Part 14 Events Window Position Accuracy

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

Measurement Limits

Trigger window position accuracy (positioned from events) must be 150 MHz Maximum Event Frequency.

Setup to Examine Events Window Position Accuracy



Setup to Check Events Window Position Accuracy

Procedure to Examine Events Window Position Accuracy

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

11201 Oscilloscope
- L1 display on/off ..... on
- **Impedance** **50Ω**
- **Vert Size: L1** ..... 500 mV/div
- **Main Size** ..... 100 ns/div

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

11201 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: Set the window trigger **Coupling** to **DC**.

☐ Step 5: Set the window **Trig Level** to 0 V.

☐ Step 6: *Examine* that the two trigger indicator arrows on the main waveform are one cycle apart.

☐ Step 7: Set the **Events Holdoff** knob to 2.

☐ Step 8: *Examine* that the two trigger indicator arrows on the waveform are two cycles apart.

☐ Step 9: *Examine* that each **Events Holdoff** knob setting from 3 to 10 reflect an equal number of cycles between the trigger indicator arrows.

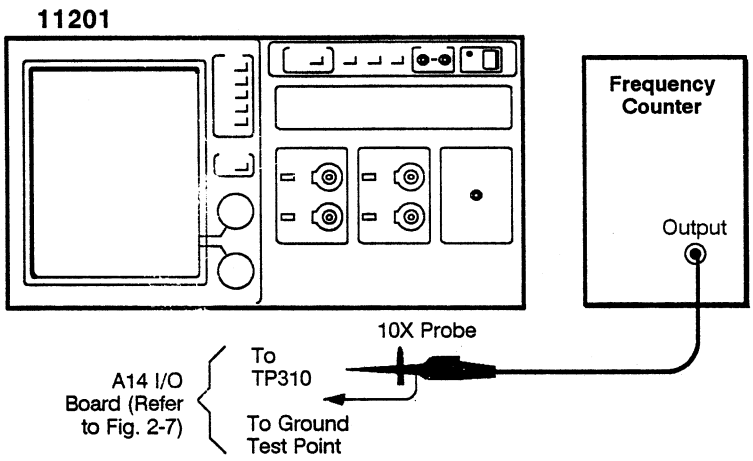
Part 15 Input/Output

In this part, the real time clock frequency is measured with a frequency counter, and the temperature sensor voltage and voltage reference is measured with a digital multimeter (see Figs 2-7 and 2-8).

Measurement Limits

Real time clock 1,000,000 μs, +50 μs or −5 μs
Temperature sensor voltage reference +6.500 V, ±5 mV.

Examine/Adjust Real Time Clock (A14C510)



Setup to Examine/Adjust Real Time Clock (A14C510)

Procedure to Examine/ Adjust Real Time Clock (A14C510)

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

11201 Oscilloscope

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

b. Remove the L bracket on the front of the card cage(see Figure 3-6 for a top view of the card cage).

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

d. Remove the A17 Main Processor board and place it in the fourth slot from the outer edge .

e. Remove the A14 I/O board and place in 3rd slot. Do not reconnect the cables.

f. Move the A18 Memory board from the first slot to the fifth slot.

g. Reconnect cables to A14 I/O board.

h. Set the 11201 front-panel ON/STANDBY switch to ON.

Frequency counter

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

☐ Step 2: Press the UTILITY button.

☐ Step 3: Select **Extended Diagnostics** from the menu/status area and **Internal I/O** from the **Block** menu.

☐ Step 4: Select **Realtime Clk** from the **Area** menu and **Calibrate** from the **Routine** menu.

☐ Step 5: Select **Run**.

☐ Step 6: *Examine* that the frequency counter reads within the limits of 1,000,050 µs and 999,995 µs.

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

☐ Step 7: *Adjust* Real Time Clock adjustment C510 for 1,000,000 µs.

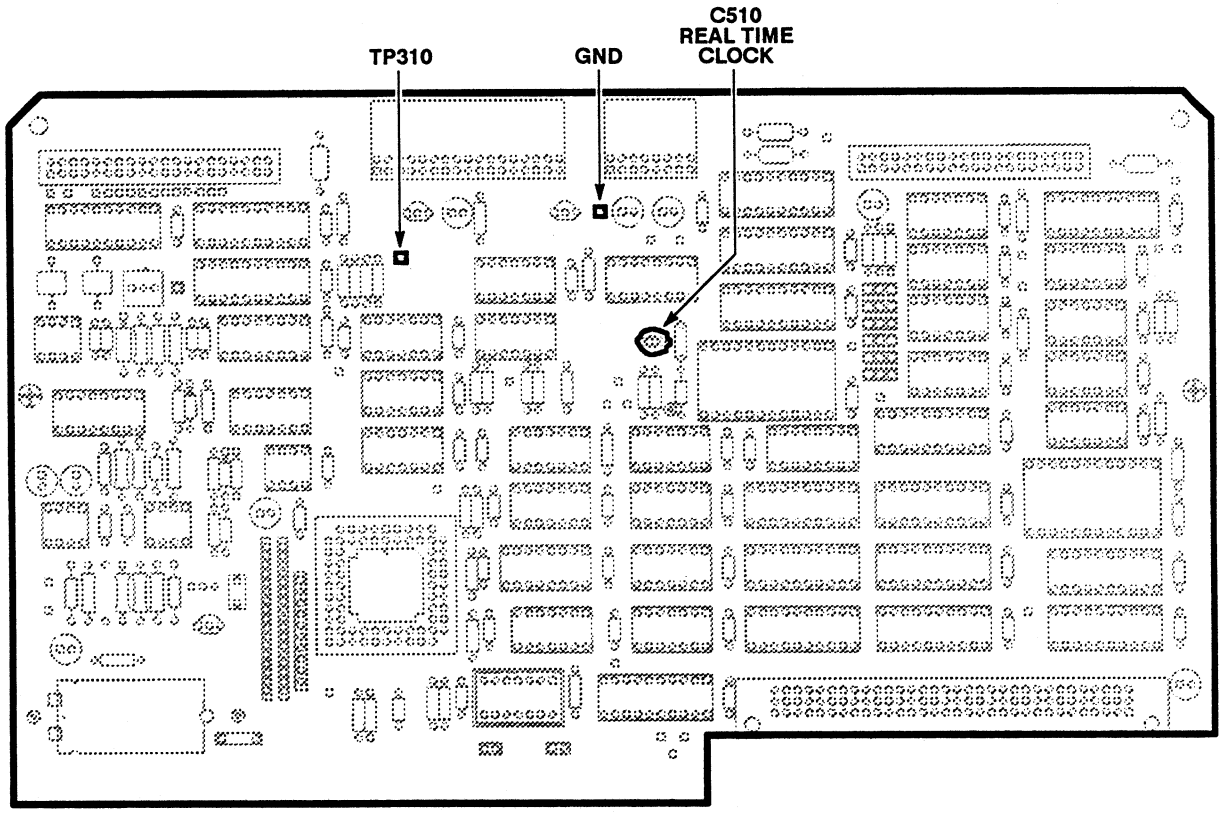
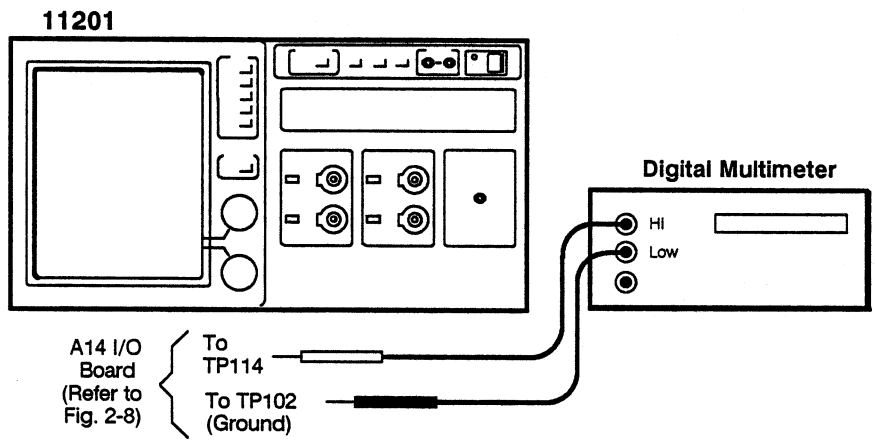


***Figure 2-7** — A14 I/O Board (Real Time Clock) Test Point and Adjustment Locations*

Setup to Examine/ Adjust Temperature Sensor Voltage Reference



Setup to Examine/Adjust Temperature Sensor Voltage Reference

Procedure to Examine/ Adjust Temperature Sensor Voltage Reference

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

11201 Oscilloscope . . . . . no setting changes required
Digital multimeter
Mode . . . . . DC

☐ 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 Temp Sensor Voltage Ref adjustment setting if the Digital Voltmeter reading is within the stated limits. Proceed to Part 16 Trigger Enhancement.

☐ Step 3: *Adjust* Temp Sensor Voltage Ref adjustment R112 for +6.500 V.

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

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

☐ Step 6: Set the ON/STANDBY to ON.

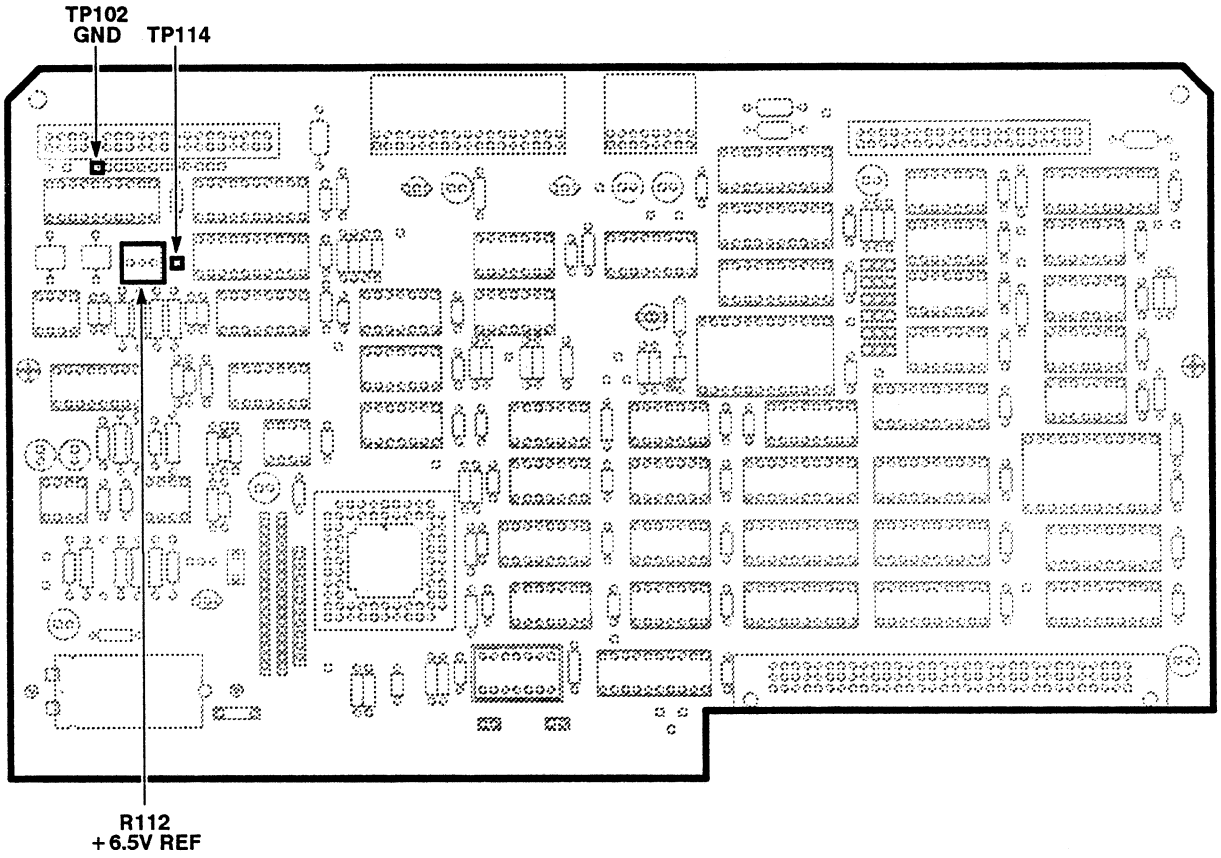


Figure 2-8 *— A14 I/O Board (Temperature Sensor) Test Point and Adjustment Locations*

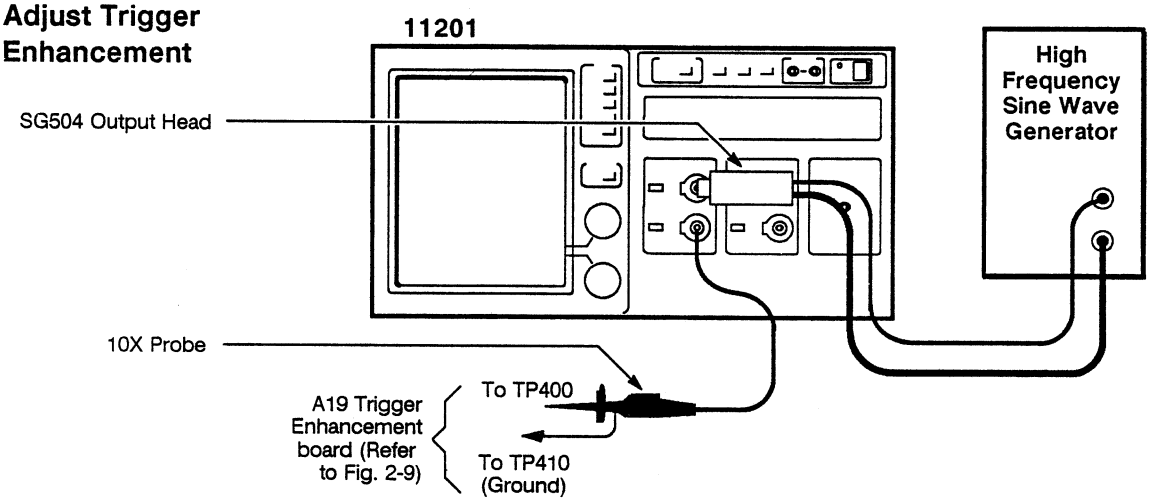
Part 16 Trigger Enhancement

In this part, the Trigger Enhancement circuit is adjusted to avoid spikes on the waveform when the end of holdoff and the triggering signal coincides.

Measurement Limits

Delay limit is 400 ps, ±80 ps.

Setup to Examine/ Adjust Trigger Enhancement



Setup to Examine/Adjust Trigger Enhancement

Procedure to Examine/Adjust Trigger Enhancement

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

a. Install a shorting strap across J3 on the A19 Trigger Enhacement board (see Figure 2-9).

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

11201 Oscilloscope

- L1 display on/off ..... on
- **Impedance** ..... **50 Ω**
- **Vert Size** ..... 500 mV/div
- L2 display on/off ..... on
- **Vert Size** ..... 500 mV/div
- **Vert Offset** ..... 3 V
- **Main Size** ..... 50 ns/div
- **Horizontal Desc** pop-up menu
  - **Main Record Length** **512**
  - **Window Record Length** **512**

High frequency sine wave generator

- Frequency ..... ≈500 MHz
- Amplitude ..... ≈6 div L1 display

☐ Step 2: Select (touch) a portion of the L1 trace.

☐ Step 3: Touch **Window1**.

☐ Step 4: Set the **Window1 Pos** knob to 400 ns.

☐ Step 5: Set the **Window1 Size** knob to 500 ps/div.

☐ Step 6: Select (touch) a portion of the L1 main trace.

☐ Step 7: Touch **Remove Wfm 1** to remove the L1 main trace from the screen.

☐ Step 8: Set the high frequency (HF) sine wave generator (**Fine**) frequency knob to a setting that displays spikes on the sine wave, then maximize the number of spikes displayed.

Note: *The maximum number of spikes are achieved when the L2 trace (main display) has the maximum number of transitions displayed.*

☐ Step 9: Select the Window1 **Cursors** label.

☐ Step 10: Touch **Cursor type** and then **Vertical Bars** in the **Cursor Type** pop-up menu.

☐ Step 11: Touch **Cursor1** and then **Fine** in the **Numeric Entry & Knob Res** pop-up menu.

☐ Step 12: Position **Cursor 1** to the first rising zero crossing point on the sine wave.

☐ Step 13: Rotate the HF sine wave generator (**Fine**) frequency knob counter-clockwise (lowers frequency) through a null of the L2 transitions to the next maximum number of displayed transitions.

☐ Step 14: Set **Cursor 2** to the position on the sine wave that was previously occupied by **Cursor 1**.

☐ Step 15: *Examine* that the Cursor **Δt** readout on the screen is 400 ps, within the limits of 320 ps and 480 ps.

*DO NOT attempt to optimize the name adjustment setting if the Cursor **Δt** readout is within the stated limits. Remove Shorting strap and probe. Proceed to Part 17—Triggering.*

☐ Step 16: Touch a portion of the window trace and then the horizontal icon.

☐ Step 17: Set the **Window1 Pos** knob to 0 s.

☐ Step 18: Press the TRIGGER button, and then set **Trigger Select** to **Main**.

☐ Step 19: Touch the **Time Holdoff: M** knob indicator selector.

☐ Step 20: Touch **Fine** in the **Numeric Entry & Knob Res** pop-up menu.

☐ Step 21: Set the **Main Holdoff** knob to 490.5 ns.

☐ Step 22: Set the HF sine wave generator (**Fine**) frequency knob to a setting that displays spikes on the sine wave, then maximize the number of spikes displayed.

☐ Step 23: Set the **Time Holdoff** to 490 ns.

☐ Step 24: *Adjust* C200 to obtain the most transitions between the high and low logic level on the L2 signal (this display is not triggered).

☐ Step 25: Set the **Time Holdoff** to 490.5 ns.

☐ Step 26: Set the HF sine wave generator (**Fine**) frequency to obtain the most transitions on the L2 signal.

☐ Step 27: Set the **Time Holdoff** to 490 ns.

☐ Step 28: *Adjust* C200 slightly to obtain the most transitions on the L2 signal.

☐ Step 29: Remove the shorting strap and 10X probe.

☐ Step 30: Turn the HF sine wave generator (**Fine**) frequency knob from end to end and observe that no spikes appear on the sine wave.

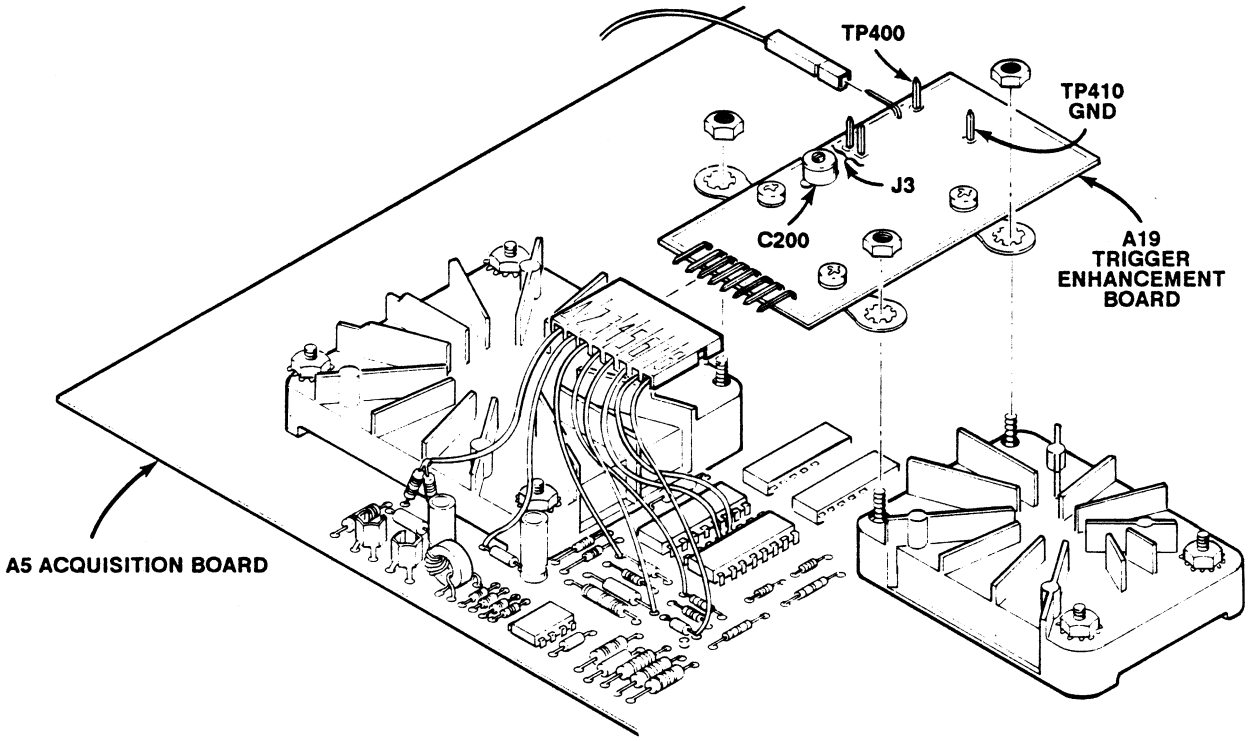


***Figure 2-9** — A19 Trigger Enhancement Board Test Point and Adjustment Locations*

Part 17 Triggering

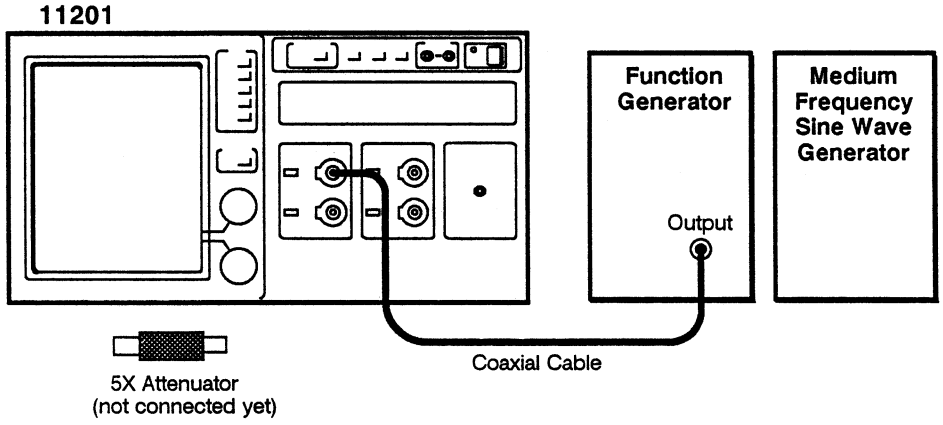
In this part, the trigger voltage is set to various values and is checked using the cursors readout on the screen.

Measurement Limits

The measurement limits for this part are as follows:

- Trigger level dc accuracy within 2.2% of full scale (20 LSBs).
- DC noise-reject coupled must be 1.2 divisions or less from dc to 50 MHz, increasing to 3.5 divisions at 400 MHz.
- AC coupled must be 1.0 divisions from 60 Hz to 50 MHz, increasing to 2.0 divisions at 400 MHz. (Attenuates signals below 60 Hz.)
- DC coupled must be 1 division from DC to 50 MHz, increasing to 2 divisions at 400 MHz.
- DC HF reject coupled must be functional
- AC LF reject coupled must be functional

Setup to Examine Triggering



Setup to Examine Triggering

Procedure to Examine Triggering

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

a. First perform Part 5 Enhanced Accuracy earlier in this section.

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

11201 Oscilloscope

L1 display on/off ..... on
Impedance ..... **50 Ω**
Vert Size ..... 100 mV/div
Main Size ..... 100 µs/div
Main Pos ..... 0 s
STORE/RECALL button ..... press
Store Settings ..... Setting 1

Function generator
- Waveform ..... triangular
- Frequency ..... 1 kHz
- Amplitude ..... 10 division signal

11201 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 ..... Not used in this part

Examine Trigger Level DC Accuracy

☐ Step 2: *Examine* that the cursor readout is V1 = 400 mV, ±22 mV.

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

☐ Step 4: *Examine* that the cursor readout is V1 = −400 mV, ±22 mV.

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

☐ 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: *Examine* that the **Cursor** readout is V1 = 400 mV, ±22 mV.

☐ Step 12: Set the window 1 **Trigger Level** to −400 mV.

☐ Step 13: *Examine* that the **Cursor** readout is V1 = −400 mV, ±22 mV.

Examine 50 MHz Sensitivity

☐ Step 14: Connect the medium frequency (MF) sine wave generator through a 5X attenuator to the L1 input connector.

☐ Step 15: Set the MF sine wave generator frequency to 50 MHz.

☐ Step 16: Recall the stored **Setting 1** (stored in Step 1).

☐ Step 17: Press the TRIGGER button, and then set the **Coupling** to **AC**.

☐ Step 18: Touch the horizontal icon, and then set the **Main Size** to 10 ns/div.

☐ Step 19: Set the function generator output for a peak-peak measurement of 50 mV.

☐ Step 20: Touch the **trig'd** icon.

☐ Step 21: *Examine* that you can adjust the **Trig Level** and achieve a stable display (use **Fine** resolution).

☐ Step 22: Select the **Window 1**.

☐ Step 23: Set **Window Size** to 10 ns/division.

☐ 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: *Examine* that you can adjust the window **Trig Level** and achieve a stable display.

Examine DC Noise Reject

☐ Step 28: 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: *Examine* 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: *Examine* that you can adjust the main **Trig Level** and achieve a stable display.

Examine DC Coupling

☐ Step 34: Connect the coaxial cable from the L1 input to the CALIBRATOR output connector of the oscilloscope.

☐ Step 35: Select the UTILITY button.

☐ Step 36: Touch **Probes**, then select L1 (this deskews the system).

☐ Step 37: Recall the stored **Setting 1** (stored in Step 1).

☐ Step 38: Connect the coaxial cable from the L1 input to the MF sine wave generator.

☐ Step 39: Set the MF sine wave generator output to its 50 kHz Reference frequency.

☐ Step 40: Set the MF Sine Wave Generator Output Amplitude for a peak-peak measurement of 600 mV.

☐ Step 41: Touch the horizontal icon, and then set the **Main Size** to 2 μs/div.

☐ Step 42: Set the **Main Pos** to position the trigger indicator (arrow) to the center vertical graticule line (-10.2 μs readout).

☐ Step 43: *Examine* that the rising portion of the sine wave crosses the center of the screen, ±0.2 divisions.

☐ Step 44: Touch the vertical icon, and then set the **Vert Offset** to move the waveform above and below its original position.

☐ Step 45: *Examine* that the trigger indicator (arrow) remains at the same level, at the center of the screen.

☐ Step 46: Set the **Vert Offset** control for 0 V readout.

Examine DC HF Reject

☐ Step 47: Touch the TRIGGER button, and then set the **Coupling** to **DC HF Reject**.

☐ Step 48: Examine that the waveform moved left of the trigger indicator (arrow) between 0.5 and 2.0 divisions.

Examine AC LF Reject

☐ Step 49: Set the trigger **Coupling** to **AC LF Reject**.

☐ Step 50: *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.

Examine AC Coupling

☐ Step 51: Set the trigger **Coupling** to **AC**.

☐ Step 52: Set the **Vert Offset**, and note that the waveform remains triggered at the same point regardless of the vertical offset.

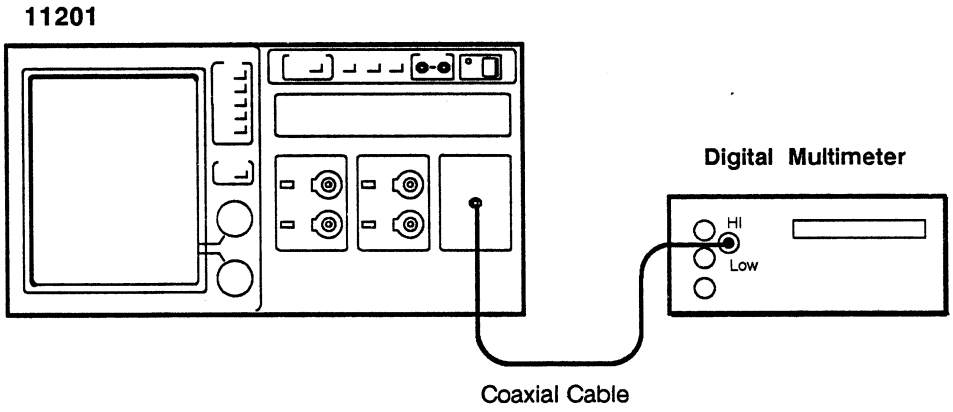
Part 18 External Trigger Input Resistance

In this part, the setup is shown and the procedure lists the steps to examine the External Trigger board's input resistance.

Measurement Limits

The external trigger input resistance is 1 M Ω ±0.05 MΩ.

Setup to Examine External Trigger Input Resistance



Setup to Examine External Trigger Input Resistance

Procedure to Examine External Trigger Input Resistance

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

11201 Oscilloscope ..... No settings required
Digital multimeter
Function ..... 2M Ω

☐ Step 2: Record the digital multimeter reading as R_2 for later use.

☐ Step 3: Reverse the connection between the dual banana adapter and the digital multimeter.

☐ Step 4: Record the digital multimeter reading as R_4 for later use.

☐ Step 5: Add the two values recorded in Step 2 (R_2) and Step 4 (R_4). Record this value as R_5 for later use.

☐ Step 6: Divide the value recorded in Step 5 (R_5) by two and record this value as R_6 external trigger input resistance for later use.

☐ Step 7: *Examine* that R_6 external trigger input resistance is 1 MΩ ±0.05 MΩ.

Part 19 External Trigger Input Calibration

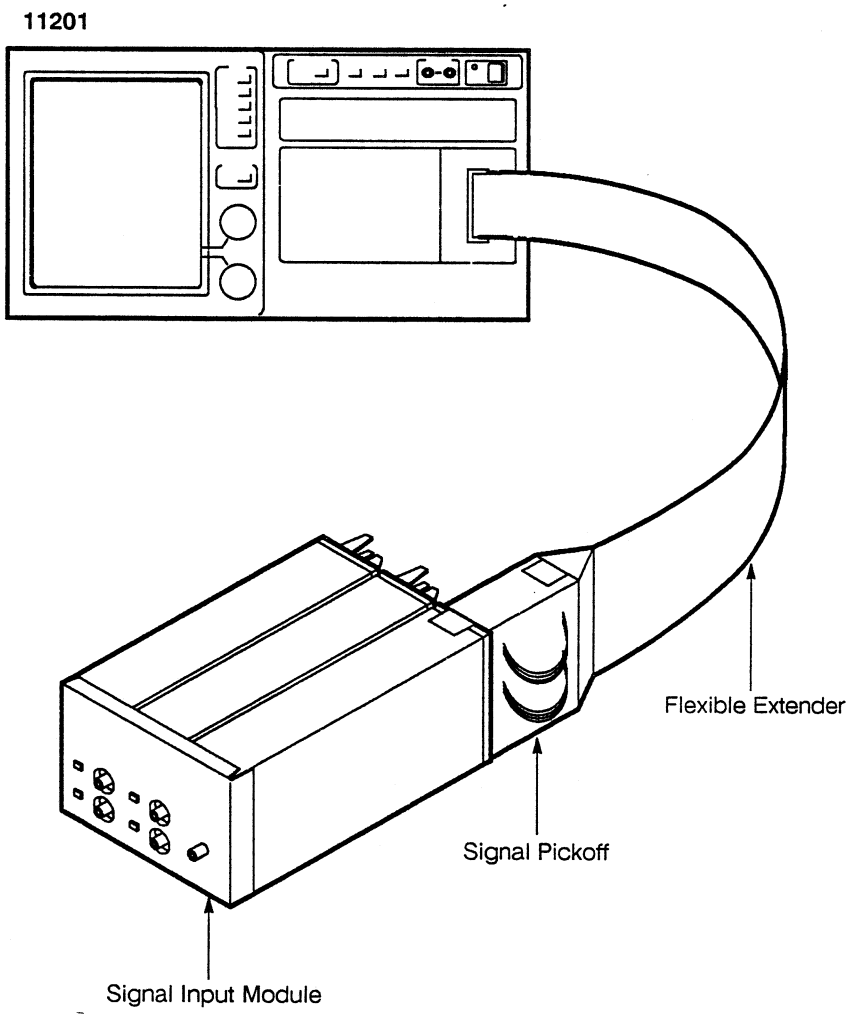
In this part, the setup is shown and the procedure lists the steps to examine/adjust the balance, input capacitance, and gain of the A22 External Trigger board.

Measurement Limits

The measurement limits for this part are as follows:

- Balance must be within ±0.500 mV
- Input Capacitance must be 15 pF ±10%
- Gain must be unity ±1%

Setup to Examine/ Adjust Balance



Setup to Examine/Adjust Balance

Procedure to Examine/ Adjust Balance

☐ Step 1: **Initiailize** the oscilloscope settings, then perform the folowing settings in the order listed:

Signal pick-off extender
Switch cable connectors A11 and A13
Switch cable connectors B11 and B13
11201 Oscilloscope
Def Wfm ..... **R**
Acquire Description pop-up menu ..... **Average N** to **On**
Set AvgN 8
MEASURE button ..... press
Measurements pop-up menu ..... **Mid**

☐ Step 2: *Examine* that the **Mid** is 0 ±500 mU.

STOP

DO NOT attempt to adjust the balance adjustment, if the reading is within the stated limits. Proceed to the Examine/Adjust Input Capacitance procedure that follows.

☐ Step 3: *Adjust* the balance adjustment R21 for a reading of approximately 0 V (see Fig. 2-10 adjustment locations).

Note: *In order to access this adjustment, the right-most frame of the Signal Input module must be removed. Refer to A22 External Trigger Board, Steps 1 through 6, under Corrective Maintenance.*

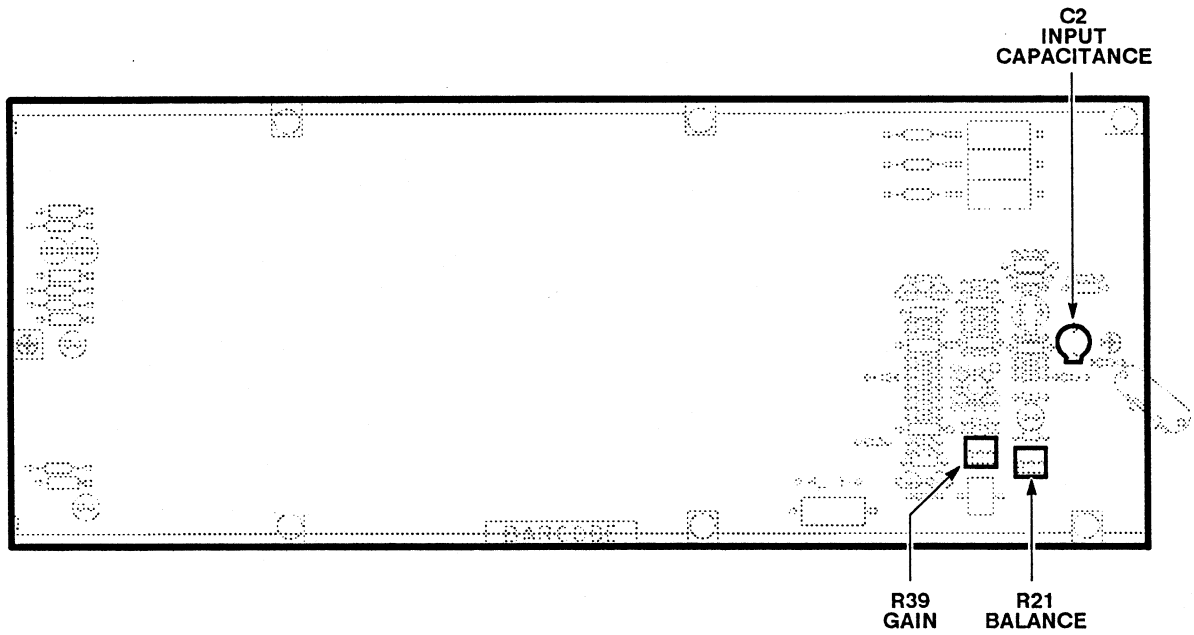
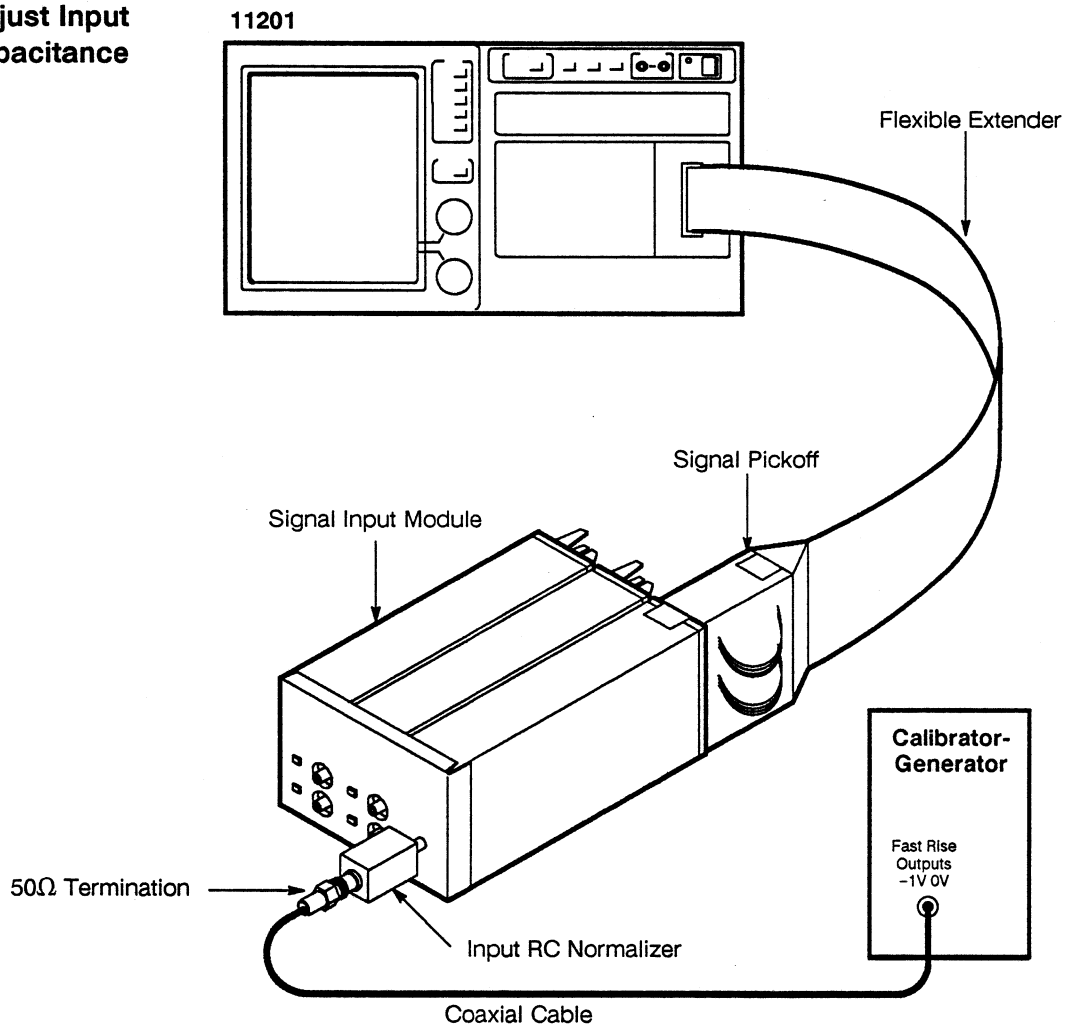


Figure 2-10 *—A22 External Trigger Board Adjustment Locations*

Setup to Examine/ Adjust Input Capacitance



Setup to Examine/Adjust Input Capacitance

Procedure to Examine/ Adjust Input Capacitance

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

11201 Oscilloscope

Def Wfm ..... **R * 10**
Main Size ..... 10 µs/div
Main Pos ..... -10 µs/div
TRIGGER button ..... press
Source Desc ..... **R**

Calibration generator

Pulse Amplitude ..... maximum
Period ..... 1 ms

☐ Step 2: Touch **Level**, and then set the **Trig Level** for a stable display

☐ Step 3: *Examine* that the waveform has a flat response (that is the front corner is not rolled up or down).

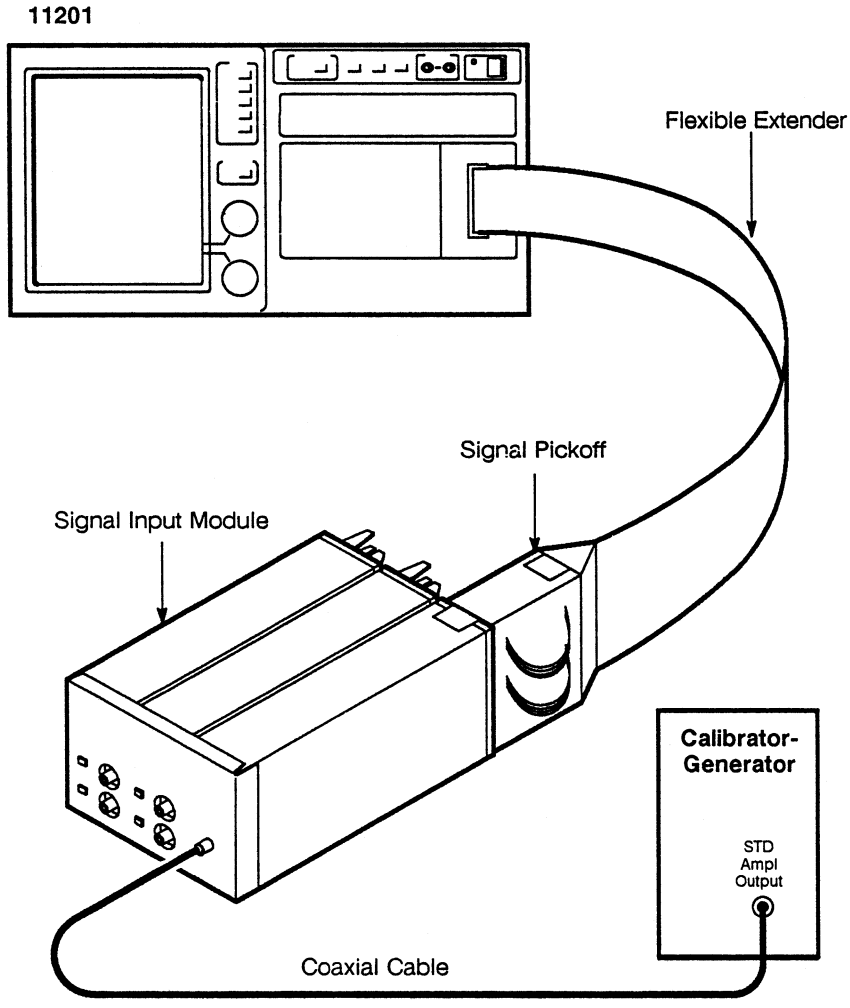
STOP

DO NOT attempt to adjust the input capacitance adjustment, if the waveform is within the stated limits. Proceed to the Examine/Adjust Gain procedure that follows.

☐ Step 4: *Adjust* the input capacitance adjustment C2 for a flat response (see Figure 2-10 for adjustment locations) .

Note: *In order to access this adjustment, the right-most frame of the Signal Input module must be removed. For specific instructions refer to A22 External Trigger Board, Steps 1 through 6, under Corrective Maintenance.*

Setup to Examine/ Adjust Gain



Setup to Examine/Adjust Gain

Procedure to Examine/ Adjust Gain

☐ Step 1: **Initiailize** the oscilloscope settings, then perform the folowing settings in the order listed:

11201 Oscilloscope
- **Def Wfm** ..... **R**
  - **Main Size** ..... 500 µs/div
  - MEASURE button ..... press
    - **Measurements** pop-up menu ..... **Peak-Peak**
  - TRIGGER button ..... press
    - **Source Desc** ..... **R**

Calibration generator
- Amplitude ..... 2.0 Volts

☐ Step 2: Touch **Level**, and then set the **Trig Level** for a stable display.

☐ Step 3: Press the WAVEFORM button.

☐ Step 4: Touch **Acquire Desc**, and then set **Average N** to **On**.

☐ Step 5: Press the MEASURE button.

☐ Step 6: *Examine* that the **Peak-Peak** is 2.0 V ±20 mV.

STOP

DO NOT attempt to adjust the gain adjustment, if the reading is within the stated limits. Proceed to the Part 20 External Trigger Performance.

☐ Step 7: *Adjust* the gain adjustment R39 for a peak-peak reading of 2 V (see Figure 2-10 for adjustment locations).

Note: *In order to access this adjustment, the right-most frame of the Signal Input module must be removed. Refer to A22 External Trigger Board, Steps 1 through 6, under Corrective Maintenance.*

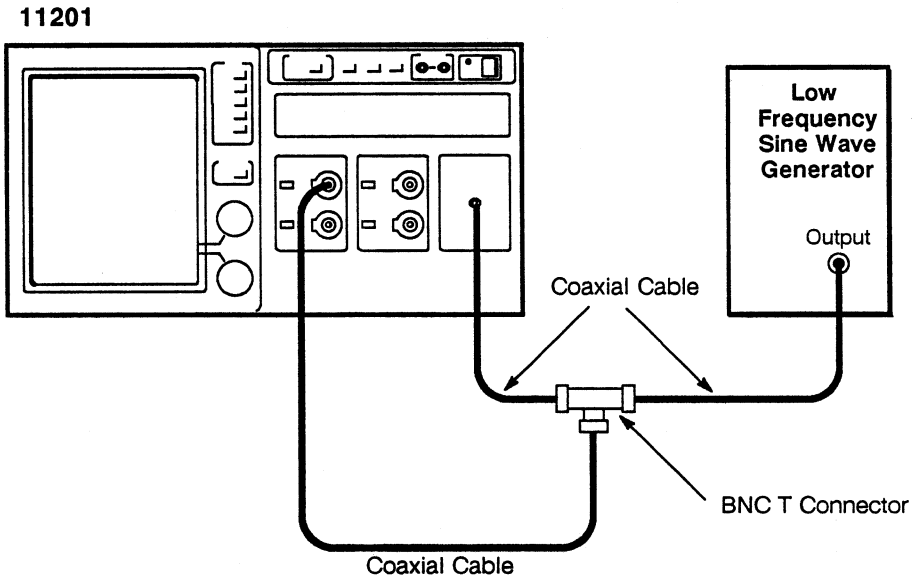
Also, turning the Main Pos knob (bottom knob) counterclockwise restarts the averaging cycles. (Turn this knob when making adjustments to the gain adjustment setting.)

Part 20 External Trigger Performance

In this part, the setup is shown and the procedure lists the steps to examine the low, medium, and high frequency external trigger performance.

Measurement Limits

Setup to Examine Low Frequency External Trigger Performance



Setup to Examine Low Frequency External Trigger Performance

Procedure to Examine Low Frequency External Trigger Performance

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

11201 Oscilloscope
- L1 Display on/off ..... on
- TRIGGER button ..... press
  - **Mode** ..... **Normal**
  - **Source Desc** **L1**
  - **Coupling** ..... **DC**
  - **Main Size** ..... 20 ms/div

Low frequency sine wave generator
- Frequency ..... 60 Hz
- Display Amplitude ..... set for 1.0 V display amplitude

☐ Step 2: Set **Vert Size** for a 1 division display.

Note: *It may be necessary to set the* **Vert Size** *resolution in the* **Numeric Entry & Knob Res** *pop-up menu to* **Fine** *in order to achieve the above setting.*

☐ Step 3: *Examine* that you can adjust the Main **Trig Level** to achieve a stable display.

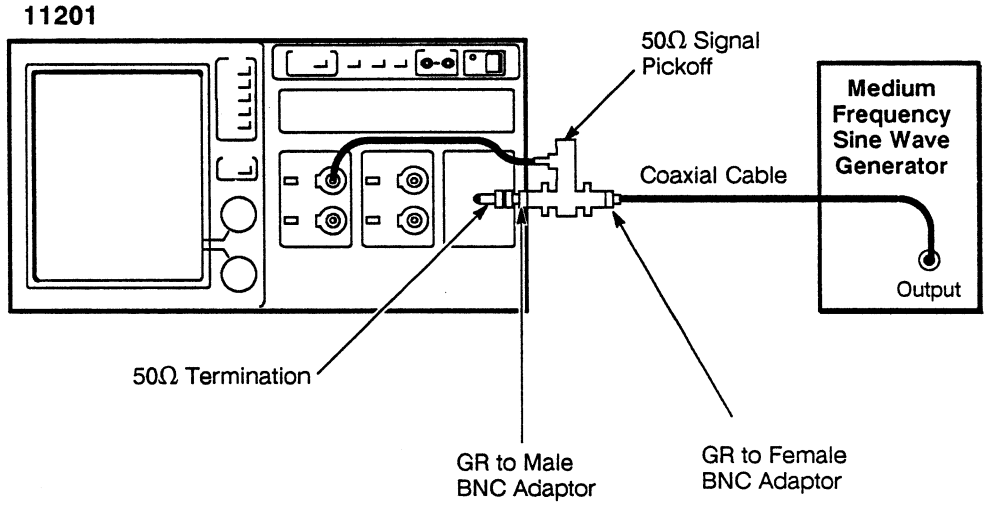
☐ Step 4: Set the **Slope** to - (minus).

☐ Step 5: Repeat Steps 1 through 3 for each (Trigger) **Coupling**, Trigger **Source**, **Main Size**, low frequency sine wave generator **Frequency** and **Display Amplitude** settings listed in Table 2-9.

Table 2-9 *— Low Frequency Trigger Performance Settings*

Coupling	Source	Main Size	Frequency	Display Amplitude (Volts)	Display Amplitude (Divisions)
AC	L1	20 ms	60 Hz	1.0 Volts	1.0 div
DC	R	20 ms	60 Hz	1.0 Volts	1.0 div
AC	R	20 ms	60 Hz	1.0 Volts	1.0 div
HF Rej	R	20 ms	60 Hz	1.0 Volts	0.7 div
HF Rej	L1	20 ms	60 Hz	1.0 Volts	0.7 div
Noise	L1	20 ms	60 Hz	1.2 Volts	1.2 div
Noise	R	20 ms	60 Hz	1.2 Volts	1.2 div
LF Rej	L1	20 µs	80 kHz	1.0 Volts	0.7 div
LF Rej	R	20 µs	80 kHz	1.0 Volts	0.7 div
HF Rej	L1	10 µs	30 kHz	1.0 Volts	0.7 div
HF Rej	R	10 µs	30 kHz	1.0 Volts	0.7 div

Setup to Examine Medium Frequency Trigger Performance



Setup to Examine Medium Frequency Trigger Performance

Procedure to Examine Medium Frequency Trigger Performance

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

11201 Oscilloscope
- L1 Display On/Off ..... on
- **Impedance** ..... **50 Ω**
- TRIGGER button ..... press
- **Source Desc** **L1**
- **Coupling** ..... **DC**
- **Main Size** 20µs/div

Medium frequency sine wave generator
- Frequency ..... 50 kHz (Ref)
- Display Amplitude ..... set for 100 mV display amplitude

☐ Step 2: Set the **Main Size** to 20 ns/div.

☐ Step 3: Set the medium frequency sine wave generator frequency to 50 MHz.

☐ Step 4: Touch the vertical icon, and then set the **Vert Size** for a 1 division display.

Note: *It may be necessary to set the* **Vert Size** *resolution to* **Fine** *in the* **Numeric Entry & Knob Res** *pop-up menu in order to achieve the above condition.*

☐ Step 5: *Examine* that the **Trig Level** can be adjusted to achieve a stable display.

☐ Step 6: Set the **Slope** to - (minus).

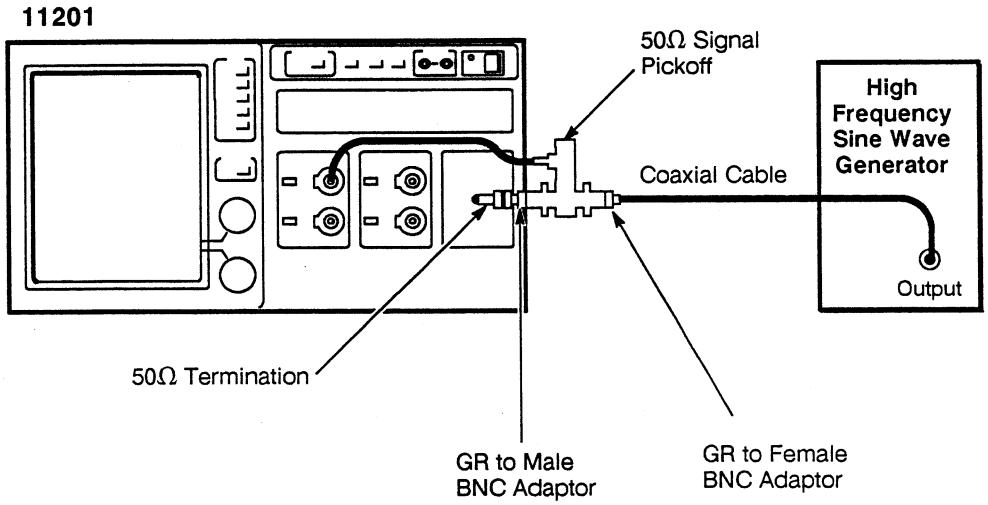
☐ Step 7: *Examine* that the **Trig Level** can be adjusted to achieve a stable display.

Repeat this Steps 1 through 8 for each Trigger **Coupling**, Trigger **Source** and **Display Amplitude** settings listed in Table 2-10.

Table 2-10 *— Medium Frequency Trigger Performance Settings*

Coupling	Source	Display Amplitude (Volts)	Display Amplitude (Divisions)
DC	L1	0.1 Volts	1.0 div
AC	L1	0.1 Volts	1.0 div
DC	R	0.1 Volts	1.0 div
AC	R	0.1 Volts	1.0 div
Noise	L1	0.12 Volts	1.2 div
Noise	R	0.12 Volts	1.2 div
LF Rej	L1	0.1 Volts	0.7 div
LF Rej	R	0.1 Volts	0.7 div

Setup to Examine High Frequency Trigger Performance



Setup to Examine High Frequency Trigger Performance

Procedure to Examine High Frequency Trigger Performance

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

11201 Oscilloscope
- L1 Display On/Off ..... on
- **Vert Size** ..... 100 mV/div
  - **Impedance** ..... **50 Ω**
- TRIGGER button ..... press
  - **Coupling** ..... **DC**
  - **Source Desc** **L1**
- **Main Size** ..... 20 µs/div

High frequency sine wave generator
- Frequency ..... 50 kHz (Ref)
- Display Amplitude ..... set for 200 mV display amplitude

☐ Step 2: Set the **Main Size** to 5 ns/div.

☐ Step 3: Set the high frequency sine wave generator frequency to 400 MHz.

☐ Step 4: Touch the vertical icon, and then set the **Vert Size** for a 2.0 division display.

Note: *It may be necessary to set the* **Vert Size** *resolution to* **Fine** *in the* **Numeric Entry & Knob Res** *pop-up menu in order to achieve the above setting.*

☐ Step 6: Set the **Slope** to – (minus).

☐ Step 7: *Examine* that the **Trig Level** can be adjusted to achieve a stable display.

☐ Step 8: Repeat Steps 1 through 6 for each Trigger **Coupling**, Trigger **Source**, and **Display Amplitude** settings in Table 2-11.

Table 2-11 *– High Frequency Trigger Performance Settings*

Coupling	Source	Display Amplitude (Volts)	Display Amplitude (Divisions)
DC	L1	0.2 Volts	2.0 div
AC	L1	0.2 Volts	2.0 div
DC	R	0.2 Volts	2.0 div
AC	R	0.2 Volts	2.0 div
Noise	L1	0.35 Volts	3.5 div
Noise	R	0.35 Volts	3.5 div
LF Rej	L1	0.2 Volts	1.5 div
LF Rej	R	0.2 Volts	1.5 div

Maintenance

This section contains information for performing preventive maintenance, corrective maintenance, and diagnostic troubleshooting on the 11201 Digitizing Oscilloscope.

Preventive Maintenance

Performaing a regular maintenance program can prevent oscilloscope from disfunctioning 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 doing preventive maintenance is prior to performing an electrical adjustment.

Removing the Cabinet Panel

WARNING

Dangerous potentials exist at several points throughout this oscilloscope. If you do 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. To remove the covers, loosen the fasteners and lift the covers off. 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 used 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

The CRT faceplate is cleaned 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. A cotton-tipped applicator is useful for cleaning in narrow spaces, or for cleaning more delicate circuit components. After cleaning, use a washcloth dampened with water to remove any residue.

CAUTION

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

You should especially 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 circuit 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 these components are at the AC line voltage potential.

Always remove 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 for the relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

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 be servicing 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.
- Keep the work station surface clear of anything that can generate or hold 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 and Replacing FRUs

Table 3-2 should be used as 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 and screw locations while you are using the procedure, which discusses these locations, 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 3-18 — Removing and Replacing the A14 I/O Board	3-40
	Figure 3-21 — Removing and Replacing the A17 Main Processor Board	3-46
Cathode Ray Tube (CRT)	Figure 3-2 — Removing and Replacing the Cathode Ray Tube	3-13
	Figure 3-13 — Removing and Replacing the A8 CRT Driver Board	3-32
	Figure 3-14 — Removing and Replacing the A10 Front Panel Control Board	3-35
	Figure 3-31 — Multi-Pin Connector Orientation	3-75
Fan Motor	Figure 3-3 — Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector-Plate	3-19
Power Supply Module	Figure 3-3 — Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector-Plate	3-19
	Figure 3-4 — A2A2 Control Rectifier Board Connector Locations	3-20
Signal Input Module	Figure 3-5 — Removing and Replacing the Decorative Trim Covers	3-21
A1 Plug-in Interface Board	Figure 3-3 — Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector-Plate	3-19
	Figure 3-4 — A2A2 Control Rectifier Board Connector Locations	3-20
	Figure 3-5 — Removing and Replacing the Decorative Trim Covers	3-21
	Figure 3-7 — Signal Input Compartment Screws Locations	3-24
	Figure 3-8 — Removing and Replacing the A1 Plug-in Interface board	3-25
	Figure 3-9 — Removing and Replacing the A4 Regulator Board	3-27
	Figure 3-10 — Removing and Replacing the A5 Acquisition Board	3-28
	Figure 3-11 — Removing and Replacing the A6 Time Base Board	3-30
	Figure 3-12 — Removing and Replacing the A7 Display Controller Board	3-31
	Figure 3-18 — Removing and Replacing the A14 I/O Board	3-40
	Figure 3-31 — Multi-Pin Connector Orientation	3-75
A4 Regulator Board	Figure 3-3 — Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector-Plate	3-19
	Figure 3-4 — A2A2 Control Rectifier Board Connector Locations	3-20
	Figure 3-9 — Removing and Replacing the A4 Regulator Board	3-27
	Figure 3-31 — Multi-Pin Connector Orientation	3-75
A5 Acquisition Board	Figure 3-10 — Removing and Replacing the A5 Acquisition Board	3-28
	Figure 3-31 — Multi-Pin Connector Orientation	3-75
A6 Time Base Board	Figure 3-10 — Removing and Replacing the A5 Acquisition Board	3-28
	Figure 3-11 — Removing and Replacing the A6 Time Base Board	3-30
	Figure 3-31 — Multi-Pin Connector Orientation	3-75
A7 Display Controller Board	Figure 3-12 — Removing and Replacing the A7 Display Controller Board	3-31
	Figure 3-31 — Multi-Pin Connector Orientation	3-75

Table 3-2 (cont) *— FRU Removal/Replacement Figure Cross Reference*

FRU to be Removed/Replaced	Figures to Reference During Removal	Page
A8 CRT Driver Board Board	Figure 3-5 — Removing and Replacing the Decorative Trim Covers	3-21
	Figure 3-2 — Removing and Replacing the Cathode Ray Tube	3-13
	Figure 3-13 — Removing and Replacing the A8 CRT Driver Board	3-32
	Figure 3-31 — Multi-Pin Connector Orientation	3-75
A9 Touch Panel Assembly	Figure 3-2 — Removing and Replacing the Cathode Ray Tube	3-13
	Figure 3-14 — Removing and Replacing the A10 Front Panel Control Board	3-35
	Figure 3-31 — Multi-Pin Connector Orientation	3-75
A10 Front Panel Control Board	Figure 3-2 — Removing and Replacing the Cathode Ray Tube	3-13
	Figure 3-12 — Removing and Replacing the A7 Display Controller Board	3-31
	Figure 3-14 — Removing and Replacing the A10 Front Panel Control Board	3-35
	Figure 3-31 — Multi-Pin Connector Orientation	3-75
A11 Front Panel Button Board	Figure 3-2 — Removing and Replacing the Cathode Ray Tube	3-13
	Figure 3-12 — Removing and Replacing the A7 Display Controller Board	3-31
	Figure 3-14 — Removing and Replacing the A10 Front Panel Control Board	3-35
	Figure 3-15 — Removing and Replacing the A11 Front Panel Button Board	3-36
	Figure 3-31 — Multi-Pin Connector Orientation	3-75
A12 Rear Panel Assembly	Figure 3-3 — Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector-Plate	3-19
	Figure 3-16 — Removing and Replacing the A12 Rear Panel Assembly	3-38
	Figure 3-31 — Multi-Pin Connector Orientation	3-75
A13 Mother Board	Figure 3-6 — Top View of the Card Cage	3-22
	Figure 3-17 — Removing and Replacing the A13 Mother Board	3-39
	Figure 3-18 — Removing and Replacing the A14 I/O Board	3-40
	Figure 3-19 — Removing and Replacing the A15 MMU Board	3-42
	Figure 3-20 — Removing and Replacing the A16 Waveform Compressor board	3-44
	Figure 3-21 — Removing and Replacing the A17 Main Processor Board	3-46
	Figure 3-22 — Removing and Replacing the A18 Memory Board	3-48
	Figure 3-31 — Multi-Pin Connector Orientation	3-75
A14 Input/Output (I/O) Board	Figure 3-6 — Top View of the Card Cage	3-22
	Figure 3-18 — Removing and Replacing the A14 I/O Board	3-40
	Figure 3-31 — Multi-Pin Connector Orientation	3-75
A15 Memory Manager Unit (MMU) Board	Figure 3-6 — Top View of the Card Cage	3-22
	Figure 3-18 — Removing and Replacing the A14 I/O Board	3-40
	Figure 3-19 — Removing and Replacing the A15 MMU Board	3-42
	Figure 3-31 — Multi-Pin Connector Orientation	3-75
A16 Waveform Compressor Board	Figure 3-6 — Top View of the Card Cage	3-22
	Figure 3-18 — Removing and Replacing the A14 I/O Board	3-40
	Figure 3-20 — Removing and Replacing the A16 Waveform Compressor board	3-44
	Figure 3-31 — Multi-Pin Connector Orientation	3-75
A17 Main Processor Board	Figure 3-6 — Top View of the Card Cage	3-22
	Figure 3-21 — Removing and Replacing the A17 Main Processor Board	3-46
	Figure 3-31 — Multi-Pin Connector Orientation	3-75
A18 Memory Board	Figure 3-6 — Top View of the Card Cage	3-22
	Figure 3-22 — Removing and Replacing the A18 Memory Board	3-48

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

FRU to be Removed/Replaced	Figures to Reference During Removal	Page
A20A1/A21A1 Main Board	Figure 3-5 – Removing and Replacing the Decorative Trim Covers	3-21
	Figure 3-23 – Signal Input Module Front Panel and Front Subpanel Screw Locations	3-50
	Figure 3-24 – Removing and Replacing the A20A1/A21A1 Main Boards	3-51
	Figure 3-26 – Removing and Replacing an Attenuator	3-58
	Figure 3-31 – Multi-Pin Connector Orientation	3-75
A20A2/A21A2 Front Panel Boards	Figure 3-5 – Removing and Replacing the Decorative Trim Covers	3-21
	Figure 3-23 – Signal Input Module Front Panel and Front Subpanel Screw Locations	3-50
	Figure 3-24 – Removing and Replacing the A20A1/A21A1 Main Boards	3-51
	Figure 3-31 – Multi-Pin Connector Orientation	3-75
A22 External Trigger	Figure 3-5 – Removing and Replacing the Decorative Trim Covers	3-21
	Figure 3-23 – Signal Input Module Front Panel and Front Subpanel Screw Locations	3-50
	Figure 3-25 – Removing and Replacing the A22 External Trigger Board	3-57
L1, L2, C1 and C2 Attenuators	Figure 3-5 – Removing and Replacing the Decorative Trim Covers	3-21
	Figure 3-23 – Signal Input Module Front Panel and Front Subpanel Screw Locations	3-50
	Figure 3-24 – Removing and Replacing the A20A1 and A21A1 Main Boards	3-51
	Figure 3-26 – Removing and Replacing an Attenuator	3-58
	Figure 3-31 – Multi-Pin Connector Orientation	3-75

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 top and/or bottom covers will need to be removed for most repairs. 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 counterclockwise.

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.

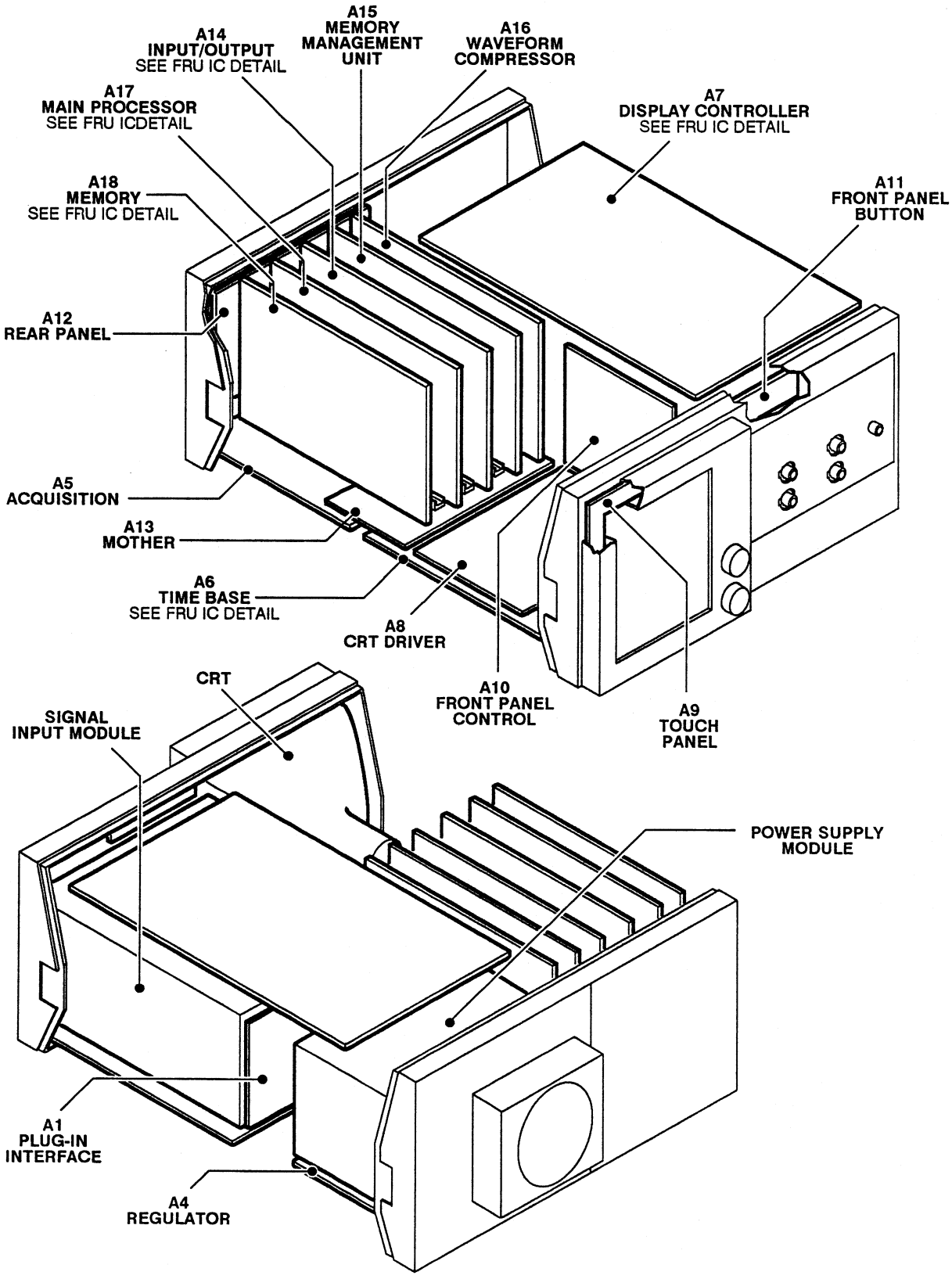
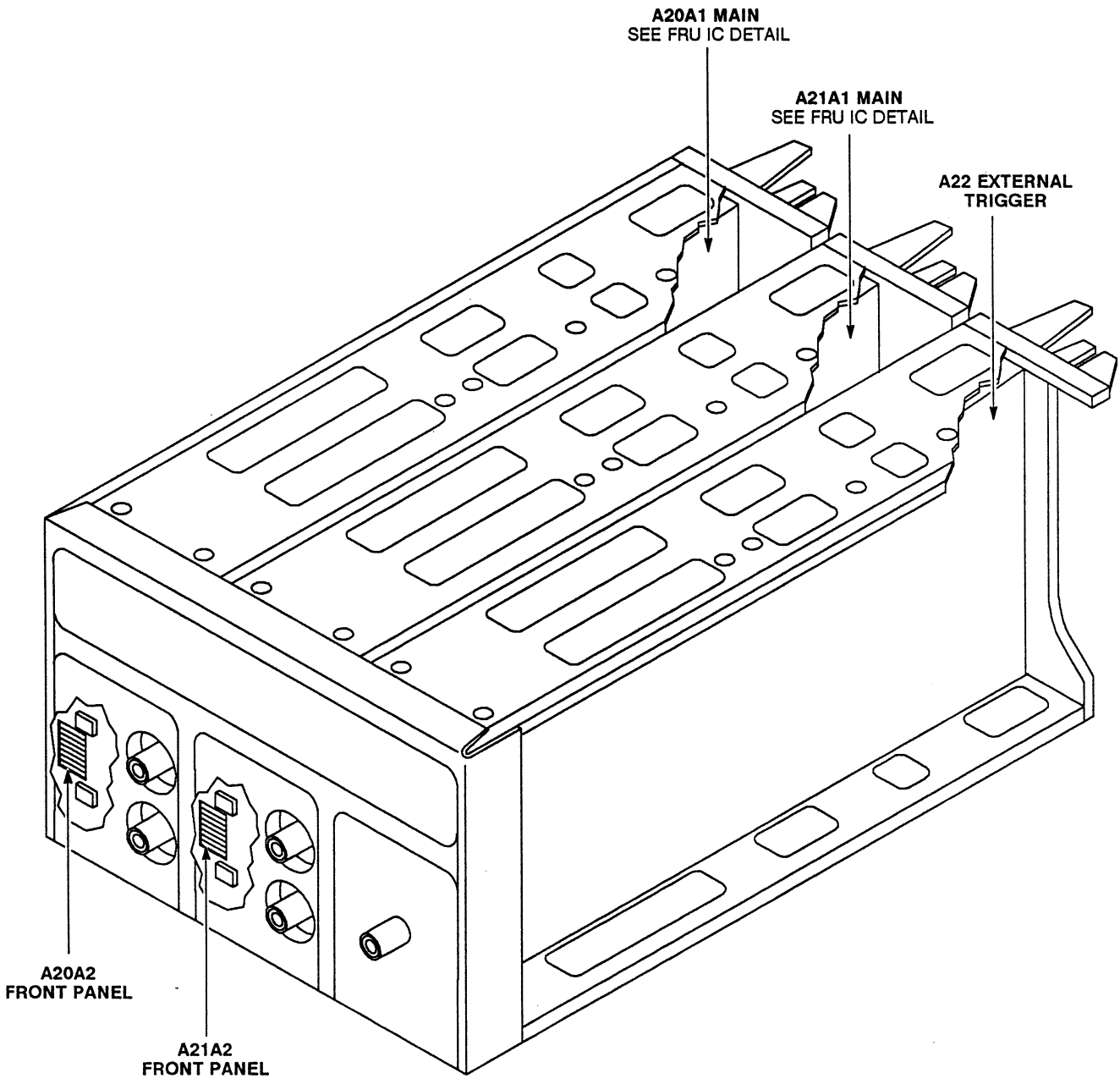


Figure 3-1 *— Field Replaceable Units (FRU) Locator*



SIGNAL INPUT MODULE

Figure 3-1 (cont) *— 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.
- ☐ 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 in the reverse order.

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 (BT160) on the A17 Main Processor board

See Figures 3-18 and 3-21 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 (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. It 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 usually causes venting.
- **Solute:** LIBF4

Table 3-3 lists the emergency procedures 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 (12 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.

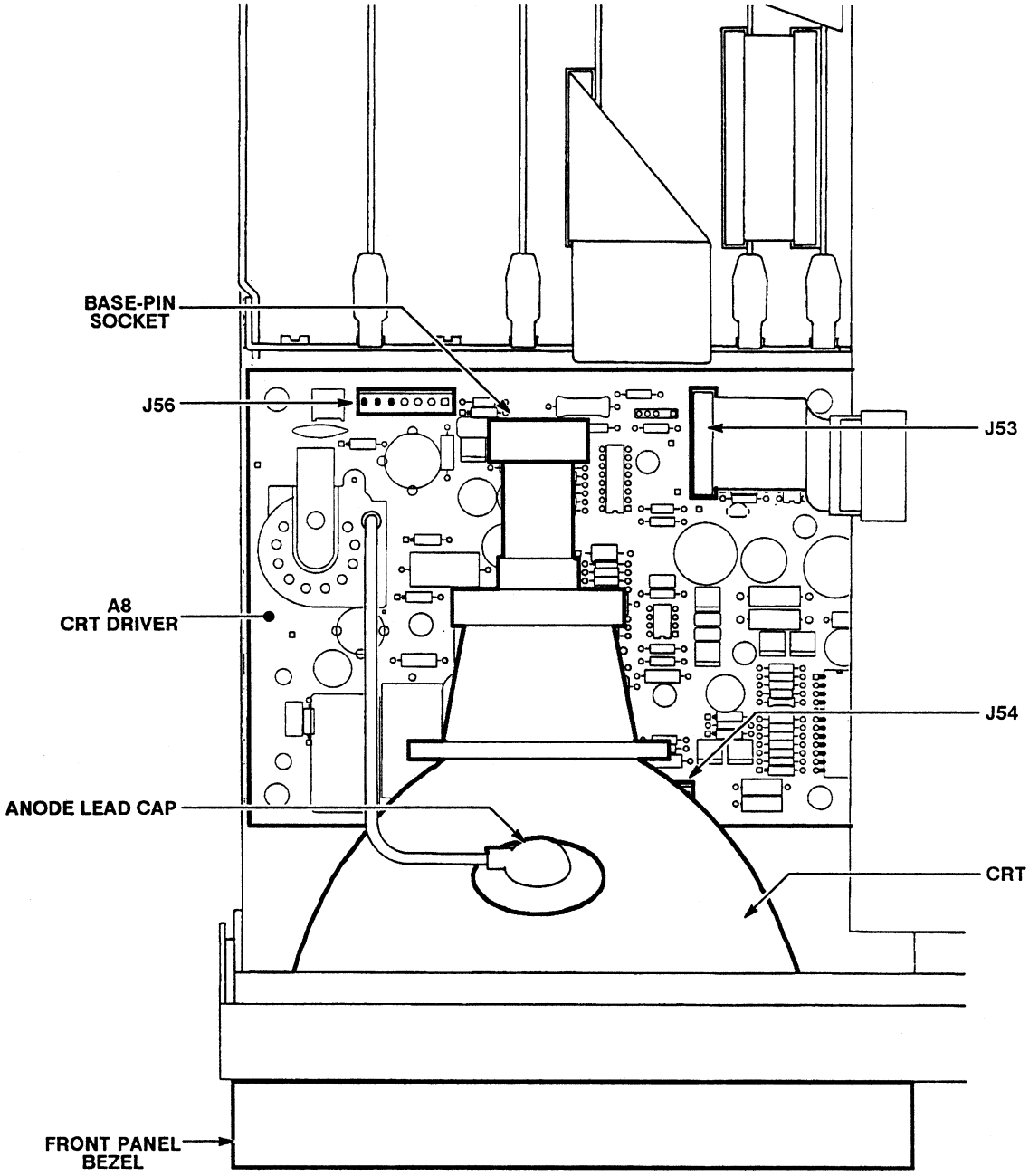


Figure 3-2 *— Removing and Replacing the Cathode Ray Tube*

See Figures 3-2, 3-13, 3-14 and 3-31 for connector, screw, and index locations.

Remove the CRT as follows:

☐ Step 1: Turn the oscilloscope so that its front is at your right. Remove the two Torx head screws securing the CRT shield to the chassis.

☐ Step 2: Lift up on the outside of the shield.

- The inner edge of the shield is held in place by two tabs. These tabs fit into slots in the chassis beneath the inner edge of the A7 Display Controller board.
- As the shield is lifted, the bottom of the shield will clear the frame behind the oscilloscope's handle. After the shield clears the frame, remove the shield carefully. Don't allow the shield to strike the CRT.

WARNING

The CRT anode voltage is 12 kV. Again, 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.

☐ Step 3: Use a non-conducting tool to pry up the 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 in the CRT opening to remove the anode. Insert a screwdriver blade tip against the anode and touching the blade to the top of the front casting to ground the anode to the chassis.

☐ Step 4: Remove the base-pin socket from the rear of the CRT.

☐ Step 5: Disconnect connector J54 from the A8 CRT Driver board. Note the position of the multi-pin connector's index triangle to ensure that the connector can be correctly replaced.

☐ Step 6: Turn the oscilloscope on its right side. (The CRT will now be facing upwards.)

☐ Step 7: Remove the two Torx head screws from the bottom of the front panel bezel.

☐ Step 8: Turn the oscilloscope in the upright position.

☐ Step 9: Remove the two control knobs from the front of the front panel bezel. (Use an Allen wrench to loosen the knob setscrews.)

☐ Step 10: Lift up on the bottom of the front panel bezel, and swing the bezel outward.

Note: *The upper part of the front panel bezel is held by two tabs. These tabs fit into two slots inside the front casting.*

☐ Step 11: Disconnect connector J73 from the A10 Front Panel Control board. The wire cable from J73 on the A10 Front Panel Control board may not be present. If the wire cable is present, carefully remove it through the slot pro-

vided in the front casting. Note the position of the multi-pin connector's index triangle to ensure that the connector can be correctly replaced.

☐ Step 12: Remove the front panel bezel.

- Remove the wire connector from the quick-disconnect contact in the upper right corner of the front casting. (This wire connector is the static discharge/grounding cable.) Move the cable aside.

CAUTION

Be careful not to damage the interconnecting cable to J73, if it is still connected.

To protect the front panel from being scratched or marred, cover the front of the bezel with some protective material.

☐ Step 13: Remove the four Torx head screws and washers from the corner prongs of the band fastened to the faceplate.

☐ Step 14: Hold one hand on the faceplate. Gently push forward on the CRT base with the other hand. Slowly remove the CRT from the front of the oscilloscope.

Replace the CRT as follows:

☐ Step 1: Replace connector J54 on the A8 CRT Driver board. Note the position of the multi-pin connector's index triangle to ensure that the connector can be correctly replaced. Replace the wire connector to the quick-disconnect contact on the front casting.

☐ Step 2: Insert the CRT into the front casting with the anode opening towards the top. The CRT fits in downward and is pushed toward the left side. Align the corner prongs of the faceplate band around the four screw holes near the faceplate corners. Replace the four Torx head screws and washers, and tighten securely.

☐ Step 3: Clean the CRT faceplate with a soft, lint-free, cloth dampened with denatured alcohol. Be careful not to scratch the glass.

Note: *If connector J73 was disconnected when the front panel bezel was removed, then reconnect it. Route the connector and cable through the slot in the front casting. Match the index triangles of the connector and its holder on the A10 Front Panel Control board. Reattach the connector, and push any cable slack toward the center of the chassis.*

Replace the cable connector to the contact on the upper front of the front casting.

☐ Step 4: Replace the front panel bezel. Insert the two tabs at the top of the bezel into the slots inside the front casting; above the upper edge of the faceplate. At the same time, center the two holes (near the bottom right) of the bezel around the shafts for each control knob. Push the bottom of the bezel backwards until it fits flush against the casting and in the side grooves of the casting. Be careful not to pinch the interconnecting cable while replacing the front panel bezel.

☐ Step 5: Reconnect the two control knobs to their respective shafts. Tighten their setscrews securely.

☐ Step 6: Turn the oscilloscope on its right side (the CRT will now be facing upwards). Replace the two Torx head screws in the bezel and tighten securely.

☐ Step 7: Turn the oscilloscope in the upright position.

☐ Step 8: Remove the protective cap from the CRT base pins.

☐ Step 9: Install the CRT base-pin socket. Align the keyway of the socket with the gap between the pins on the base. Push the socket over the CRT pins until it is seated.

☐ Step 10: Install the anode lead in the hole near the top of the CRT. Inside the rubber cap is a spring clip. Put one side of the clip into the CRT hole, then push the other side in the hole. Lightly tug on the cap to check that the clip is connected.

☐ Step 11: Replace the CRT shield. Insert the two tabs, on the shield's inner edge, into their respective slots in the chassis. (These slots are underneath the A7 Display Controller board.)

Slide the outer edge of the shield behind the handle and inside the chassis. Align the countersunk holes with the threaded openings on the inside of the shield.

☐ Step 12: Replace the two Torx head screws, and tighten the screws securely.

Note: *If the CRT is replaced, then the oscilloscope will have to be readjusted.*

Fan Motor Removal/ Replacement

See Figure 3-3 for 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 determining the positioning of the motor. Remove the four screws securing the housing to the rear of the oscilloscope mainframe. Hold 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 positioning, or the fan wires may not reach.*

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

- use the mark from Step 1 to determine the original positioning of the motor
- tighten the screws securely
- remove the mark from the top of the housing
- check 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 3-3, 3-4, and 3-31 for 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: Remove the wire connectors from the A2A2 Control Rectifier board. Note the position of the multi-pin connector's index triangles on each connector to ensure correct replacement.

☐ 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 in the reverse order.

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.

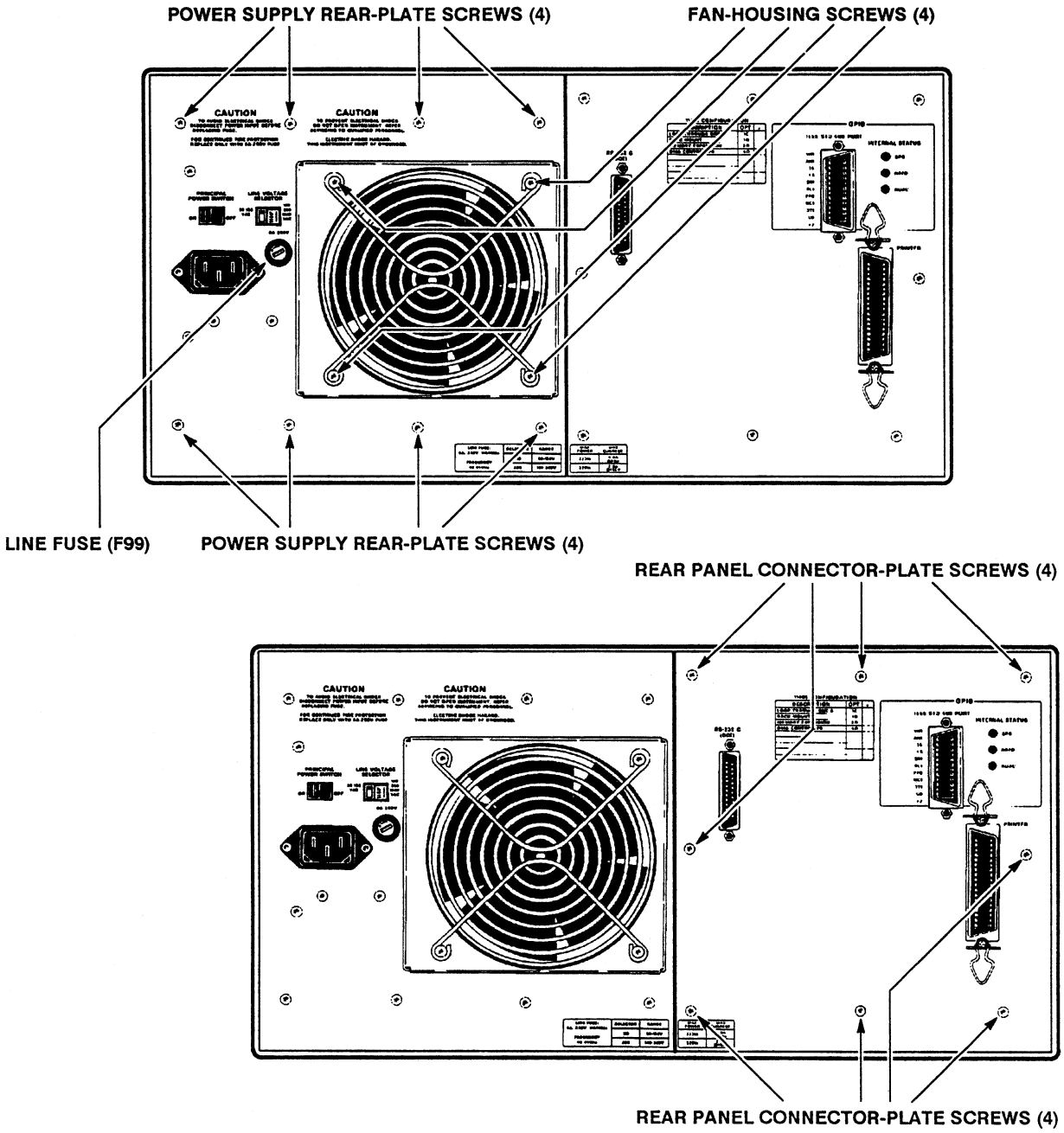


Figure 3-3 *— Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector-Plate*

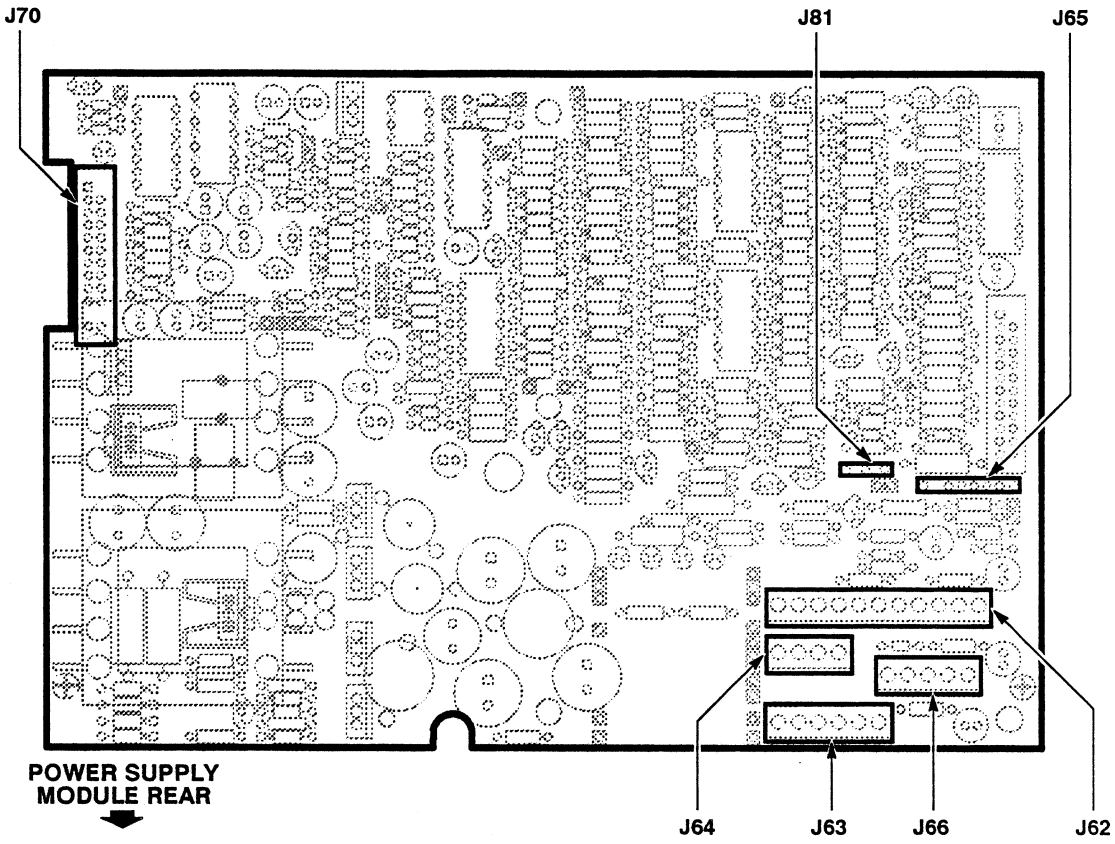


Figure 3-4 *— A2A2 Control Rectifier Board Connector Locations*

Signal Input Module Removal/Replacement

See Figure 3-5 for screw locations.

Remove and replace the Signal Input module as follows:

☐ Step 1: Remove the front trim cover from the right side of the oscilloscope (as viewed from the front of the oscilloscope).

CAUTION

Do not lift the trim covers to remove them; doing so will break the trim covers. There is a clip on the inside of the trim cover which slides over the end of the side frame section. To remove the trim covers properly, and prevent breakage of these covers, move each cover towards the end of the oscilloscope. (The front cover moves forward and the rear cover moves backward.) Move the clip about 1/8-inch to release the cover, and then, remove the cover from the oscilloscope.

☐ Step 2: Remove the two Torx head screws that secure the Signal Input module in place.

☐ Step 3: From behind the front sub-panel casting, carefully push the Signal Input module's front subpanel away from the oscilloscope. When the Signal Input module disconnects from the A1 Plug-in Interface board, grasp the Signal Input module front panel, and then slowly pull the module out of the oscilloscope.

To replace the Signal Input module, perform the previous steps in the reverse order.

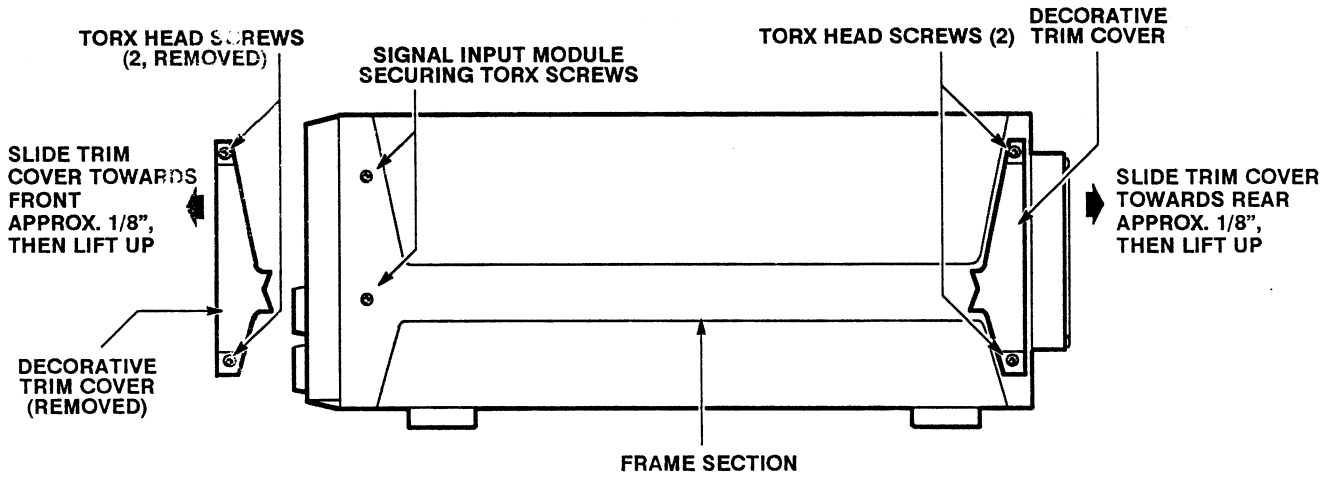


Figure 3-5 *— Removing and Replacing the Decorative Trim Covers*

FRU Board Assembly Removal

Pin connectors are used for electrical interconnection with chassis mounted components and other boards. Most boards/assemblies in the oscilloscope are mounted on the chassis. The following five boards plug on to the top of the A13 Mother board (see Fig. 3-6 for the location of these boards in the card cage):

- A14 Input/Output (I/O)
- A15 Memory Management Unit (MMU)
- A16 Waveform Compressor
- A17 Main Processor
- A18 Memory

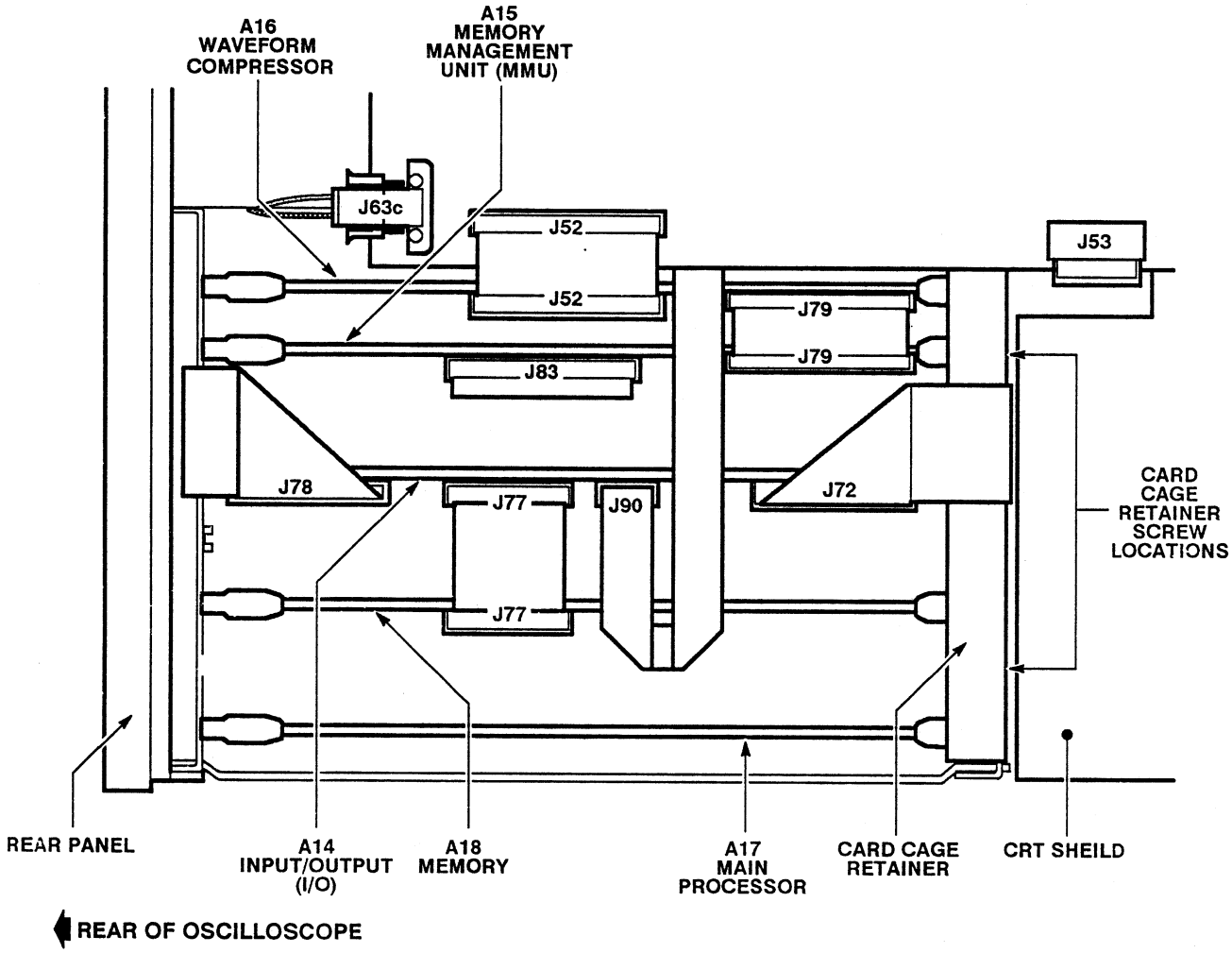


***Figure 3-6** — Top View of the Card Cage*

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

The following five boards are mounted within the Signal Input module (see Fig. 3-1 for the locations of these boards in the Signal Input module):

- A20A1 and A21A1 Main boards
- A20A2 and A21A2 Front Panel boards
- A22 External Trigger 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 3-3, 3-4, 3-5, 3-7, 3-8, 3-9, 3-10, 3-12, 3-18 and 3-31 for connector, screw, and index locations.

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

☐ Step 1: Remove the Signal Input module.

☐ Step 2: Remove the nine Torx head screws that fasten the three interface connector receptacles to the chassis.

☐ Step 3: Remove all the connectors from the A7 Display Controller board. Note the position of the multi-pin connector's index triangles to ensure that the connectors can be correctly replaced. Remove the six Torx head screws that fasten the board to the chassis. Remove the A7 Display Controller board.

☐ Step 4: Remove the Power Supply module.

☐ Step 5: Remove the connectors from the A2A2 Control Rectifier board, except for J70 and J81.

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 6: Disconnect connectors J57 and J60 from the A4 Regulator board. Remove the two Torx head screws from the metal heatsink at the rear of this 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 7: 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 8: Remove the A4 Regulator board.

☐ Step 9: Disconnect connector J90 from the A14 Input/Output board.

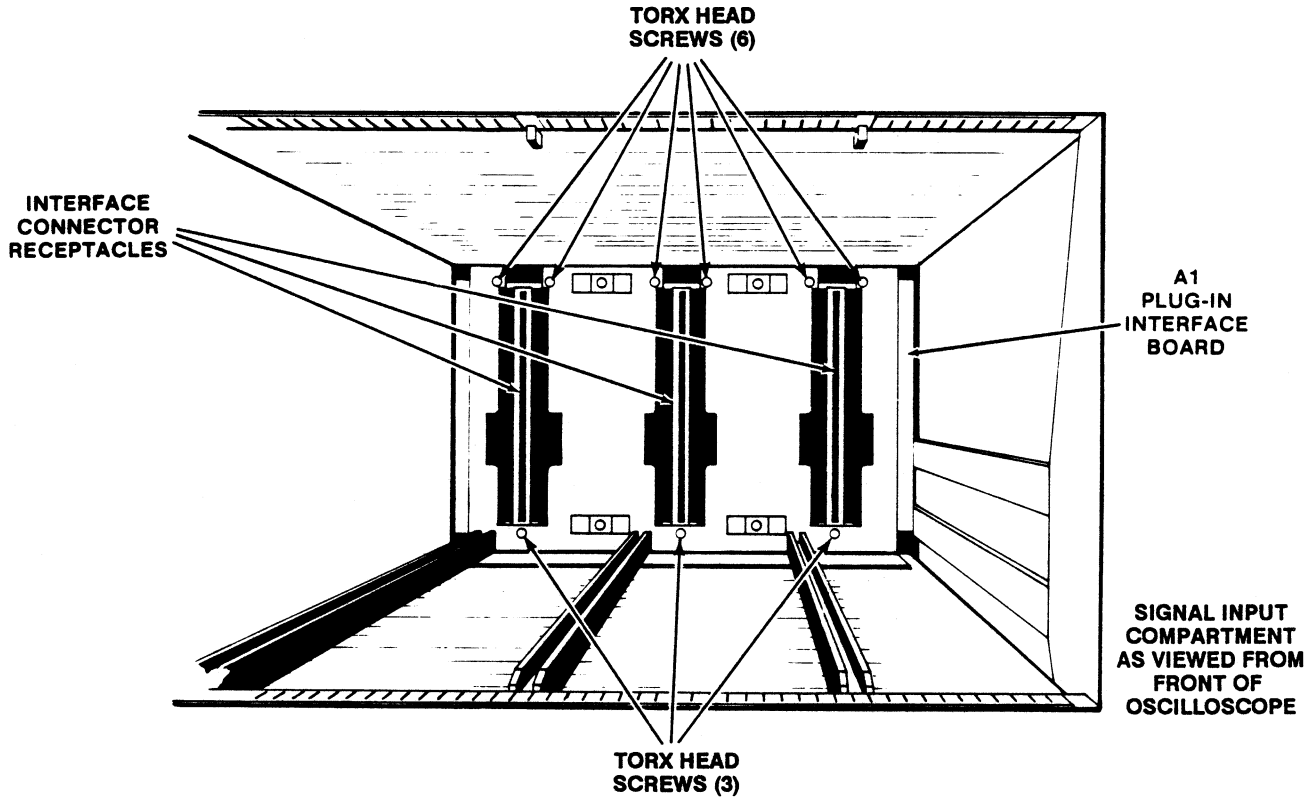


Figure 3-7 *— Signal Input Compartment Screw Locations*

☐ Step 10: Remove the A5 Acquisition board.

☐ Step 11: Disconnect connector J91B from the A6 Time Base board.

Note: *The A1 Plug-in Interface board is no longer attached to the oscilloscope. However, care must be taken when removing the board and attached wire assemblies.*

☐ Step 12: Position the oscilloscope so that the A1 Plug-in Interface board can be removed through the top of the mainframe chassis.

☐ Step 13: Remove the A1 Plug-in Interface board.

☐ Step 14: 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 in the reverse order. Match the index triangle on the pin connectors to the corresponding triangle on the circuit boards or connectors.

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

CAUTION *Check 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 when the A1 Plug-in Interface board is reinstalled in the oscilloscope. Then, tighten all nine Torx head screws into the connector receptacles.*

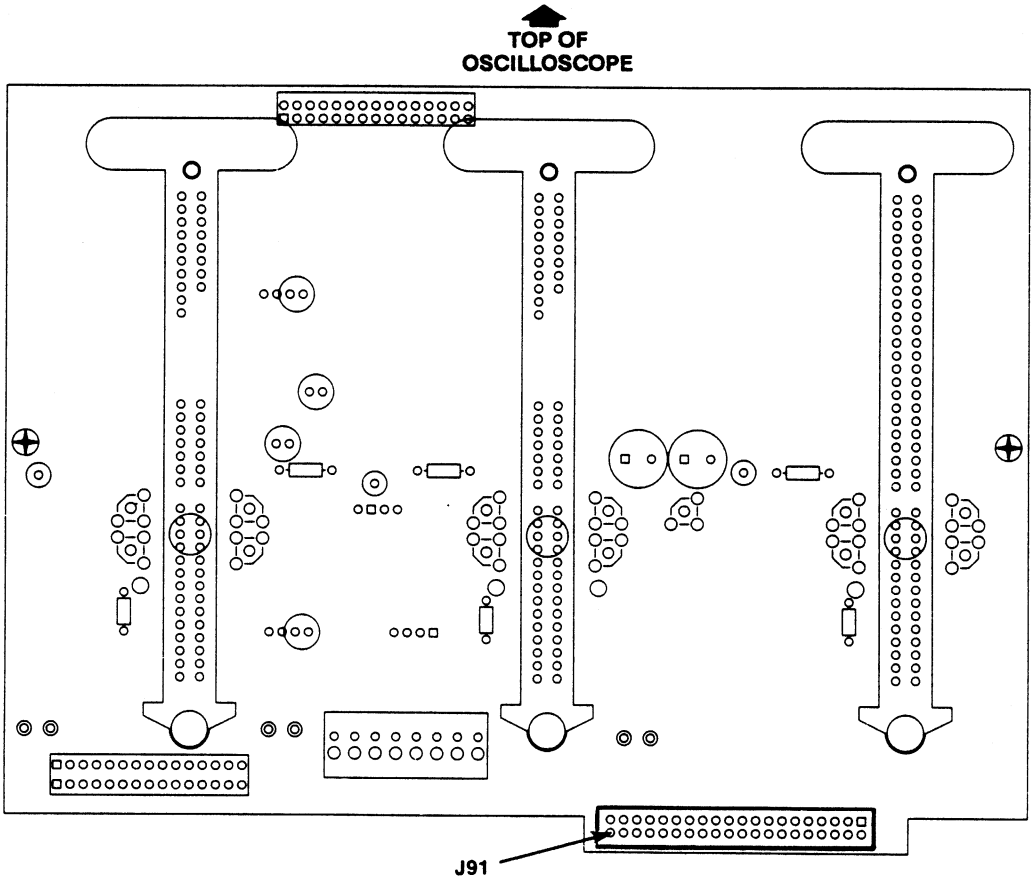


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Figure 3-8 *— Removing and Replacing the A1 Plug-in Interface Board*

A4 Regulator Board

See Figures 3-3, 3-4, 3-9 and 3-31 for 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 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 the connectors can be correctly replaced.

☐ 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 interconnecting 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 in the reverse order.

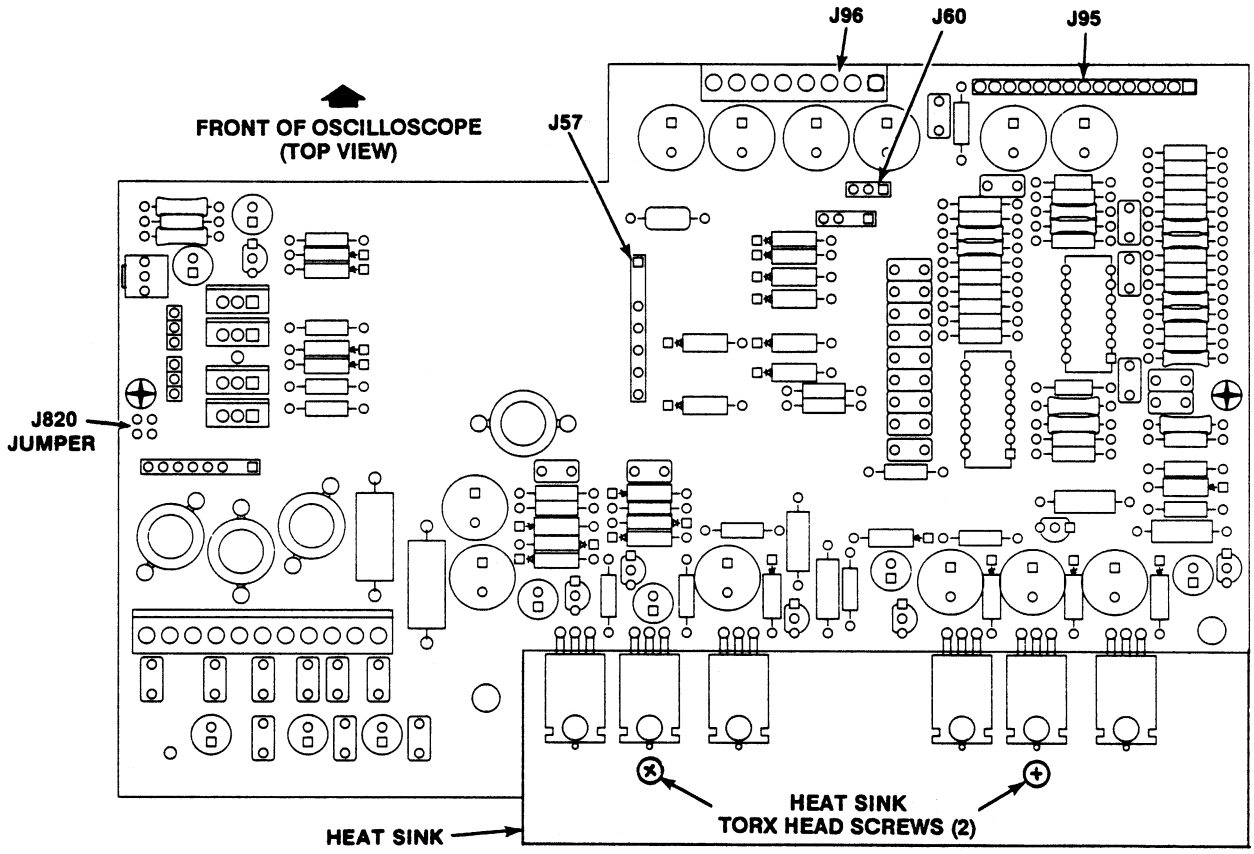

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Figure 3-9 *— Removing and Replacing the A4 Regulator Board*

A5 Acquisition Board

See Figures 3-10 and 3-31 for 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 six Torx head screws from the board.

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

☐ Step 4: Move the rear side of the board outward. Position the board so that its outside edge is approximately perpendicular to the bottom of the oscilloscope. Do not stress the wire bundles.

Note: *Observe the positions of the multi-pin connector's index triangles and the position of the receptacles to ensure that the connectors and receptacles can be correctly replaced.*

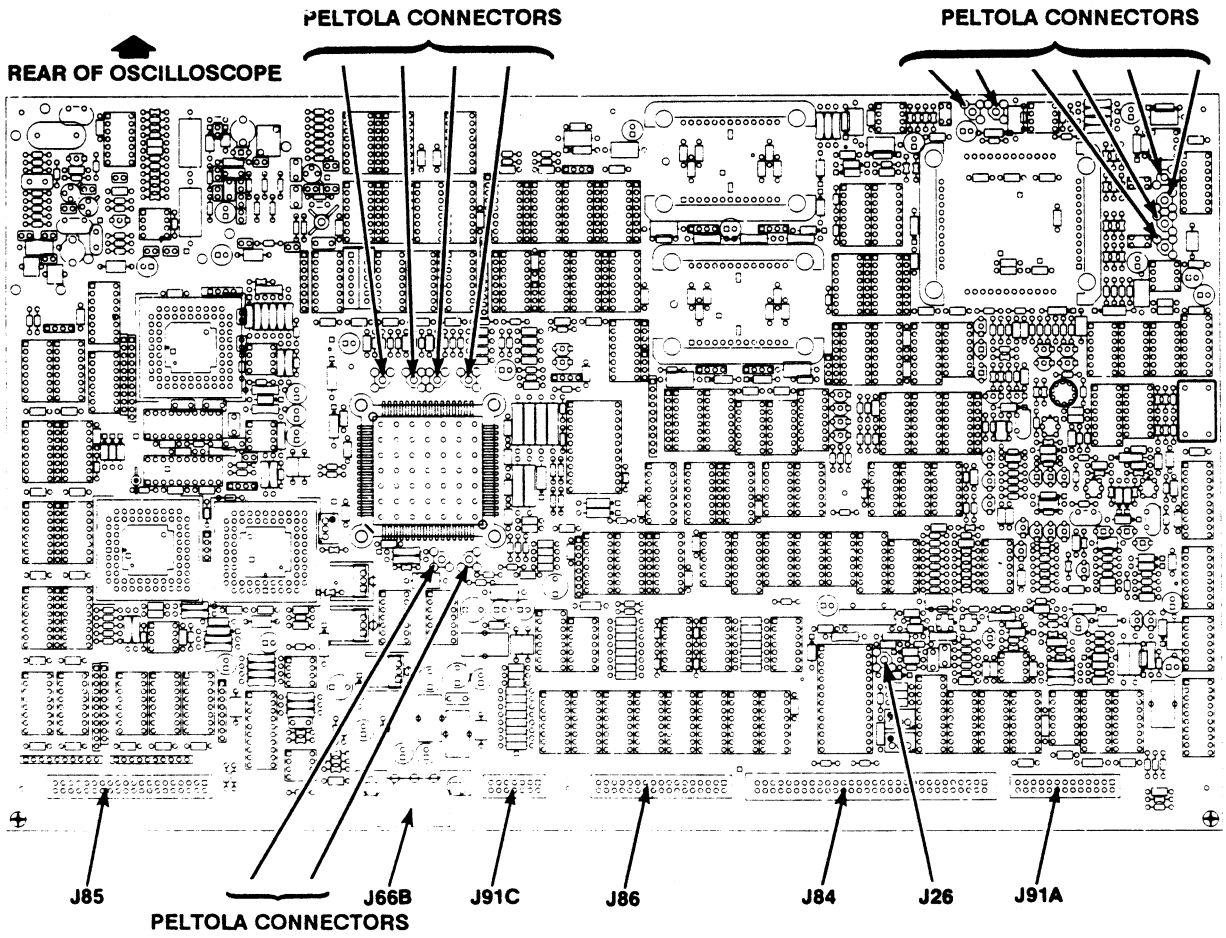


***Figure 3-10** — Removing and Replacing the A5 Acquisition Board*

☐ Step 5: Disconnect the Peltola connectors from the center and edges of the A5 Acquisition board.

☐ Step 6: Disconnect connectors J85, J66B, J91C, J86, J84, and J91A from along the inside edge of the A5 Acquisition board.

☐ Step 7: Remove the A5 Acquisition board.

To replace the A5 Acquisition board, perform the previous steps in the reverse order.

CAUTION

Do not pinch any interconnecting wires underneath the board. Arrange the wires away from the posts; which the Torx head screws will be fastened.

A6 Time Base Board

See Figures 3-10, 3-11 and 3-31 for 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 Torx head screws from the A5 Acquisition board. **Do not remove the board's connectors**.

☐ Step 3: Move the A5 Acquisition board, and then remove the A6 Time Base board.

☐ Step 4: Remove connectors J85, J66A, J83, J86, J84, and J91B.

Note: *Observe the position of the multi-pin connector's index triangles to ensure that these connectors can be correctly replaced.*

☐ Step 5: Remove the spacer post and five Torx head screws.

☐ Step 6: Remove the A6 Time Base board.

To replace the A6 Time Base board, perform the previous steps in the reverse order.

CAUTION

Do not pinch any interconnecting wires.

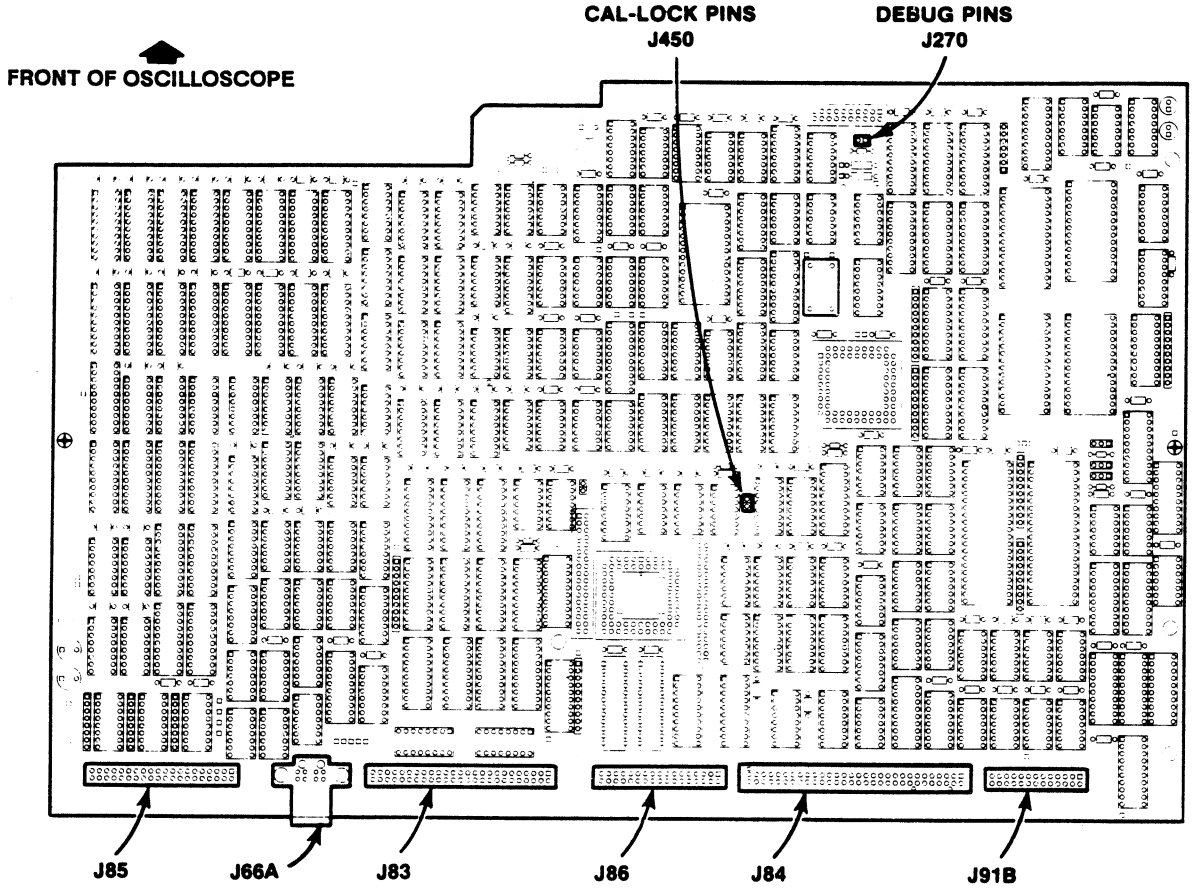


Figure 3-11 *— Removing and Replacing the A6 Time Base Board*

A7 Display Controller Board

See Figures 3-12 and 3-31 for connector, screw, and index locations.

Remove and replace the A7 Display Controller board as follows:

- ☐ Step 1: Remove connectors J52, J53, J57, and J63C from the A7 Display Controller board. Note the position of the multi-pin connector's index triangles on each connector to ensure that the connectors can be correctly replaced.
- ☐ Step 2: Remove the six Torx head screws.
- ☐ Step 3: Lift the A7 Display Controller board toward the right side of the oscilloscope (as viewed from the front of the oscilloscope).
- ☐ Step 4: Remove the A7 Display Controller board.

Note: *The inside edge of the board is held in place by slots in the bottom edges of the board guides. (These guides secure the boards within the card cage compartment.) Use care when removing or replacing this board.*

To replace the A7 Display Controller board, perform the previous steps in the reverse order.

CAUTION *Observe the routing of wires underneath the A7 Display Controller board. Be careful not to pinch any interconnecting wires while replacing this board.*

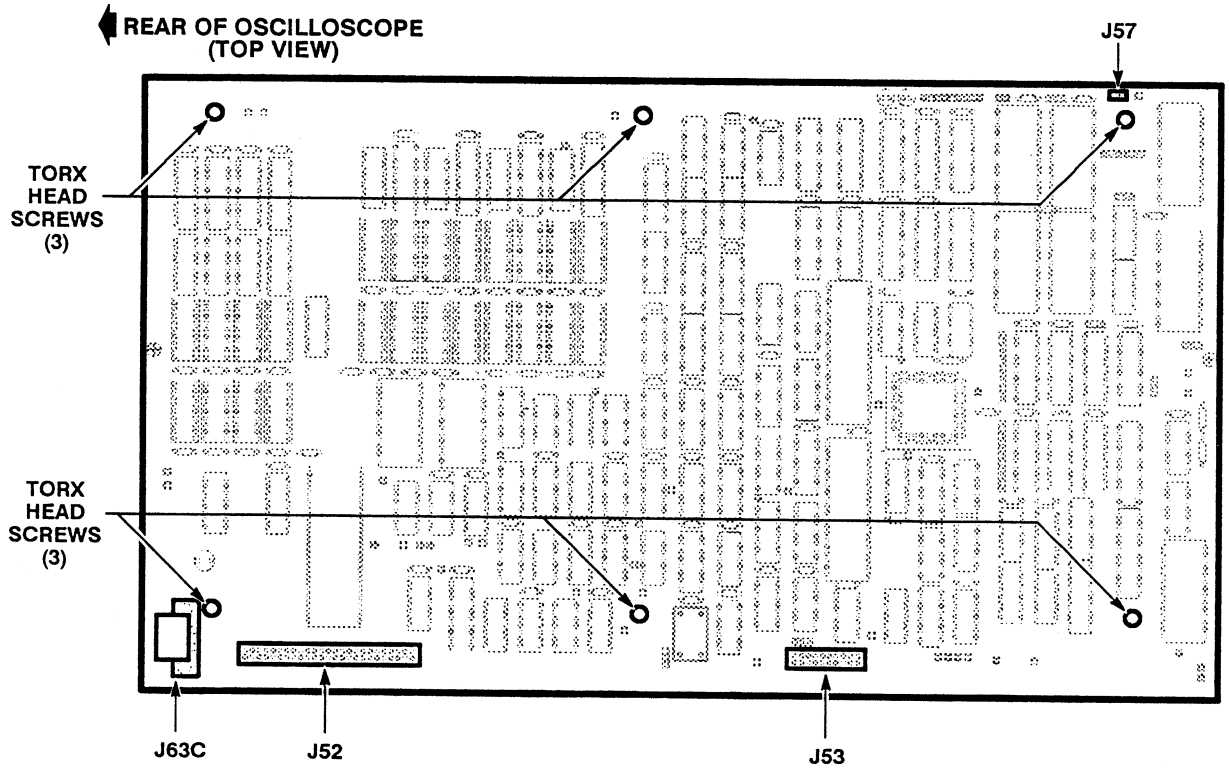


Figure 3-12 *— Removing and Replacing the A7 Display Controller Board*

Note: *Reinsert the inner edge of this board into the board guide slot. (Be certain the guides are seated correctly on top of the circuit boards in the card cage).*

A8 CRT Driver board

See Figures 3-2, 3-5, 3-13 and 3-31 for connector, screw, and index locations.

Remove and replace the A8 CRT Driver board as follows:

☐ Step 1: Remove the CRT shield.

☐ Step 2: Remove J53, J54, J56, and J57 connectors from the A8 CRT Driver board. Note the position of the multi-pin connectors' index triangles to ensure that the connectors can be correctly replaced.

☐ Step 3: Remove the Torx head screws from the (left side) front and rear decorative trim covers.

☐ Step 4: Remove the left side trim covers.

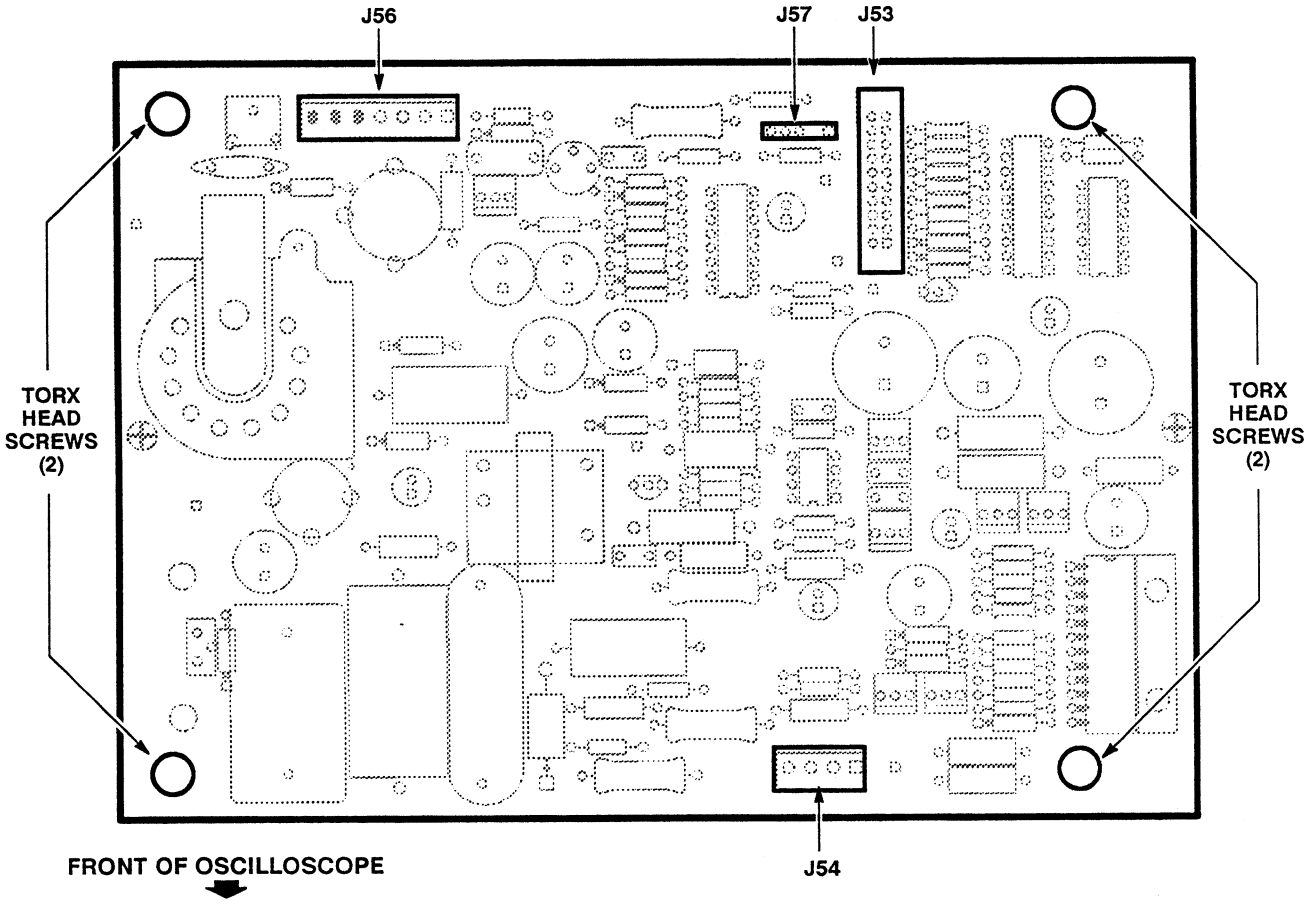


Figure 3-13 *— Removing and Replacing the A8 CRT Driver Board*

CAUTION

Do not lift the trim covers to remove them; doing so will break the trim covers. There is a clip on the inside of the trim cover which slides over the end of the side frame section. To remove the trim covers properly, and prevent breakage of these covers, move each cover towards the end of the oscilloscope. (The front cover moves forward and the rear cover moves backward.) Move the clip about 1/8-inch to release the cover, and then, remove the cover from the oscilloscope.

☐ Step 5: Remove the single Torx head screw from the center of the (left side) frame section.

☐ Step 6: Remove the screws from the ends of the frame section.

☐ Step 7: Remove the frame section.

☐ Step 8: Remove the Torx head screws from each corner of the A8 CRT Driver board.

☐ Step 9: Slide the A8 CRT Driver board under the neck of the CRT and then to the left side of the oscilloscope.

☐ Step 10: Remove the A8 CRT Driver board.

To replace the A8 CRT Driver board, perform the previous steps in the reverse order.

A9 Touch Panel Assembly

See Figures 3-2, 3-14 and 3-31 for connector, screw, and index locations.

Remove and replace the A9 Touch Panel assembly as follows:

☐ Step 1: Remove the front panel bezel. (Refer to the removal instructions under Cathode Ray Tube Removal/Replacement earlier in this section; beginning with Step 6 and proceeding through Step 12).

☐ Step 2: Disconnect connector J73 from the A10 Front Panel Control board. Note the position of multi-pin connector's index triangles to ensure that the connector can be correctly replaced. Carefully remove the wire cable through the slot provided in the front casting.

Protect the front of the bezel after the bezel is removed. And, since the plastic exterior may scratch, cover the exterior with protective material.

☐ Step 3: To replace the A9 Touch Panel Assembly board, route the J73 wire cable back through the slot in the chassis. Attach the connector to the board after checking that the multi-pin connectors' index triangles are oriented to the position noted in Step 2.

☐ Step 4: Replace the front panel bezel. (Refer to the replacement instructions under Cathode Ray Tube Removal/Replacement earlier in this section; begin with Step 4 and proceed through Step 7.)

Note: *Push any slack cable, from connector J73, inside the chassis (near the A10 Front Panel Control board). Be careful not to pinch the interconnecting cable while replacing the front panel bezel.*

A10 Front Panel Control Board

See Figures 3-2, 3-12, 3-14 and 3-31 for connector, screw, and index locations.

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

- ☐ Step 1: Remove the CRT shield. (Refer to the removal instructions under Cathode Ray Tube Removal/Replacement earlier in this section; following Steps 1 and 2.)
- ☐ Step 2: Remove connector J53 from the A7 Display Controller board.
- ☐ Step 3: Remove connectors J72, J73, J74 and J75 from the A10 Front Panel Button board. Note the position of the multi-pin connector's index triangles to ensure that the connectors can be correctly replaced.
- ☐ Step 4: Remove the two Torx head screws at the upper edge of the board.
- ☐ Step 5: Lift the board away from the board guides at the bottom
- ☐ Step 6: Remove the A10 Front Panel Control board.

To replace the A10 Front Panel Control board, perform the previous steps in the reverse order.

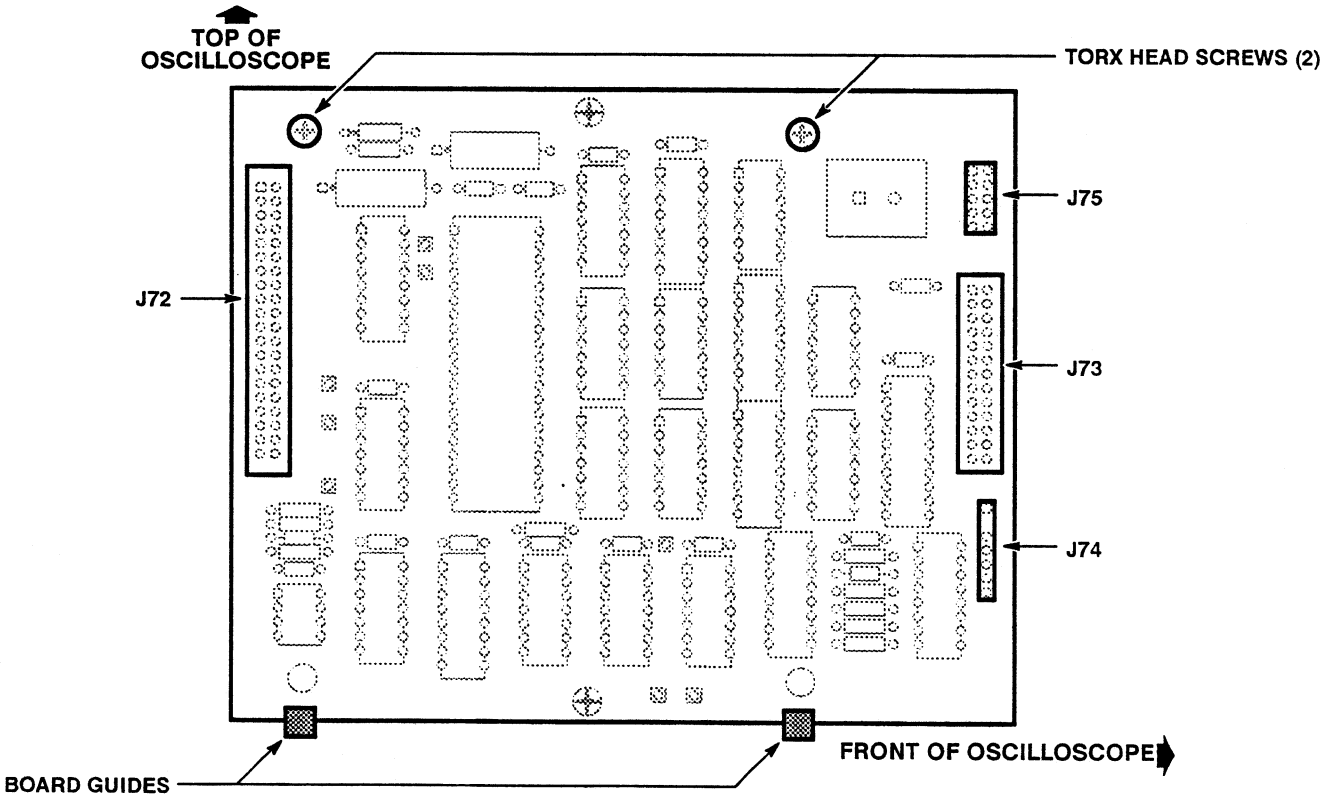


Figure 3-14 *— Removing and Replacing the A10 Front Panel Control Board*

A11 Front Panel Button Board

See Figures 3-2, 3-12, 3-14, 3-15 and 3-31 for connector and screw locations.

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

☐ Step 1: Remove the A7 Display Controller board.

☐ Step 2: Remove the CRT shield. (Refer to the removal instructions under Cathode Ray Tube Removal/Replacement earlier in this section; following Steps 1 and 2.)

☐ Step 3: Remove connector J75 from the A10 Front Panel Control board. Note the position of the multi-pin connector's index triangles to ensure that the connector can be correctly replaced.

☐ Step 4: 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 5: Remove the A11 Front Panel Button board.

To replace the A11 Front Panel Button board, perform the previous steps in the reverse order.

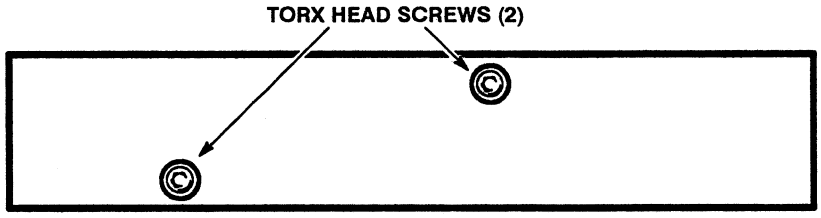


Figure 3-15 *— Removing and Replacing the A11 Front Panel Button Board*

A12 Rear Panel Assembly

See Figures 3-3, 3-16 and 3-31 for connector and screw locations.

Remove and replace the A12 Rear Panel assembly as follows:

☐ Step 1: Remove the connectors from the RS-232-C, the GPIB, and the PRINTER connector holders.

☐ Step 2: Remove the eight Torx head screws from the outer edges of the rear panel connector-plate.

☐ Step 3: Tilt the plate away from the oscilloscope. Remove connector J78 from the top of the A12 Rear Panel assembly. Note the position of the connector's index triangles to ensure that the connectors can be correctly replaced.

☐ Step 4: Remove the rear panel connector-plate and the attached A12 Rear Panel Assembly.

☐ Step 5: 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 lower left, if present)

☐ Step 6: 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 fall off.*

To replace the A12 Rear Panel assembly, perform the previous steps in the reverse order.

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.*

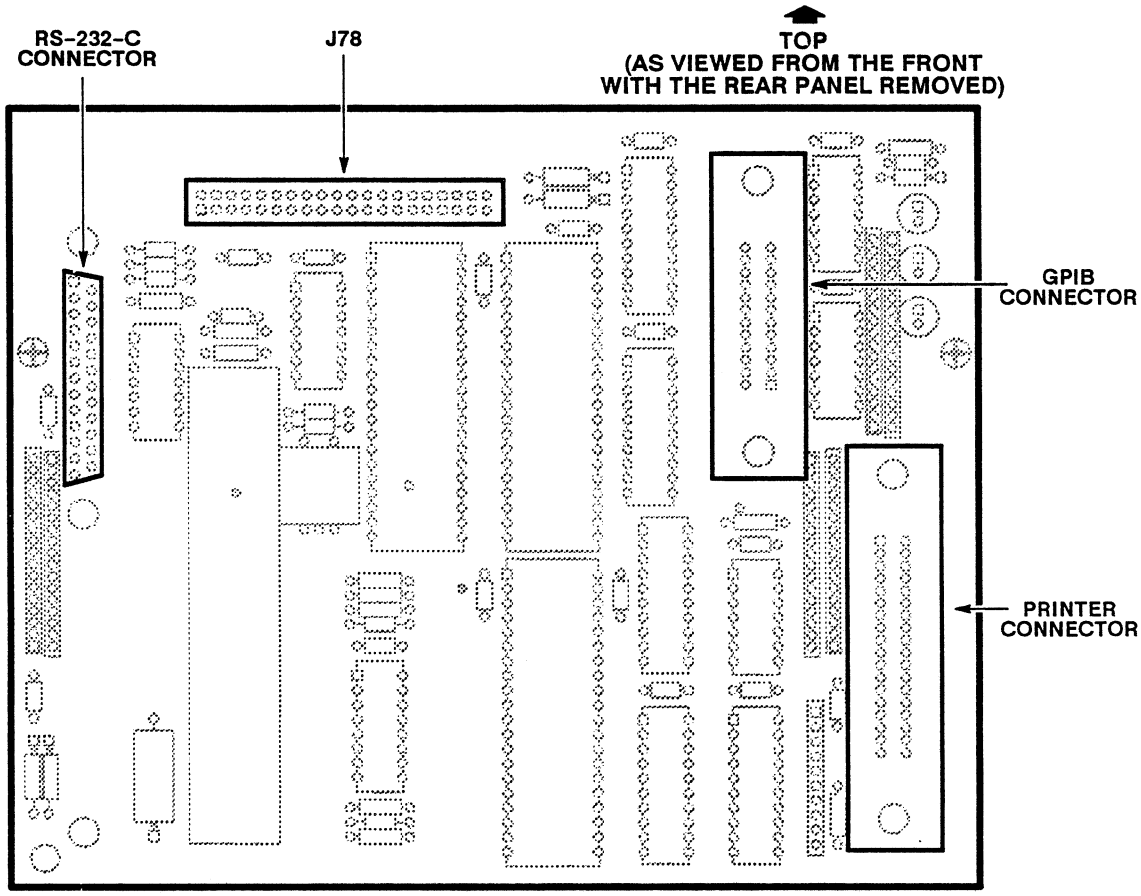


Figure 3-16 *— Removing and Replacing the A12 Rear Panel Assembly*

A13 Mother Board

See Figures 3-6, 3-17, 3-18, 3-19, 3-20, 3-21, 3-22 and 3-31 for connector, screw, and index locations.

Remove and replace the A13 Mother board as follows:

☐ Step 1: Remove the card cage's two screws to remove the card cage retainer from the top front of the card cage. Remove both 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 the A7 Display Controller board. Both ends of the guides can be pried loose for removal.

☐ Step 2: Remove the A14 I/O, A15 MMU, A16 Compressor, 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 as well.*

☐ Step 3: Remove connector J63A from the A13 Mother board.

☐ Step 4: Remove the six Torx head screws.

☐ Step 5: Remove the A13 Mother board.

To replace the A13 Mother board, perform the previous steps in the reverse order.

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

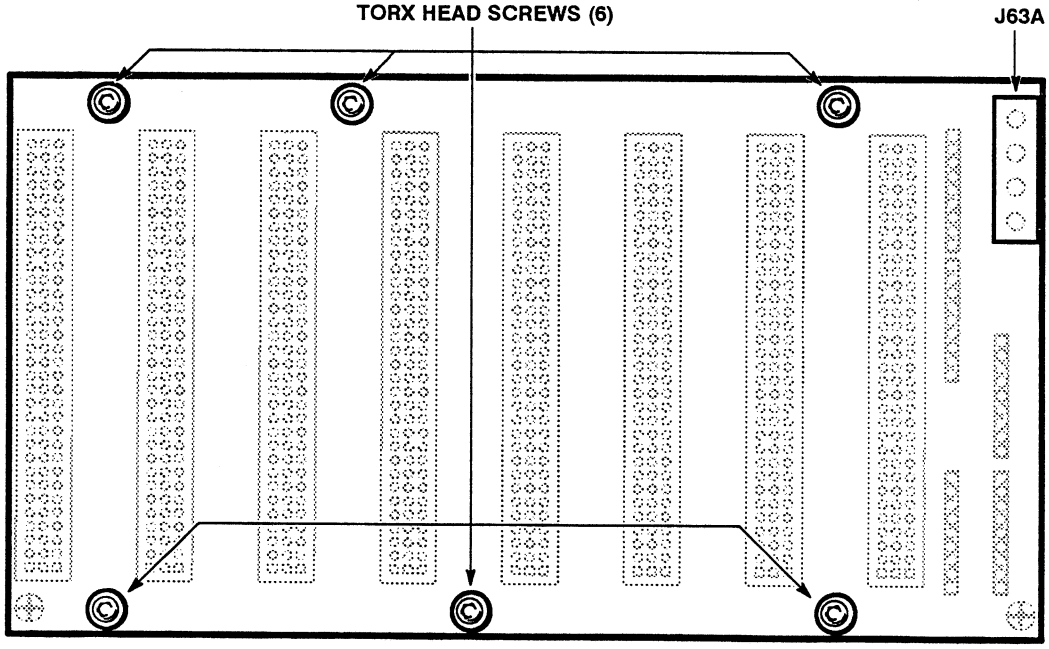


Figure 3-17 *— Removing and Replacing the A13 Mother Board*

A14 Input/Output (I/O) Board

See Figures 3-6, 3-18 and 3-31 for connector, screw, and index locations.

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

☐ Step 1: Remove the card cage's two screws to remove the card cage retainer from the top front of the card cage. Remove both 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 the A7 Display Controller board. Both ends of the guides can be pried loose for removal.

☐ Step 2: Remove connectors J72, J77, J78, and J90 from the A14 I/O board. Note the position of multi-pin connector's triangles to ensure that the connectors can be correctly replaced.

☐ Step 3: 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 4: Remove the A14 I/O board.

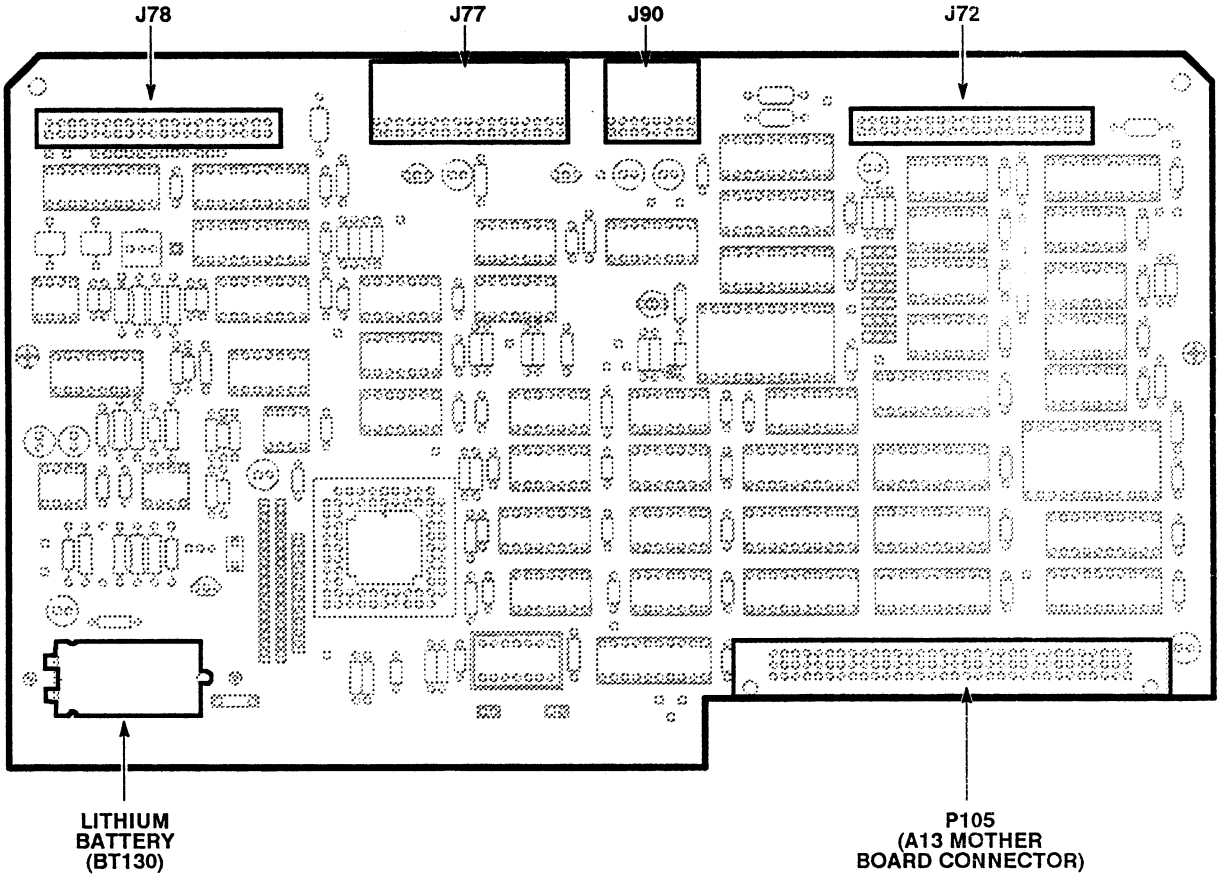


Figure 3-18 *— Removing and Replacing the A14 I/O Board*

To replace the A14 I/O 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.*

Check 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. (Plastic standoffs are used to prevent shorts.)*

A15 Memory Manager Unit (MMU) Board

See Figures 3-6, 3-18, 3-19 and 3-31 for connector, screw, and index locations.

Remove and replace the A15 MMU board as follows:

- ☐ Step 1: Remove the card cages two screws to remove the card cage retainer from the top front of the card cage. Remove both 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 the A7 Display Controller board. Both ends of the guides can be pried loose for removal.
- ☐ Step 2: Remove connectors J79 and J83 from the A15 MMU board. Note the position of the multi-pin connector's index triangles to ensure that the connectors can be correct replaced.
- ☐ Step 3: Remove J90 from the A14 I/O board.
- ☐ Step 4: 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 5: Remove the A15 MMU board.

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.*

Check 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.

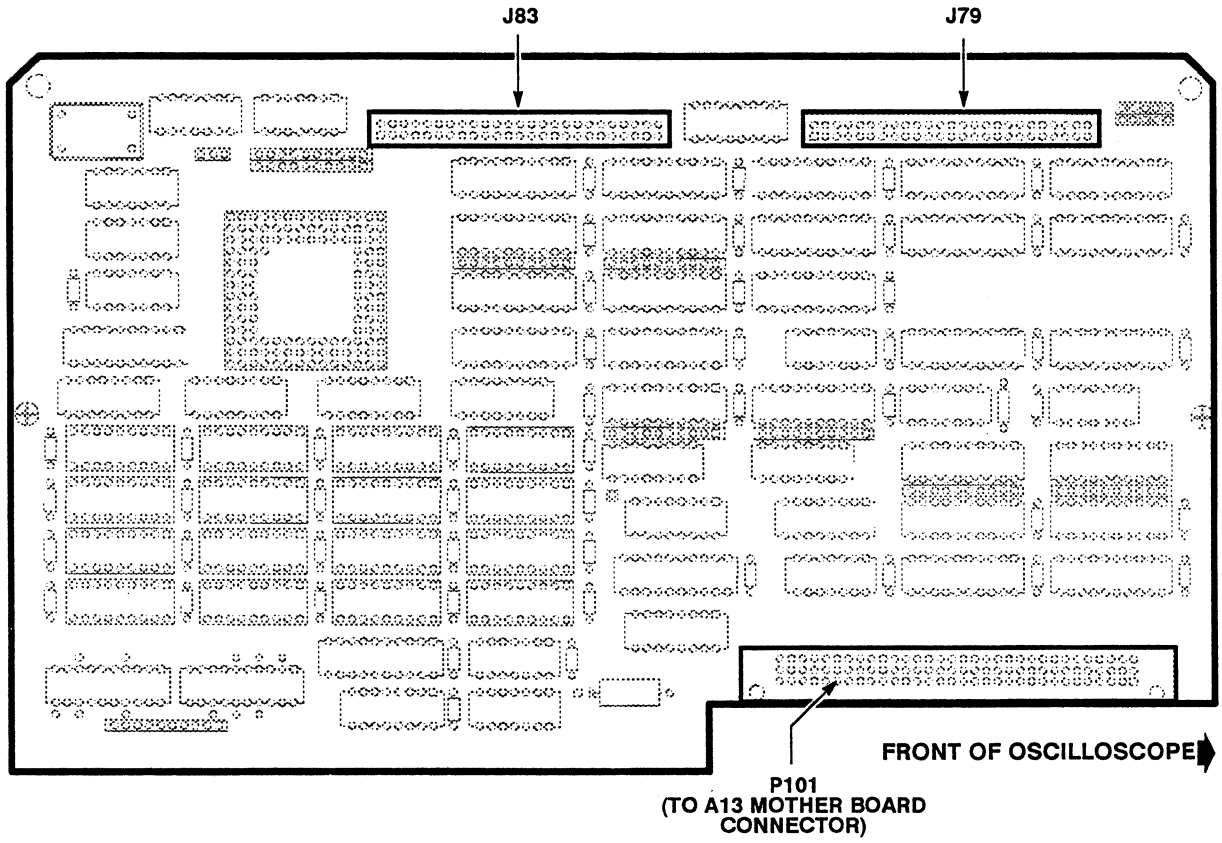


Figure 3-19 *— Removing and Replacing the A15 MMU Board*

A16 Waveform Compressor Board

See Figures 3-6, 3-18, 3-20 and 3-31 for connector, screw, and index locations.

Remove and replace the A16 Waveform Compressor board as follows:

- ☐ Step 1: Remove the card cage's two screws to remove the card cage retainer from the top front of the card cage. Remove both board guides from the top of the card cage. The guides are retained by two small catches located in two holes of the left bracket of the card cage. The other ends of the guides contain slots which attach to the edge of the A7 Display Controller board. Both ends of the guides can be pried loose for removal.
- ☐ Step 2: Remove connectors J52 and J79 from the A16 Waveform Compressor board. Note the position of the multi-pin connector's index triangles to ensure that the connector can be correctly replaced.
- ☐ Step 3: Remove J90 from the A14 I/O board.
- ☐ Step 4: Lift the white, hinged tabs at the front and rear edges of the board. Pull the tabs upward until the A16 Waveform Compressor board separates from the A13 Mother board.
- ☐ Step 5: Remove the A16 Waveform Compressor board.

To replace the A16 Waveform Compressor 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.*

Check that connector P100 is seated onto the A13 Mother board connector. Push down firmly on the A16 Waveform Compressor board to connect this connector to the A13 Mother board.

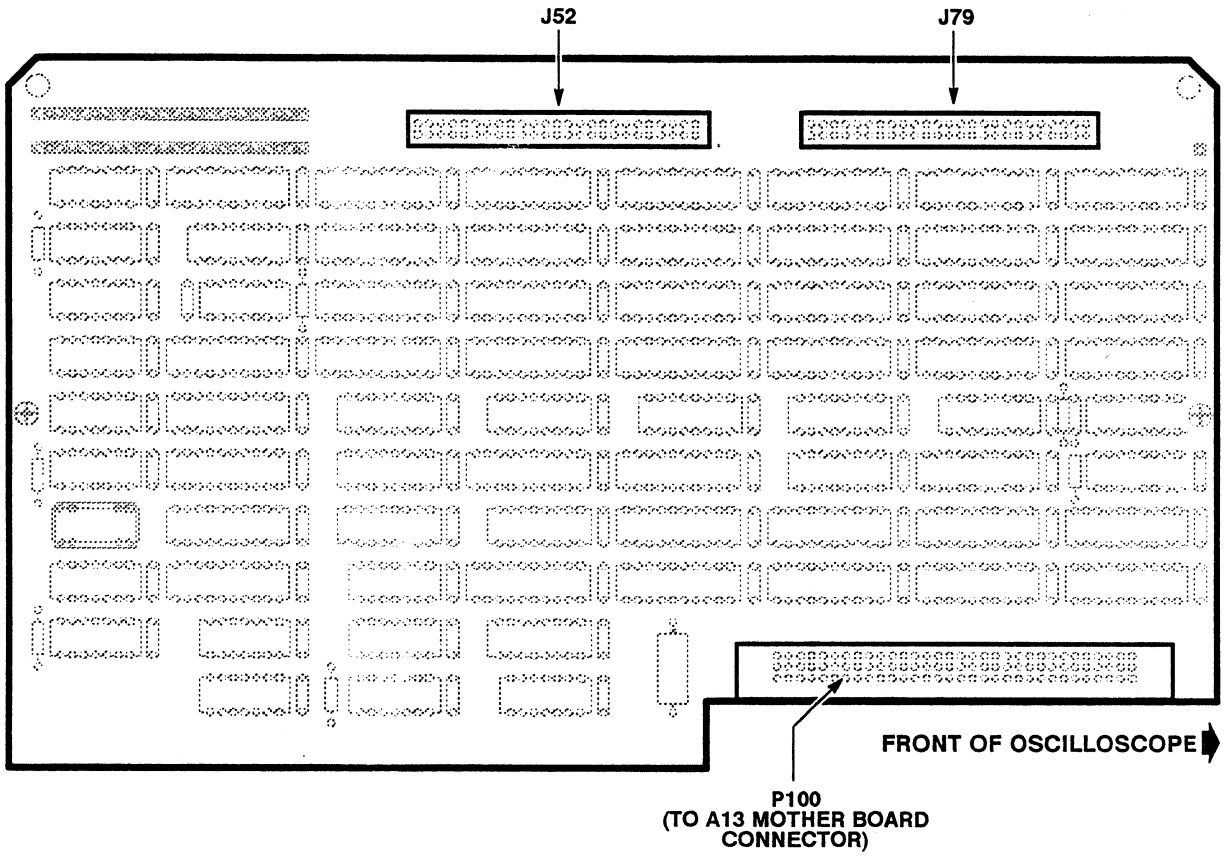


Figure 3-20 *— Removing and Replacing the A16 Waveform Compressor Board*

A17 Main Processor Board

See Figures 3-6, 3-21 and 3-31 for connector, screw, and index locations.

Remove and replace the A17 Main Processor board as follows:

☐ Step 1: Remove the card cage's two screws to remove the card cage retainer from the top front of the card cage. Remove both 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 the A7 Display Controller board. Both ends of the guides can be pried loose for removal.

☐ Step 2: Remove connector J77 from the A17 Main Processor board. Note the position of the multi-pin connector's index triangle to ensure that the connector can be correctly replaced.

☐ Step 3: Lift the white, hinged tabs at the front and rear edges of the board. Pull the tabs upward until the A17 Main Processor board separates from the A13 Mother board.

☐ Step 4: Remove the A17 Main Processor board.

To replace the A17 Main Processor 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.*

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

WARNING

A lithium battery (BT160) is mounted on the A17 Main Processor 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 A17 Main Processor board on metal surfaces. If some IC or battery leads are shorted, the battery may discharge or overheat and vent. (Plastic standoffs are to prevent shorts.)*

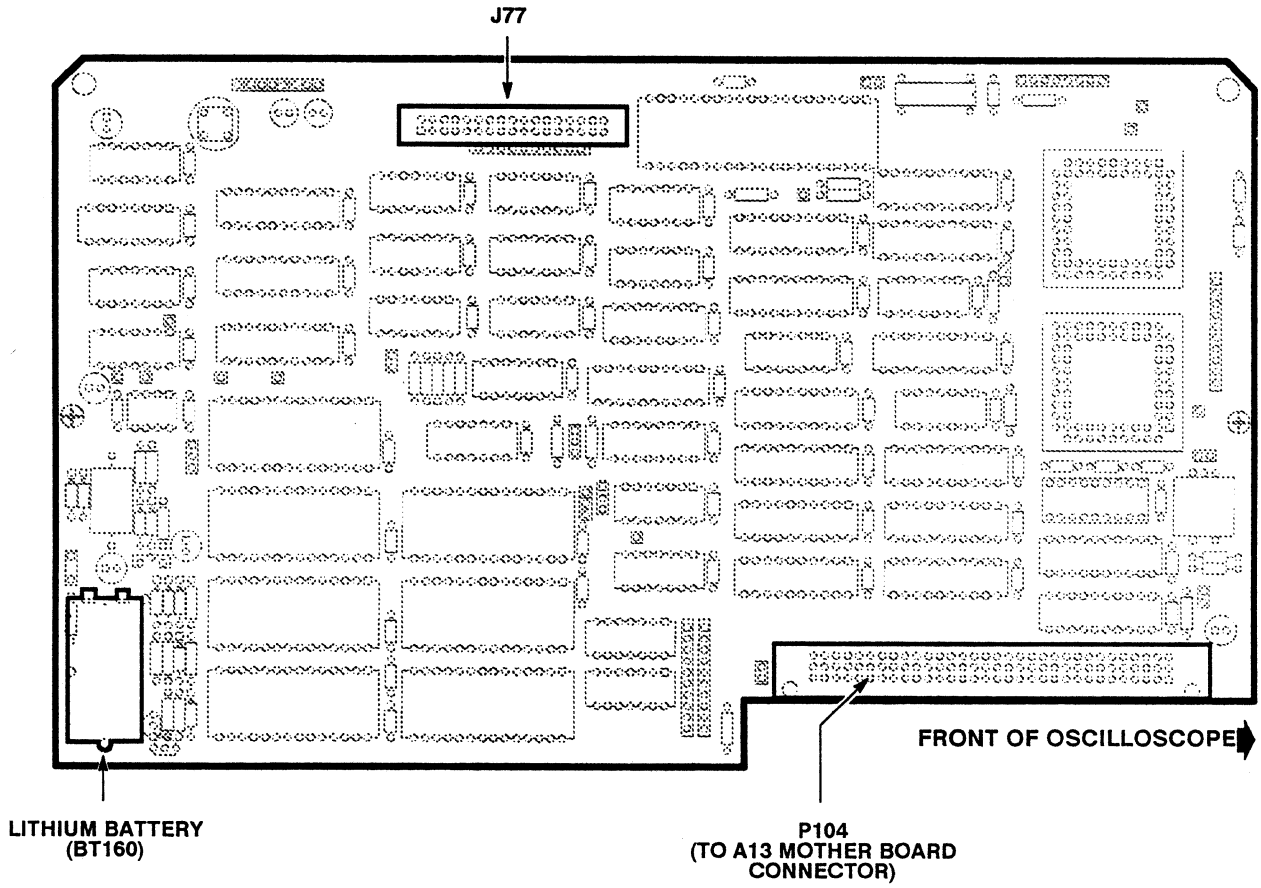


Figure 3-21 *— Removing and Replacing the A17 Main Processor Board*

A18 Memory Board

See Figures 3-6 and 3-22 for connector and screw locations.

Remove and replace the A18 Memory board as follows:

☐ Step 1: Remove the card cage's two screws to remove the card cage retainer from the top front of the card cage. Remove both 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 the A7 Display Controller board. Both ends of the guides can be pried loose for removal.

☐ Step 2: 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 3: Remove the A18 Memory board.

To replace the A18 Memory board, perform the previous steps in the reverse order.

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

Check 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.

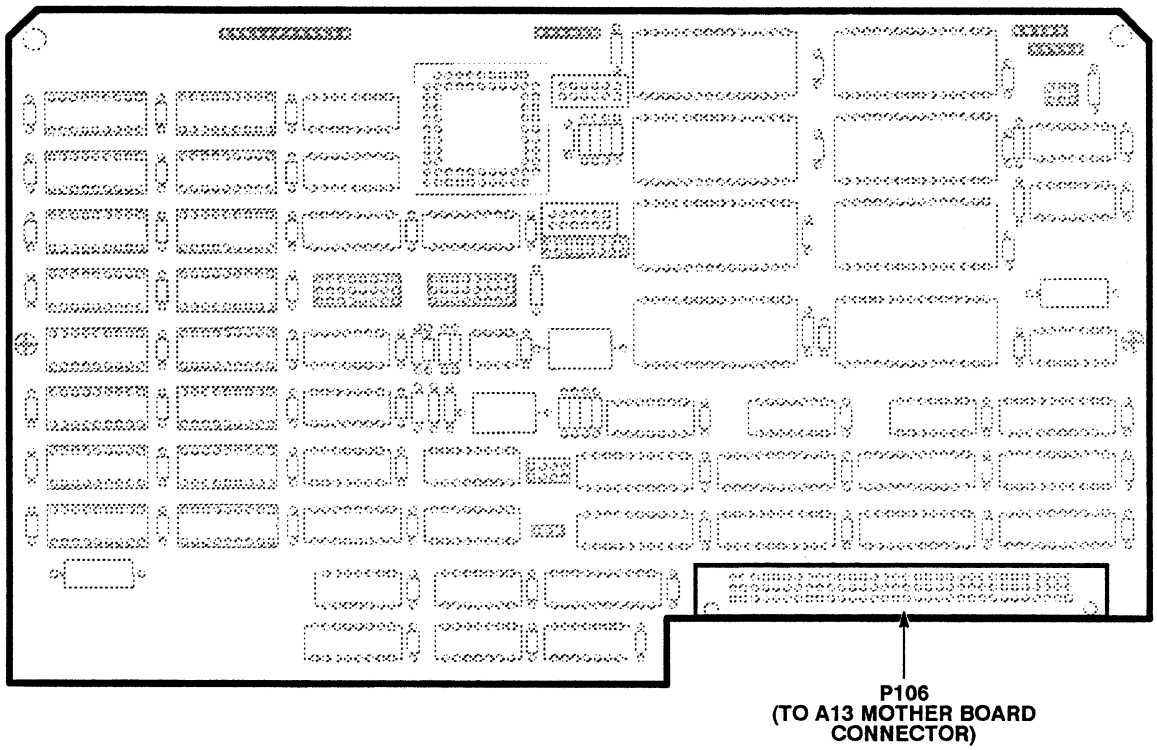


Figure 3-22 *— Removing and Replacing the A18 Memory Board*

A20A1 Main Board

See Figures 3-5, 3-23, 3-24, 3-26 and 3-31 for connector, screw, and index locations.

Remove the A20A1 Main board as follows:

- ☐ Step 1: Remove the Signal Input module.
- ☐ Step 2: Remove the four, 1/4-inch nuts holding the Signal Input module front panel in place.
- ☐ Step 3: Remove the Signal Input module front panel.
- ☐ Step 4: Remove the eight Torx head screws that fasten the L1 and L2 attenuators (four screws per attenuator) to the front subpanel of the Signal Input module.
- ☐ Step 5: Disconnect the multi-pin connector that connects from the A20A2 Front Panel board to the A20A1 Main board. Note the position of the multi-pin connector's index triangle to ensure that the connector can be correctly replaced.
- ☐ Step 6: Remove the four Torx head screws that fasten the left frame to the front subpanel.
- ☐ Step 7: Remove the left frame from the Signal Input module.
- ☐ Step 8: Unplug the cables that connect the attenuators to the receptacles on the A20A1 Main board.
- ☐ Step 9: Remove the four Torx head screws from the component side of the A20A1 Main board (that hold the attenuator in place) to remove the two attenuators from the A20A1 Main boards.
- ☐ Step 10: Remove the metal-on-elastomer (MOE) strips and holder.
- ☐ Step 11: Remove the two Torx head screws that fasten the heat sink to the A20A1 Main board.
- ☐ Step 12: Remove the five nut blocks that secure the A20A1 Main board to the left frame. (Use a screwdriver with a narrow shaft since the screws have only a slight offset from the top and bottom of the frame.)
- ☐ Step 13: Remove the four screws that fasten the plastic rear panel to the frame.
- ☐ Step 14: Remove the A20A1 Main board and attached rear panel from the left frame.
- ☐ Step 15: Remove the rear panel from the A20A1 Main boards.

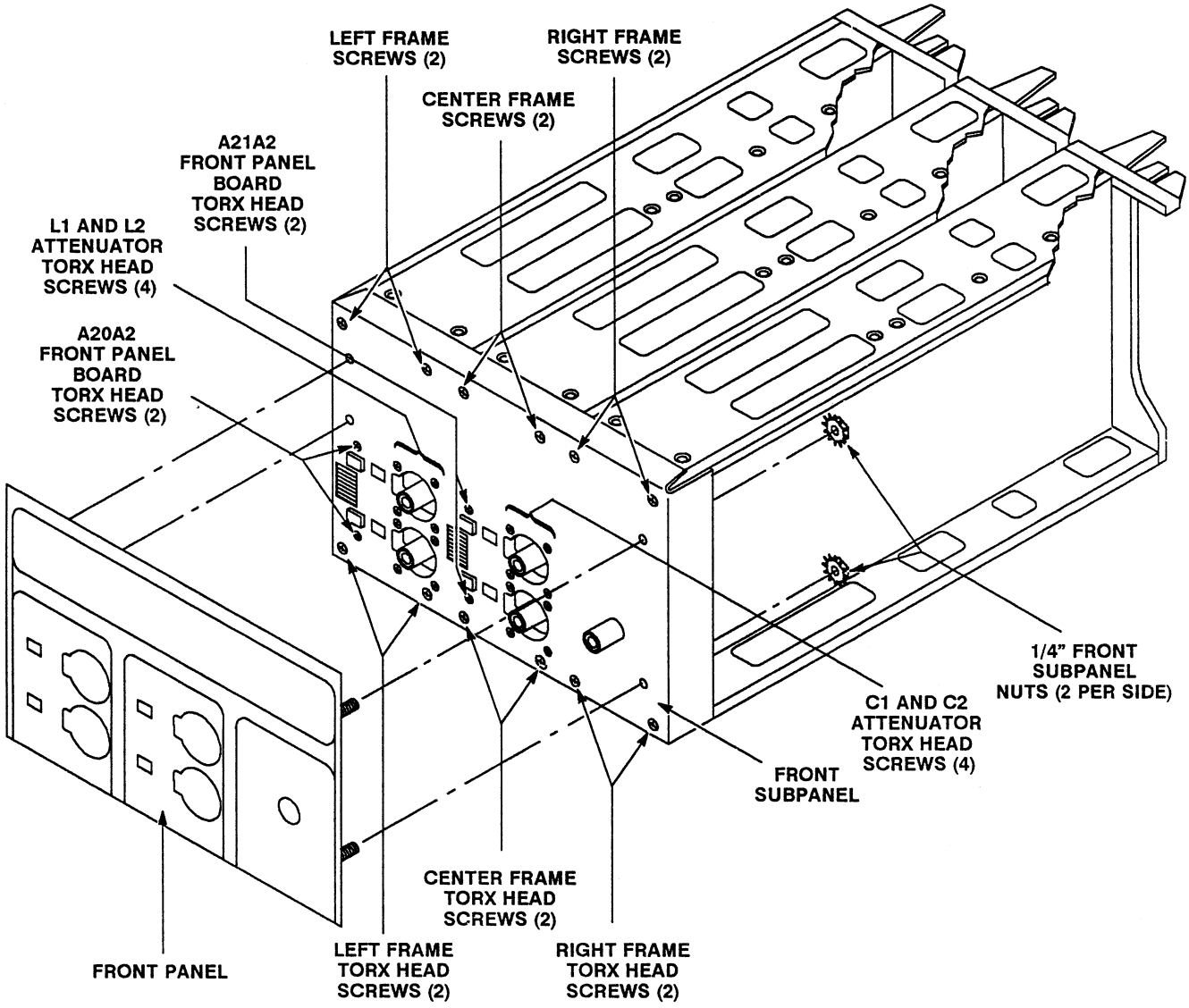


Figure 3-23 *— Signal Input Module Front Panel and Front Subpanel Screw Locations*

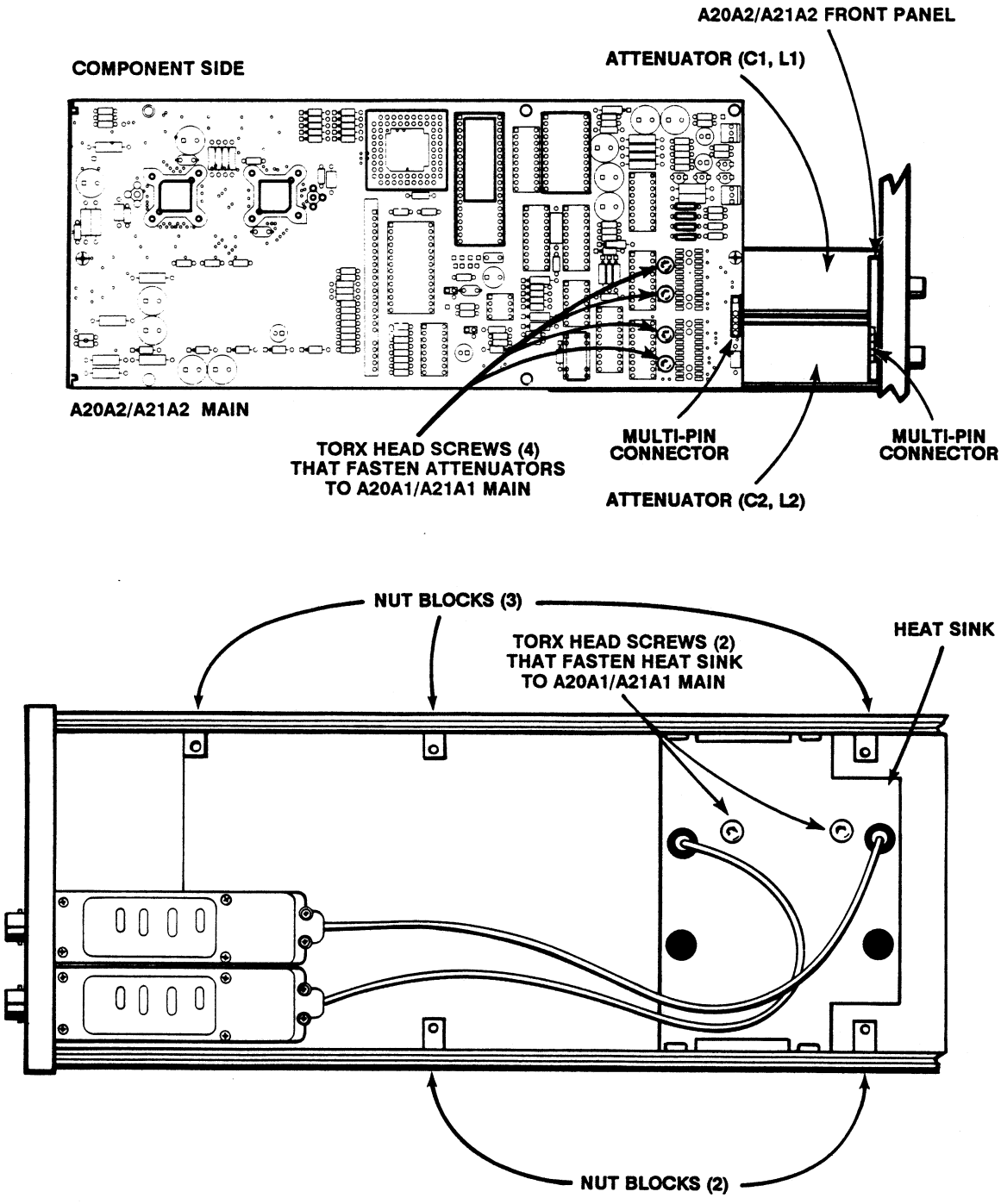


Figure 3-24 *— Removing and Replacing the A20A1/A21A1 Main Boards*

Replace the A20A1 Main board as follows:

- ☐ Step 1: Reattach the rear panel to the replacement A20A1 Main board.
- ☐ Step 2: Carefully insert the A20A1 Main board between the frames until the plastic rear panel contacts the top and bottom of the frame. (The board fits on the top of the center ridges of the left frame.)
- ☐ Step 3: Start the four Torx head screws that fasten the rear panel to the left frame.
- ☐ Step 4: Start the five Torx head screws and nut blocks that clamp the A20A1 Main board to the left frame.
- ☐ Step 5: Start the two Torx head screws that fasten the heat sink to the A20A1 Main board.
- ☐ Step 6: Tighten the Torx head screws that you reinstalled in Step 3, 4, and 5.
- ☐ Step 7: Replace the MOE holders on the A20A1 Main board, and then place the MOE strips in the holders.
- ☐ Step 8: Hold the attenuators against the MOE strips, and start the four Torx head screws that attach the attenuators to the A20A1 Main board. Then, tighten these Torx head screws.
- ☐ Step 9: Plug the cables, from the attenuators, into the receptacles in the A20A1 Main board.
- ☐ Step 10: Slide the attenuator inputs through the openings in the front subpanel. Make sure that the plastic collars are over the BNC input connectors before you insert the inputs through the front subpanel.
- ☐ Step 11: Reinstall the four Torx head screws that fasten the front subpanel to the frame.
- ☐ Step 12: Reinstall the eight Torx head screws that fasten the two attenuators (four screws per attenuator) to the front subpanel.
- ☐ Step 13: Connect the multi-pin connector from the A20A2 Front Panel board to the A20A1 Main board.
- ☐ Step 14: Reinstall the Signal Input module front panel.
- ☐ Step 15: Reinstall the Signal Input module into the oscilloscope.

A21A1 Main Board

See Figures 3-5, 3-23, 3-24, 3-26 and 3-31 for connector, screw, and index locations.

Remove the A21A1 Main board as follows:

- ☐ Step 1: Remove the Signal Input module.
- ☐ Step 2: Remove the four, 1/4-inch nuts holding the Signal Input module front panel in place.
- ☐ Step 3: Remove the Signal Input module front panel.
- ☐ Step 4: Remove the eight Torx head screws that fasten the C1 and C2 attenuators (four per attenuator) to the front subpanel at the Signal Input module.
- ☐ Step 5: Remove the four Torx head screws that fasten the center frame to the front subpanel. However, do not remove the center frame from the Signal Input module.
- ☐ Step 6: Use a needle-nose pliers to disconnect the multi-pin connector that connects from the A21A2 Front Panel board to the A21A1 Main board. Note the position of the multi-pin connector's index triangle to ensure that the connector can be correctly replaced.
- ☐ Step 7: Remove the center frame from the Signal Input module.
- ☐ Step 8: Unplug the cables that connects the attenuators to the receptacles on the A21A1 Main board.
- ☐ Step 9: Remove the four Torx head screws from the component side of the A21A1 Main board (that hold the attenuators in place) to remove the two attenuators from the A21A1 Main board.
- ☐ Step 10: Remove the metal-on-elastomer (MOE) strips and holders.
- ☐ Step 11: Remove the two Torx head screws that fasten the heat sink to the A21A1 Main board.
- ☐ Step 12: Remove the five nut blocks that secure the A21A1 Main board to the frame. (Use a screwdriver with a narrow shaft since the screws have only a slight offset from the top and bottom of the frame.)
- ☐ Step 13: Remove the four screws that fasten the plastic rear panel to the frame.
- ☐ Step 14: Remove the A21A1 Main board and attached rear panel from the center frame.
- ☐ Step 15: Remove the rear panel from the A21A1 Main board.

Replace the A21A1 Main board as follows:

- ☐ Step 1: Reattach the rear panel to the replacement A21A1 Main board.

- ☐ Step 2: Carefully insert the A21A1 Main board between the frames until the plastic rear panel contacts the top and bottom of the center frame. (The board fits on the top of the center ridges of the center frame.)
- ☐ Step 3: Start the four Torx head screws that fasten the rear panel to the center frame.
- ☐ Step 4: Start the five Torx head screws and nut blocks that clamp the A21A1 Main board to the center frame.
- ☐ Step 5: Start the two Torx head screws that fasten the heat sink to the A21A1 Main board.
- ☐ Step 6: Tighten the Torx head screws that you reinstalled in Step 3, 4, and 5.
- ☐ Step 7: Replace the MOE holders on the A21A1 Main board, and then place the MOE strips in the holders.
- ☐ Step 8: Hold the attenuators against the MOE strips, and start the four Torx head screws that attach the attenuators to the A21A1 Main board. Then, tighten these Torx head screws.
- ☐ Step 9: Plug the cables, from the attenuators, into the receptacles in the A21A1 Main board.
- ☐ Step 10: Slide the attenuator inputs through the openings in the front subpanel. Make sure that the plastic collars are over the BNC input connectors before you insert the inputs through the front subpanel.
- ☐ Step 11: Use needle-nose pliers to connect the multi-pin connector from the A21A2 Front Panel board to the A21A1 Main board.
- ☐ Step 12: Reinstall the four Torx head screws that fasten the front subpanel to the center frame.
- ☐ Step 13: Reinstall the eight Torx head screws that fasten the two attenuators (four screws per attenuator) to the front subpanel.
- ☐ Step 14: Reinstall the Signal Input module front panel.
- ☐ Step 15: Reinstall the Signal Input module into the oscilloscope.

A20A2 Front Panel Board

See Figures 3-5, 3-23, 3-24 and 3-31 for connector, screw, and index locations.

Remove and replace the A20A2 Front Panel board as follows:

- ☐ Step 1: Remove the Signal Input module.
- ☐ Step 2: Remove the four, 1/4-inch nuts holding the Signal Input module front panel in place.
- ☐ Step 3: Remove the Signal Input module front panel.
- ☐ Step 4: Disconnect the multi-pin connector that connects from the A20A2 Front Panel board to the A20A1 Main board. Note the position of the multi-pin connector's index triangle to ensure that the connector can be correctly replaced.
- ☐ Step 5: Remove the two Torx head screws that fasten the A20A2 Front Panel board to the front subpanel.
- ☐ Step 6: Remove the A20A2 Front Panel board.

To replace the A20A2 Front Panel board, perform the previous steps in the reverse order.

A21A2 Front Panel Board

See Figures 3-5, 3-23, 3-24 and 3-31 for connector, screw, and index locations.

Remove and replace the A21A2 Front Panel board as follows:

- ☐ Step 1: Remove the Signal Input module.
- ☐ Step 2: Remove the four, 1/4-inch nuts holding the Signal Input module front panel in place.
- ☐ Step 3: Remove the Signal Input module front panel.
- ☐ Step 4: Remove the eight Torx head screws that fasten the C1 and C2 attenuators (four screws per attenuator) to the front subpanel at the Signal Input module.
- ☐ Step 5: Remove the four Torx head screws that fasten the center frame to the front subpanel.
- ☐ Step 6: Use needle-nose pliers to disconnect the multi-pin connector that connects from the A21A2 Front Panel board to the A21A2 Main boards. Note the position of the multi-pin connector's index triangle to ensure that the connector can be correctly replaced.
- ☐ Step 7: Remove the center frame from the Signal Input module.
- ☐ Step 8: Remove the two Torx head screws that fasten the A21A2 Front Panel board to the front subpanel.
- ☐ Step 9: Remove the A21A2 Front Panel board.

To replace the A21A2 Front Panel board, perform the previous steps in the reverse order.

A22 External Trigger Board

See Figures 3-5 and 3-25 for connector and screw locations.

Remove and replace the A22 External Trigger board as follows:

- ☐ Step 1: Remove the Signal Input module.
- ☐ Step 2: Remove the four, 1/4-inch nuts that fasten the Signal Input module front panel to the Signal Input module.
- ☐ Step 3: Remove the Signal Input module front panel.
- ☐ Step 4: Unsolder the capacitor and resistor network that connects from the BNC output connector to the A22 External Trigger board.
- ☐ Step 5: Remove the four Torx head screws that fasten the right frame to the front subpanel.
- ☐ Step 6: Remove the right frame from the front subpanel.
- ☐ Step 7: Remove the six Torx head screws and nut blocks that secure the A22 External Trigger board to the right frame.
- ☐ Step 8: Remove the A22 External Trigger board.
- ☐ Step 9: Remove the four Torx head screws that fasten the plastic rear panel to the right frame.
- ☐ Step 10: Remove the rear panel from the A22 External Trigger board.

To replace the A22 External Trigger board, perform the previous steps in the reverse order.

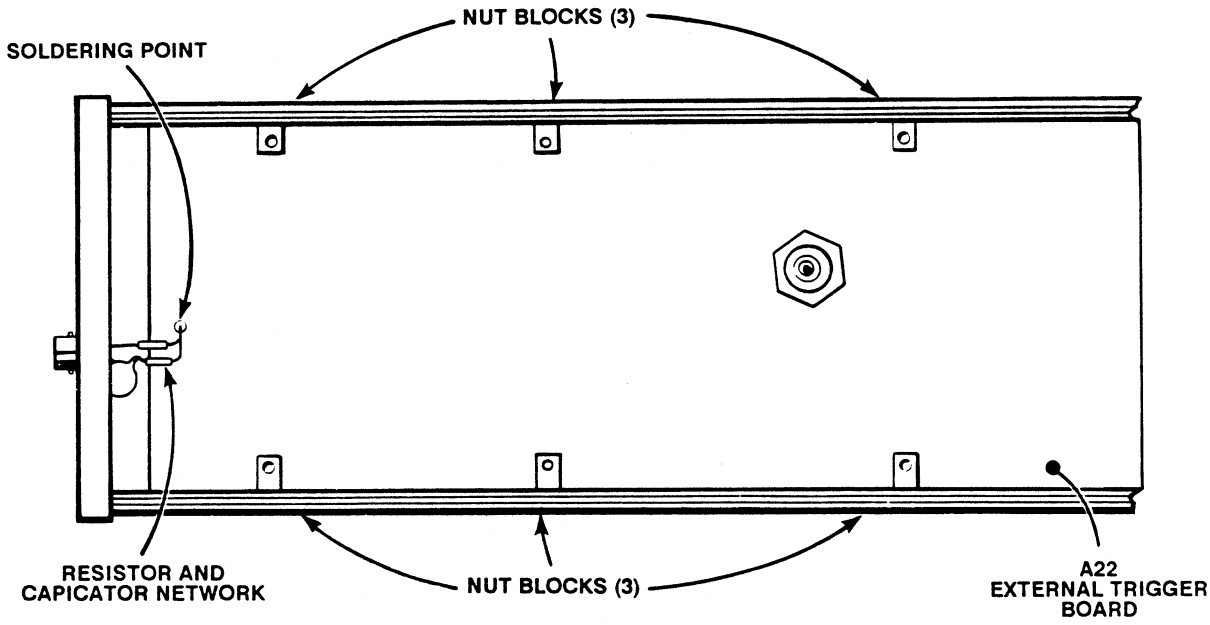


***Figure 3-25** — Removing and Replacing the A22 External Trigger Board*

Removing and Replacing the L1 and L2 Attenuators

See Figures 3-5, 3-23, 3-24, 3-26 and 3-31 for connector, screw, and index locations.

The L1 and L2 attenuators are attached to the A20A1 Main board. Remove either the L1 or L2 attenuator as follows:

☐ Step 1: Remove the Signal Input module.

☐ Step 2: Remove the four, 1/4-inch nuts holding the Signal Input module front panel in place.

☐ Step 3: Remove the Signal Input module front panel.

☐ Step 4: Remove the eight Torx head screws that fasten the L1 and L2 attenuators (four screws per attenuator) to the front subpanel.

☐ Step 5: Disconnect the multi-pin connector, that connects to the A20A2 Front-Panel board, from the A20A1 Main board. Note the position of the multi-pin connector's index triangle to ensure that the connector can be correctly replaced.

☐ Step 6: Remove the four Torx head screws that fasten the left frame to the front subpanel.

☐ Step 7: Remove the left frame from the Signal Input module.

☐ Step 8: Unplug the cable that connects the attenuator to the receptacles on the A20A1 Main board.

☐ Step 9: Remove the two Torx head screws from the component side of the A20A1 Main board (that holds the attenuator in place) to remove the attenuator.

Note: *The two MOE strips should be loose in the MOE holder.*

☐ Step 10: Remove the attenuator.

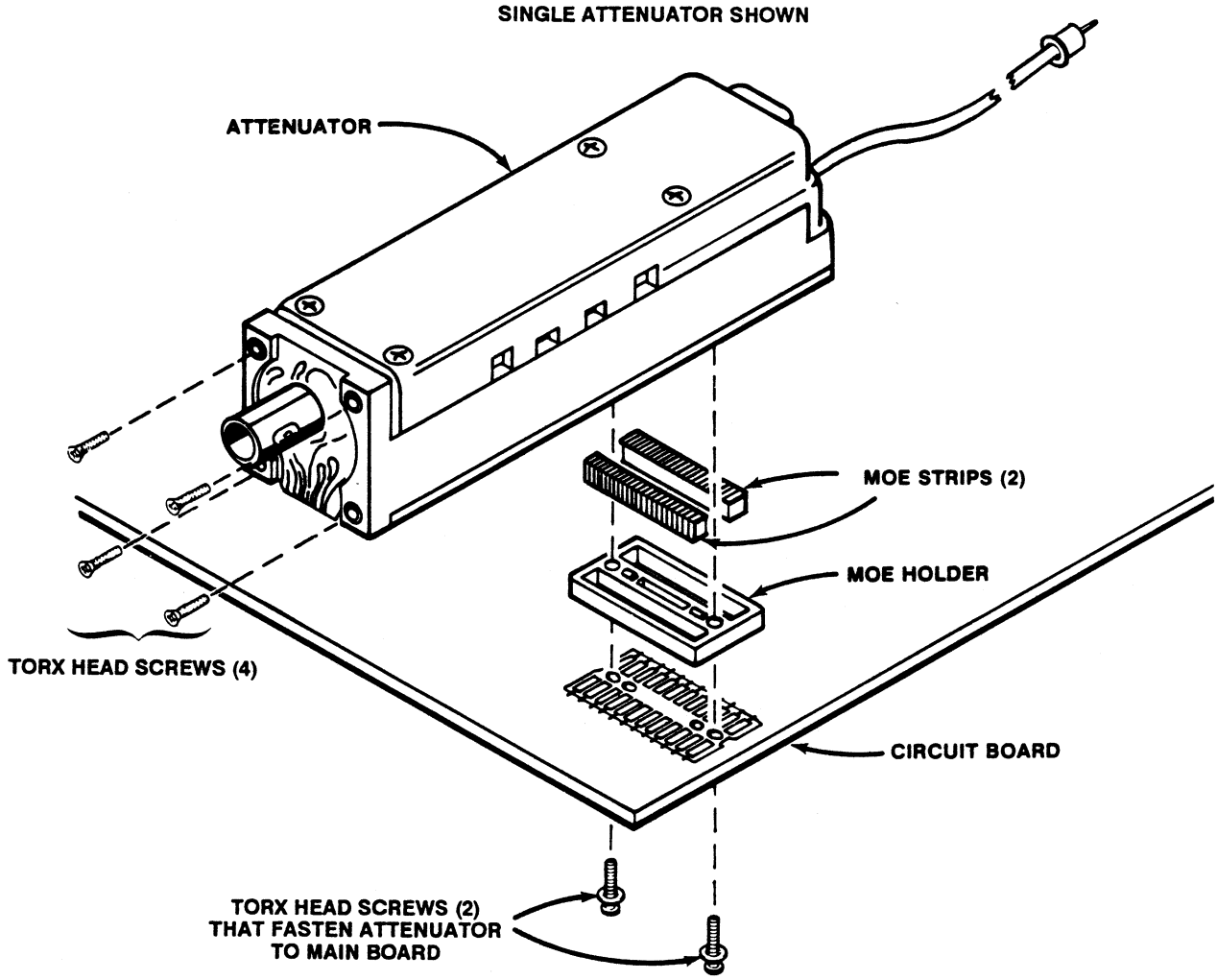


***Figure 3-26** — Removing and Replacing an Attenuator*

Replace either the L1 or L2 attenuator as follows:

☐ Step 1: Put the MOE strip holder on the A20A1 Main board.

☐ Step 2: Position the two MOE strips in the holder. (The exposed elastomer side of each strip should face the center of the holder.)

☐ Step 3: Hold the attenuator against the MOE assembly, and then start the two Torx head screws that fasten the attenuator to the A20A1 Main board. Then, tighten these screws.

☐ Step 4: Attach the left frame to the front subpanel with the four Torx head screws. Ensure that the plastic collars are positioned around the attenuator inputs before you attach the left frame to the front subpanel.

☐ Step 5: Connect the multi-pin connector to the A20A1 Main board.

☐ Step 6: Reinstall the eight Torx head screws that fasten the attenuators to the front subpanel.

☐ Step 7: Reinstall the Signal Input module front panel.

☐ Step 8: Reinstall the Signal Input module in the oscilloscope.

Removing and Replacing the C1 and C2 Attenuators

See Figures 3-5, 3-23, 3-24,3-26 and 3-31 for connector, screw, and index locations.

The C1 and C2 attenuators are attached to the A21A1 Main board. Remove either the C1 or C2 attenuator as follows:

☐ Step 1: Remove the Signal Input module.

☐ Step 2: Remove the four, 1/4-inch nuts holding the Signal Input module front panel in place.

☐ Step 3: Remove the Signal Input module front panel.

☐ Step 4: Remove the eight Torx head screws that fasten the C1 and C2 attenuators (four screws per attenuator) to the front subpanel.

☐ Step 5: Remove the four Torx head screws that fasten the center frame to the front subpanel.

☐ Step 6: Use needle-nose pliers to disconnect the multi-pin connector, that connects to the A21A2 Front-Panel board, from the A21A1 Main board. Note the position of the multi-pin connector's index triangle to ensure that the connector can be correctly replaced.

☐ Step 7: Remove the center frame from the Signal Input module.

☐ Step 8: Unplug the cable that connects the attenuator to the receptacles on the A21A1 Main board.

☐ Step 9: Remove the two Torx head screws from the component side of the A21A1 Main board (that hold the attenuator in place) to remove the attenuator.

Note: *The two MOE strips should be loose in the MOE holder.*

☐ Step 10: Remove the attenuator.

Replace either the C1 and C2 attenuator as follows:

☐ Step 1: Put the MOE strip holder on the A20A1 Main board in the appropriate position.

☐ Step 2: Put the two MOE strips in the holder. (The exposed elastomer side of each strip should face the center of the holder.)

☐ Step 3: Hold the attenuator against the MOE assembly, and then start the two Torx head screws that fasten the attenuatora to the A21A1 Main board. Then, tighten these screws.

☐ Step 4: Slide the attenuator inputs through the openings in the front subpanel. Ensure that the plastic collars cover the attenuator inputs before you attach the center frame to the front subpanel.

☐ Step 5: Reinstall the the four Torx head screws that fasten the center frame to the front subpanel.

☐ Step 6: Use a needle-nose pliers to connect the multi-pin connector to the A21A1 Main board.

☐ Step 7: Reinstall the eight Torx head screws that fasten the C1 and C2 attenuators to the front subpanel.

☐ Step 8: Slide the L1 and L2 attenuator inputs (that are connected to the A20A1 Main board in the left frame) through the openings in the front subpanel. Make sure that the plastic collars are positioned around the BNC input connectors before you insert the inputs through the front subpanel.

☐ Step 9: Reinstall the four Torx head screws that fasten the front subpanel to the frame.

☐ Step 10: Connect the multi-pin connector to the A20A1 Main board.

☐ Step 11: Reinstall the eight Torx head screws that fasten the attenuators to the front subpanel.

☐ Step 12: Reinstall the Signal Input module front panel.

☐ Step 13: Reinstall the Signal Input module in the oscilloscope.

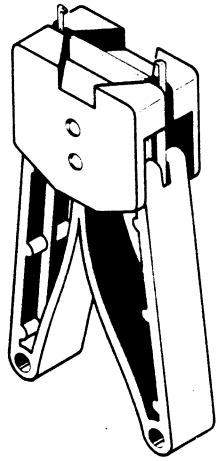
FRU IC Removal

This section lists the procedures for removing and replacing the FRU ICs in the oscilloscope (see Figures 3-27, 3-28, 3-29 and 3-30).

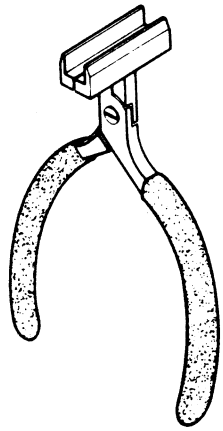
The DAG IC (U166) is located on the A6 Time Base board. The IC is seated in a socket soldered onto the board. The IC is oriented to its socket by a beveled corner. (One IC corner is beveled while the other three are notched.) This beveled corner aligns with a beveled corner on the outer edge of the IC socket.

Remove a DAG IC as follows:

☐ Step 1: Remove the IC with extraction pliers. (Refer to Table 2-2 for the part number of these pliers)



DAG IC EXTRACTION TOOL



DIP IC EXTRACTION TOOL

7279-325

Figure 3-27 *— IC Extraction Tools*

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

☐ Step 2: Insert the hook-shaped, plier, tips into the slots in the opposite corners of the IC socket.

☐ Step 3: Squeeze the handles of the pliers to lift the IC from the socket.

☐ Step 4: Carefully remove the IC; ensuring not to damage any IC pins.

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

FRU (FIELD REPLACEABLE UNITS) IC DETAIL

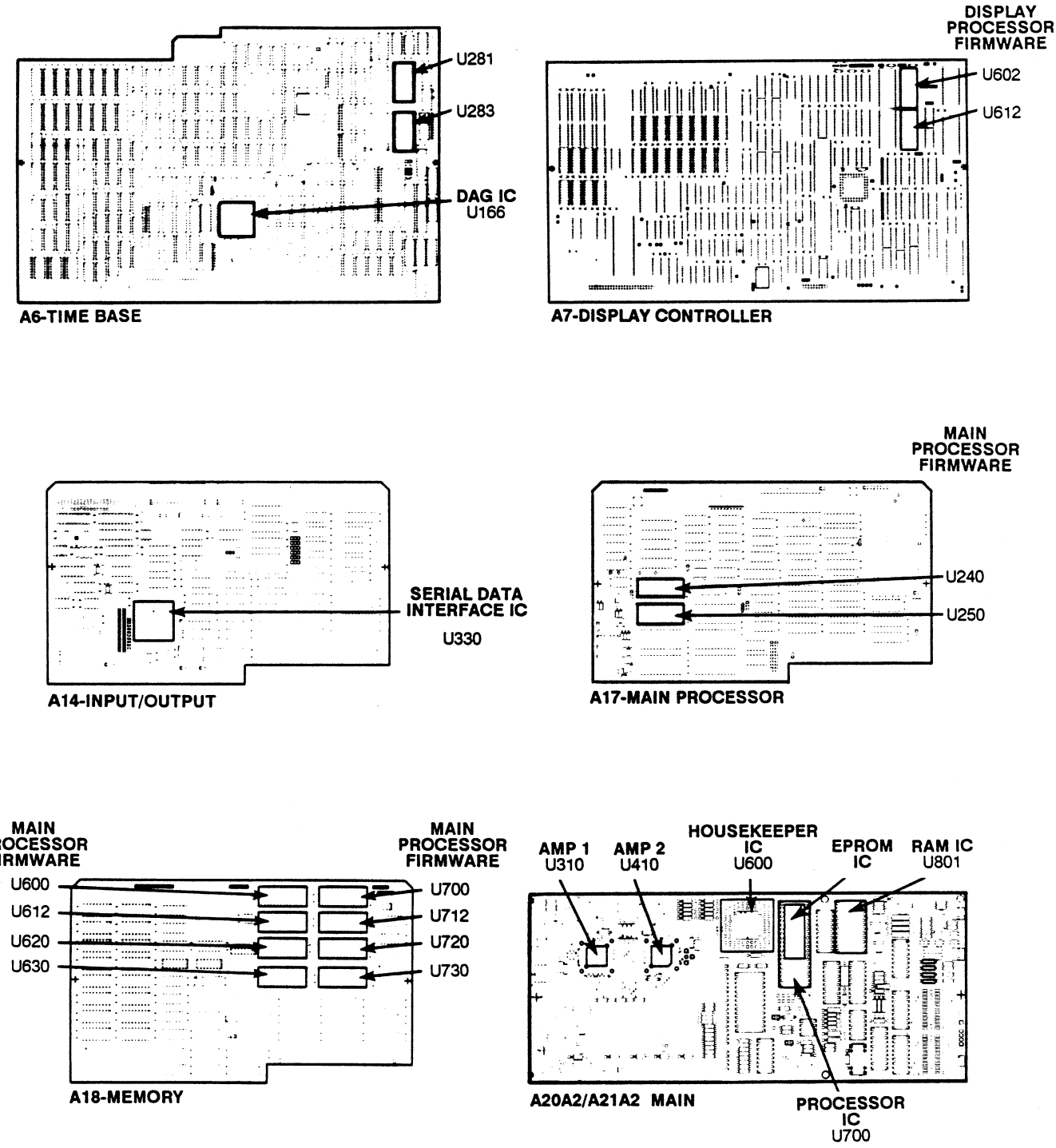


Figure 3-28 *— FRU IC Detail*

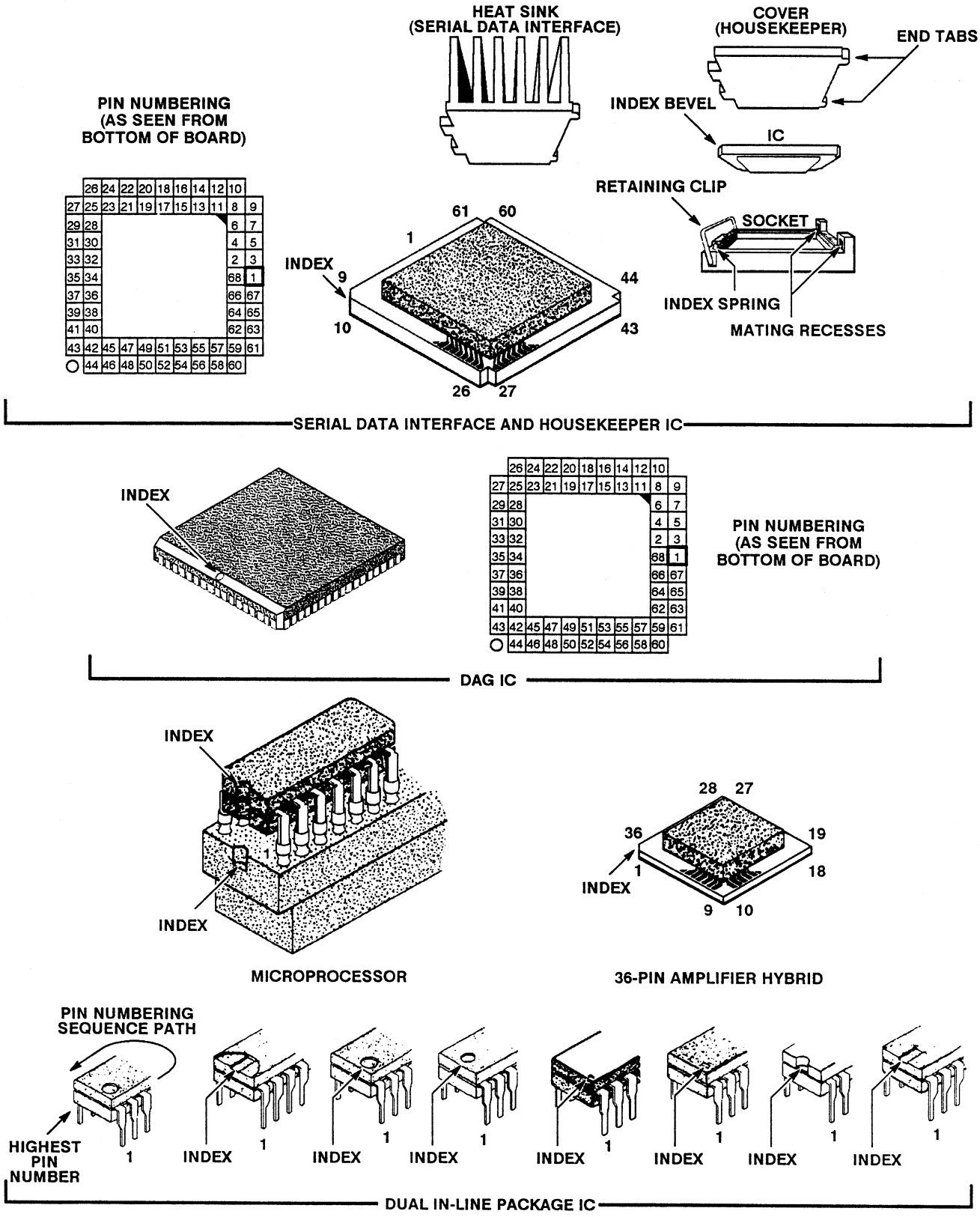


Figure 3-29 *— Semiconductor Indexing Diagram*

Replace the DAG IC as follows:

Note: *One of the upper sides of the IC is also beveled. This side has a dot which indicates the location of pin 1. Another pin 1 indicator (an arrow) is marked on the bottom of the IC socket.*

☐ Step 1: Align the beveled side of the IC (with the dot) 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 Circuits and Housekeeper Integrated Circuit ("Slam-Pack" ICs)

The Serial Data Interface IC (U330) is mounted on the A14 I/O board and the Housekeeper IC (U600) is mounted on the A20A1/A21A1 Main boards. The Serial Data Interface IC has a raised, ridged, heat sink, cover. The Housekeeper IC has a flat, metallic, cover. Both IC's 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 Serial Data Interface or Housedeeper IC as follows:

☐ Step 1: Remove the A14 I/O board or the A20A1/A21A1 Main boards.

☐ 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. Finger oils can degrade reliability.*

Replace the Serial Data Interface or Housekeeper IC as follows:

☐ Step 1: 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 2: Arrange the other corners, with the tweezers, to fit evenly at the edges of the socket.
- ☐ Step 3: Set the cover flat on the IC with its end tabs properly aligned with, but not in, the mating recesses in the socket.
- ☐ Step 4: 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 5: Check that the cover is secure.
- ☐ Step 6: Replace the A14 I/O board or the A20A1/A21A1 Main boards.

Amplifier Hybrids

Figure 3-30 shows an exploded view of the Hypcon (**Hy**brid-**p**rinted circuit **con**nector) and gives disassembly and replacement instructions. When replacing the hybrid, do not touch the elastomer's gold-plated contacts with your fingers. Use a cleaner which will not lessen contact reliability. The Hypcon socket contacts are fragile. Therefore, see the caution that follows when removing and replacing a Hypcon to avoid damaging these contacts.

Before reinstallation, use a 4X (or greater) magnifying glass to examine the hybrid, elastomer, and the Hypcon contacts for dust, hair, lint, or other foreign matter. If the etched circuit board surfaces require more cleaning, then scrub the surface with a soft rubber eraser. Then, blow or vacuum clean while dusting the surface with a small clean brush.

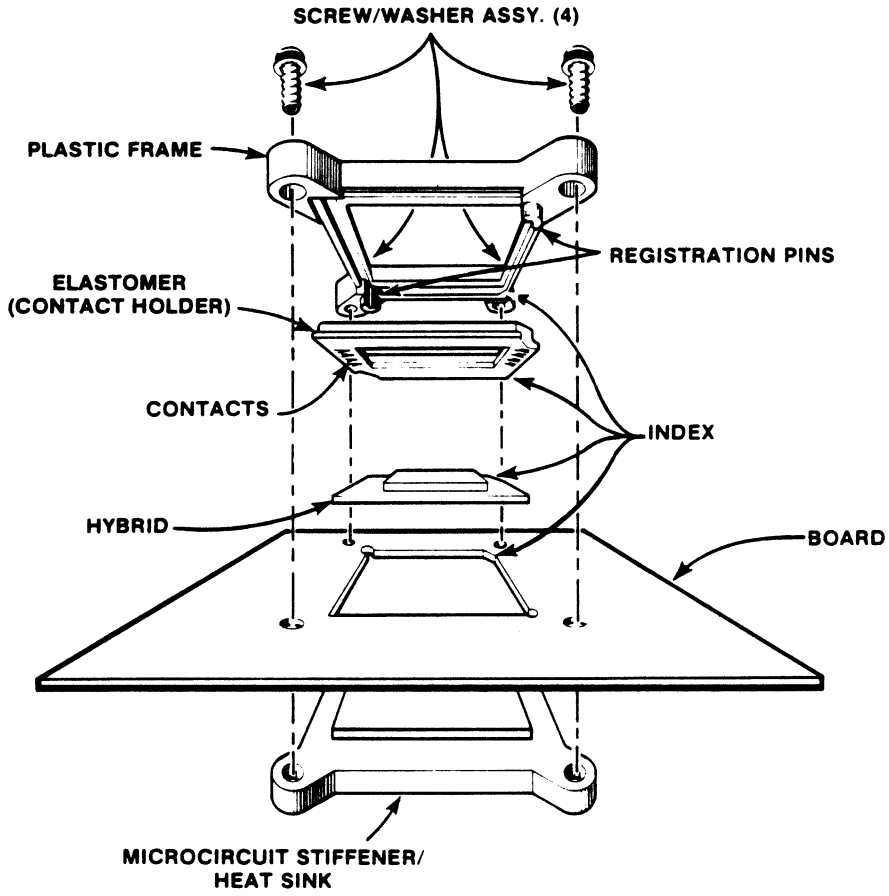
If the hybrid and elastomer contact holders are contaminated, then flush or spray the holders with alcohol. **Do not scrub with a cotton-tipped swab or similar device.** (Cotton fibers may adhere to the contacts.) If the contact holder is excessively contaminated, then replace the holder.

Next, tighten the mounting screws with two inch-pounds of torque (2.3 centimeter-kilograms) to secure the Hypcon to the board.

Ensure that the elastomer is properly seated in the contact holder before remounting the assembly to the board. Use care when mounting the assembly to the board to ensure that the proper alignment exists between the connector and board.

CAUTION *Special care must be taken to ensure correct index alignment of each Hypcon part during reassembly. Failure to do so can result in a cracked hybrid substrate.*

EXPLODED VIEW OF HYPCON CONNECTOR



CROSS SECTION VIEW OF HYPCON CONNECTOR

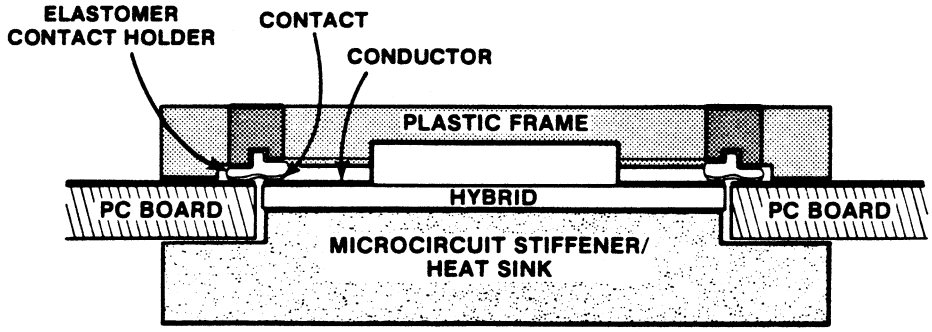


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Figure 3-30 *— Removing and Replacing the Hypcon Assembly*

Remove the Amplifier Hybrid as follows:

☐ Step 1: Notice the index on the board (arrow) and the plastic frame (pointed tab).

☐ Step 2: Unscrew and remove the four screw/washer assemblies.

☐ Step 3: Lift the plastic frame from the board.

☐ Step 4: Notice the index location of the hybrid and remove from the hybrid board with the tweezers.

Note: *Step 5 describes the removal of the elastomer from the plastic frame. This step is unnecessary when replacing only the hybrid.*

☐ Step 5: Notice the index location of the elastomer contact holder. Grasp and lift the corner of the contact holder with the tweezers to remove the holder from the plastic frame. Do not touch the gold-plated contacts with your fingers.

Replace the Amplifier Hybrid as follows:

☐ Step 1: Grasp a corner of the elastomer with the tweezers and place the elastomer into the plastic frame. Align the keyed corner of the elastomer with keyed corner of plastic frame. Tap the elastomer into the plastic frame uniformly.

Note: *Keeping the elastomer clean is very important. Small hairs and elastomer flash under the contacts, which are almost invisible to the naked eye, prevent good electrical contact. Most apparent failures of the hybrid are actually due to contamination of the Hypcon. Do not touch the gold-plated contacts with fingers.*

☐ Step 2: Place the hybrid into the square hole in the board. The hybrid is keyed so that it will fit into the board in only one orientation. When the back of the hybrid rests on the heat sink pedestal, the top of the hybrid should be flush with the top of the board.

☐ Step 3: Place the plastic frame, with the elastomer installed over the hybrid, so that the key (pointed tab) aligns with the corner arrow on the board.

☐ Step 4: Insert the mounting hardware, and apply two inch-pounds of torque, (2.3 cm-kg) to secure the connector assembly. Do not overtighten the assembly. Overtightening the assembly will strip the microcircuit stiffener/heat sink mounting threads.

RAM IC

If the RAM IC (U801) is soldered into the board, then consult a Tektronix service center for recommended removal procedures. Do not solder in the replacement IC. Instead, install a 24-pin socket, and plug the RAM IC into this socket.

EPROM IC

If your EPROM IC is not mounted on top of the Processor IC and you have a mask-rom single-chip microcomputer package, then remove and replace the IC as described under *Processor IC*, and any references to the EPROM IC do not apply to your oscilloscope.

CAUTION

Do not remove the label affixed to the top of the EPROM IC. Removing this label will allow light into the chip, and may cause partial erasure of this IC's data.

The EPROM IC is mounted on top of the Processor IC on the A20A1/A21A1 Main boards.

Remove the EPROM IC as follows:

- ☐ Step 1: Grasp the IC with the insertion-extraction pliers. Ensure that all the IC pins are straight and evenly spaced.
- ☐ Step 2: Position the pliers around the outside of the IC. Squeeze the handles of the pliers to grasp the IC, and slowly pull the IC from the socket.

CAUTION

Avoid touching the IC pins or socket contacts with your fingers. Finger oils can lessen contact reliability.

Replace the EPROM IC as follows:

- ☐ Step 1: Grasp the IC with the insertion-extraction pliers. Ensure that all the IC pins are straight and evenly spaced.
- ☐ Step 2: Do not use the IC label as an index. Look for the index on the IC body. Align the index slot with that of the Processor IC (that is mounted upon).
- ☐ Step 3: Align the pins with their respective socket contacts, and push down slowly and evenly to seat the IC.

Processor IC

The Processor IC (U700) is located on the A20A1/A21A1 Main boards. The EPROM IC is mounted on top of this.

Remove the Processor IC as follows:

- ☐ Step 1: Remove the EPROM IC as described earlier in this section.
- ☐ Step 2: Grasp the IC with the insertion-extraction pliers. Ensure that all the IC pins are straight and evenly spaced.

☐ Step 3: Position the pliers around the outside of the IC. Squeeze the handles of the pliers to grasp the IC, and slowly pull the IC from the socket.

CAUTION

Do not damage the EPROM sockets with the pliers. Avoid touching the IC pins or the socket contacts with your fingers. Finger oils can lessen contact reliability.

Replace the Processor IC as follows:

☐ Step 1: Grasp the replacement IC with the insertion-extraction pliers. Ensure that all its pins are straight and evenly spaced.

☐ Step 2: Align the index slot on the IC with the corresponding index on its socket.

☐ Step 3: Align the IC pins with their respective socket contacts, and push down slowly and evenly to seat the IC.

☐ Step 4: Replace the EPROM IC as described earlier in this section.

Firmware Integrated Circuits ("Dual In-Line Package" ICs)

The firmware ICs are located on six separate circuit boards. The boards and their respective firmware (FW) are as follows:

- **A6 Time Base board** Digitizer FW (U281 & U283)
- **A7 Display Controller board** Display Processor FW (U602, U612)
- **A17 Main Processor board** Main Processor FW (U240 & U250)
- **A18 Memory board** Main Processor FW (U600, U612, U620, U630, U700, U712, U720, & U730)

All of the ICs listed above are ordered by a single Tektronix Part Number. (**Each IC cannot be ordered separately**.) For the 11201 Oscilloscope, the total firmware kit number is 020-1744-00.

To remove and replace the firmware 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.

Preliminary Verification Procedure

☐ Step 1: Prepare the oscilloscope as follows:

a. Set the PRINCIPAL POWER SWITCH to OFF and remove the power cord.

b. Place the oscilloscope on its right side and use a large flat-blade screwdriver or coin to remove the bottom cover.

☐ Step 2: Check the Cal Constant Tag as follows:

a. Locate the Cal Constant tag on the A5 Acquisition board. This small tag has the printed label:

mcalconst 134

b. Check that the Cal Constant tag also includes a handwritten four-digit number. Record the value of this number for use later in this procedure.

☐ Step 3: Check the Cal Constant as follows:

a. Connect a power cord to the oscilloscope.

b. Connect a terminal or controller to the oscilloscope. Refer to the *11201 Digitizing Oscilloscope User Reference* manual for more information on this connection.

c. Set the PRINCIPAL POWER SWITCH and ON/STANDBY switch to ON.

d. Set the necessary communication parameters; for example, baud rate.

e. When the oscilloscope is powered-on, enter the following commands to establish communication from the terminal or controller (<CR> is the return key):

e<CR>
v<CR>

f. Enter the query:

mcalconst? **134**<CR>

Note: *If the four-digit value returned after the query does not match the value on the A5 Acquisition board tag, then do not proceed with the firmware upgrade. Contact the Tektronix service center for assistance.*

If the number returned after the query matches the number written on the Cal Constant tag, then note the number for use in Step 8 of the Firmware Upgrade Procedure that follows.

☐ Step 4: Prepare the oscilloscope for the Firmware Upgrade Procedure

a. Set the PRINCIPAL POWER SWITCH to OFF and remove the power cord.

b. 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.

Firmware Upgrade Procedure

☐ Step 1: Upgrade the A7 Display Controller board firmware as follows:

a. Make sure the PRINCIPAL POWER SWITCH is set to OFF and the power cord is disconnected.

b. Remove the oscilloscope's top panel cover.

c. Locate the A7 Display Controller board (see Fig. 3-1). The A7 Display Controller board is horizontally positioned above the Signal Input module.

d. Locate the two EPROMs (U602 and U612), in the right corner of the board.

CAUTION *Ensure that pin 1 is positioned correctly when replacing components.*

Note: *Use the IC insertion-extraction pliers for removing and replacing the ICs.*

Do not use the label on the IC for an index because it may be applied incorrectly.

e. Remove U602 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.

f. Similarly replace U612 with an upgraded IC.

☐ Step 2: Access boards within the card cage as follows:

a. Remove the two nylon board guides from the top of the card cage (at the left rear of the oscilloscope).

b. Remove the screws that secure the card cage retainer (an angle bar that prevents removal of the boards in the card cage). (See Fig. 3-6.)

☐ Step 3: Upgrade the A18 Memory board firmware as follows:

a. Remove the A18 Memory board from the card cage. (The A18 Memory board is typically located nearest the outside of the oscilloscope.)

b. On the A18 Memory board, replace the following ICs:

U600	U700
U612	U712
U620	U720
U630	U730

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.

c. Return the A18 Memory board to its former location in the card cage.

☐ Step 4: Upgrade the A17 Main Processor board firmware as follows:

a. Remove the A17 Main Processor board, which is typically located in the slot near the A18 Memory board. A cable connector must be removed from the top of the board before it can be removed from the oscilloscope. (Refer to the A17 Main Processor board under FRU Board Assembly Removal earlier in this section.)

b. On the A17 Main Processor board, replace U240 and U250. 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 the pin 1 is oriented correctly when inserting the new parts.

☐ Step 5: Replace the card cage and board retainers as follows:

a. Replace the card cage retainer with two screws.

b. Replace the two nylon board guides.

c. Reconnect the cable at the top of the A17 Main Processor board.

d. Replace the top cover of the oscilloscope.

☐ Step 6: Upgrade the A6 Time Base board firmware as follows:

a. Locate U281 and U283 on the A6 Time Base board. These components are found near the bottom front of the oscilloscope while the oscilloscope is positioned on its right side.

b. 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 7: Set the Cal Constant as follows:

a. Locate the CAL-LOCK pins, J450, on the A6 Time Base board (see Fig. 3-11), and add the terminal connector link. (Refer to the Shorting Jumper in Table 2-2.)

b. Connect a power cord to the oscilloscope.

c. Connect a terminal or controller to the oscilloscope. Refer to the *11201 Digitizing Oscilloscope User Reference* manual for more information on this connector.

d. Set the PRINCIPAL POWER SWITCH and ON/STANDBY switch to ON.

e. Set necessary communication parameters, for example, baud rate.

f. 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>

g. Enter the command:

mcalconst 134:**XXXX**<CR>

where **XXXX** is the 4-digit value noted on the A5 Acquisition board Cal Constant tag. (Refer to Step 4 of the Preliminary Verification Procedure earlier in this section.)

☐ Step 8: Verify the Cal Constant as follows:

a. Press the ENHANCED ACCURACY button to begin Enhanced Accuracy.

b. Check that the oscilloscope successfully completes the Enhanced Accuracy cycle.

Note: *The Enhanced Accuracy cycle must be performed for the oscilloscope to recognize the new Cal Constant value.*

c. If desired, the stored Cal Constant can be verified with the query:

mcalconst? **134**<CR>

d. Verify that the value returned is the same as the value hand written on the Cal Constant tag.

☐ Step 9: Verify the instrument serial number as follows:

a. Verify that the serial number on the oscilloscope's front panel matches the instrument serial number found under the **Instrument Options** pop-up menu in the UTILITY major menu.

b. 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.

c. Verify that the proper ID is now displayed in the **Instrument Options** pop-up menu.

☐ Step 10: Remove the procedure setup as follows:

a. Set the PRINCIPAL POWER SWITCH to OFF.

b. Remove the J450 CAL-LOCK jumper on the A6 Time Base board.

c. Replace the bottom oscilloscope cover and set the oscilloscope upright.

☐ Step 11: Perform final power-on and verification as follows:

Note: *The power-on sequence must be performed for the oscilloscope to recognize the new CAL-LOCK strap configuration and Cal Constant value.*

a. Set the PRINCIPAL POWER SWITCH and ON/STANDBY switch to ON.

b. Verify that the oscilloscope powers-on and successfully completes the Self-Tests diagnostics sequence.

c. 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 circuit boards, modules, and assemblies. Use this diagram for a reference when you are removing and/or 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 3-31 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.

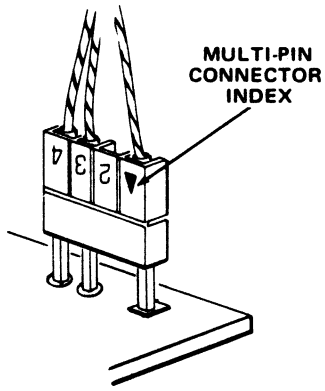

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Figure 3-31 *— Multi-Pin Connector Orientation*

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 the cable.

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, then 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, grasp the ends of the connector, and pull the connector straight out from the connector socket.

Checks After FRU Replacement

After any FRU has been replaced, that particular unit should be checked. (Table 3-4 lists the required checks.)

Table 3-4 *— Checks Required After FRU Replacement*

FRU Replaced	Checks Required
Power Supply Module	Part 1—Power-Up Diagnostics Part 2—Extended Diagnostics Part 3—Voltage Reference Part 5—Enhanced Accuracy Part 6—Calibration Output Accuracy Part 7—High Frequency Response Part 8—DC Balance Part 12—RMS Noise Part 13—Time Base
A1 Plug-In Interface board	Part 5—Enhanced Accuracy
A4 Regulator board	Part 1—Power-On Diagnostics Part 2—Extended Diagnostics Part 3—Voltage Reference Part 5—Enhanced Accuracy Part 6—Calibration Output Accuracy Part 7—High Frequency Response Part 8—DC Balance Part 12—RMS Noise Part 13—Time Base
A5 Acquisition board	Part 1—Power-On Diagnostics Part 2—Extended Diagnostics Part 5—Enhanced Accuracy Part 6—Calibration Output Accuracy Part 7—High Frequency Response Part 8—DC Balance Part 11—Trigger Sensitivity at 400 MHz Part 12—RMS Noise Part 13—Time Base Part 17—Triggering
A6 Time Base board	Part 13—Time Base
A7 Display Controller board	Part 1—Power-On Diagnostics Part 2—Extended Diagnostics Part 5—Enhanced Accuracy
A8 CRT Driver board	Part 4—Display
A9 Touch Panel board	Part 1—Power-On Diagnostics Part 2—Extended Diagnostics Part 5—Enhanced Accuracy

Table 3-4 (cont) *– Checks Required After FRU Replacement*

FRU Replaced	Checks Required
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 15 – Input/Output
A15 Memory Management Unit board	Part 1 – Power-On Diagnostics Part 2 – Extended Diagnostics Part 5 – Enhanced Accuracy
A16 Waveform Compressor board	Part 1 – Power-On Diagnostics Part 2 – Extended Diagnostics Part 5 – Enhanced Accuracy
A17 Main 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
A20A1/A21A1 Main board	Part 1 – Power-On Diagnostics Part 2 – Extended Diagnostics Part 5 – Enhanced Accuracy Part 7 – High Frequency Response Part 8 – DC Balance Part 9 – ΔV DC Accuracy Part 10 – DC Offset Accuracy Part 12 – RMS Noise
A20A2/A21A2 Front Panel board	Part 2 – Extended Diagnostics
A22 Trigger Amplifier board	Part 2 – Extended Diagnostics Part 18 – External Trigger Input Resistance Part 19 – External Trigger Input Calibration Part 20 – External Trigger Performance

Table 3-4 (cont) *— Checks Required After FRU Replacement*

FRU Replaced	Checks Required
SDI (Serial Data Interface) IC	Part 1—Power-On Diagnostics Part 2—Extended Diagnostics Part 5—Enhanced Accuracy
DAG (Destination Address Generator) IC	Part 1—Power-On Diagnostics Part 2—Extended Diagnostics Part 5—Enhanced Accuracy
Firmware ICs	Part 1—Power-Up Diagnostics Part 2—Extended Diagnostics Part 5—Enhanced Accuracy
Processor IC	Part 1—Power-On Diagnostics Part 2—Extended Diagnostics Part 5—Enhanced Accuracy
Housekeeper IC	Part 1—Power-On Diagnostics Part 2—Extended Diagnostics Part 5—Enhanced Accuracy
EEPROM IC	Part 1—Power-On Diagnostics Part 2—Extended Diagnostics Part 5—Enhanced Accuracy
RAM IC	Part 1—Power-On Diagnostics Part 2—Extended Diagnostics Part 5—Enhanced Accuracy
CRT (Cathode Ray Tube)	Part 4—Display

Diagnostic Troubleshooting

This section provides the information necessary to troubleshoot a faulty oscilloscope to the Field Replaceable Unit (FRU) level. In most cases a FRU is a circuit board. Two FRUs are an exception; the Cathode Ray Tube (CRT)/CRT Driver board and the Power Supply Module. The primary means for troubleshooting is to use the error index code output from the Kernel Diagnostics or Self-Tests and cross-reference them to the suspect circuit boards in the FRU Guide tables below. After the faulty FRU is replaced, some recalibration of the oscilloscope is normally required (this is discussed further below). 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, A8 CRT Driver, A13 Mother board, or fuses.

Diagnostics Overview

Each subsystem (Executive, Display, Digitizer, and Signal Input) processor executes a set of Kernel diagnostics prior to the Self-Tests diagnostics. After the Display, Digitizer, and Signal Input processors verify their support circuitry, these procesesors attempt to establish communication with the Executive Processor. If this link is successful, then the Self-Tests diagnostics execute to verify the functionality of each of the subsystems. After all the Self-Tests diagnostics are executed, any failures cause the oscilloscope to enter Extended Diagnostics and to display the error index codes in the **Extended Diagnostics** pop-up menu. Extended Diagnostics tests are a superset of the Self-Tests diagnostics.

The Kernel diagnostics (low-level Self-Tests diagnostics) and Self-Tests/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-Tests diagnostics (that is, some errors codes are only generated by manually selecting tests or Extended Diagnostics). Also, some tests may only indicate a faulty FRU(s) after achieving Enhanced Accuracy.

The next two subsections provide a quick overview of Kernel and Extended Diagnostics.

Kernel Diagnostics

Each time the front panel ON/STANDBY switch is set to ON, the 11201 oscilloscope performs Power-On diagnostics on its microprocessor subsystems and Self-Tests 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. If corruption occurs, refer to Restoring Data later in this section.

When Power-On diagnostics begins, 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, followed by testing of the communication between these subsystems. If the oscillo-

scope is being powered-on from a cold condition, the diagnostics may finish before the CRT is able (warmed-up sufficiently) to display these messages.

The starting of the Self-Tests diagnostics indicates successful completion of the Power-On diagnostics between the Executive and Display subsystems. If the Digitizer processor Kernel diagnostics fail, then the oscilloscope automatically enters Extended Diagnostics at the end of the Self-Tests diagnostics. However, if the Digitizer processor Kernel diagnostics pass, then the graticule is displayed and the front panel settings in effect at the last power-down are restored as well. The message, **Dsy Kernel Failure**, or an beep and illuminated menu buttons indicates the failure of the Power-On diagnostics. If the Signal Input subsystem fails its Power-on diagnostics, then it is unlikely that these processors can communicate failure information to the Executive processor. Also if such a failure occurs, the flashing of a fault code on the Signal Input module front panel LEDs will indicate which Kernel diagnostic tests are failing.

Kernel Diagnostics tests—execute concurrently in all of the subsystem processors at power-on. Address, data, and control lines to local ROM (containing the diagnostic test code), RAM, and the interrupt controllers are all verified. Thus, in the Executive/Main processor, the basic operation for most boards in the Executive card cage (that is, those plugged in to the mother board) are checked. The last test for the Display and Digitizer processors is to verify communication with the Executive processor. In a processor, all Kernel tests must execute without failures before the subsystem's Self-Tests diagnostics can execute.

Since the condition of the oscilloscope is unknown at power-on, the low-level Kernel Diagnostics in the Executive and Digitizer processors do not attempt to display error index codes. Instead, the low-level Kernel diagnostics generate two-digit hex numbers that are read as a series of binary bits, such as XXX1 0101 (the upper bits are not used). This binary number is converted into a hex error index code (in this case, 15*hex*). Refer to the text under Tables 3-7 and 3-13 for examples of these two-digit hex numbers.

The Display Kernel diagnostics display an error message on the screen giving the name of the test that failed. For example, the message

Dsy Kernel Failure
Timer 2

indicates that the Timer 2 test failed. If the display is disabled, then the error index code is read from status pins on the Display Controller board (see Figs. 3-33, 3-34, and 3-35 for examples of these status pins) .

If the Signal Input module Kernel diagnostic tests— detect a fault, then the C2/L2 LED is flashed eight times to display a fault code. Each time the C2/L2 LED lights, count the occurrences. If the C1/L1 LED is lit during a cycle of the C2/L2 LED, then the test corresponding to the current count accumulated is the one which failed. See the timing diagram in Figure 3-32 for an example LED fault code. (The timing diagram illustrates a test number 2 failure.)

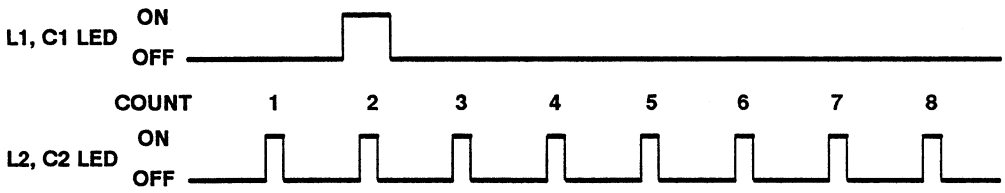

Figure 3-32 *— Sample Signal Input LED Fault Code Timing Diagram*

Refer to Table 3-16 for information on the Signal Input module Kernel diagnostic tests.

The Kernel diagnostic tests are:

Test 1: The ROM Checksum Test computes a checksum of the content of the firmware ROM. This calculated checksum is then compared with a checksum stored in the ROM. If the checksums do not match, then the test fails and Signal Input module front-panel LEDs flash to report a fault code 1. After the fault code is reported, the Signal Input module attempts to begin normal operation; yet it is unlikely that the Signal Input module can function properly with a bad ROM Checksum.

Test 2: The non-volatile RAM (NV RAM) Test verifies that the NV RAM is functioning properly. Since the NV RAM contains calibration information, which must remain undamaged, this test does not alter critical data. If the testing algorithm detects a failure, then the Signal Input processor reports a fault code of 2, and repeatedly loops the NV RAM Test. The oscilloscope continues looping the NV RAM Test until the power is removed. Until the condition causing the NV RAM Test to fail is corrected, the Executive processor does not recognize the Signal Input processor.

The NV RAM Test could corrupt calibration data stored in the NV RAM if the power is cycled or removed during this test. If corruption occurs, then the Calconstant Checksum is corrupted as well. Furthermore, at the next power-on, the Signal Input processor resets the calibration constants to default ROM settings, and reports a Signal Input calconstant checksum error during Power-On diagnostics. However, after the oscilloscope has iachieved Enhanced Accuracy, the Signal Input module is once again properly calibrated.

Test 3: The Housekeeper IC Test verifies the functionality of the Housekeeper IC. The Housekeeper IC performs many housekeeping chores of the amplifier; including channel sequencing, refreshing the analog control voltage system, latching amplifier step gain settings, and communicating with the Executive processor. This test exercises this IC, and records the IC's reactions using an algorithm similar to the algorithm that signature analysis uses. If the resulting signature of the Housekeeper IC does not match a known good signature, then the test fails and reports a fault code of 3. Also, the test is executed repeatedly if it fails. The oscilloscope will continue looping the Housekeeper IC Test until power is removed. Until the condition causing the Housekeeper IC Test to fail is corrected, the Executive processor does not recognize the Signal Input processor.

After all power-on Kernel diagnostic tests have completed and successfully passed, the the Signal Input processor will initialize its settings and communicate with the Executive processor.

Self Test/Extended Diagnostics

To indicate that the Self-Tests diagnostics have begun, **Self Test in Progress** is displayed. Flashing and pattern changes on the display make test progress obvious. Return to normal operation indicates successful completion of the Self-Tests diagnostics. Any failures cause the oscilloscope to execute the remaining tests, and then display the Extended Diagnostics menu. Record the displayed error codes for the failed circuit block(s), and refer the oscilloscope to a qualified service person.

The format of the error index codes is based on the Extended Diagnostics menu structure. The **Extended Diagnostics** menu status areas are in a three level hierarchy with the **Block** pop-up menu at the highest level. Each circuit block name in the **Block** pop-up menu is individually selectable and testable. A selected circuit block is divided into a number of parts or circuit areas in the **Area** pop-up menu, the second level. Touching **Area** in the menu/status area, displays the **Area** pop-up menu for the selected block. Each circuit area has a **Routine** pop-up menu, the third level, as well; which has one or more selectable routines. Routines are the smallest test units that are selectable and executable. This **Block**, **Area**, and **Routine** pop-up menu hierarchy generates the error index codes.

Extended Diagnostics error index codes are five-character codes. The first character indicates the subsystem tested. The last four digits are hexadecimal (hex) numbers that indicate the **Block**, **Area**, **Routine**, and the failure identity. 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

The subsystem character of an error index code is one of the following:

E	Executive
D	Display
G	Digitizer
L	Left Signal Input Channels (Vertical amplifier)
C	Center Signal Input Channels (Vertical amplifier)

Front panel controls are active during the Self-Tests diagnostic sequence, and any disturbance causes a test failure. If a failure occurs, then the oscilloscope automatically enters the Extended Diagnostics mode and displays the **Extended Diagnostics** menu/status area. Touching **Exit** removes the menu, and resumes normal operation. However, if the diagnostics detect a fatal Digitizer processor Kernel diagnostics fault, then exiting the menu to normal operation is not 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
- time bases
- points acquisition
- triggers
- points/address generator
- left vertical amplifier channels
- center vertical amplifier channels

Using the Self-Tests/Extended Diagnostics—After all Self-Tests/Extended Diagnostic have executed, any resultant error index codes appear on the display next to the associated circuit block names in the **Extended Diagnostics** menu/status area. Each circuit block that experienced a failure, reports the first error encountered and the number of failures in the block. To obtain a more complete list of the error index codes in a block, select the label of a failed block, then select **Area**. If you select **Routine**, the lowest level test routines in the selected **Area** are displayed. The currently selected **Block**, **Area**, and **Routine** are displayed below their labels at the bottom of the menu/status area. Several operating mode selectors are also available at the bottom of the menu/status area. When certain test routines are selected, some of these operating modes are unselectable. The mode operators are as follows:

- **Exit**—Extended Diagnostics is terminated and the oscilloscope enters the normal operating mode.
- **Loop**—Toggles On and Off. When On, the selected test(s) is executed continuously with the number of iterations displayed.

- **Terse**—Toggles On and Off. When On, tests in the loop mode execute at the fastest rate, but the iteration readout is not updated until the test is stopped. To manually stop the test, touch the screen or a button.
- **All**—Toggles On and Off. When On, all tests in the current menu are selected to execute when started.
- **Stop on Err**—Toggles On and Off. When On, testing stops after the first failed test completes.
- **Run/Quit**—Starts or stops the currently selected tests.

Note: *Touching any place on the screen (or any front panel button) while a test is executing, will stop the test when the current routine is completed.*

Restoring Data

If the PRINCIPAL POWER SWITCH is turned OFF during probe calibration, Self-Tests diagnostics, or Extended Diagnostics, some internal data may be corrupted. The display of the Extended Diagnostics menu when the power is turned on, indicates that this corruption has occurred.

If the Extended Diagnostics menu displays a Signal Input Cksm Probe error (this error indicates that PRINCIPAL POWER SWITCH was turned OFF during probe calibration), then using the following procedure usually restores normal operation:

☐ Step 1: Note from the **Extended Diagnostics** menu/status area which channels are (L, or C) at fault.

☐ Step 2: Exit the **Extended Diagnostics** menu/status area.

☐ Step 3: Remove and reinstall the probes on the channels that are at fault.

☐ Step 4: Repeat the calibration of these probes.

☐ Step 5: Execute the Self-Tests diagnostics, and confirm that the tests have **pass** status.

If the Extended Diagnostics menu displays a Signal Input Cksm Plug or any other new error, then using the following procedure usually restores normal operation:

☐ Step 1: Exit the **Extended Diagnostic** menu/status area.

☐ Step 2: Wait for the Self-Tests diagnostic to complete and have **pass** status.

☐ Step 3: Execute the Self-Tests diagnostics, and confirm that the tests have **pass** status.

Usually these procedures restore normal operation. If these procedures do not restore normal operation, then your oscilloscope requries servicing.

Battery Testing

The 11201 oscilloscope contains two lithium batteries to provide power when the oscilloscope is turned off. Battery BT130 powers the Real Time Clock (V614) on the A14 I/O board. Battery BT160 provides power to the static RAM (NV RAM) on the A17 Main Processor board.

The Real Time Clock on the A14 I/O board will typically operate for five years on one battery. If the clock begins to lose time rapidly when the oscilloscope is turned off or the diagnostics report that the Real Time Clock has failed, the most likely source of the problem is the battery. If the battery drops below 2.7 V (at 20° C), then follow the instructions for replacement, under Battery Disposal and First Aid, earlier in this section.

The NV RAM will typically hold its contents for five years on one battery. If the diagnostics consistently report that the battery for the NV RAM is dead, then the battery should be tested. If the battery measures less than 2.45 V (at 20° C), then follow the instructions for replacement, under Battery Disposal and First Aid, earlier in this section.

Note: *If the diagnostics report an NV RAM battery failure, then exit the diagnostics. This will rewrite the confidence words into the NV RAM. Turn the oscilloscope OFF for at least one hour. Now, switch the PRINCIPAL POWER SWITCH ON. If the diagnostics still indicate an NV RAM battery failure, then the battery should be tested.*

Turning the PRINCIPAL POWER SWITCH OFF while the Extended Diagnostics is executing the NV RAM Memory Test usually causes a single failure of the NV RAM battery test.

Field Replaceable Unit (FRU) Guide

This section correlates error index codes resulting from diagnostic tests with the hybrid/integrated circuit (IC) and the board FRU(s) suspected of causing each error. The FRU(s) in the board FRU category are listed in most-to-least probable cause order (assuming only one error is indicated). If any diagnostic errors occur, inspect the suspect FRU for loose connections and components, and repeat the diagnostic test. If any diagnostic error is repeated, then replace the suspect FRU(s) with a known good FRU or FRUs. Check that the new FRU is configured exactly like the original FRU, and that any installed firmware matches the version in the original FRU. In addition, refer to Table 3-4, Checks Required After FRU Replacement earlier in this section, for any necessary adjustments and precautions.

The error index codes and tests are divided into three groups based on the five subsystems: Executive/Main Processor, Display, Digitizer, and Signal Input (two). The prefix letters on the error index codes, E, D, G, L, and C refer to these processors, respectively. Each subsystem group has a table of Kernel diagnostic error index codes, a table of Self-Tests/Extended Diagnostic error index codes, and a table of manual test error index codes.

Kernel error index codes for the Digitizer and Display are read as TTL logic levels on board pins using a logic probe. Refer to Table 2-2 for a complete description of the logic probe recommended.

Abbreviations of FRU Names

Table 3-5 lists FRU boards/assemblies and their abbreviation and number.

Table 3-5 *— Board FRUs/Assemblies*

FRU	Board/Assembly	Board No.
PIINT	Plug-In Interface board	(A1)
REG	Regulator board	(A4)
ACQ	Acquisition board	(A5)
STROBEDRV	Strobe Driver board	(A5A1)
TB	Time Base board	(A6)
DSY	Display Controller board	(A7)
CRT	Cathode Ray Tube	
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)
CMPR	Waveform Compressor board	(A16)
MPU	Main Processor board	(A17)
MEM	Memory board	(A18)
LMAIN	Main board (Left)	(A20A1)
CMAIN	Main board (Center)	(A21A1)
LFRONT	Front Panel board (Left)	(A20A2)
CFRONT	Front Panel board (Center)	(A21A2)
EXTRIG	External Trigger board	(A22)

Abbreviations of Component and Module Names

Table 3-6 lists the FRU components and modules and their abbreviation.

Table 3-6 *– FRU Components and Modules*

FRU	Component/Module
FW	Main Processor Firmware
FW	Display Processor Firmware
FW	Digitizer Processor Firmware
SDI	Serial Data Interface IC
DAG	DAG IC
PS	Power Supply Module
MPU	Main Board Processor
EPROM	Main Board Firmware
HK	Main Board Housekeeper
Att1	Attenuator, (L1, C1)
Att2	Attenuator, (L2, C2)
Amp1	Amplifier, (L1, C1)
Amp2	Amplifier, (L2, C2)

The Main, Display, and Digitizer Processor firmware are not separate components. These three components are packaged in a firmware (FW) kit.

Executive Subsystem Error Index Codes

Table 3-7 lists the Executive Processor Kernel Error Index Codes and their suspect faulty FRU(s). Table 3-8 lists the Exicutive Processor Self-Tests/Extended Diagnostics error index codes and their suspect faulty FRU(s).

Table 3-7 *— Executive Processor Kernel Error Index Codes*

Error Index*hex*	Hybrid/IC FRUs	Suspect Board FRUs
1F - 1C		MEM, MPU
1B - 18	FW	MPU
17 - 14	FW	MEM, MPU
13 - 11		IO, MPU
10		MPU
0F		MPU, MEM
0E		FPCTRL, IO, MPU
0D		IO, MPU
0C		IO, MPU
0B - 09		REAR, IO, MPU
08 - 06		MMU, MPU
04		REAR, IO, MPU
05		MPU, MEM

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.

Reading the Executive/Main processor subsystem error bits from the A17 Main Processor Board test points TP201 (MSB) to TP205 (LSB) is also possible (See Fig. 3-33 for the location of these status pins). The bits are high (+5 V) true.

The LEDs will flash while the Kernel diagnostic tests are executing. If a kernel failure is detected, then one or both LEDs will be lit.

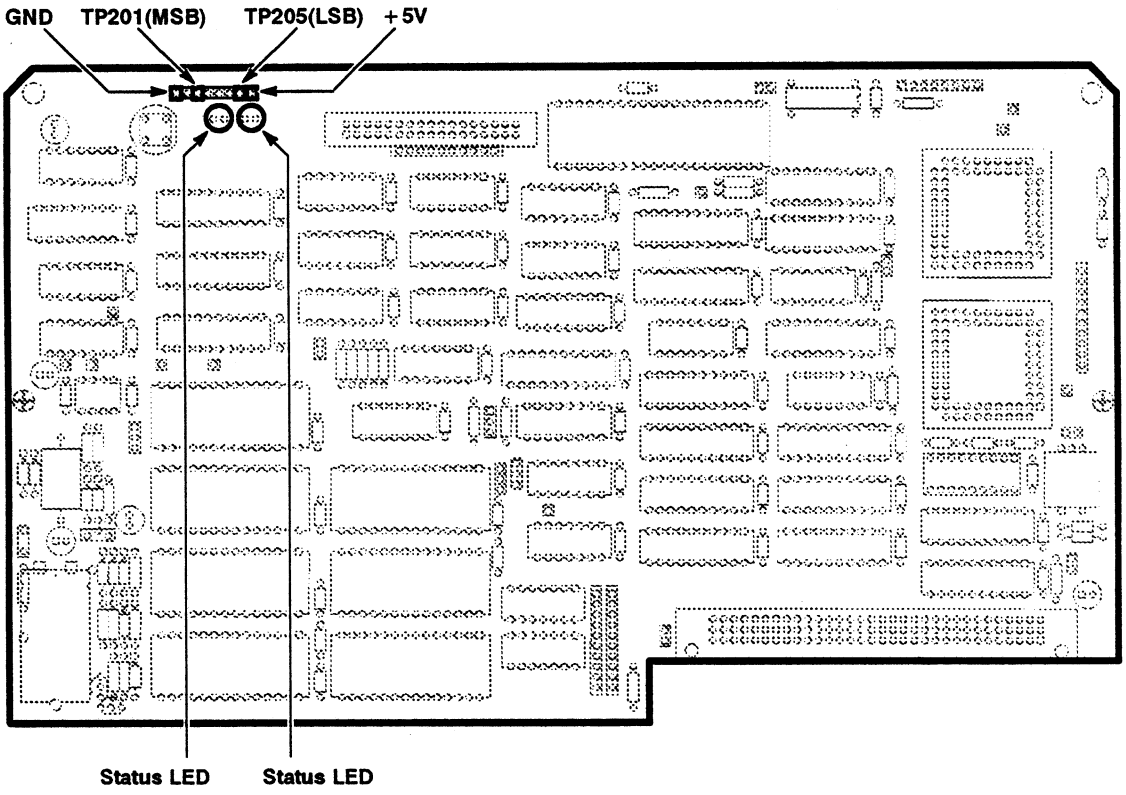

Figure 3-33 *— A17 Main Processor Board Status Pins*

Table 3-8 *— Executive Processor Self-Tests/ Extended Diagnostics Error Index Codes*

Error Index	Suspect Hybrid /IC FRUs	Suspect Board FRUs
E111X - E112X	FW	MPU
E113X - E11AX	FW	MEM, MPU
E121X - E122X	FW	MPU
E123X - E12AX	FW	MEM, MPU
E13XX		MEM, MPU
E14XX		MEM, MPU
E15XX		MPU
E16XX		MPU
E17XX		IO, MPU
E18XX		IO, MPU
E19XX		MPU, IO

Table 3-8 (cont) *– Executive Processor Self-Tests/Extended Error Index Codes*

Error Index	Suspect Hybrid /IC FRUs	Suspect Board FRUs
E1AXX		MEM, IO, MPU
E1BXX		MPU
E1CXX		MPU, MEM
E21XX		FPCTRL, IO, MPU
E22XX		FPBUT, TOUCH, FPCTRL, IO,MPU
E23XX		TOUCH, FPCTRL, IO, MPU
E24XX		IO, FPCTRL, MPU
E3XXX		IO, MPU
E4XXX		REAR, IO, MPU
E51XX		MMU, MPU
E52XX		MMU, MPU
E531X		CMPR, MPU
E532X - E53BX		CMPR, MMU, MPU
E54XX		CMPR, MMU, MPU
E55XX		CMPR, MMU, MPU
E561X		DSY, CMPR, MMU, MPU
E562X		TB, MMU, MPU
E57XX	SDI	IO, MPU
E581X		LMAIN, IO, PIINT, MPU
E582X		CMAIN, IO, PIINT, MPU
E583X		IO, PIINT, MPU

Table 3-9 lists the Executive Processor Manual Tests, 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, and produce no error index code displays. These tests 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 3-9 *– Executive Processor Manual Tests*

Test	Verification Procedure	Verification Procedure Failure: Suspect Board FRUs
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 you to interact, and is only executable 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 in 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.	FPBUT, TOUCH, FPCTRL, IO, MPU
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 you to interact, and is only executable 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.	TOUCH, FPCTRL, IO, MPU

Table 3-9 (cont) *– Executive Processor Manual Tests*

Test	Verification Procedure	Verification Procedure Failure: Suspect Board FRUs
Front Panel (cont)		
Verify (cont)		
Knobs	This test allows you to interactively turn either of the knobs and verify their operation. This test verifies knob movement with visual feedback. This test requires you to interact, and is only executable 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 its associated counter value changes.	IO, FPCTRL, MPU
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 you to interact, and is only executable 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.	IO, FPCTRL, MPU

Table 3-9 (cont) *– Executive Processor Manual Tests*

Test	Verification Procedure	Verification Procedure Failure: Suspect Board FRUs
Internal I/O		
RealTime Clk		
Calibrate	This test allows you to check and adjust the Real Time Clock period. This test requires you to interact, and is only executable 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 the Section 2, Checks and Adjustments.	IO, MPU
External I/O		
Printer		
Pattern	This test prints a set of of patterns (all printable ASCII characters) to help you verify the external printer interface. This test requires you interact, and is only executable in the **Routine** pop-up menu with the **All** mode set to **Off**. Before executing this test, the operator should connect a Centronics-compatible printer to the printer connector on the rear panel of the oscilloscope.	REAR, IO, MPU

Table 3-9 (cont) *– Executive Processor Manual Tests*

Test	Verification Procedure	Verification Procedure Failure: Suspect Board FRUs
External I/O		
RS-232		
Extern Loop	This test verifies parts of the external RS-232 interface This test requires you to interact, and is only executable in the **Routine** pop-up menu with the **All** mode set to **Off**. Before executing this test, the operator should connect an external loopback connector to the RS-232 connector on the rear panel of the oscilloscope.	REAR, IO, MPU
GPIB		
Intrpt 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 you to interact, and is only executable in the **Routine** pop-up menu with the **All** and **Loop** modes set to **Off**. Before executing this test, the operator should disconnect the oscilloscope from the GPIB bus.	REAR, IO, MPU

Display Subsystem Error Index Codes

Table 3-10 lists the Display Processor Kernel Error Index Codes and their suspect faulty FRU(s). Table 3-11 lists the Display Processor Self-Tests/Extended Diagnostics error index codes and their suspect faulty FRU(s).

Table 3-10 *— Display Processor Kernel Error Index Codes*

Error Index$_{hex}$	Suspect Hybrid/ IC FRUs	Suspect Board FRUs
FF - FE		DSY
FD - FA	FW	DSY
F9 - F5		DSY
F4		DSY, CMPR

The name of the first Display Kernel test that fails is displayed on the screen. The Display Processor error index code are read from the A7 Display Controller board test points TPH (LSB) to TPA (MSB) next to the STATUS 0 and STATUS 1 LEDs (see Fig. 3-34 for the location of these status pins). The bits are high (+5 V) true.

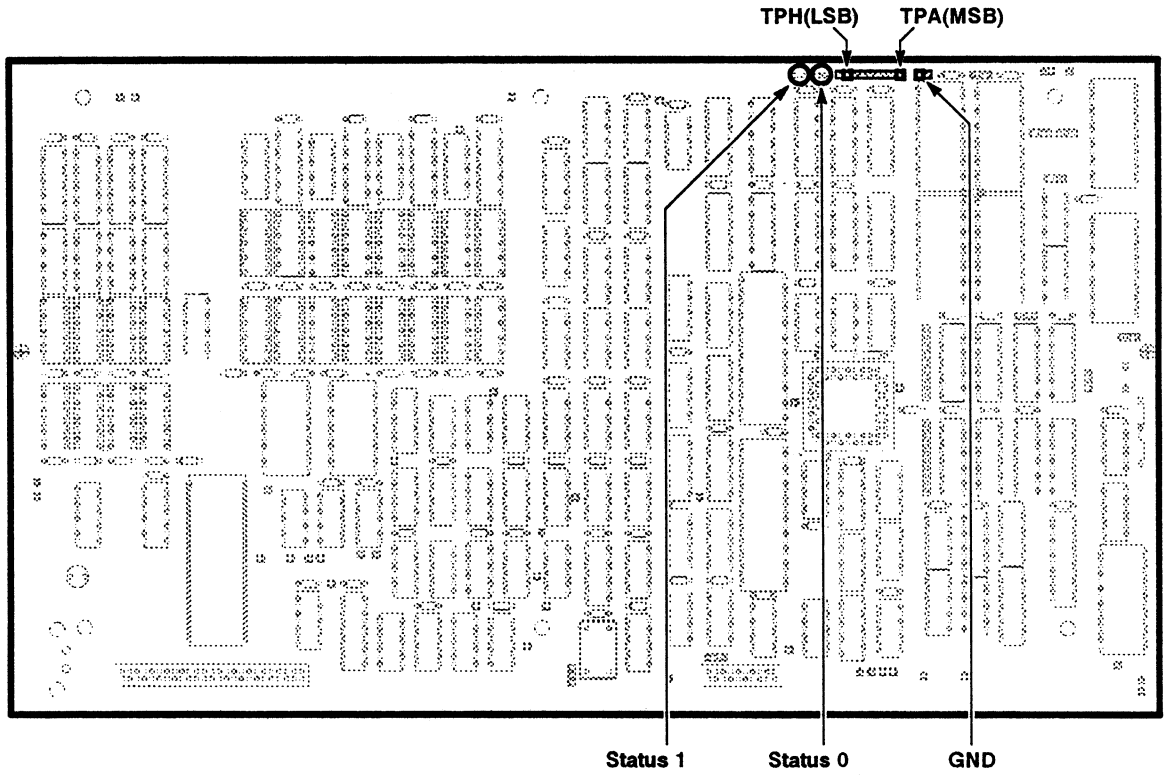

Figure 3-34 *— A7 Display Controller Board Status Pins*

Table 3-11 *– Display Processor Self-Tests/Extended Diagnostics Error Index Codes*

Error Index	Suspect Hybrid/ IC FRUs	Suspect Board FRUs
D11XX - D12XX	FW	DSY
D13XX		DSY
D14XX - D15XX		DSY
D161X		DSY, CMPR
D162X		DSY, CMPR
D163X		DSY, CMPR
D164X		DSY, CMPR
D21XX		DSY
D22XX - D26XX		DSY

Table 3-12 lists the Display Processor Manual Tests, the verification procedures, and the suspect board FRUs. If the condition specified in the verification procedure listed is not met, then the board FRUs listed are suspect.

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-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 3-12 *– Display Processor Manual Tests*

Error Index	Verification Procedure	Verification Procedure Failure: Suspect Board FRUs
Video Gen		
CRT Driver		
Stimulus	This test verifies the capability of the CRT Driver board to change the intensity of the CRT display screen. This test requires you to interact, and is only executable in the **Routine** pop-up menu with the **All** mode set to **Off**. Once this test is invoked, the operator is required to verify that the intensity of the display CRT screen changes through four different intensity levels.	CRTDR, DSY, CRT

Digitizer Subsystem Error Index Codes

Table 3-13 lists the Digitizer Processor Kernel diagnostic error index codes and their suspect faulty FRU(s). Table 3-14 lists the Digitizer Processor Self-Tests/Extended Diagnostics error index codes and their suspect faulty FRU(s).

Table 3-13 *— Digitizer Processor Kernel Diagnostic Tests Error Index Codes*

Error Index	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 Fig. 3-35 for the location of these status pins). The bits are high (+5 V) true.

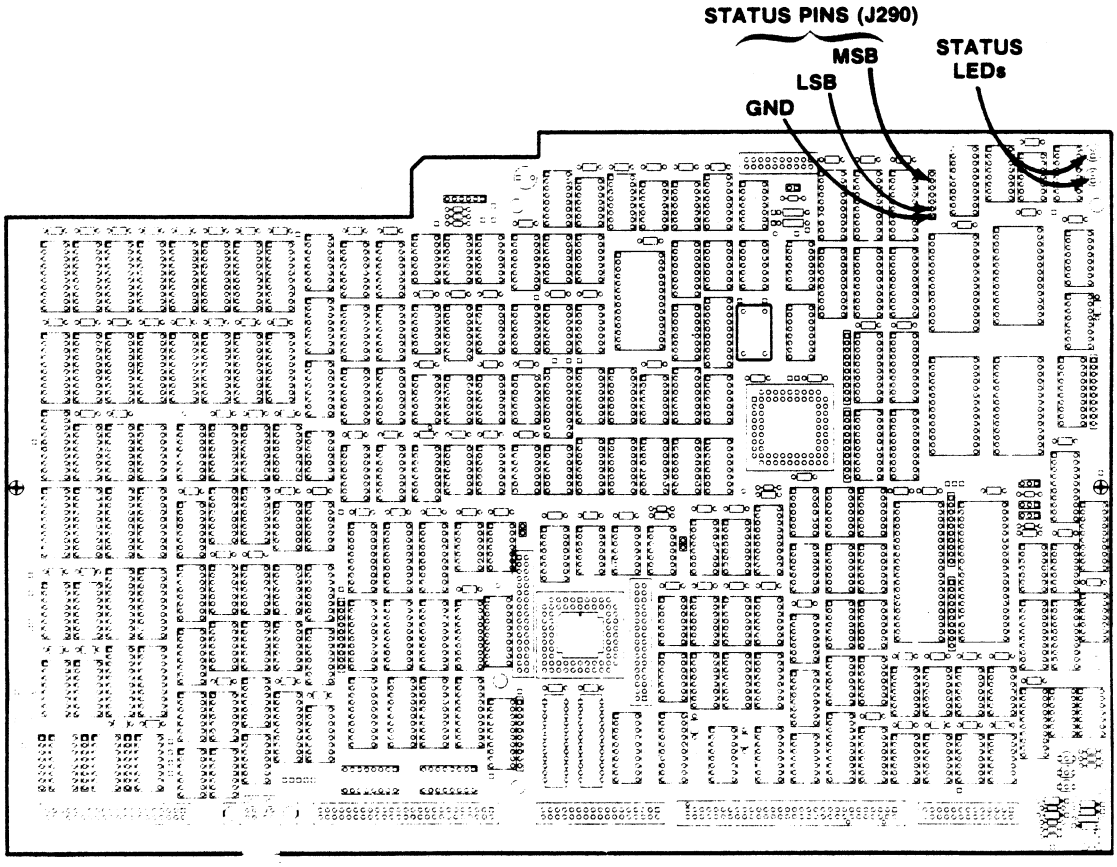

Figure 3-35 *— A6 Time Base Board Status Pins*

Table 3-14 *– Digitizer Processor Self-Tests/ Extended Diagnostics Error Index Codes*

Error Index	Suspect Hybrid/ IC FRUs	Suspect Board FRUs
G11XX - G12XX	FW	TB
G13XX		TB
G14XX - G15XX		TB
G16XX		TB, MMU
G21XX		ACQ, TB
G221X		TB
G222X - G223X		TB
G231X		TB
G232X		TB
G233X		TB
G234X		TB
G235X		TB
G236X		TB, ACQ
G31XX - G32XX		TB
G33XX		TB, ACQ
G351X - G352X		ACQ, TB
G353X		ACQ, TB
G35XX		ACQ, TB
G411X - G412X		TB, ACQ
G413X		TB, ACQ
G421X		TB, ACQ
G511X		TB
G52XX	DAG	TB
G53XX		TB, MMU

Table 3-15 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 3-15** — Digitizer Processor Manual Tests*

Error Index	Verification Procedure	Verification Procedure Failure: Suspect Board FRUs
Points Acq		
Cal Refs		
FP 1 KHz	This test verifies that the front panel CALIBRATOR is capable of generating a 6 V peak-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.	ACQ, TB
FP 1 MHz	This test verifies that the front panel CALIBRATOR is capable of generating a 6 V peak-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.	ACQ, TB
FP −10.000 V FP −5.000 V FP −2.5000 V FP −1.000 V FP −100.00mV FP +99.951mV FP +999.51mV FP +2.4988 V FP +4.9976 V FP +9.9951 V	This test verifies that the front panel CALIBRATOR is capable of generating −10.000 V dc, respectively. Once this test is invoked, you can use a Digital Voltmeter to verify the voltage present on the front panel CALIBRATOR bnc. Refer to Table 2-2 for a complete description of the digital multimeter required.	ACQ, TB

Note: *In Table 3-15, Points Acq denotes points acquired, Cal Refs denotes calibrator references, and FP denotes the Front Panel.*

Signal Input Module Error Index Codes

Table 3-16 lists the Signal Input Module Kernel error index codes and their suspect faulty FRU(s). Table 3-17 lists the Signal Input Module Kernel error index codes and their suspect faulty FRU(s).

Table 3-16 *– Signal Input Module Kernel Error Index Codes*

Error Code	Suspect Module, Hybrid, or IC FRU(s)	Suspect Board FRU(s)
1	EPROM, MPU	LMAIN, CMAIN
2	RAM	LMAIN, CMAIN
3	HK, MPU	LMAIN, CMAIN

Table 3-17 *– Signal Input Module Self-Tests/ Extended Diagnostics Error Index Codes*

Error Index	Suspect Module, Hybrid, or IC FRU(s)	Suspect Board FRU(s)
-1111		LMAIN, CMAIN
-1121		LMAIN, CMAIN
-1131[1]	RAM	LMAIN, CMAIN
-1141[1]	RAM	LMAIN, CMAIN
-1211		LMAIN, CMAIN
-1221	FUSE	LMAIN, CMAIN
-1311	HK	LMAIN, CMAIN
-1611	Amp	LMAIN, CMAIN
-1621	Att, Amp	LMAIN, CMAIN

[1]**These error indexes may also result from corruption of calibration data (refer to Restoring Calibration Data earlier in this section).**

Interconnections, such as A13 Mother board, cable, and Power Supply module interconnections, are not listed, but should be considered as possible problem sources.

Table 3-18 lists the error messages resulting from Enhanced Accuracy. Enhanced Accuracy is achieved after the system has a 20-minute warmup period.

Table 3-18 *—Enhanced Accuracy Error Index Codes*

Error Index	Suspect Hybrid/ IC FRU(s)	Suspect Board FRU(s)
-1411	Att1	
-1421	Att1	
-1431	Amp1	LMAIN, CMAIN
-1441	Amp1	LMAIN, CMAIN
-1451	Att1, Amp1	LMAIN, CMAIN
-1461	Amp1	LMAIN, CMAIN
-1471	Att1, Amp1	LMAIN, CMAIN
-1481	Amp1	LMAIN, CMAIN
-1491	Amp1	LMAIN, CMAIN
-14A1	Amp1	LMAIN, CMAIN
-1511	Att2	
-1521	Att2	
-1531	Amp2	LMAIN, CMAIN
-1541	Amp2	LMAIN, CMAIN
-1551	Att2, Amp2	LMAIN, CMAIN
-1561	Amp2	LMAIN, CMAIN
-1571	Att2, Amp2	LMAIN, CMAIN
-1581	Amp2	LMAIN, CMAIN
-1591	Amp2	LMAIN, CMAIN
-15A1	Amp2	LMAIN, CMAIN

Enhanced Accuracy Mode Troubleshooting

Table 3-19 lists the error messages that are possible in the Enhanced Accuracy state and the troubleshooting technique to use to eliminate this error. Enhanced accuracy is available after the system has a 20-minute warmup period.

Table 3-19 *– 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 Acquisiton 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	Reset the Digitizer Cal Constants as described on the following page. If the error message does not disappear, then replace the A5 Acquisition board.
Window Fine Holdoff'	Reset the Digitizer Cal Constants as described on the following page. If the error message does not disappear, then replace the A5 Acquisition board.
Main Trigger Level	Replace the A5 Acquisition board and/or the A1 Plug-in Interface board.

Note: *In Table 3-19, A/D denotes an analog to digital converter, and D/A denotes a digital to analog converter.*

Reset Digitizer Cal Constants

When an error message indicates the need to reset the digitizer cal constants (refer to Table 3-19) you should complete the following steps: (You will need a CAL-LOCK strap, debug strap, and a diagnostic terminal; refer to Table 2-2.)

- ☐ Step 1: Set the ON/STANDBY switch to STANDBY.
- ☐ Step 2: Remove the bottom cover from the oscilloscope.
- ☐ Step 3: Connect the CAL-LOCK strap to the J540 CAL-LOCK pins (see Fig. 3-11 for the location of these pins).
- ☐ Step 4: Connect the debug strap to the J270 DEBUG pins (see Fig. 3-11 for the location of these pins).
- ☐ Step 5: Connect the test terminal to the oscilloscope.
- ☐ Step 6: Turn the ON/STANDBY switch to ON.
- ☐ Step 7: Ignore any diagnostic error messages, and exit diagnostics.
- ☐ Step 8: Remove the debug strap.
- ☐ Step 9: Using the diagnostic test terminal, set Cal Constant 134 to the value written on the sticker attached to the A5 Acquisition board as follows:

mcalconst to 134:XXXX <CR>

- ☐ Step 10: To verify the cal constant, use the diagnostic test terminal to enter the query:

mcalconst? 134 <CR>

- ☐ Step 11: Turn the ON/STANDBY switch to STANDBY, and remove the CAL-LOCK strap and terminal.
- ☐ Step 12: Replace the bottom cover.

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 the following:

- ☐ Step 1: The PRINCIPAL POWER SWITCH located on the back panel is in the ON position.
- ☐ Step 2: The line cord is connected to a functional power source with the same output voltage set with the LINE VOLTAGE SELECTOR on the back panel.
- ☐ Step 3: Check that the fuse is good. If the fuse is blown, then replace the fuse.
- ☐ Step 4: Ensure that 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 power supplies test fixture, and refer to its accompanying documentation. The test fixture displays which power supply voltage source is having a problem. To help isolate the source of the problem, disconnect the power connection to the board, (with the defective source), and power-on the oscilloscope, again. This procedure is only effective for externally shorted power supplies. Once again, refer to documentation accompaning 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 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. Two different procedures are described here to help you determine whether the A7 Display Controller board, the CRT, or the A8 CRT Driver board is at fault.

- ☐ Step 1: With the power off (ON/STANDBY switch to STANDBY), remove the top cover, then turn the power on. Observe the two LEDs on the A7 Display

Controller board and those on the A17 Main Processor board in the card cage. These LEDs flicker on and off until the diagnostic tests are complete, then these LEDs should 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 or A8 CRT Driver board is suspect. Several ICs centered around the J53 cable connection between the A7 Display Controller board and the A8 CRT Driver board are also suspect. (These ICs generate the analog signals for the A8 CRT Driver board; but the diagnostics do not check these ICs.)

☐ Step 2: With the power off, connect a test terminal (ANSI 3.64-compatible) with 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/status area on the terminal display. If the displayed errors are only for the front panel touch screen, then the CRT or the A8 CRT Driver board is at fault. Note any other errors, and use the Table 3-5, earlier in this section to identify a suspect board.

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. 3-36). 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 panel 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 powered on). (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 Main Processor board's NV RAM. If the NV RAM 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 A17 Main Processor board uses the +15 V supply to operate the NV RAM circuitry. The information above and Table 3-20 will help you to identify a failure of one of these fuses. If a test fails, then check the fuses.

The A20A1/A21A1 Main boards have four fuses each (see Fig. 3-37). Probe power fuses F1001 through F1004 supply the attenuators connected to the board with +15 V, −15 V +5 V and −5 V power supplies.

Signal Input failure code 1221 indicates that one or more probe power fuses are defective.

To find a defective fuse, remove the Signal Input module from the oscilloscope, and use a multimeter to check for continuity across each fuse. Replace all defective fuses. Then, install the Signal Input module in the oscilloscope, and verify that the diagnostic error does not reappear.

The most probable cause of a blown fuse is a short circuit applied at the front panel TEKPROBE® input connector. If a newly installed fuse blows with nothing connected to the TEKPROBE® input connector, then search for a short circuit in the A20A1/A21A1 Main boards or on the flexible circuit connecting the A20A1/A21A1 Main boards to the TEKPROBE® input connector.

CAUTION

Using a replacement fuse with an incorrect current rating may cause ribbon cables to melt and create fire danger during a component fault.

See Figures 3-5 and 3-36 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 3-20 *— A14 I/O Board Fuse Failures*

Fuse	Kernel Test Failure J715 — J710	Test Failure J715 — J710
F200 open	OB hex (GPIB Interrupt)	
F800 open	OE hex (Front Panel Inter) Note: Front panel lights do not work. 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.	Exec Control E1511 2 NV RAM E1511 2 Battery E1511 1 Data Lines E1521 1 *Addr/Data E1531 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. It is not automatically executed by Self-Tests.**

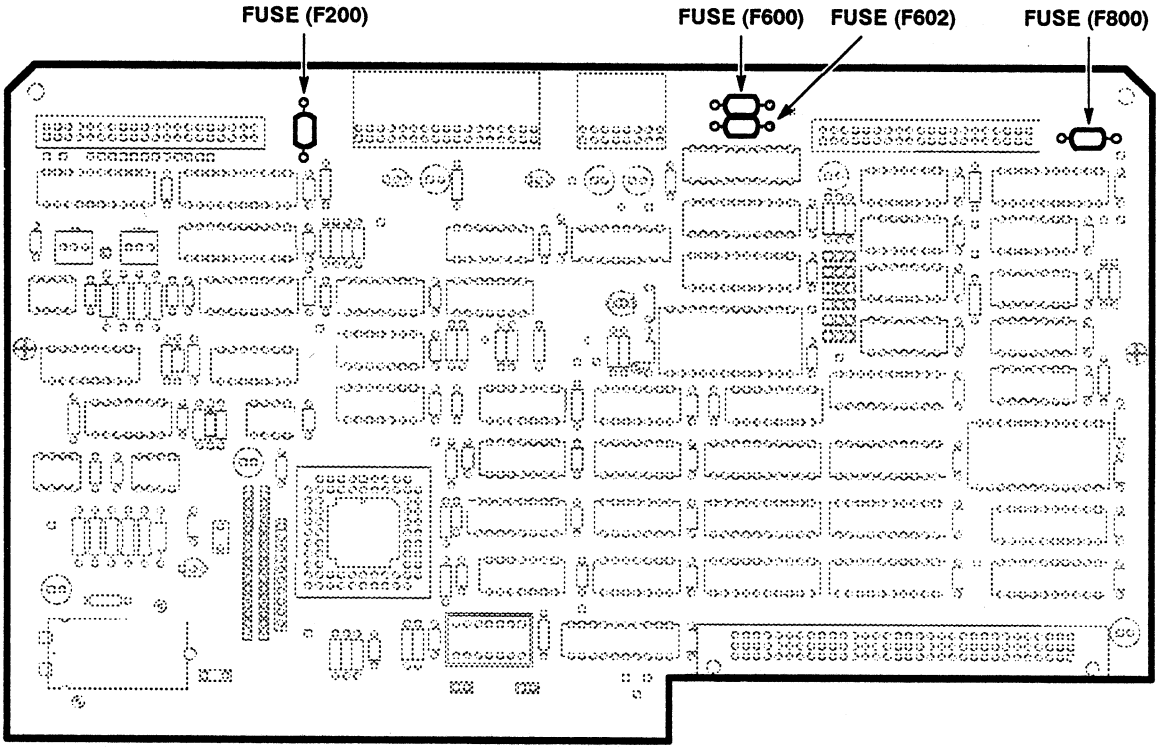

Figure 3-36 *— A14 I/O Board Fuse Locator Diagram*

Jumpers

Four jumpers are installed on the A20A1/A21A1 Main boards as follows for normal operation:

UID J611 in the vertical position
J740 in the vertical position
TP606 connected to TP607
TP605 connected to TP608

Refer to Figure 3-37, and verify that these jumpers are properly installed.

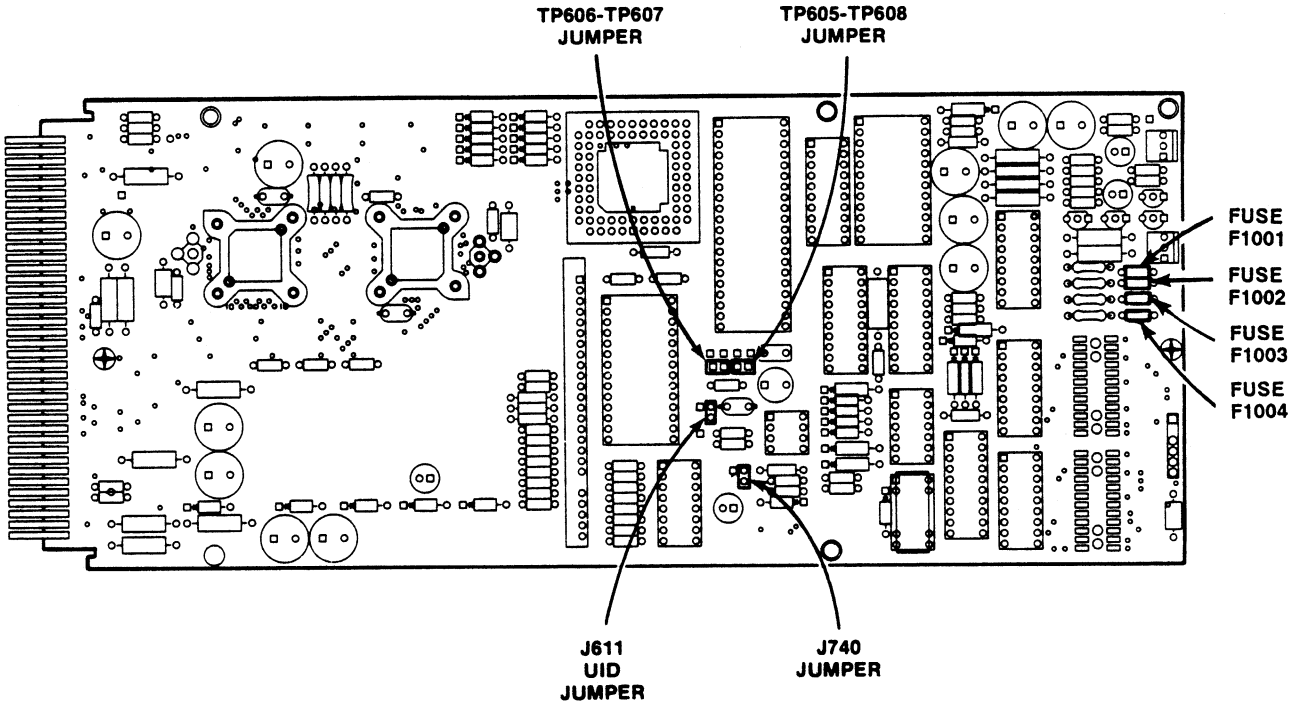

Figure 3-37 *— Location and Orientation of Jumpers and Fuses Installed on the A20A1/A21A1 Main Boards*

Theory of Operation

The 11201 Oscilloscope is a high resolution digitizing oscilloscope that provides four input channels and an internal trigger output signal. Features include:

- sweep rates ranging from one hundred seconds/division to one nanosecond/division
- autoset to provide a suitably adjusted display for viewing and further manual adjustment
- windows for viewing expanded sections of a trace
- Self-Test diagnosticss 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

System Functional Overview

This section describes and illustrates the major functional blocks of the 11201 Oscilloscope (see Fig. 4-1).

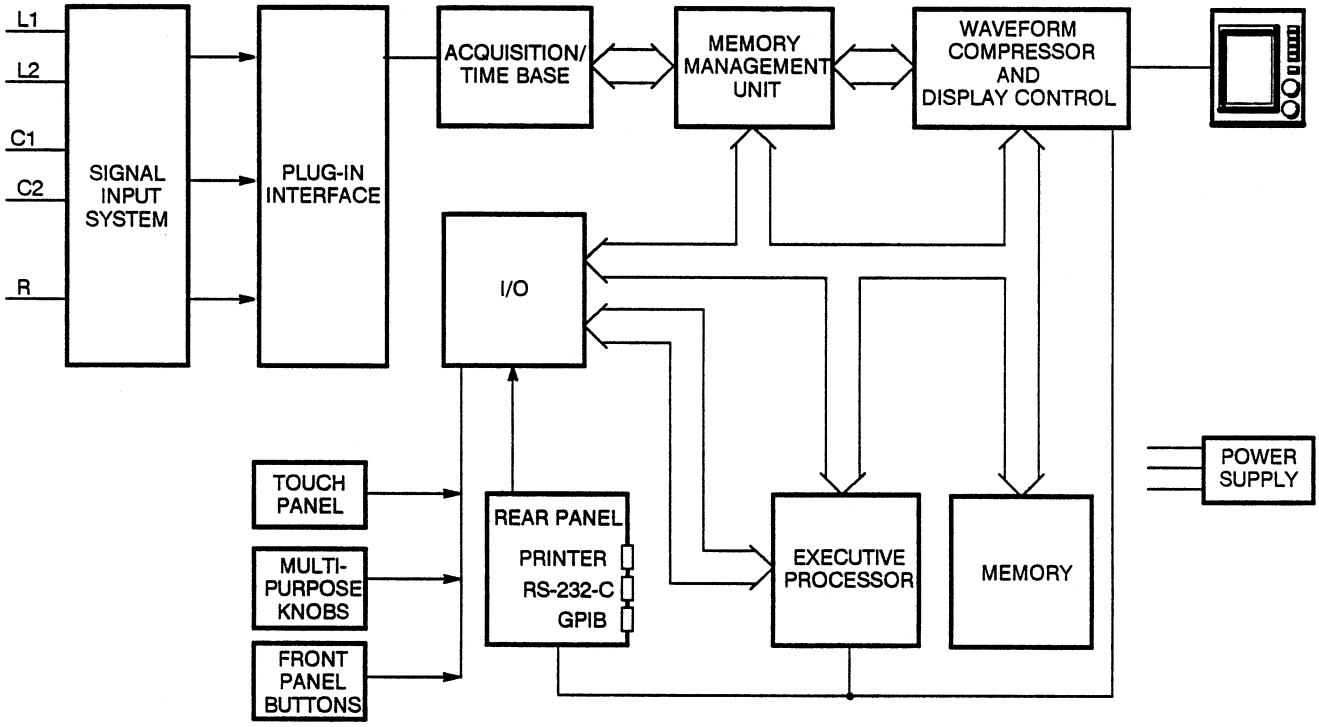

***Figure 4-1** — 11201 Oscilloscope System Functional Block Diagram*

Signal Input Block

The Signal Input system block is comprised of two vertical amplifiers and a trigger amplifier. Each vertical amplifier contains a microprocessor and associated ROM and RAM.

The Signal Input system block receives input signals from the channel input connectors (L1, L2, C1, C2, and R). The signal is attenuated, amplified, and then sent to the Acquisition/Time Base block through the Plug-in Interface block.

Time Base/ Acquisition Block

The Acquisition/Time Base block is comprised of:

- a microprocessor (Digitizer) with local RAM and ROM
- the time base and trigger circuits
- interface to the Memory Management Unit (MMU) and the Plug-in Interface

Memory Management Unit Block

The Memory Management Unit (MMU) arbitrates requests for access to the Memory from three sources:

- the Waveform Compressor and Display Control block
- the Digitizer Processor (Acquisition/Time block)
- the Executive Processor (EXP)

This arbitration allows all three systems transparent access to the Memory.

Waveform Compressor and Display Control Block

The Display Control subsystem of the oscilloscope is used to provide 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 (which include menus, labeling for touch panel input, and an interactive output to assist in operating the system; that is, the current mode-setting information).

The oscilloscope uses a custom vertical raster-scan display that provides excellent resolution for both waveform display and text. The Display control system produces a display as follows:

1. the display system transfers waveform data from the Memory
2. then, the display system compresses the waveform in data into 512 horizontal pixels
3. then, the display system converts the compressed waveform data into a format compatible with the vertical raster-scan display

The waveform compressor takes waveforms with more than 512 data points and compresses these points into 512 groups. For example, for a 1024-point waveform, each group would contain two points; and for 2048-point waveforms, each group would contain four points. The waveform compressor finds the largest and smallest vertical value in a group of points and then either draws dots at the maximum and minimum values or a vector between the maximum and minimum values.

I/O Block

The I/O block provides an interface to the Rear Panel block and also the front panel buttons, touch panel and multi-purpose knobs.

Front Panel Controls

User control of the oscilloscope is primarily through:

- the front panel (major-menu) buttons
- the touch panel
- the multi-purpose knobs

The major menu buttons are the top level menu selections for the oscilloscope. Touching an icon, menu item, or waveform selects that particular icon, menu item, or waveform, respectively. The multi-purpose knobs control the function of the particular item that is selected.

Rear Panel Block

The Rear Panel block provides a GPIB port, RS-232-C port, and a PRINTER port for interfacing various peripheral devices.

Executive Processor Block

After the user requests 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 the user's request. To control operations the EXP controls and monitors the other circuit boards sharing the executive system bus. Through the Executive bus boards, the EXP also indirectly controls all other oscilloscope boards. The EXP generates commands and status signals to control onboard devices and I/O devices, such as GPIB and RS-232-C interfaces, that help process data and help control the rest of the oscilloscope.

Memory Block

The main function of the Memory block is to provide the EXP with dynamic 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:

1. Turn the rear panel PRINCIPAL POWER switch to ON
2. Turn the front panel ON/STANDBY switch to ON

A small green indicator lamp should light indicating the power is on.

Typical Waveform Processing Cycle

The following 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 RAM in the Memory block.
4. The EXP processes information from the human interfaces (that is; the menus, icons, buttons, and knobs that you interact with to control the oscilloscope).
5. The EXP sends commands to the Waveform Compressor and Display Control block so that the function that you selected is displayed.
6. When instructed by the EXP, the Waveform Compressor and Display Control 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 and illustrates the 11201 Oscilloscope block diagram (see Fig. 4-2).

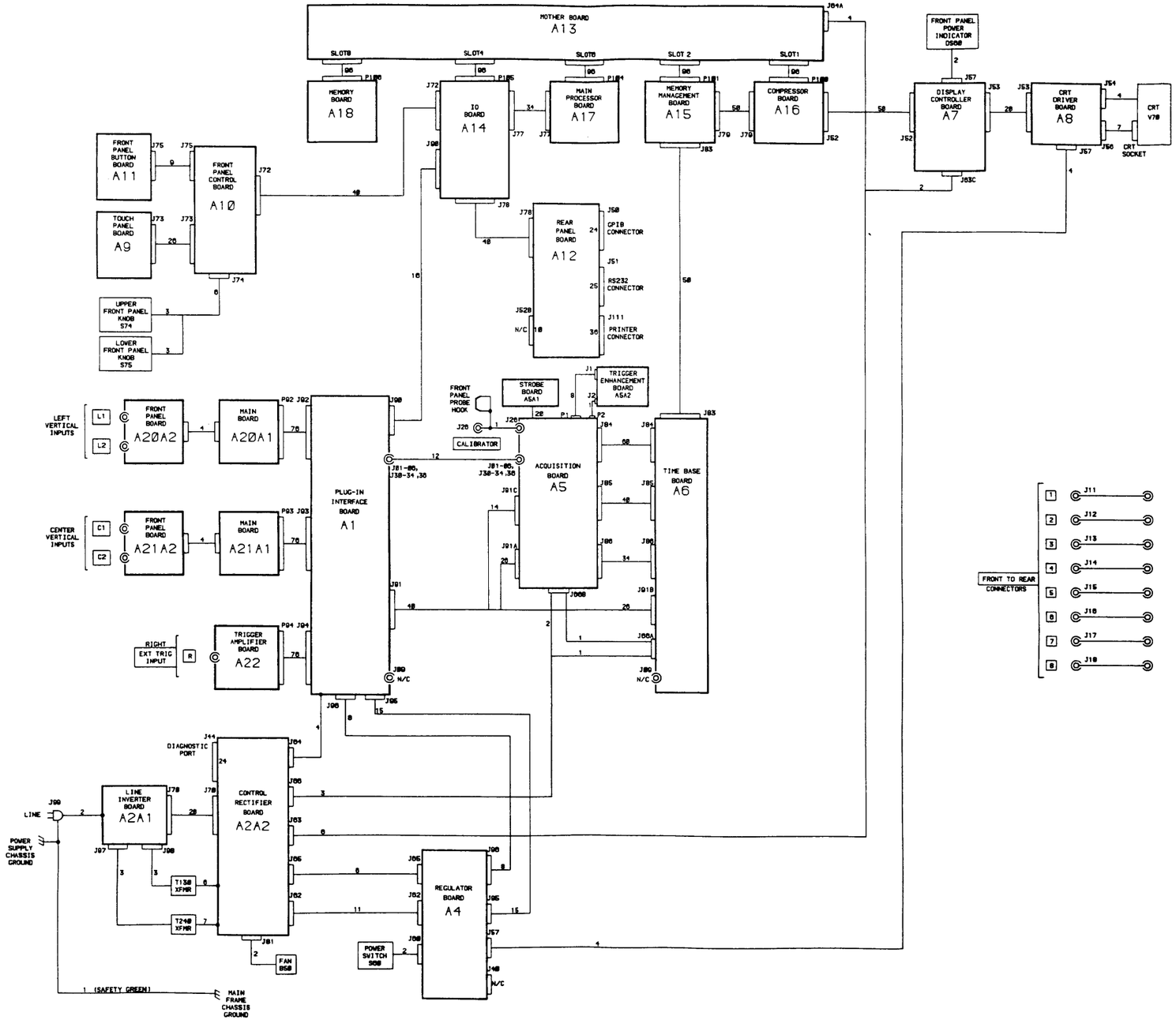

Figure 4-2 *— 11201 Oscilloscope Detailed Block (Cabling) Diagram*

A1 Plug-in Interface Board

The A1 Plug-in Interface board is the interface between the Signal Input module and the the other oscilloscope subsystems (Executive, Display, Digitizer, and Signal Input). 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

-15 V

+5 V

+15 V

-50 V

The operational amplifiers used for the +50, +15, +5, -50, -15 and -5 V regulators require that the following special voltages be generated for their operation:

- semi-regulated +54 V supply generates the +20 V supply
- semi-regulated -54 V supply generates the -20 V supply
- semi-regulated +54 V supply generates the +10 V supply
- semi-regulated -54 supply generates the -10 V supply
- +10.0 REF is used as 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 if 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.

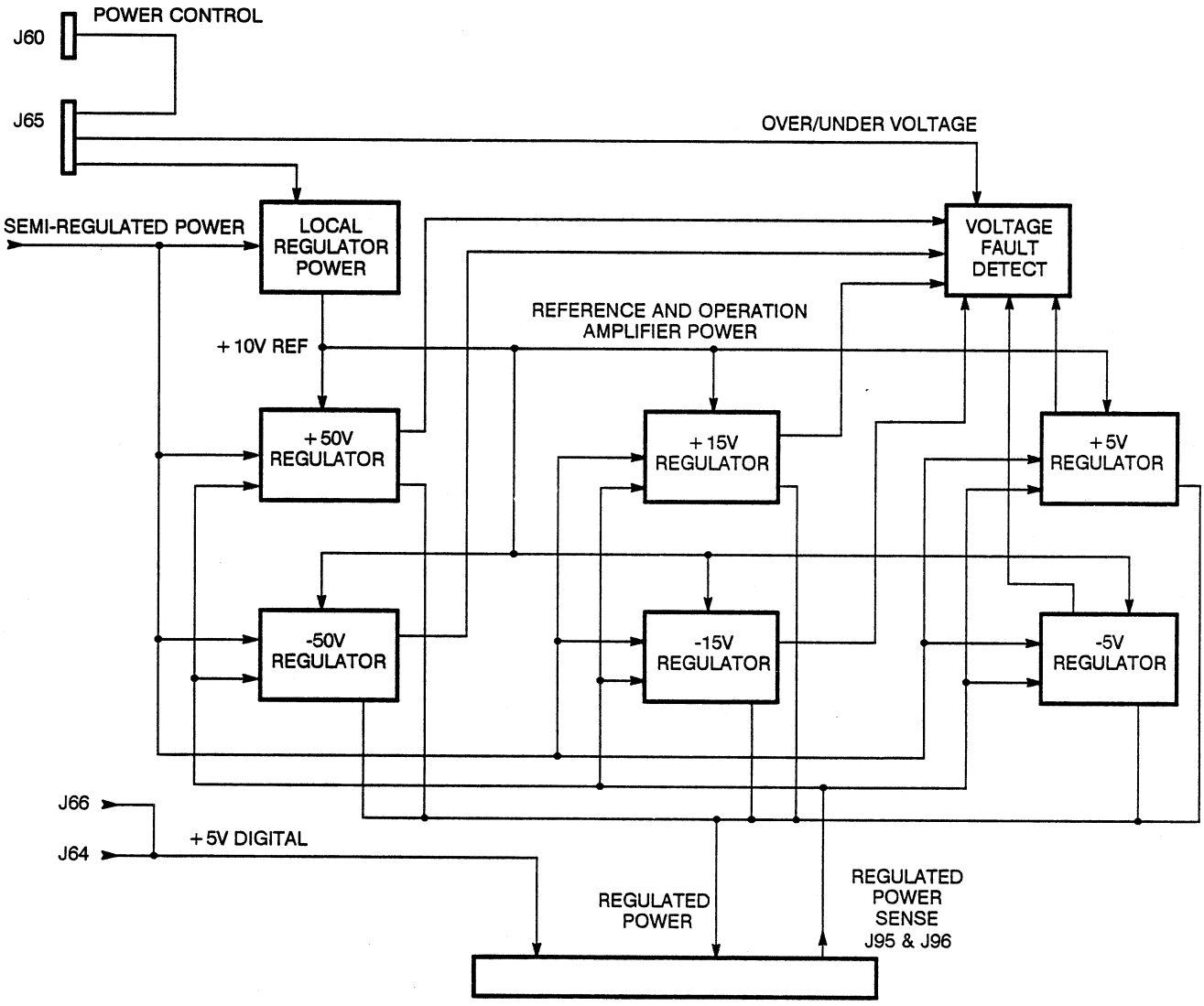

Figure 4-3 *— A4 Regulator Board Block Diagram*

A5 Acquisition Board

The A5 Acquisition board consists of:

- sample and hold circuits and the channel switch
- sample strobe generators
- analog to digital (A/D) converter
- 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 and hold circuits and the channel switch—collect input signals from the vertical amplifiers in the Signal Input module. Each of the vertical amplifiers has a sample/hold circuit dedicated to it. The voltage that is present at the time of the sample is stored in a capacitor followed by a buffer amplifier. The buffer amplifier from each sample/hold is fed to a channel switch. The A/D converter selects one of the input signals during its conversion cycle.

The sample strobe generators—generate the sampling strobe signals that drive the sample and hold circuits at the time of the sample. The strobe signal is a narrow pulse that turns off the sampler very quickly. This allows capturing of the high frequency components of the signals from the vertical amplifiers. Both sample/hold circuits are driven simultaneously, however the A/D conversion is done one at a time.

The analog to digital (A/D) converter—is a 10-bit, two-stage flash converter with error correction.

The clock generator—consists of two asynchronous oscillators. The first supplies signals to the strobe generators, A/D converter, time interpolators, and time base circuits. The second oscillator provides a clock for the main and window holdoff control circuits.

Main and window triggers circuits—both provide very similar features. An input channel switch allows selecting input signal sources. The channel switch provides a signal to the trigger latch. The holdoff circuit resets and enables this latch.

Holdoff control—determines when triggering is allowed. This enables the operator to trigger on specific portions of a complex signal. It also allows the system to prevent triggering when other operations are in progress.

Independent holdoff controls are provided for main and window triggers. The circuits are similar; consisting of fine and coarse sections. The coarse section consists of counters to provide relatively long periods of delay. The fine section uses analog ramp circuits to provide 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 allows the input signal samples to be placed with high resolution in the waveform record. Counters are used in conjunction with the time interpolators to provide both coarse and fine time placement of the samples.

Holdoff by events counters—consists of two sections. The high-speed counters are in these sections. (The slower-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 used for the Enhanced Accuracy feature of the oscilloscope. The circuit that provides these programmable control voltages utilizes one precision digital to analog (D/A) converter and many sample/hold 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 use when compensating and deskewing probes.

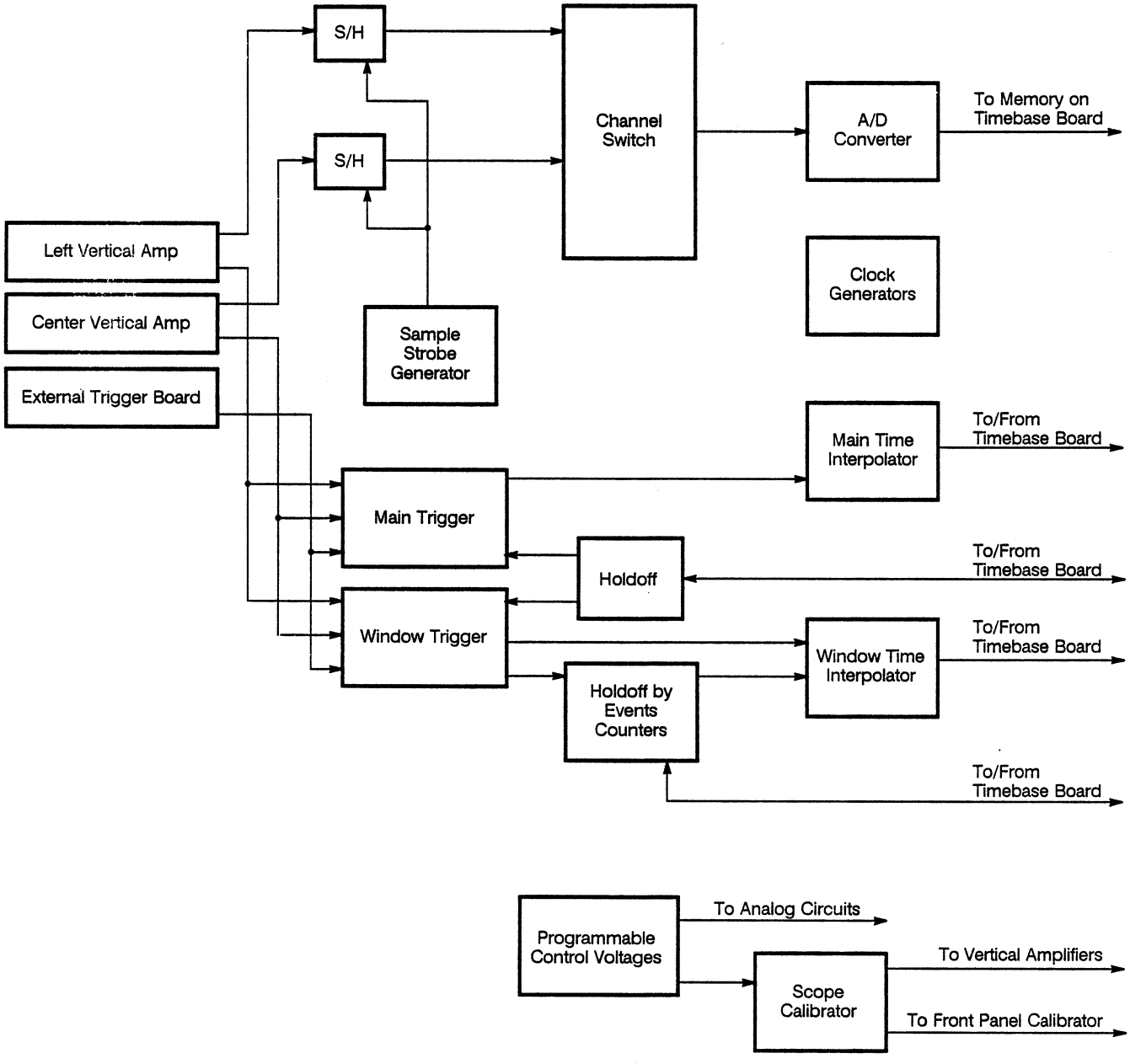

Figure 4-4 *— A5 Acquisition Board Block Diagram*

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:

- input data latches
- main record logic circuitry
- window record logic circuitry
- chop sequencer
- acquisitihon memory
- end detect logic circuitry
- destination Address Generator
- MPU system

See Figure 4-5 for a block diagram of this board.

Input data latches—temporarily store incoming data points from the Signal Input module.

Main record logic 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 in order to determine the position of each record in time.

Window record logic 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 logic circuitry—detects the end of the sweep for each record.

Destination Address Generator (DAG)—assigns each waveform data point an exact 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.

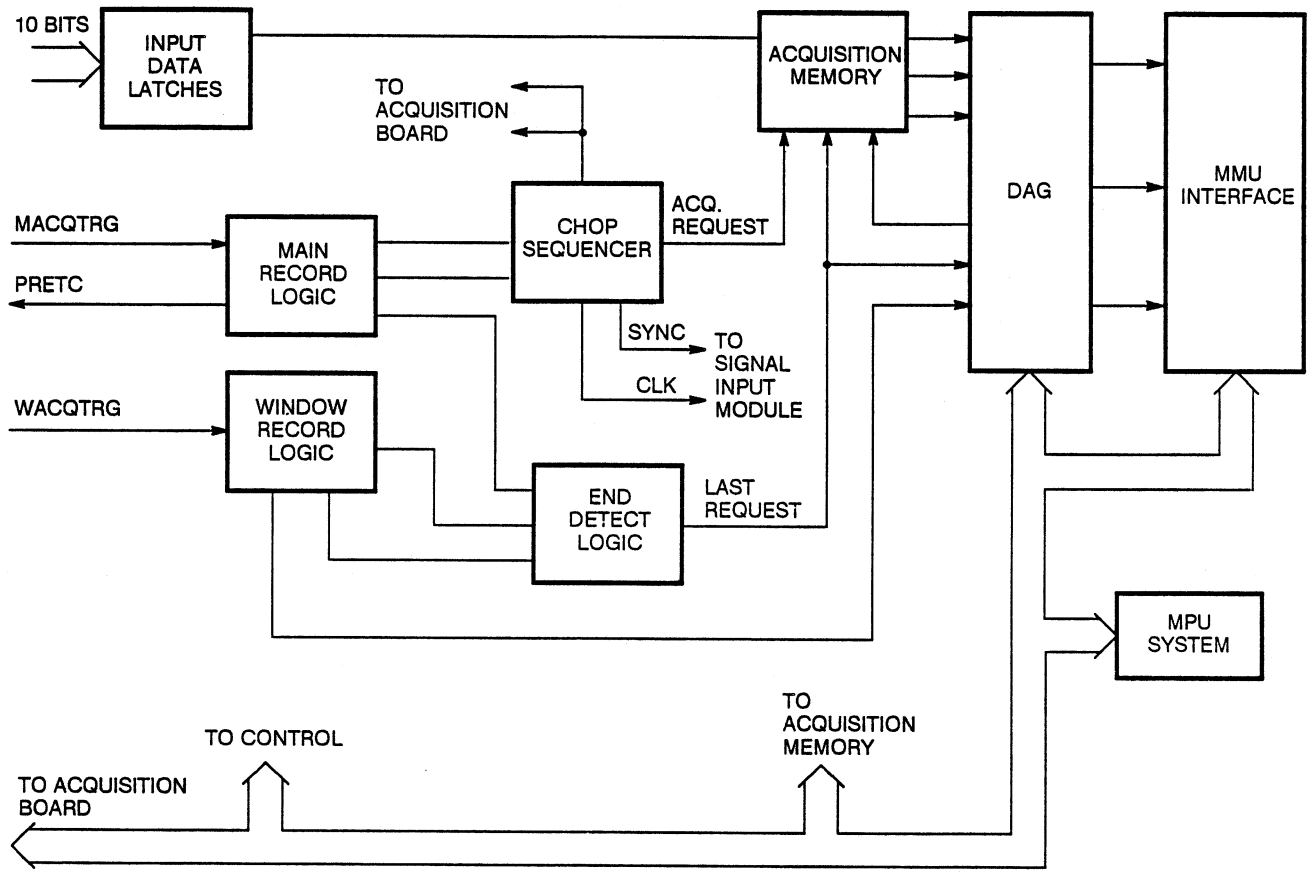

***Figure 4-5** — A6 Time Base Board Block Diagram*

The MPU system—is centered around a microprocessor that operates at 8 MHz. This microprocessor addresses several different blocks of memory and various I/O devices. A possible 250 K of EPROM and 16 K of RAM can be addressable to the microprocessor.

A7 Display Controller Board

The A7 Display Controller board is comprised of hardware and firmware working in conjunction to allow the EXP to present trace and other displays quickly and accurately. The hardware consists of:

- data communications circuitry
- a microprocessor
- CRT controller
- bit map RAM
- video raster scan (VRS) and Display RAM circuitry

The Display RAM, whose description follows, configures the displays. Then, the firmware places the display elements into the bit map.

And, the hardware and firmware of the A7 Display controller board form the complete Display subsystem of the oscilloscope.

See Figure 4-6 for a block diagram of this board.

The Data Communications circuitry—is the intended communication link with the EXP; and this communication occurs through the DMA channels incorporated in the microprocessor. (A serial channel is incorporated for diagnostic purposes only.)

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 address space of the microprocessor. The clock for this microprocessor operates at a frequency of 8 MHz.

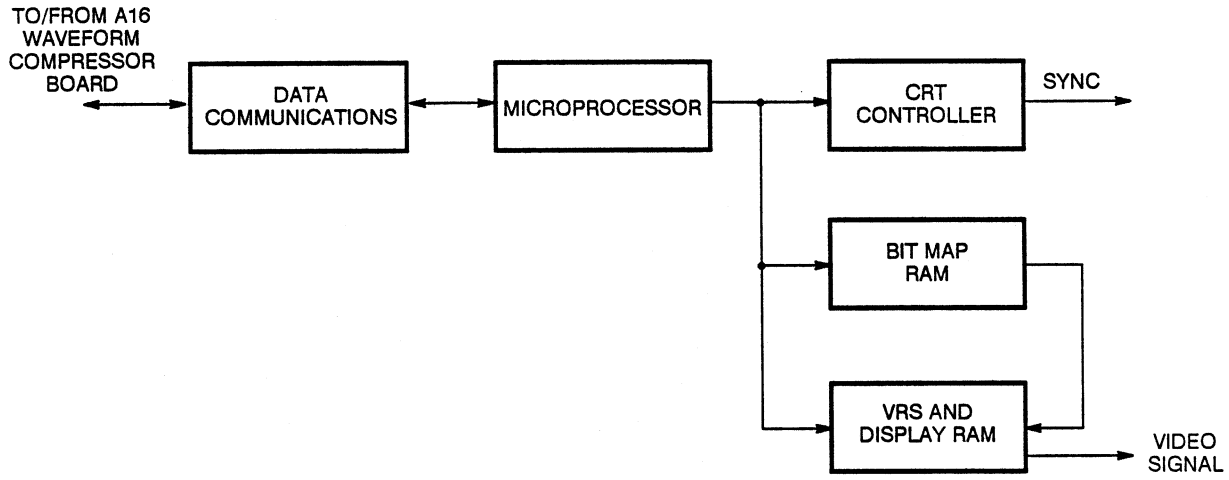

Figure 4-6 *— A7 Display Controller Board Block Diagram*

The CRT controller—is implemented with a VLSI IC. The controller is virtually automatic in operation and invisible to the firmware programmer, with the exception that several internal registers must be initialized at power-on.

The bit map RAM—consists of 196,608 bytes of RAM, divided into three bit planes of 65,536 bytes each (only two of these planes are used). 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 video raster scan (VRS) and Display RAM circuitry—is where the hardware recognizes and displays specific data structures, while the raster-scan displays the contents of the bit map. The VRS and display RAM consist of 65,536 bytes. These bytes contain minimum/maximum pairs of values, along with color index information and overrange/underrange settings. During the refresh of the screen, the hardware takes bit map data and combines it with any traces to be displayed; yielding a final color index that is used as an entry to the color map to determine a color or gray shade to be displayed.

A ninth data structure in this area is a clipping boundary; defined as the vertical height below which trace data (not bit map data) is suppressed during display. This height boundary can be set for each horizontal location across the screen, and is useful for the temporary suppression of traces within a specific area (for example, pop-up menus). When the boundary is completely reset to zero, all trace data is made visible again.

A8 CRT Driver Board

The A8 CRT Driver board consists of:

- horizontal sweep circuitry
- vertical sweep circuitry
- high voltage and grid voltage generator circuitry
- z-axis amplifier
- intensity circuitry

The A8 CRT Driver board circuitry drives the raster scan CRT. The video and sync signals from the A7 Display Controller board are used in generating the Z-Axis, sweep signals, and grid bias voltages for the CRT.

See Figure 4-7 for a block diagram of this board.

The horizontal sweep circuitry—generates the sweep current for the horizontal deflection yoke. The horizontal driver includes a voltage-controlled oscillator, a voltage ramp generator, a high-gain amplifier, and a flyback generator. These components provide sweep synchronization, horizontal deflection, and linearity.

The 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 high voltage and grid voltage generator circuitry—consists of the flyback transformer from the flyback waveform, which generates the 11.5 kV CRT anode potential and other bias voltages. This transformer is in parallel with the yokes and also supplies some of the sweep current for the yoke winding.

The Z-axis amplifier—produces the video signals which are decoded to give four output levels; off, dim, norm and bright. These signals are amplified by the Z-Axis amplifier. The resulting output is applied to the CRT through a peaking inductor. The Z-axis amplifier operates in a common-base configuration with a 50 MHz bandwidth.

The intensity circuitry—sets the intensity of the CRT image. The intensity is proportional to the output of a digital to analog converter. The serial input MON DATA sets this output, and the MON CLK clocks this output.

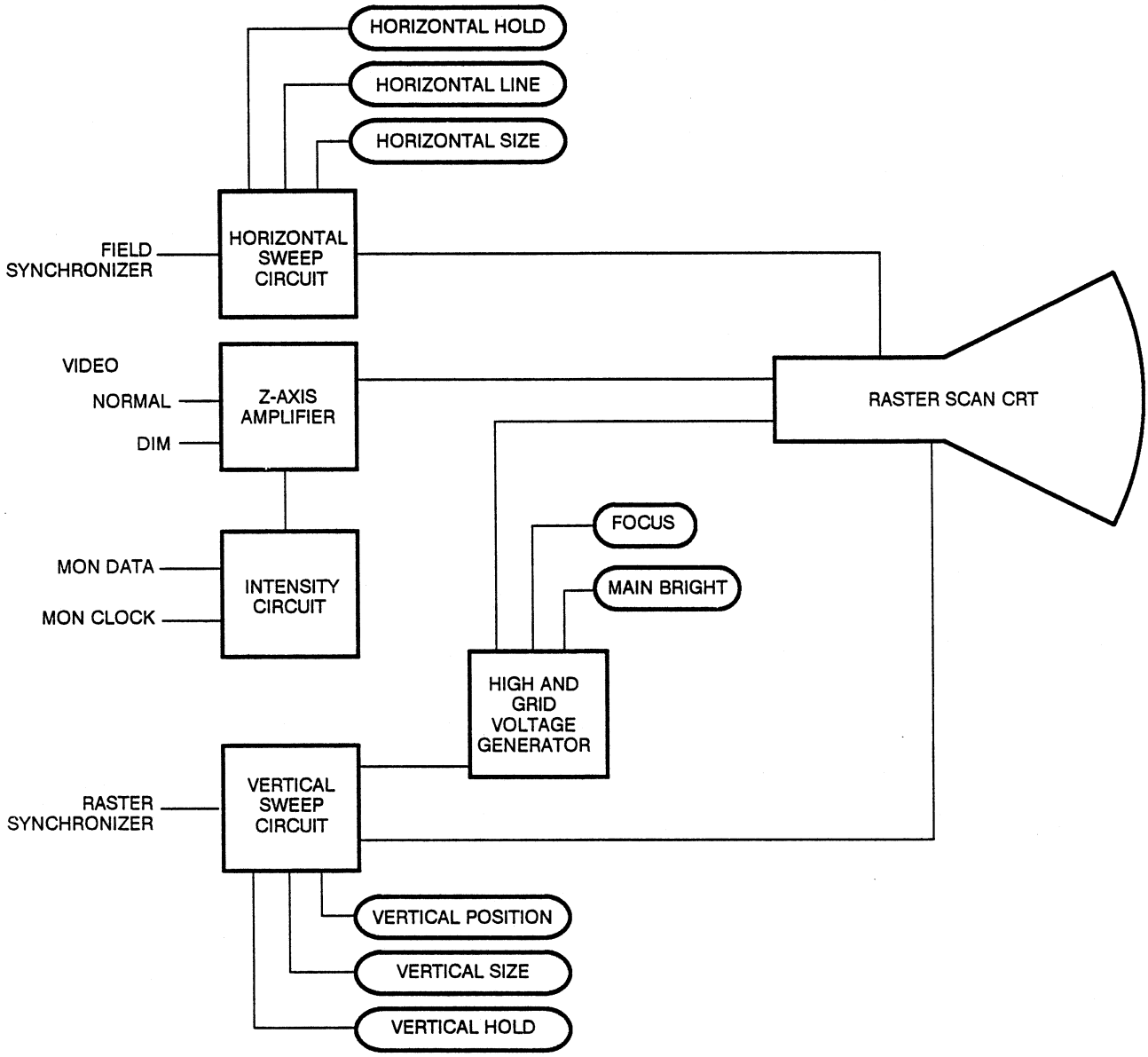

Figure 4-7 *— A8 CRT Driver Board Block Diagram*

A9, A10, and A11 Front Panel Boards

The A9, A10, and A11 Front Panel circuit boards specifically consist of:

- A9 Touch Panel assembly
- A10 Front Panel Control board
- A11 Front Panel Button board

The touch panel, major menu keys (hard keys), and menu status LED drive. 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 handles the touch matrix and hard keys. The display function drives the menu LED light bars.

The A9 Touch Panel assembly—is comprised of infrared LEDs that produce a matrix of light beams that are interrupted when you touch a particular touch zone. The touch panel and hard key matrix are scanned continuously until a shadow or keypress is detected. When a hit is detected, that scan is completed and the display controller asserts that interrupt line. During this time, the interrupt is active and no new data is written into the sensor RAM from the touch panel or hard keys, even though the hardware continues to scan; therefore, the data will remain stable in the sensor RAM while the microprocessor is in the process of reading this data.

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 bus that is used to select an infrared LED and its compliment phototransistor on the A9 Touch Panel board.

The A11 Front Panel Button board—is comprised of the major menu LED light bars which the display refresh register output of the A7 Display Controller board drives. Internally, there is a matrix of display RAM organized in an 8-bit by 8-bit matrix. This display RAM is scanned column by column (automatically); lighting the appropriate LED bar(s) when a high bit is encountered. A latch, controlled by the EXP, drives the coarse/fine LEDs. The **coarse/fine** selections are sensed on the A9 Touch Panel board.

A12 Rear Panel Assembly

The A12 Rear Panel assembly links the oscilloscope to other devices. This assembly contains connectors for:

- one GPIB Port
- one RS-232-C Port
- one 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:

- an 8-bit bidirectional data bus
- a four-bit address bus
- four interrupt lines
- GPIB DMA request and grant lines
- four device control lines
- assorted power supply and ground lines

See Figure 4-8 for a block diagram of this assembly.

The GPIB data and address bus—drive the GPIB controller IC directly. The GPIB controller IC uses the control signals, DBIN and WR to determine if the microprocessor is attempting to read or to write it. The interrupt controllers in the A17 Main Processor board monitor this interrupt line and will signal the microprocessor to service the GPIB controller IC. The GPIB controller IC requires the following:

- receiver section of the GPIB controller IC has a byte of data (inbyte register) from the GPIB bus that the microprocessor needs to read
- transmitter section register (outbyte register) is empty and is ready to receive another byte cf data
- microprocessor notification if the status of the GPIB bus or the GPIB controller IC has changed

On the opposite sides of the GPIB controller IC is another bus system. This other bus system includes an 8-bit data bus which accesses a directional GPIB data buffer; and an eight-bit control bus which 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 the buffer driver.

The state of three control signals from the GPIB controller IC, SRQ, NRFD, and NDAC, are monitored and displayed on the rear panel of the oscilloscope. These LEDs show the state that the GPIB controller IC is-in, not the state of the GPIB.

Two other significant signals are GPIB RQ and GPIB GR. The DMA Controller on the A17 Main Processor board uses these signals to communicate with the GPIB controller IC (if the DMAC IC is installed). The microprocessor can program the DMA to service either the inbyte register or the outbyte register.

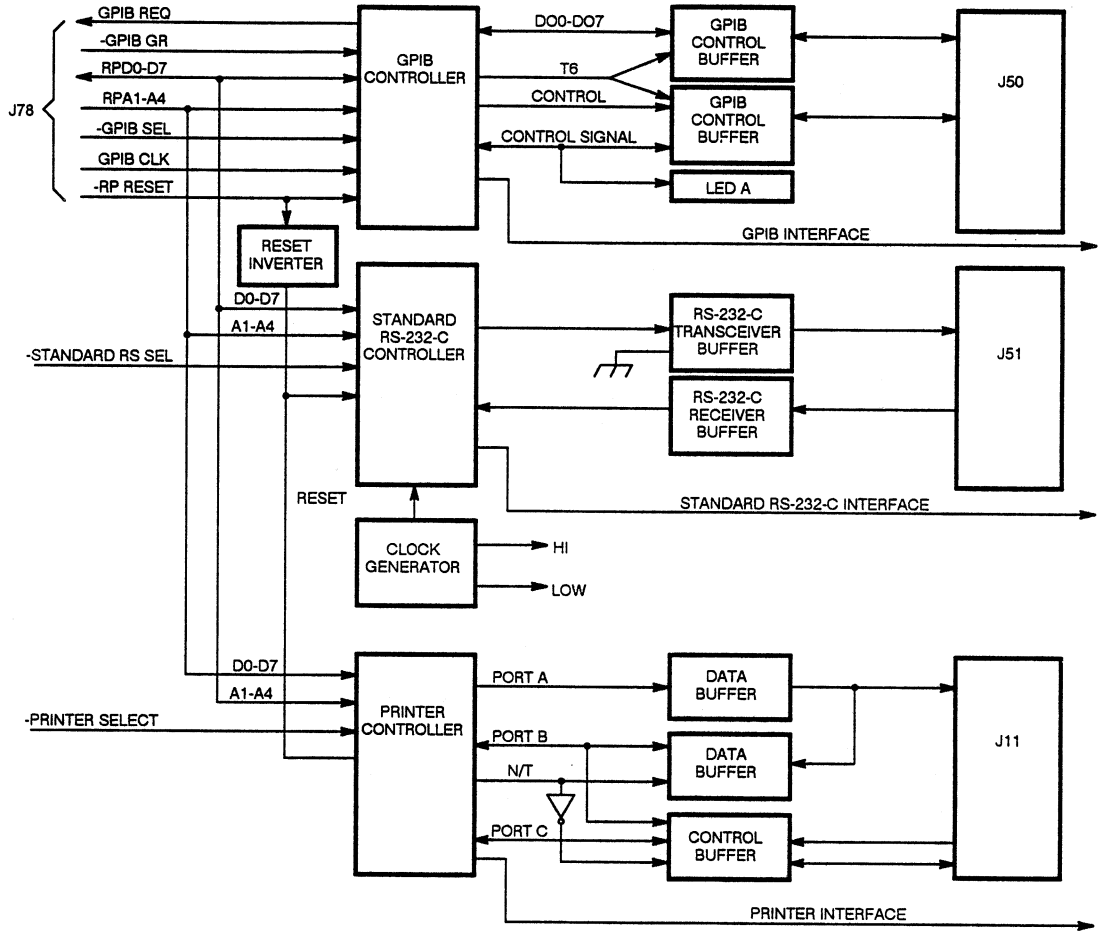

***Figure 4-8** — A12 Rear Panel Assembly Block Diagram*

The Standard RS-232-C controller—is connected to the same data bus and address bus as the GPIB controller IC. 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 GPIB controller IC. The STD RS SEL line goes low when the microprocessor wants to communicate with the RS-232-C controller. (This line also drives the Chip Enable).

The microprocessor drives the RD and WR signals if the GPIB controller IC is to be read or written into. This IC sets the STD RS INTR (interrupt) line low to request service from the microprocessor. The microprocessor writes a byte into the transmit buffer of the IC 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 it also converts serial data from the RS-232-C bus to parallel data for the microprocessor.

The transmit and receive buffers are compatible with the RS-232-C bus. The microprocessor Clear To Send (CTS) and Data Set Ready (DSR) can control the RS-232-C signals. The microprocessor can read the Request to Send (RTS) and

Data Terminal Ready (DTR) signals. The received signal detect (RSD) control signal is always high when power is on. The RS-232-C port is a DCE type.

The PRINTER Port (J111, Centronics style) – is controlled by a programmable peripheral interface IC. This IC has all the control lines necessary to connect to a microprocessor, plus two general purpose eight-bit ports and the control signals to use them. 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 the interface. 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 input port. Port C provides the control signals.

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
- A16 Waveform Compressor board
- A17 Main Processor board
- A18 Memory board

A14 Input/Output (I/O) Board

The A14 I/O board contains:

- data buffers
- timer configuration logic
- real time clock
- serial data interface (SDI)
- temp/tone readback buffer
- tone generator

The A14 I/O board is an interface between the EXP and communications ports (for example, RS-232-C and GPIB), devices on the A9, A10, A11 Front Panel circuit boards, the A12 Rear Panel assembly, and the Signal Input module. The EXP reads and writes to these I/O devices and the communication ports 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 and to read their statuses. Note that only one I/O device can be accessed at a time.

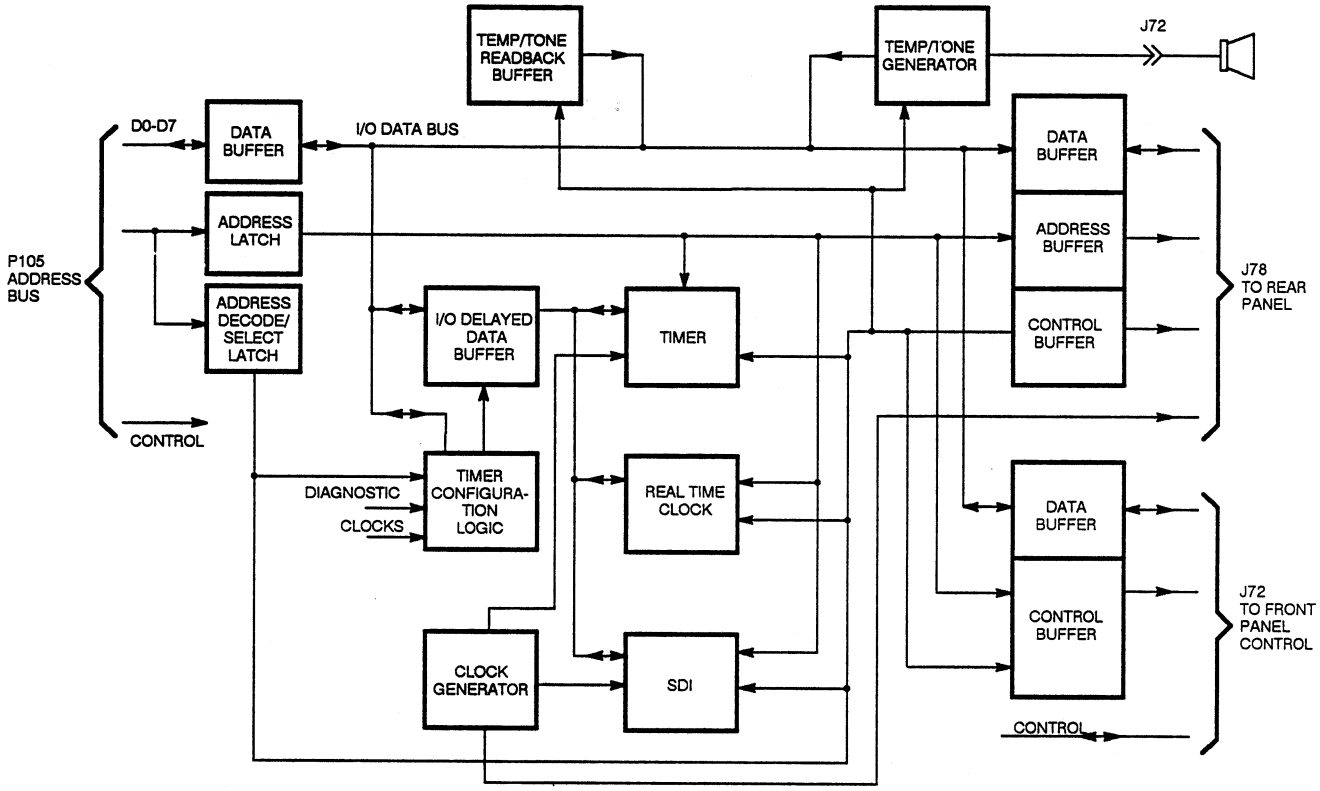

Figure 4-9 *— A14 I/O Board Block Diagram*

When the DMA controller is installed on the A17 Main Processor board, the A14 I/O board alters how it handles GPIB operations.

See Figure 4-9 for a block diagram of this board.

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 six different on-board devices, includes:

- I/O delayed data buffer
- rear panel data buffer
- front panel data buffer
- digital to analog converter (DAC) data latch
- tone/temp readback buffer
- timer configuration logic

The I/O delayed data buffer—interfaces between the I/O data bus and the Write Delayed data bus.

The timer configuration logic—is comprised of a latch and three two-input data multiplexers built with discrete gates. When the EXP writes to I/O address 3200*hex*, LS4(L) and BIOWC(L) go active and latch the I/O data bus. Some of the latched bits individually configure the usage of counters 1 and 2. This allows the timer 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 on.

The real time clock—and its oscillator circuit maintains the current time of day, which sets and reads the EXP.

The serial data interface (SDI)—is a custom IC that interfaces the EXP with both front panel knobs. The EXP controls this IC, and this IC interrupts the EXP when a device requires service.

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 temperature.

The tone generator—is based on a 555 timer; with a special current driver to set its frequency. The timer puts out a square wave whose frequency is inversely proportional to the digital value written to the temp/tone DAC. A zero value into the DAC produces the highest tone.

A15 Memory Management Unit (MMU) Board

The A15 MMU board consists of:

- the MMU gate array
- the status and mode registration (SMR)
- the display interface
- the Digitizer interface
- the Execution Processor interface

The A15 MMU board coordinates communications among three of the oscilloscope subsystems:

- Display
- Digitizer
- Executive Processor

The MMU gate array controls each interface with a different set of handshaking and buffer control lines. This board also contains buffers for each interface and two banks of DRAMS for waveform memory, address decode/select circuits, and integrated diagnostic control circuitry. To perform transfers, the EXP sets bits in a control register called the status and mode register (SMR). It must also load addresses and byte count information into either the sequential address generator (SAG) or the random address generator (RAG), which reside within the MMU.

See Figure 4-10 for a block diagram of this board.

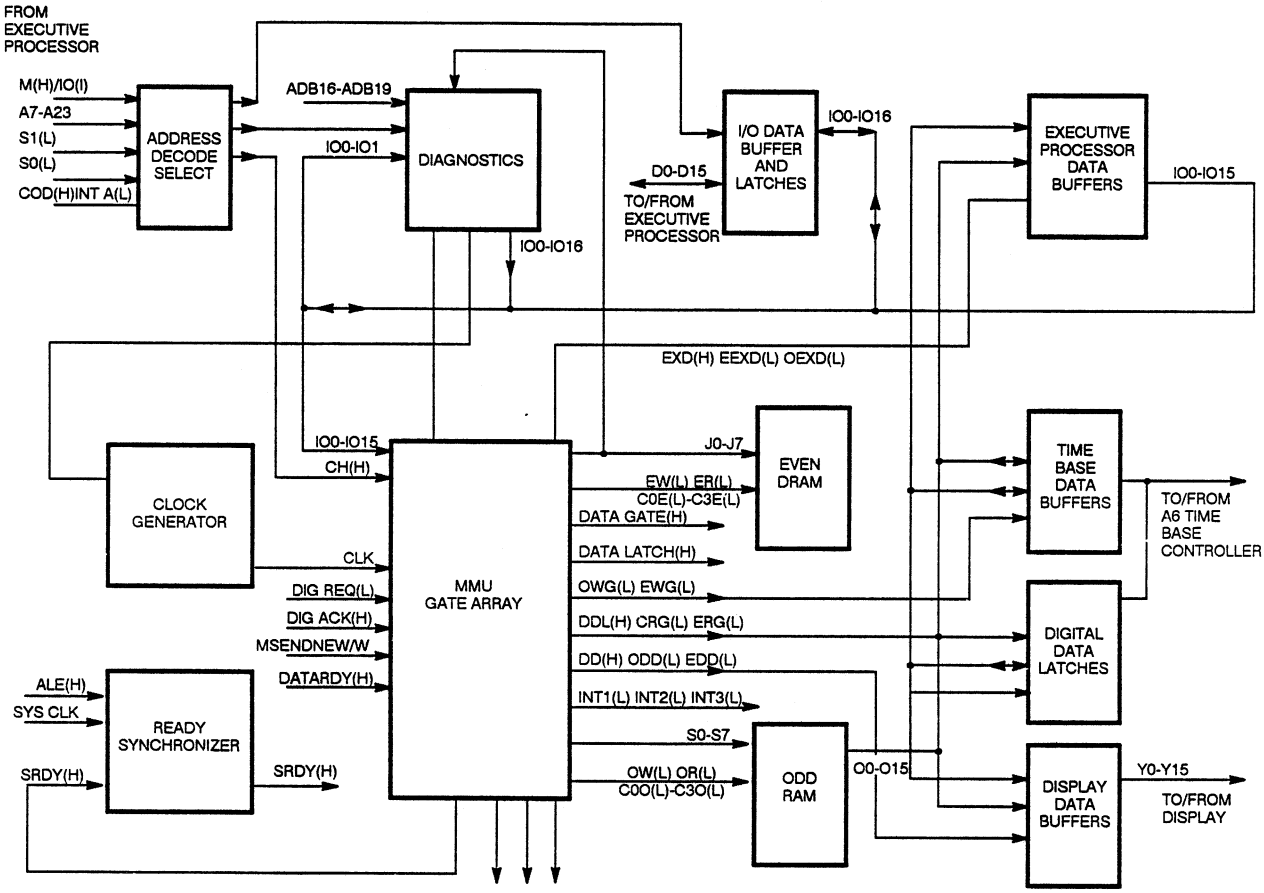

Figure 4-10 *— A15 MMU Board Block Diagram*

The MMU gate array—controls all data transfers to and from waveform memory. The MMU gate array controls high-speed transfers of waveform data and communication messages between waveform memory 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.

Through the status and mode register (SMR)—the EXP controls the MMU gate array; which is located at the EXPs I/O address, 1860*hex*. Upon power-on, the EXP must initialize the SMR, Display subsystem (bits 0 and 1), and the Time Base/ Controller subsystem (bits 5 and 6). When set, bit 7 allows the EXP to access the normally inaccessible registers, which are associated with the RAG, SAG and refresh counter.

Through the Display interface—data is transferred to and from the display through the A16 Waveform Compressor board on a 16-bit data bus (Y0-Y15). These data transfers use the SAG to specify the destination or source addresses in waveform memory. Data is buffered with the bi-directional Display data buffers for even and odd bank waveform memory accesses.

Through the Digitizer interface—data is transferred to and from the Digitizer on a 20-line multiplexed address/data bus, which dedicated handshaking lines coordinate. For transfers to waveform memory, the Digitizer sends a 20-bit address, then a 16-bit data word. During transfers from waveform memory to the Digitizer, only 16-bit data words are sent (while the MMU gate array's SAG provides the addressing for waveform memory).

This interface also consists of address, data, and status/control inputs, EXP interrupt outputs, and a data ready output.

The Executive Processor interface—performs two main functions:

- provides the EXP access to waveform memory for passing subsystem message and manipulation of waveform record data
- provides access to the status mode register (SMR) and the diagnostic facilities; allowing the EXP to coordinate system operation

A16 Waveform Compressor Board

The A16 Waveform Compressor board consists of:

- the adder circuitry
- the mode select latch
- the X and Y comparator output latch registers
- the X and Y comparators

The oscilloscope waveform display is comprised of 512 vertical lines, regardless of the waveform being displayed. The length of the individual vertical lines depends on the change in voltage at the time represented by the horizontal location of the particular vertical line.

The A16 Waveform Compressor board provides 512 pairs of data points to the display. The A15 MMU board always provides 512 groups of data points to the compressor. Hence, the name compressor, since the waveform compressor reduces its groups of input data points to pairs of data points.

The pairs of points transferred to the display are the minimum and the maximum of the input group.

See Figure 4-11 for a block diagram of this board.

The adder circuitry—provides you with vertical display position control, by either adding a digital offset (which is stored in the offset register) or subtracting the same digital offset from the data points.

A normal, nonvectored display may have gaps or holes between adjacent points. If you want a continuous display, without gaps or holes, then you can select the vectored display.

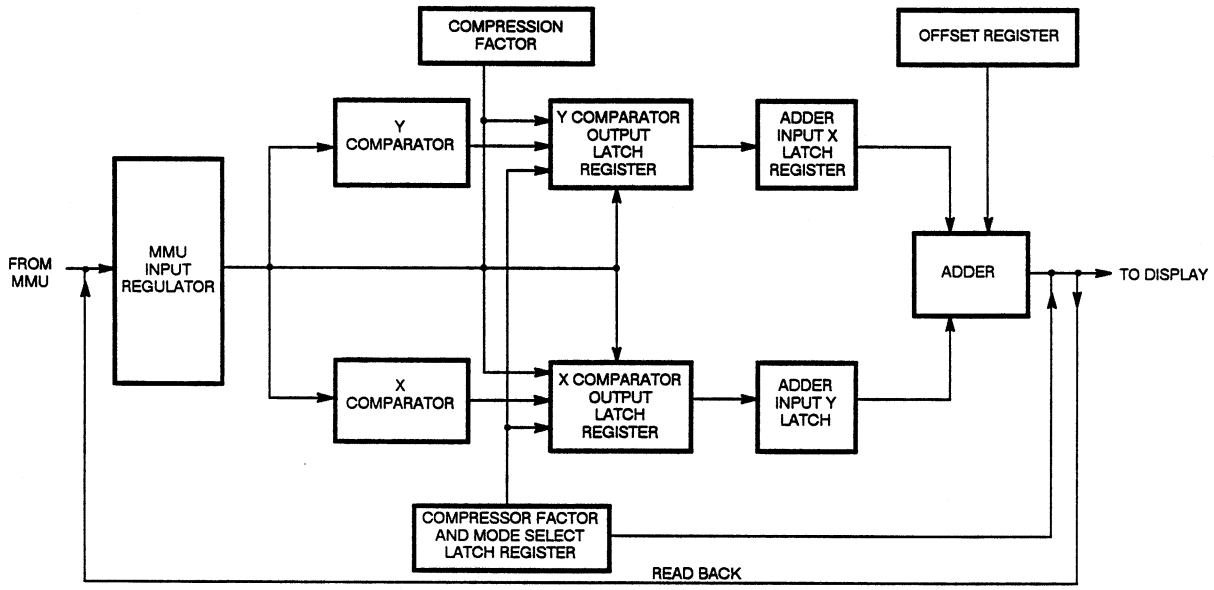

***Figure 4-11** — A16 Waveform Compressor Board Block Diagram*

Vectoring takes place by comparing each new data point in a set with a previous pair of displayed values, to determine if the new point is greater than, equal to, or less than those values.

The compression factor (CF) is the number of data points from which the compressor will select a min-max pair for the adder. The CF is an eight-bit number, valid in the 1 to 255 range. This value is stored in the compression factor register.

The Mode Select Latch—has three separate mode control bits; which allows eight modes. All eight modes are theoretically possible, although not all are particularly useful. The three mode selections are compress/transparent, vectored/nonvectored, and normal/test.

In the compress/transparent mode, the adder sends the X and Y register values; thus producing two output values for each input group. In the transparent mode, only the X or Y value is sent; that is, just one output for each input group.

The vectored/nonvectored mode determines whether previous data is considered when an operation is performed. When vectoring is on, consecutive data groups are compressed with respect to the previous group's minimum and maximum values. With vectoring off, the compressor's X and Y values are marked undefined before performing an operation on a new group.

The normal/test mode specifies whether the adder output is to be transferred to the Display or presented to the Executive Processor subsystem. In normal mode, the adder state machine waits for the Display's SENDNEW(L) signal before sending the data. In test mode, the adder state machine waits for the decoded DREAD(L) (data read) signal.

The X comparator and Y comparator output latch registers—hold the intermediate values of the compressed data groups, minimum and maximum values. The X com-parator output latch register can serve as either the minimum or maximum register; as determined by the M/M MUXSEL signal. The Y comparator output latch register will always be the opposite of X (that is, if X is min, then Y will be max; and vice versa). The outputs of the X and Y comparator output latch registers are connected directly to the input of the adder input X and Y registers, respectively.

The X and Y comparators—are eight-bit comparators that permit the oscilloscope to compare the compressor's present contents with the current input from the MMU. The MMU input register is connected to the P input of the X and Y comparators, and the X and Y comparator output latches are connected to their Q inputs. The four output signals encode the relationship between the values being compared. These signals are decoded in the min-max latch decoder.

A17 Main Processor Board

The A17 Main Processor board consists of the:

- numeric processor extension circuitry
- bus controller circuitry
- reset circuitry
- wait state circuitry
- interrupt controllers
- power-down circuitry

The EXP executes firmware routines stored in EPROMS located on the A17 Main Processor board and on the A18 Memory board to effectively control the operation of the oscilloscope. Along with the numeric processor extension, 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 on-board EPROMs and on the A18 Memory board.

See Figure 4-12 for a block diagram of this board.

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 $0FF_{hex}$. Latched select line LS1 enables the numeric co-processor at the numeric processor select input, NPS1 (pin 34).

Address decoders, address latches, and memory data buffers are all support circuits for input/output and memory devices.

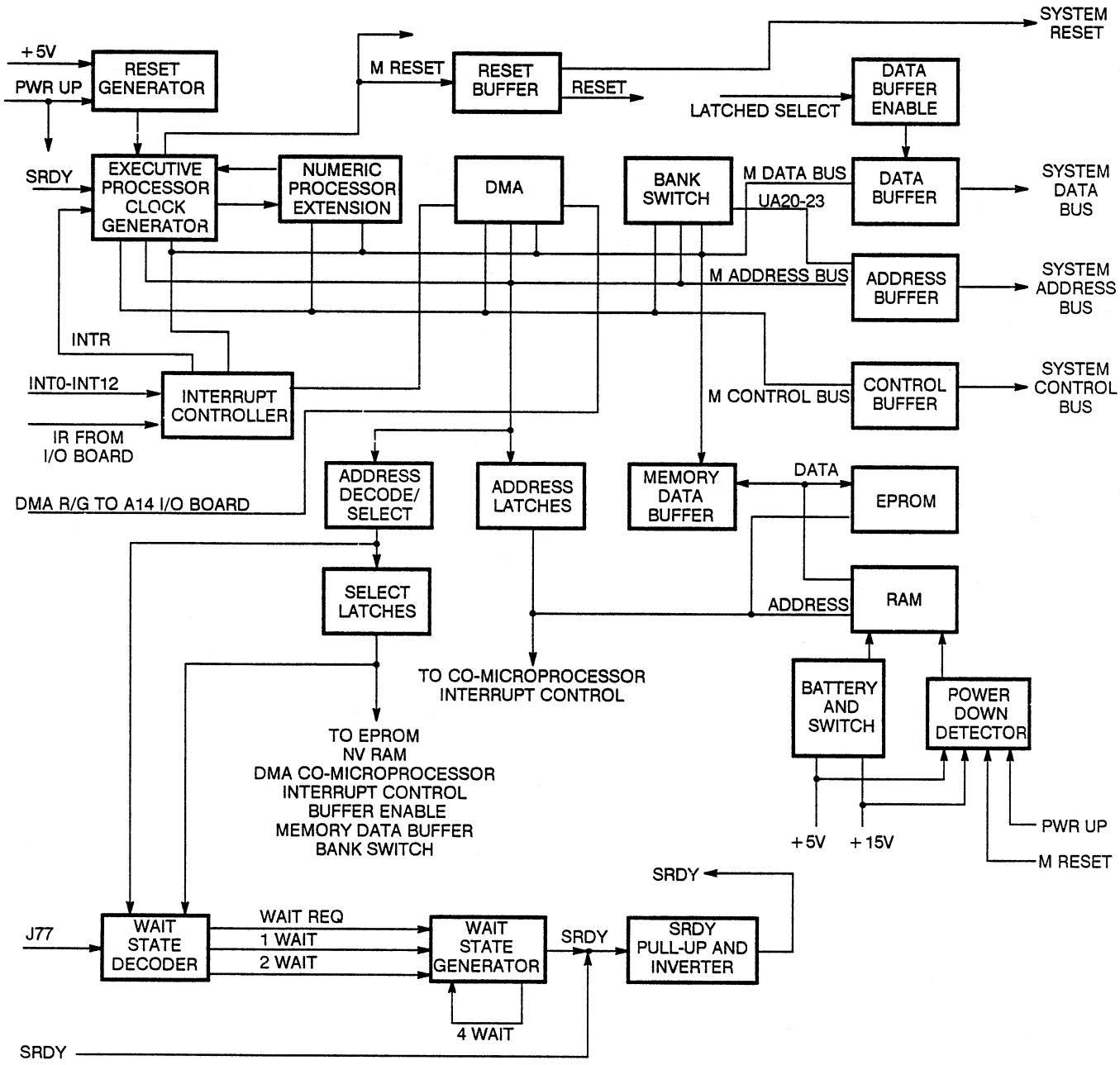

Figure 4-12 *— A17 Main Processor Board Block Diagram*

The bus controller circuitry—consists of a data address/buffer, and a control buffer that provide command and control signals for the microprocessor and the Executive busses. The bus controller decodes the EXP's status and control lines to generate its command and control signals. (The bus controller's outputs are always enabled). The bus controller produces optimal bus cycle timing (minimum number of CLK cycles per bus cycle) and inserts wait cycles only while the READY(L) input remains high through the fourth CLK cycle. The timing of all bus

signals is referenced to the input signal, CLK. Then, the input signals are sampled and appropriate output signals are asserted.

The data, address, and control buffers increase the signal levels before sending these signals to the system bus.

The reset circuitry—generates the synchronized READY(L) and RESET control signals.

The Wait State circuitry—extends the bus cycle so that slower devices have sufficient time to transmit data.

The EPROM—contains the operating system code and also some diagnostics code.

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.

The power-down circuitry—consists of the power-down detector and the battery and switch circuit. This circuitry disables the nonvolatile RAM (NV RAM) and provides battery-backup power when it detects the power supplies failing, an active MRESET signal, or PWR UP false. During normal power supply operation, PWR UP is high, MRESET is low, and after a one second time delay starts, the NV RAM is enabled.

A18 Memory Board

The A18 Memory board consists of:

- the address latches
- the address decode Programmable array of logic (PAL)
- EPROMs
- the bank enable circuitry
- the memory wait state generator
- DRAM controller block
- DRAM circuitry
- the DRAM configuration jumpers
- the DRAM controller reset generator

The A18 Memory Board provides the EXP with DRAM and EPROM for most operations. Support circuitry for the memories and diagnostic circuitry for troubleshooting are located on-board. The A17 Main Processor board initiates all accesses to DRAM or EPROMs.

See Figure 4-13 for a block diagram of this board.

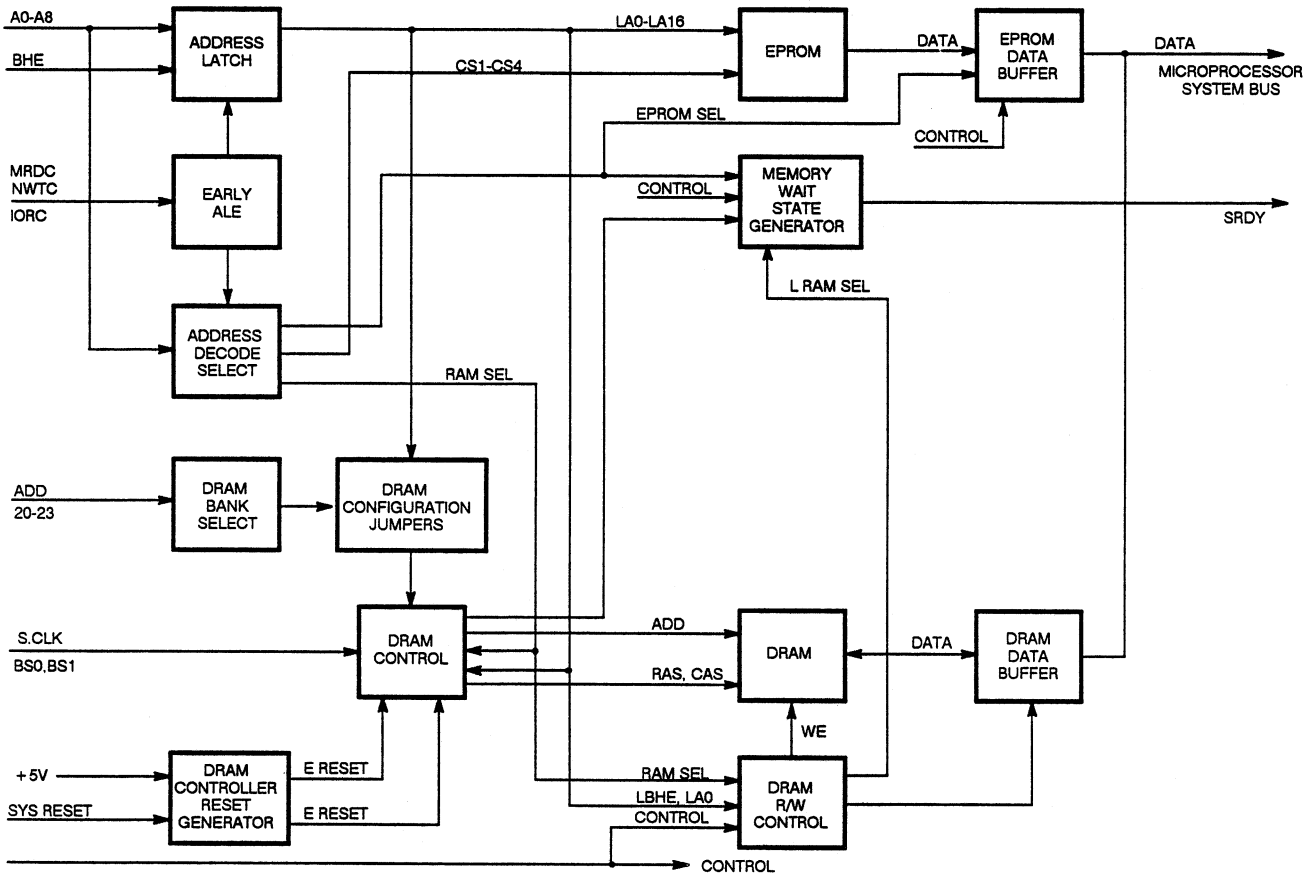

Figure 4-13 *— A18 Memory Board Block Diagram*

The address latches—buffer and hold the Executive address lines and BHE(L) for the EPROMS, DRAM controller IC, and other on-board devices. With the latch outputs always enabled and LE (An Early ALE) high, these latches are transparent; allowing any addresses to pass through as soon as they are available.

The address decoder the programmable array of logic (PAL)—decodes the address lines to produce RAM select signal RAM SEL(L) and four EPROM select signals, CS1(L)–CS4(L) (refer to Table 4-1). RAM SEL(L) enables the DRAM controller to begin a DRAM access cycle.

Table 4-1 *— PAL Address Line Decoding*

Select	Switch		Address Range$_{hex}$	ICs Enabled
RAM SEL(L)	Low Bank Switch	x	0-01FFFFF	ALL RAM
		1	20000-3BFFF	ALL RAM
CS1(L)	High Bank Switch	0	C0000-DFFFF	U630, U730
CS2(L)		1	80000-9FFFF	U620, U720
CS3(L)		1	A0000-BFFFF	U612, U712
CS4(L)		1	C0000-DFFFF	U600, U700

Note: x= don't care condition

The EPROMs—contain most of the operating system code for the EXP. All the EPROMs share the same latched address bus. These address lines are buffered until the middle of the access cycle; at which point they are latched. This allows the address information to be available to the EPROMs as early in the bus cycle as possible. The EPROMs are organized into high- and low-byte pairs. A separate latched chip-select signal, which is generated by the address decode PAL, selects each pair. The output data drivers of an EPROM pair are enabled when the pair is selected.

The bank enable circuitry—buffers address lines ADD A20-A23, to produce bank address lines for the RAM and ROM bank addresses.

The memory wait state generator—signals the EXP to extend the bus cycle a specific number of clock cycles (PCLK) when a memory access starts.

When an EPROM pair is selected, the EPROM SEL line goes high. If jumper J800 is not set on zero waits, the high will be clocked to the Q output. The high Q output is SRDY(L); which is inverted to drive the system signal SRDY. When SRDY is driven low, it signals the EXP to begin inserting wait states. When jumper J800 causes SRDY to be reset, the wait request state is ended.

The DRAM controller block—is configurable for DRAMs of different sizes and speeds in a two- or four-bank arrangement. The DRAM controller provides high speed access to the standard two banks of 64 k × 4-bit DRAM ICs, and also automatically provides refresh signals. The DRAM controller IC supports dual-port access to the DRAM and uses only the port A interface. In addition to the DRAM controller IC, a set of initialization shift registers and a high/low byte enable circuit are incorporated into this block.

The DRAM circuitry—in the standard configuration, is comprised of two groups of four 64 k × 4 bit DRAMs. The A18 Memory Board is designed to allow two more groups of RAM to be added later if desired.

The DRAM controller IC and the buffered EXP control line, DT/R, control the DRAM. The DRAM may be written to with just a high- or low-byte of data. The high and low write-enable and the high and low output-enable lines provide this function.

The DRAM configuration jumpers—allow the DRAM to be arranged in different configurations to facilitate various customer options and design considerations. The jumpers select which address and bank-address lines will be applied to the DRAM Controller.

The DRAM controller reset generator—monitors the system RESET line and uses this line to generate a shorter reset pulse for the DRAM controller IC than the pulse for the system reset. The 45 ms system RESET pulse is buffered, then differentiated. The resultant quick 10 ms reset pulse appears on the output of the reset generator where it gets inverted and applied to the DRAM controller IC.

A20A1/A21A1 Main Boards

The A20A1/A21A1 Main boards contain hardware and firmware that process and relay an input signal to the A5 Acquisition board through the A1 Plug-in Interface board. Each board consists of:

- two attenuators
- two amplifiers
- a microprocessor (MPU); with associated ROM and RAM
- a Housekeeper IC
- an analog-to-digital (A/D) converter

See Figure 4-14 for a block diagram of these boards.

The attenuators—contain resistive dividers, capacitive dividers, an ac coupling capacitor, relays, and a buffer amplifier.

The amplifiers—provide gain switching and bandwidth limit filters.

The microprocessor (MPU)—communicates with the other blocks of the oscilloscope. The MPU also constantly monitors the Overload Sense and the Probe Data communication lines. The MPU operates through the internally stored program in its read only memory (ROM). The MPU stores the amplifier calibration constants in random access memory (RAM). A battery backs-ups the MPU; therefore the internal calibration constants are not lost upon power-down. Also, when powering-down, the oscilloscope stores its settings; and, when the oscilloscope re-powers, these settings are restored back to the MPU.

The housekeeper IC—allows the MPU to communicate with the other blocks of the oscillsocope. The Housekeeper converts the 8-bit data bytes from the MPU into a serial data signal. Conversely, the Housekeeper IC converts serial data sent to the MPU into 8-bit data bytes for the processor to read. The MPU stores the channel switching sequence in the Housekeeper IC. The Housekeeper IC also updates the analog control voltages.

An analog-to-digital (A/D) converter—is used by the MPU to read the value of the Overload Sense and Probe Data lines. The A/D converter is also used in the Self-Test diagnostics.

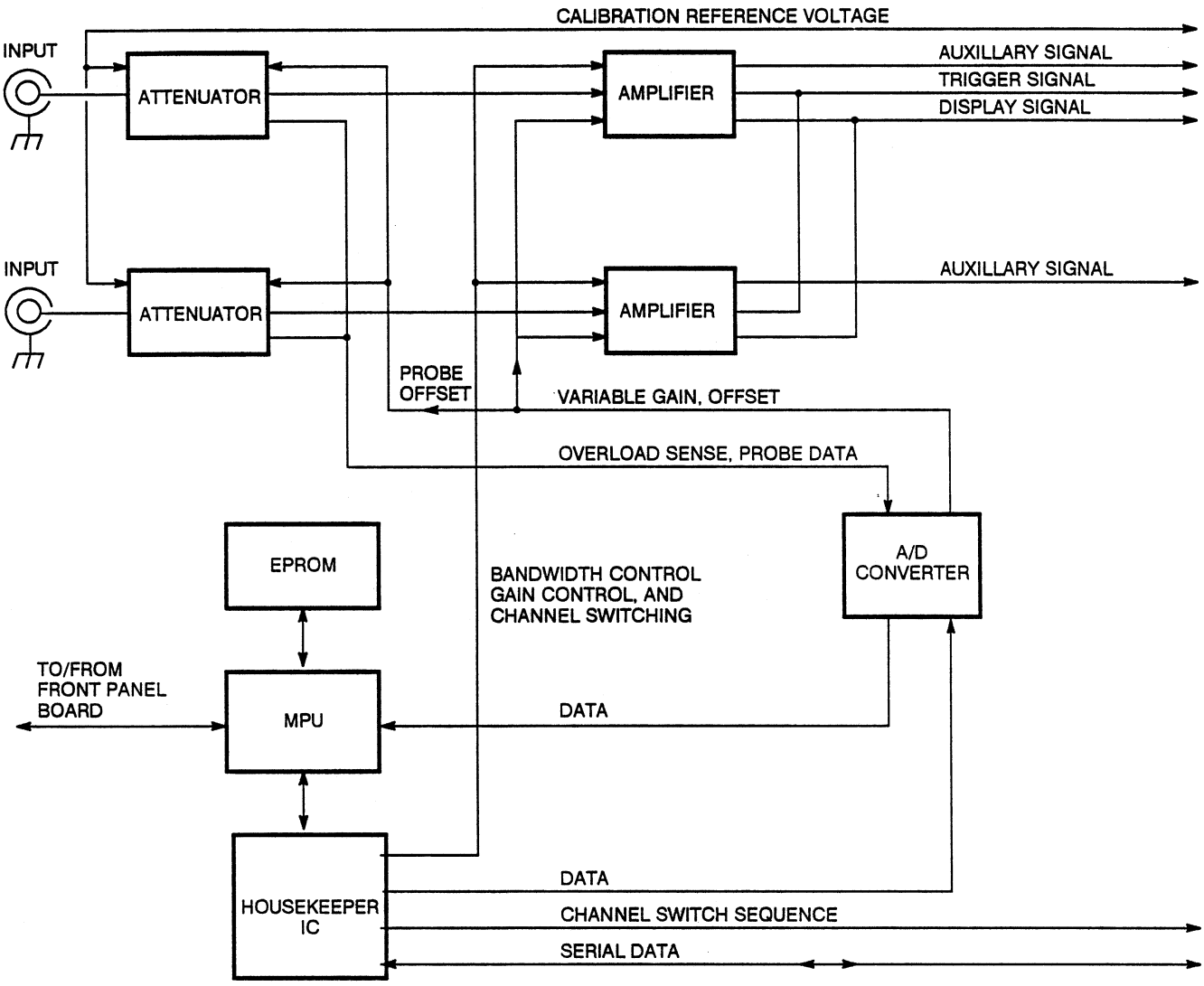

Figure 4-14 *— A20A1/A21A1 Main Boards Block Diagram*

A20A2/A21A2 Front Panel Board

The A20A1/A21A1 Main board processors read the status of the A20A2/A21A2 Front Panel boards, respectively. The A20A2/A21A2 Front Panel board status relates to the front-panel push buttons that have been selected on the Signal Input module. The A20A1/A21A1 Main boards MPU's then relay this information to the EXP. The EXP then informs the A20A1/A21A1 Main board's MPU what action to take (for example, display the selected channel and turn on that channel's respective front panel LED).

A22 External Trigger Board

Signals triggered through the A22 External Trigger board can be selected independently for main and window trigger sources. The external signal must be time-related to the displayed waveform when triggering on an external source to obtain a stable display. The A22 External Trigger Board contains the following hardware:

- external trigger circuitry
- pickoff circuitry
- adjustments

See Figure 4-15 for a block diagram of this board.

The external trigger circuitry—consists of a 1 MΩ, 15 pF input stage connected to a paraphase amplifier. The input sensitivity at the BNC connector is 1 V/div for both the trigger and display paths. The circuit attenuates input signals twentyfold to prevent overdrive at the interface connector.

A pickoff circuitry—permits the trigger signal access to the display path while providing isolation between the trigger and display circuitry. This access allows the probe compensation pulse while a probe connected to the External Trigger Input is compensated.

The adjustments—provided on the A22 Trigger Amplifier board include:

- a Balance adjustment to center the quiescent trace level
- a Gain adjustment in order to attain programmed Trigger Level accuracy,
- an Input Capacitance adjustment to ensure compatibility with 1 MΩ probes

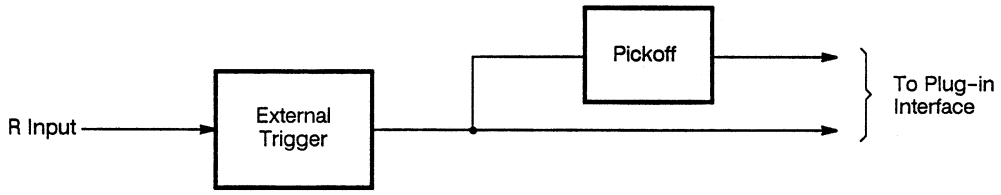

Figure 4-15 *— A22 External Trigger Board Block Diagram*

Replaceable Parts

This section contains a list of the components that are replaceable for the 11201 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 be come 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 11201 Oscilloscope is serviced by module replacement so there are three options you should consider:

- **Module Exchange.** In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1 800 TEKWIDE, extension BV 5799.
- **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 in the same indentation as the item it mounts, while the detail parts are in dented 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
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
12327	FREEWAY CORP	9301 ALLEN DR	CLEVELAND OH 44125-4632
13511	AMPHENOL CADRE DIV BUNKER RAMO CORP		LOS GATOS CA
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
30817	INSTRUMENT SPECIALTIES CO INC	EXIT 53 RT 80 BOX A	DELAWARE WATER GAP PA 18327
53387	MINNESOTA MINING AND MFG CO ELECTRONIC PRODUCTS DIV	3M CENTER	ST PAUL MN 55101-1428
61058	MATSUSHITA ELECTRIC CORP OF AMERICA PANASONIC INDUSTRIAL CO DIV	ONE PANASONIC WAY PO BOX 1502	SECAUCUS NJ 07094-2917
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 97707-0001
81041	HOWARD INDUSTRIES DIV OF MSL INDUSTRIES INC	1 NORTH DIXIE HWY PO BOX 287	MILFORD IL 60953
83385	MICRODOT MFG INC GREER-CENTRAL DIV	3221 W BIG BEAVER RD	TROY MI 48098
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
TK1918	SHIN-ETSU POLYMER AMERICA INC	1181 NORTH 4TH ST	SAN JOSE CA 95112

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
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	200-3126-00			1	COVER,CABINET:LIFT OFF,UPPER	80009	200-3126-00
-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	200-3127-00			1	COVER,CABINET:LIFT OFF,LOWER	80009	200-3127-00
-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 (ATTACHING PARTS)	80009	348-0879-00
-11	211-0711-00			4	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-12	348-0875-00			1	FLIPSTAND,CAB.:	80009	348-0875-00

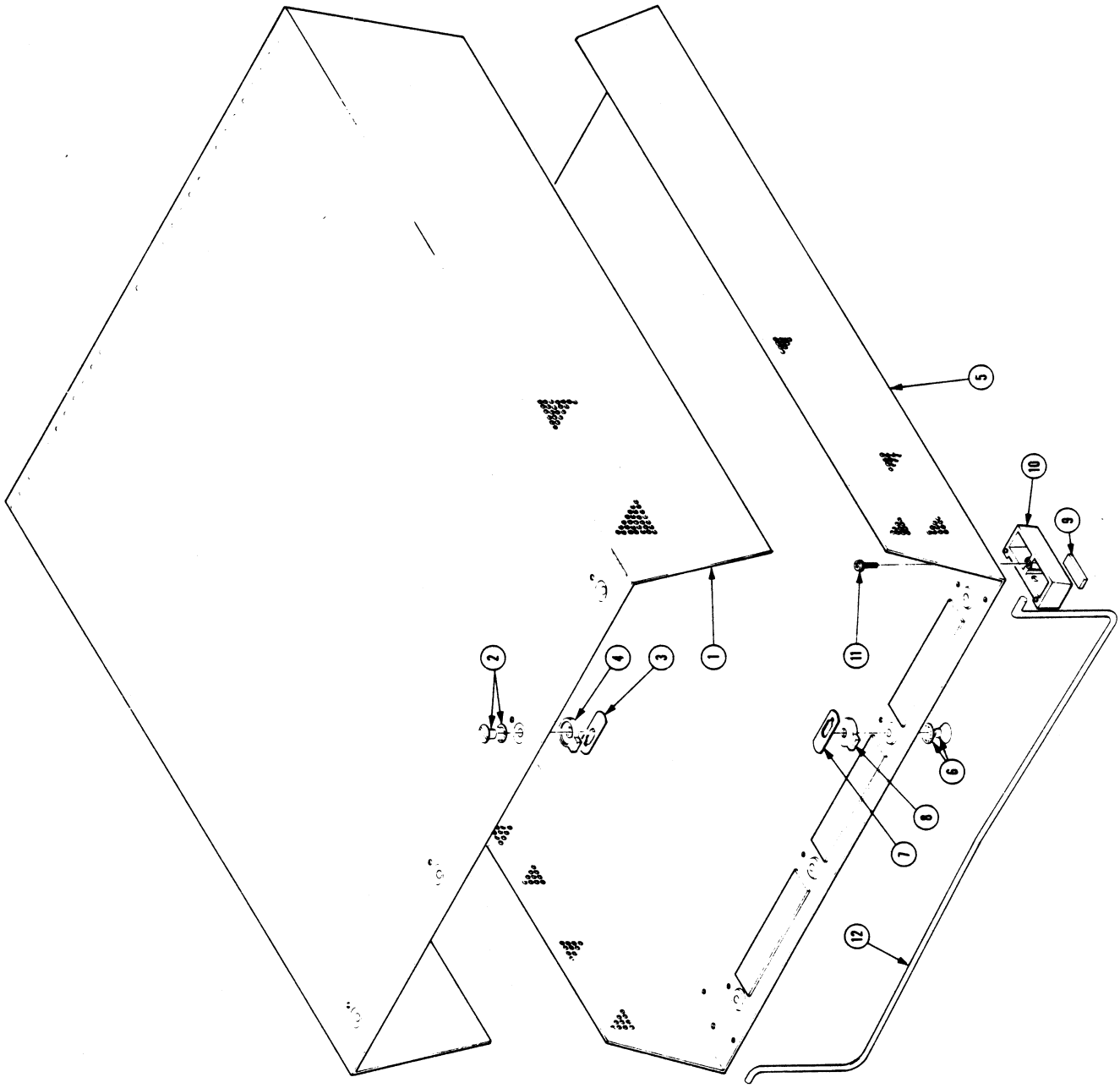

Fig. 1 Cabinet
11201 Service Reference Manual

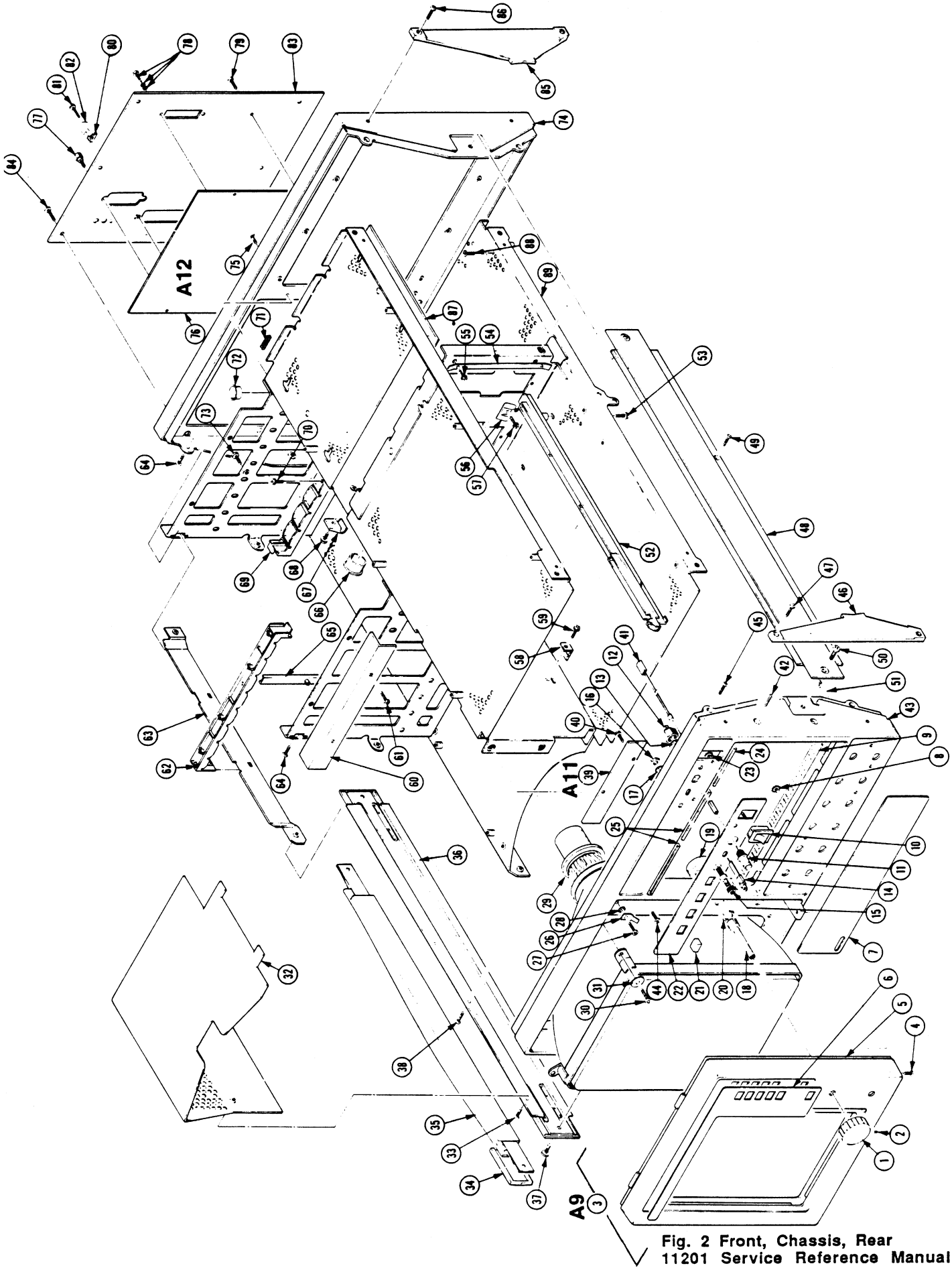

Fig. 2 Front, Chassis, Rear
11201 Service Reference Manual

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	614-0852-00			1	FRONT PNL ASSY:11201 (SEE A9, EXCHANGE ITEM) (ATTACHING PARTS)	80009	614-0852-00
-4	211-0392-00			2	SCREW,MACHINE:4-40 X 0.25,FLH,82 DEG,STL (END ATTACHING PARTS) FRONT PANEL ASSEMBLY INCLUDES:	80009	211-0392-00
-5	200-3143-01			1	.COVER,CRT SCALE:BEZEL	80009	200-3143-01
-6	333-3688-00			1	.PANEL,FRONT:11201	80009	333-3688-00
-7	333-3231-00			1	PANEL,FRONT:LOWER(STANDARD) (ATTACHING PARTS)	80009	333-3231-00
-8	210-0586-00			4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL (END ATTACHING PARTS)	78189	211-041800-00
-9	348-0878-00			1	SHLD GSKT,ELEK:SOLID TYPE,7.646 L	80009	348-0878-00
-10	260-2275-00			1	SWITCH,ROCKER:SPST,30MA,12V	TK1262	ME010-D
-11	131-3767-00			1	CONN ASSY,ELEC:CAL TERMINAL (ATTACHING PARTS)	80009	131-3767-00
-12	103-0268-01			1	ADPTR COAX CONN:0.438 HEX,SST	80009	103-0268-01
-13	210-0012-00			1	WASHER,LOCK:0.384 ID,INTL,0.022 THK,STL (END ATTACHING PARTS)	09772	ORDER BY DESCR
-14	131-3768-00			1	TERMINAL ASSY:CALIBRATOR	80009	131-3768-00
-15	129-0103-00			1	POST,BDG,ELEC:ASSEMBLY (ATTACHING PARTS)	80009	129-0103-00
-16	210-0455-00			1	NUT,PLAIN,HEX:0.25-28 X 0.375,BRS NP	73743	3089-402
-17	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,STL (END ATTACHING PARTS)	77900	1214-05-00-0541C
-18	384-1682-00			2	EXTENSION SHAFT:2.375 L,POLYCARBONATE	80009	384-1682-00
-19	311-2320-00			2	ENCODER,DIGITAL:INCREMENTAL,50PPR,50 DETENT ,QUAD OUTPUT,LOC LUG AT 9 O'CLOCK (ATTACHING PARTS)	TK1869	LA22661
-20	220-0052-00			2	NUT,PLAIN,HEX:M9 X 0.75 (END ATTACHING PARTS)	73743	ORDER BY DESCR
-21	366-0600-00			4	PUSH BUTTON:0.269 X 0.409,ABS	80009	366-0600-00
-22	333-3213-00			1	PANEL,FRONT:UPPER (ATTACHING PARTS)	80009	333-3213-00
-23	210-0586-00			4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL (END ATTACHING PARTS)	78189	211-041800-00
-24	348-0877-00			1	SHLD GSKT,ELEK:SOLID TYPE,1.860 L	80009	348-0877-00
-25	348-0876-00			2	SHLD GSKT,ELEK:SOLID TYPE,2.480 L	80009	348-0876-00
-26	131-1688-00			1	TERM,QIK DISC.:MALE,0.032 X 0.25 BL (ATTACHING PARTS)	00779	42577-4
-27	211-0721-00			1	SCREW,MACHINE:6-32 X 0.375,PHN,STL	83486	ORDER BY DESCR
-28	210-0006-00			1	WASHER,LOCK:#6 INTL,0.018 THK,STL (END ATTACHING PARTS)	77900	1206-00-00-0541C
-29	154-0898-00			1	ELECTRON TUBE:CRT W/DEFLECTION YOKE (ATTACHING PARTS)	61058	M22JPT3GH/M-ITC
-30	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PHN,STL	83486	ORDER BY DESCR
-31	210-0949-00			4	WASHER,FLAT:0.141 ID X 0.5 OD X 0.062,BRS (END ATTACHING PARTS)	12327	ORDER BY DESCR
-32	200-3142-00			1	COVER,CRT:GUARD (ATTACHING PARTS)	80009	200-3142-00
-33	211-0718-00			2	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-34	200-2191-00			2	CAP,RETAINER:PLASTIC	80009	200-2191-00
-35	367-0248-01			1	HANDLE,CARRYING:16.341 L,W/CLIP	80009	367-0248-01
-36	426-2098-01			1	FRAME SECT,CAB.:LEFT SIDE (ATTACHING PARTS)	80009	426-2098-01
-37	212-0681-00			2	SCREW,MACHINE:10-32 X 0.25,PNH,STL	83486	ORDER BY DESCR
-38	211-0718-00			1	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-39	670-9367-00			1	CIRCUIT BD ASSY:FRONT PANEL BUTTON (SEE A11) (ATTACHING PARTS)	80009	670-9367-00
-40	211-0410-00			2	SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL (END ATTACHING PARTS)	93907	ORDER BY DESCR
-41	150-0121-05			1	LAMP,CARTRIDGE:5V,0.06A,GREEN LENS	80009	150-0121-05
-42	211-0721-00			2	SCREW,MACHINE:6-32 X 0.375,PHN,STL	83486	ORDER BY DESCR

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-					(ATTACHING PART TO MODULE)		
-43	386-5268-05			1	SUBPANEL,FRONT:	80009	386-5268-05
					(ATTACHING PARTS)		
-44	211-0721-00			2	SCREW,MACHINE:6-32 X 0.375,PHN,STL	83486	ORDER BY DESCR
-45	211-0718-00			3	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-46	101-0107-00			2	TRIM,DECORATIVE:RIGHT SIDE,FRONT CASTING	80009	101-0107-00
					(ATTACHING PARTS)		
-47	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PHN,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-48	426-2099-01			1	FRAME SECT,CAB.:RIGHT SIDE	80009	426-2099-01
					(ATTACHING PARTS)		
-49	211-0718-00			1	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
-50	212-0681-00			2	SCREW,MACHINE:10-32 X 0.25,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-51	348-0886-00			4	SHLD GSKT,ELEK:FINGER TYPE,18.310 L	80009	348-0886-00
-52	351-0744-00			3	GUIDE,PLUG-IN:POLYAMIDE	80009	351-0744-00
					(ATTACHING PARTS)		
-53	211-0711-00			3	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-54	131-0800-03			2	CONTACT,ELEC:PLUG-IN GND,BE NI HT TR	80009	131-0800-03
					(ATTACHING PARTS)		
-55	211-0408-00			4	SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-56	131-0799-00			4	CONTACT,ELEC:PLUG-IN GND,BE NI CD PL	80009	131-0799-00
					(ATTACHING PARTS)		
-57	211-0408-00			4	SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-58	344-0133-00			2	CLIP,SPR TNSN:CKT BOARD MT,WHITE	80009	344-0133-00
					(ATTACHING PARTS)		
-59	211-0408-00			2	SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-60	343-1267-01			1	RTNR,CARD CAGE:ALUMINUM	80009	343-1267-01
					(ATTACHING PARTS)		
-61	211-0711-00			2	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-62	351-0746-00			2	GUIDE,CKT BOARD:NYLON 6.803 L	80009	351-0746-00
-63	407-3438-01			1	BRACKET,CHASSIS:ALUMINUM	80009	407-3438-01
					(ATTACHING PARTS)		
-64	211-0718-00			5	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-65	351-0765-00			16	GUIDE,CKT BOARD:NYLON	30010	29-0124D
-66	348-0532-00			1	GROMMET,PLASTIC:BLACK,ROUND,0.625 ID	28520	SB-750-10
-67	343-0081-00			1	STRAP,RETAINING:0.125 DIA,NYLON	85480	CPNY-172BK
					(ATTACHING PARTS)		
-68	211-0722-00			1	SCREW,MACHINE:6-32 X 0.25,PNH,STL	80009	211-0722-00
					(END ATTACHING PARTS)		
-69	351-0746-00			1	GUIDE,CKT BOARD:NYLON 6.803 L	80009	351-0746-00
					(ATTACHING PARTS)		
-70	211-0711-00			1	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-71	255-0334-00			2	PLASTIC CHANNEL:12.75 X 0.175 X 0.155,NYLON	11897	122-37-2500
-72	342-0313-00			1	GROMMET,PLASTIC:0.437 ID X 0.562 OD,NYLON	28520	2066
-73	211-0711-00			1	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(ATTACHES GROUND WIRE)		
-74	386-5269-02			1	SUBPANEL,REAR:PLATED	80009	386-5269-02
					(ATTACHING PARTS)		
-75	211-0718-00			2	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-76	670-8853-00			1	CIRCUIT BD ASSY:REAR PANEL	80009	670-8853-00
					(SEE A12, EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-77	129-0744-00			2	SPACER,POST:0.875 L,4-40 BOTH ENDS,AL	80009	129-0744-00
-78	214-3106-00			2	HARDWARE KIT:JACK SOCKET	53387	3341-1S
-79	211-0372-00			1	SCREW,MACHINE:4-40 X 0.312,PNH,STL	TK1543	B80-00020-003
					(END ATTACHING PARTS)		
-80	407-3446-00			2	BRKT,BAIL MTG:STEEL,0.35 X 0.289	00779	552101-1
					(ATTACHING PARTS)		

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-81	211-0410-00			2	SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL (END ATTACHING PARTS)	93907	ORDER BY DESCR
-82	344-0387-00			2	CLIP,BAIL:STAINLESS STEEL	80009	344-0387-00
-83	386-5369-00			1	PLATE,CONN:8.388 X 7.852,AL	80009	386-5369-00
	334-6776-00			1	MARKER,IDENT:MKD GPIB (ATTACHING PARTS)	80009	334-6776-00
-84	211-0721-00			8	SCREW,MACHINE:6-32 X 0.375,PHN,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-85	101-0106-00			2	TRIM,DECORATIVE:LEFT SIDE,FRONT CASTING (ATTACHING PARTS)	80009	101-0106-00
-86	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PHN,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-87	386-5283-00			2	SUPPORT,CHASSIS:POWER SUPPLY,POLYCARBONATE	80009	386-5283-00
-88	211-0722-00			1	SCREW,MACHINE:6-32 X 0.25,PNH,STL (ATTACHING PART TO PWR SPLY GROUND WIRE)	80009	211-0722-00
-89	610-0751-03			1	CHASSIS ASSY:	80009	610-0751-03

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-1	670-8849-03			1	CIRCUIT BD ASSY:TIME BASE	80009	670-8849-03
					(SEE A6, EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-2	211-0711-00			5	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-3	129-0591-00			1	SPACER,POST:0.937 L,6-32 INT-EXT,STL	80009	129-0591-00
-4	670-8847-01			1	CIRCUIT BD ASSY:FRONT PANEL CONTROL	80009	670-8847-01
					(SEE A10)		
					(ATTACHING PARTS)		
-5	211-0711-00			2	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-6	670-8846-03			1	CIRCUIT BD ASSY:CRT DRIVER	80009	670-8846-03
					(SEE A8, EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-7	211-0711-00			4	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
					CRT DRIVER BOARD ASSEMBLY INCLUDES:		
-8	159-0279-00			1	.FUSE,WIRE LEAD:0.375A,250V,SLOW	75915	230.375
-9	159-0103-00			1	.FUSE,CARTRIDGE:0.4A,125V,0.25SEC	75915	279.400
-10	670-8856-01			1	CIRCUIT BD ASSY:MEMORY	80009	670-8856-01
					(SEE A18, EXCHANGE ITEM)		
-11	671-0068-03			1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	671-0068-03
					(SEE A17, EXCHANGE ITEM)		
	671-0068-53			1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	671-0068-53
					(SEE A17, OPTION 4D ONLY)		
-12	146-0055-00			1	.BATTERY,DRY:3.0V,1200 MAH,LITHIUM	TK0510	BR-2/3A-E2P
-13	670-8854-01			1	CIRCUIT BD ASSY:INPUT/OUTPUT	80009	670-8854-01
					(SEE A14, EXCHANGE ITEM)		
-14	146-0055-00			1	.BATTERY,DRY:3.0V,1200 MAH,LITHIUM	TK0510	BR-2/3A-E2P
-15	159-0245-00			4	.FUSE,WIRE LEAD:1A,125V,FAST	75915	R251001T1
-16	670-8858-01			1	CIRCUIT BD ASSY:MEMORY MGT UNIT	80009	670-8858-01
					(SEE A15, EXCHANGE ITEM)		
	670-8858-51			1	CIRCUIT BD ASSY:MEM MGT UNIT	80009	670-8858-51
					(SEE A15, OPTION 2D ONLY)		
-17	670-8859-00			1	CIRCUIT BD ASSY:COMPRESSOR	80009	670-8859-00
					(SEE A16, EXCHANGE ITEM)		
-18	670-8851-00			1	CIRCUIT BD ASSY:MOTHER	80009	670-8851-00
					(SEE A13)		
					(ATTACHING PARTS)		
-19	211-0711-00			6	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-20	670-8848-01			1	CIRCUIT BD ASSY:DISPLAY CONTROLLER	80009	670-8848-01
					(SEE A7, EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-21	211-0711-00			6	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-22	670-8852-00			1	CIRCUIT BD ASSY:PL-IN INTERFACE	80009	670-8852-00
					(SEE A1)		
					(ATTACHING PARTS)		
-23	211-0410-00			9	SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-24	346-0154-00			3	STRAP,TIEDOWN,E:6.125 L,PLASTIC,LATCH	06383	PLP1.5I INTERMED
-25	670-8840-01			1	CIRCUIT BD ASSY:REGULATOR	80009	670-8840-01
					(SEE A4, EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-26	211-0721-00			2	SCREW,MACHINE:6-32 X 0.375,PHN,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
					REGULATOR BOARD ASSEMBLY INCLUDES:		
-27	159-0220-00			1	.FUSE,WIRE LEAD:3A,125V,FAST	71400	TRA3
-28	671-0024-04			1	CIRCUIT BD ASSY:ACQUISITION	80009	671-0024-04
					(SEE A5, EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-29	211-0711-00			6	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
-30	211-0754-00			2	SCR,ASSEM WSHR:6-32 X 1.375,PNH,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-31	386-5428-00			1	SUPPORT,PIVOT:CKT,LEFT	80009	386-5428-00
					(ATTACHING PARTS)		
-32	213-0992-00			1	SCREW,TPG,TF:4-24 X 0.375,PNH,STL	93907	B80-70000-003

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-					(END ATTACHING PARTS)		
-33	386-5429-00			1	SUPPORT,PIVOT:CKT,RIGHT	80009	386-5429-00
					(ATTACHING PARTS)		
-34	213-0992-00			1	SCREW,TPG,TF:4-24 X 0.375,PNH,STL	93907	B80-70000-003
					(END ATTACHING PARTS)		
	020-1744-00			1	COMPONENT KIT:11201 VER 4.0	80009	020-1744-00
					WIRE ASSEMBLIES		
	175-9873-00			1	CA ASSY,SP,ELEC:2,14,2,16 AWG,18 L (FROM A3J63 TO A7J63,A13J63)	80009	175-9873-00
	175-9912-00			1	CABLE ASSY,RF:50 OHM COAX,48.0 L,6-2,6-3 (FROM A1J32,J33 TO A5J32,J33)	80009	175-9912-00
	175-9913-00			1	CABLE ASSY,RF:50 OHM COAX,48.0 L,6-4,6-N (FROM A1J34,J36 TO A5J34,J36)	80009	175-9913-00
	175-9914-00			1	CABLE ASSY,RF:50 OHM COAX,48.0 L,6-0,6-1 (FROM A1J30,J31 TO A5J30,J31)	80009	175-9914-00
	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 (FROM A1J03 TO A5J03)	80009	175-9907-00
	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
	174-0287-00			1	CABLE ASSY,RF:50 OHM COAX,29.0 L,W/PELTALAS (FROM A5J26 TO J26)	80009	174-0287-00
	175-9810-00			1	CA ASSY,SP,ELEC:50,4.0 L (FROM A7J52 TO A16J52)	80009	175-9810-00
	175-9811-00			1	CA ASSY,SP,ELEC:20,6.0 L (FROM A7J53 TO A8J53)	80009	175-9811-00
	175-9855-00			1	CA ASSY,SP,ELEC:7 PIN CONN W/CRT SKT,4.5 L (FROM A8J56 TO CRT SOCKET)	80009	175-9855-00
	175-9799-00			1	CA ASSY,SP,ELEC:16.5 L (FROM A7J57 TO DS60)	80009	175-9799-00
	175-9857-00			1	CA ASSY,SP,ELEC:11,18 AWG,7.25 L,RIBBON (FROM A2A2J63 TO A7J63 AND A13J64)	80009	175-9857-00
	175-9803-00			1	CA ASSY,SP,ELEC:7,26 AWG,7.5 L,RIBBON (FROM A2A2J65 TO A4J65)	80009	175-9803-00
	175-9798-00			1	CA ASSY,SP,ELEC:18.0 L (FROM A2A2J66 TO A5J66 AND A6J66)	80009	175-9798-00
	175-9854-00			1	CA ASSY,SP,ELEC:36,28 AWG,7.0 L (FROM A10J72 TO A14J72)	80009	175-9854-00
	175-9807-00			1	CA,ASSY,SP,ELEC: (FROM A10J74 TO S74 AND S75)	80009	175-9807-00
	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 A12J78 TO A14J78)	80009	175-9815-00
	175-9809-00			1	CA ASSY,SP,ELEC:50,3.0 L (FROM A15J79 TO A16J79)	80009	175-9809-00
	175-9808-00			1	CA ASSY,SP,ELEC:50,18.0 L (FROM A6J83 TO A15J83)	80009	175-9808-00
	175-9806-00			1	CA ASSY,SP,ELEC:60,4.0 L (FROM A5J84 TO A6J84)	80009	175-9806-00
	175-9805-00			1	CA ASSY,SP,ELEC:40,4.0 L (FROM A5J85 TO A6J85)	80009	175-9805-00
	175-9804-00			1	CA ASSY,SP,ELEC:34,4.0 L (FROM A5J86 TO A6J86)	80009	175-9804-00
	175-9812-00			1	CA ASSY,SP,ELEC:26,7.0 L (FROM A1J91 TO A5J91 AND A6J91)	80009	175-9812-00

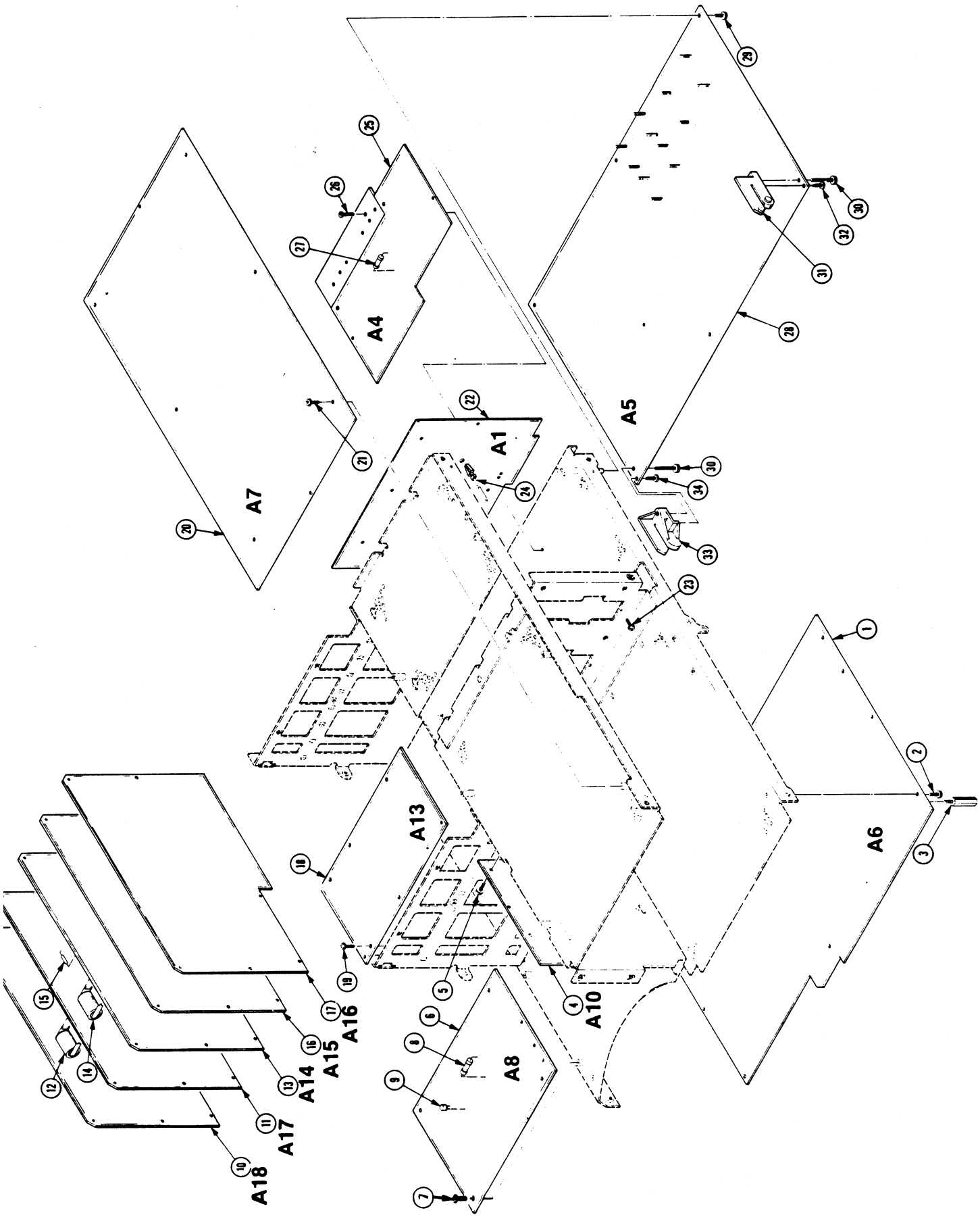

Fig. 3 Circuit Boards
11201 Service Reference Manual

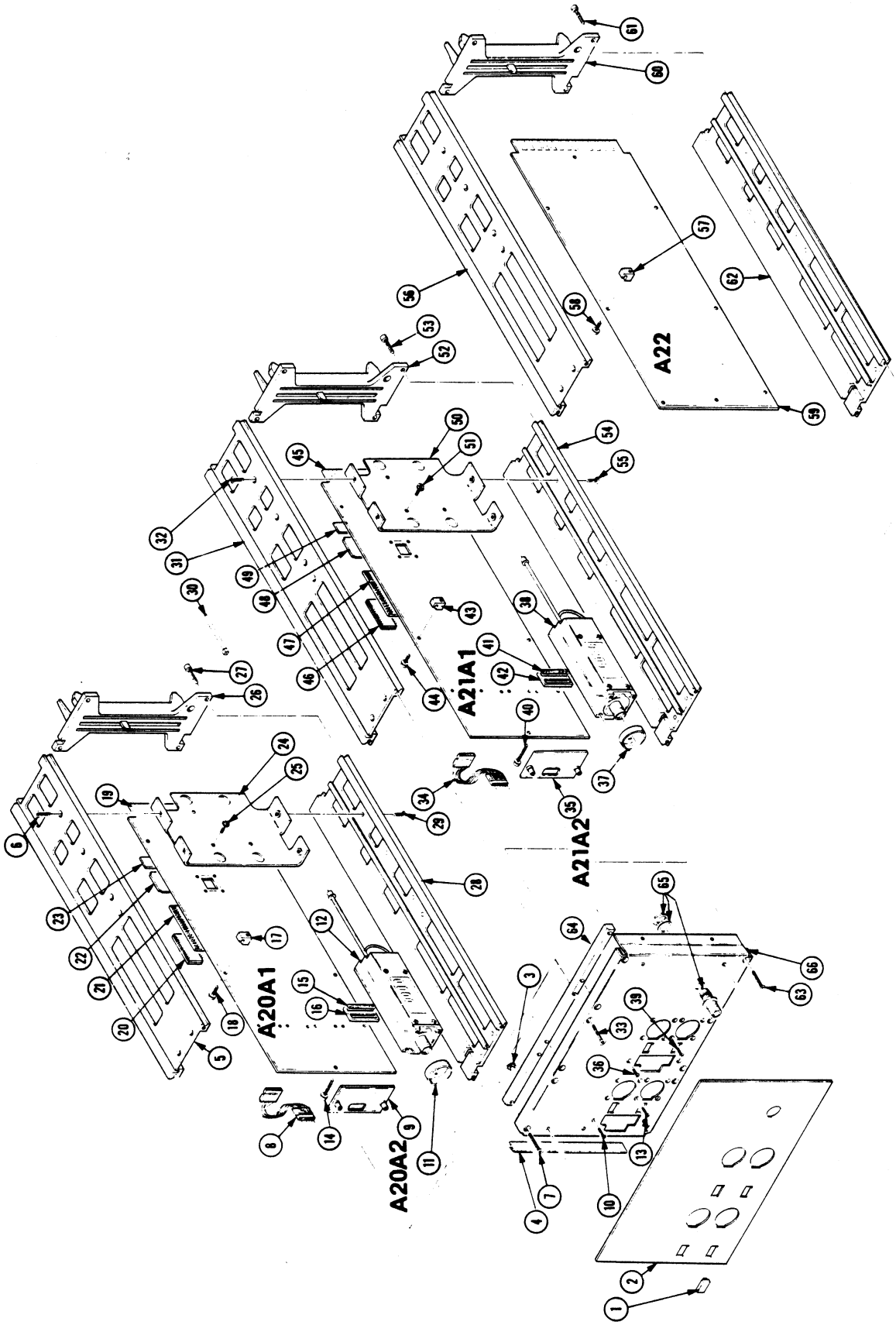

Fig. 4 Signal Input Module
11201 Service Reference Manual

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
4-1	366-0600-00			4	PUSH BUTTON:0.269 X 0.409,ABS	80009	366-0600-00
-2	333-3687-00			1	PANEL,FRONT:	80009	333-3687-00
					(ATTACHING PARTS)		
-3	210-0586-00			4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
					(END ATTACHING PARTS)		
-4	348-0798-00			1	GASKET:0.38 W,COPPER BERYL,W/STICKY BACK	30817	0097-0541-02
-5	426-2060-00			1	FR SECT,PLUG-IN:UPPER,ALUMINUMN	80009	426-2060-00
					(ATTACHING PARTS)		
-6	211-0392-00			2	SCREW,MACHINE:4-40 X 0.25,FLH,82 DEG,STL	80009	211-0392-00
-7	213-0914-00			4	SCREW,TPG,TR:6-32 X 0.75,FLH,100 DEG,STL	83385	ORDER BY DESCR
					(END ATTACHING PARTS)		
-8	174-0159-00			1	CA ASSY,SP,ELEC:6,26 AWG,3.0 L,RIBBON	80009	174-0159-00
-9	670-9336-00			1	CIRCUIT BD ASSY:FRONT PANEL	80009	670-9336-00
					(SEE A20A2)		
					(ATTACHING PARTS)		
-10	211-0390-00			2	SCREW,MACHINE:2-56 X 0.188,FH,STL CD PL	80009	211-0390-00
					(END ATTACHING PARTS)		
-11	354-0654-01			2	RING,CONN:BNC	80009	354-0654-01
-12	119-2000-02			2	ATTENUATOR:ACTIVELY TRIMMED NOVAR	80009	119-2000-02
					ATTENUATOR & BUFFER AMPLIFIER ASSY		
					(ATTACHING PARTS)		
-13	211-0390-00			8	SCREW,MACHINE:2-56 X 0.188,FH,STL CD PL	80009	211-0390-00
-14	211-0391-00			4	SCREW,MACHINE:2-56 X 0.437,P4,STL CD PL	80009	211-0391-00
					(END ATTACHING PARTS)		
-15	131-3383-01			4	CONN ASSY,ELEC:ELASTOMERIC,3.8MM X 3.0MM X	TK1918	.4PX24X3.8X3.0
					24.0MM,0.4MM L CONTACT PT		
-16	352-0780-00			2	HOLDER,CNDCT:ELASTOMERIC	80009	352-0780-00
-17	220-0022-00			5	NUT BLK:0.4 X 0.25 X 0.33,4-40 THRU,NI SIL	80009	220-0022-00
					(ATTACHING PARTS)		
-18	211-0409-00			5	SCR,ASSEM WSHR:4-40 X 0.312,PNH,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-19	670-8977-01			1	CIRCUIT BD ASSY:MAIN	80009	670-8977-01
					(SEE A20A1, EXCHANGE ITEM)		
-20	160-4009-08			1	.MICROCKT,DGTL:HMOS,16385 X 8 EPROM,PRGM	80009	160-4009-08
-21	156-2962-00			1	.MICROCKT,DGTL:NMOS,MICROCOMPUTER,8 BIT W/	80009	156-2962-00
					.SOCKET,EPROM		
-22	156-2625-00			1	.MICROCKT,DGTL:NMOS,CUSTOM,SENESCHAL	80009	156-2625-00
-23	165-2089-05			1	.MICROCKT,LINEAR:VERTICAL PREAMP,100 OHM	80009	165-2089-05
-24	407-3363-00			1	BRACKET,HEAT SK:ALUMINUM	80009	407-3363-00
					(ATTACHING PARTS)		
-25	211-0711-00			2	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-26	386-5296-00			1	PANEL,REAR:	80009	386-5296-00
					(ATTACHING PARTS)		
-27	213-0904-00			4	SCREW,TPG,TR:6-32 X 0.5,PNH,STL	83385	ORDER BY DESCR
					(END ATTACHING PARTS)		
-28	426-2061-00			1	FR SECT,PLUG-IN:LOWER,ALUMINUM	80009	426-2061-00
					(ATTACHING PARTS)		
-29	211-0392-00			2	SCREW,MACHINE:4-40 X 0.25,FLH,82 DEG,STL	80009	211-0392-00
					(END ATTACHING PARTS)		
-30	343-0549-00			2	STRAP,TIEDOWN,E:0.091 W X 4.0 L,ZYTEL	06383	PLT1M
-31	426-2060-00			1	FR SECT,PLUG-IN:UPPER,ALUMINUMN	80009	426-2060-00
					(ATTACHING PARTS)		
-32	211-0392-00			2	SCREW,MACHINE:4-40 X 0.25,FLH,82 DEG,STL	80009	211-0392-00
-33	213-0914-00			4	SCREW,TPG,TR:6-32 X 0.75,FLH,100 DEG,STL	83385	ORDER BY DESCR
					(END ATTACHING PARTS)		
-34	174-0159-00			1	CA ASSY,SP,ELEC:6,26 AWG,3.0 L,RIBBON	80009	174-0159-00
-35	670-9336-00			1	CIRCUIT BD ASSY:FRONT PANEL	80009	670-9336-00
					(SEE A21A2)		
					(ATTACHING PARTS)		
-36	211-0390-00			2	SCREW,MACHINE:2-56 X 0.188,FH,STL CD PL	80009	211-0390-00
					(END ATTACHING PARTS)		
-37	354-0654-01			2	RING,CONN:BNC	80009	354-0654-01
-38	119-2000-02			2	ATTENUATOR:ACTIVELY TRIMMED NOVAR	80009	119-2000-02
					ATTENUATOR & BUFFER AMPLIFIER ASSY		
					(ATTACHING PARTS)		
-39	211-0390-00			8	SCREW,MACHINE:2-56 X 0.188,FH,STL CD PL	80009	211-0390-00
-40	211-0391-00			4	SCREW,MACHINE:2-56 X 0.437,P4,STL CD PL	80009	211-0391-00

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
4-					(END ATTACHING PARTS)		
-41	131-3383-01			4	CONN ASSY,ELEC:ELASTOMERIC,3.8MM X 3.0MM X 24.0MM,0.4MM L CONTACT PT	TK1918	.4PX24X3.8X3.0
-42	352-0780-00			2	HOLDER,CNDCT:ELASTOMERIC	80009	352-0780-00
-43	220-0022-00			5	NUT BLK:0.4 X 0.25 X 0.33,4-40 THRU,NI SIL (ATTACHING PARTS)	80009	220-0022-00
-44	211-0409-00			5	SCR,ASSEM WSHR:4-40 X 0.312,PNH,STL (END ATTACHING PARTS)	93907	ORDER BY DESCR
-45	670-8977-01			1	CIRCUIT BD ASSY:MAIN (SEE A21A1, EXCHANGE ITEM)	80009	670-8977-01
-46	160-4009-08			1	.MICROCKT,DGTL:HMOS,16385 X 8 EPROM,PRGM	80009	160-4009-08
-47	156-2962-00			1	.MICROCKT,DGTL:NMOS,MICROCOMPUTER,8 BIT W/ .SOCKET,EPROM	80009	156-2962-00
-48	156-2625-00			1	.MICROCKT,DGTL:NMOS,CUSTOM,SENESCHAL	80009	156-2625-00
-49	165-2089-05			1	.MICROCKT,LINEAR:VERTICAL PREAMP,100 OHM	80009	165-2089-05
-50	407-3363-00			1	BRACKET,HEAT SK:ALUMINUM (ATTACHING PARTS)	80009	407-3363-00
-51	211-0711-00			2	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-52	386-5296-00			1	PANEL,REAR: (ATTACHING PARTS)	80009	386-5296-00
-53	213-0904-00			4	SCREW,TPG,TR:6-32 X 0.5,PNH,STL (END ATTACHING PARTS)	83385	ORDER BY DESCR
-54	426-2061-00			1	FR SECT,PLUG-IN:LOWER,ALUMINUM (ATTACHING PARTS)	80009	426-2061-00
-55	211-0392-00			2	SCREW,MACHINE:4-40 X 0.25,FLH,82 DEG,STL (END ATTACHING PARTS)	80009	211-0392-00
-56	426-2060-00			1	FR SECT,PLUG-IN:UPPER,ALUMINUMN	80009	426-2060-00
-57	220-0022-00			6	NUT BLK:0.4 X 0.25 X 0.33,4-40 THRU,NI SIL (ATTACHING PARTS)	80009	220-0022-00
-58	211-0409-00			6	SCR,ASSEM WSHR:4-40 X 0.312,PNH,STL (END ATTACHING PARTS)	93907	ORDER BY DESCR
-59	671-0991-00			1	CIRCUIT BD ASSY:TRIGGER AMPLIFIER (SEE A22, EXCHANGE ITEM)	80009	671-0991-00
-60	386-5296-00			1	PANEL,REAR: (ATTACHING PARTS)	80009	386-5296-00
-61	213-0904-00			4	SCREW,TPG,TR:6-32 X 0.5,PNH,STL (END ATTACHING PARTS)	83385	ORDER BY DESCR
-62	426-2061-00			1	FR SECT,PLUG-IN:LOWER,ALUMINUM (ATTACHING PARTS)	80009	426-2061-00
-63	213-0914-00			4	SCREW,TPG,TR:6-32 X 0.75,FLH,100 DEG,STL (END ATTACHING PARTS)	83385	ORDER BY DESCR
-64	407-3814-00			2	BRACKET,FRONT:ALUMINUM	80009	407-3814-00
-65	131-0955-00			1	CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
-66	386-5635-00			1	SUBPANEL,FRONT:ALUMINUM	80009	386-5635-00

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
5-1	620-0022-01			1	POWER SUPPLY:ET,RT,HIRES MAIN FRAMES (EXCHANGE ITEM) (ATTACHING PARTS)	80009	620-0022-01
-2	211-0721-00			8	SCREW,MACHINE:6-32 X 0.375,PHN,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-3	200-2222-00			1	.GUARD,FAN: (ATTACHING PARTS)	81041	6-182-033
-4	211-0744-00			4	.SCREW,MACHINE:6-32 X 2.0,PNH,TORX,STL,CD (END ATTACHING PARTS)	04348	ORDER BY DESCR
-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,MEDIUM BLOW .(FUSE USED IN FUSE HOLDER)	71400	MTH-CW-6
	159-0021-00			1	.FUSE,CARTRIDGE:3AG,2A,250V,FAST BLOW .(FUSE USED ON LINE INVERTER BOARD)	71400	AGC-CW-2
-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

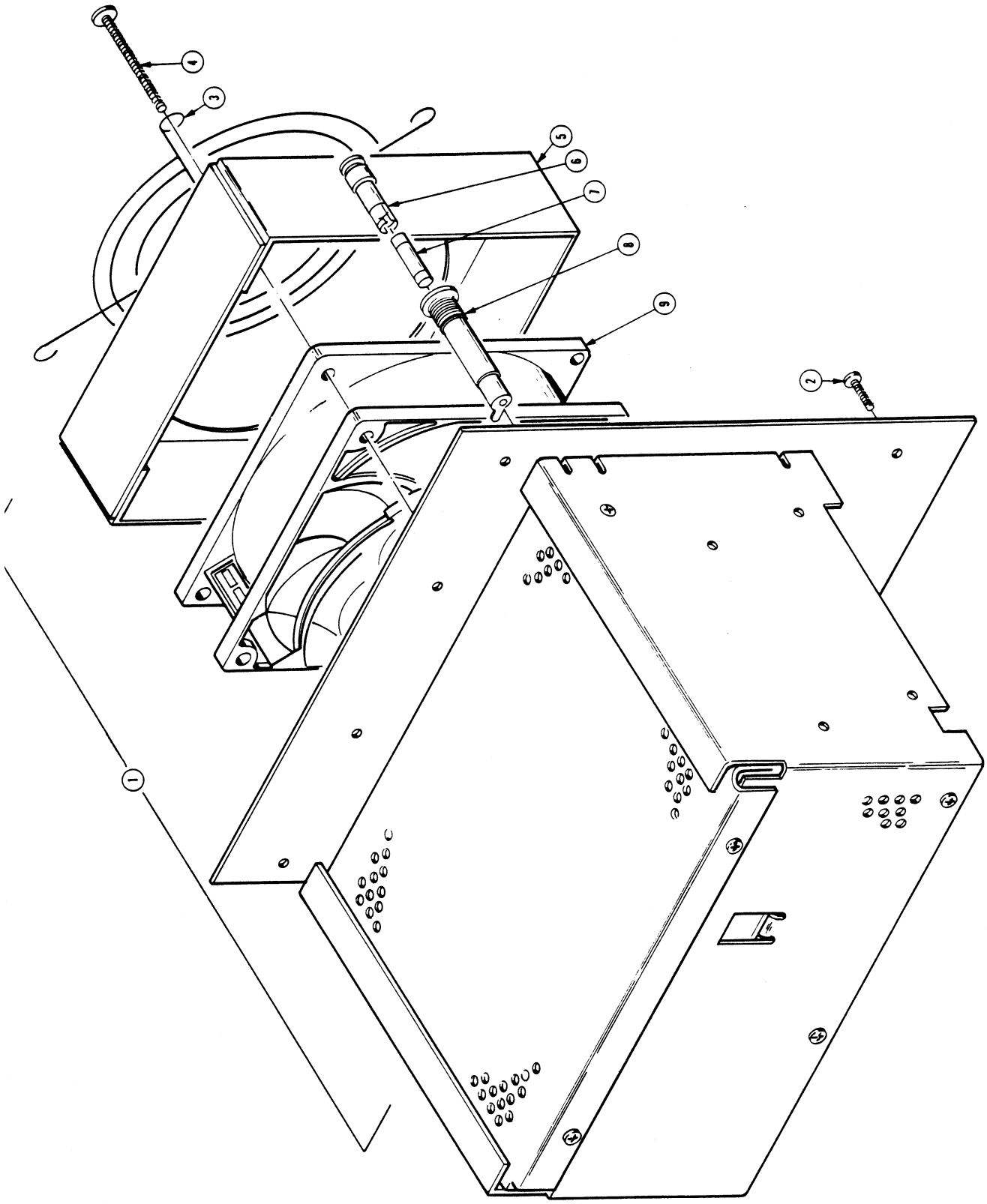

Fig. 5 Power Supply
11201 Service Reference Manual

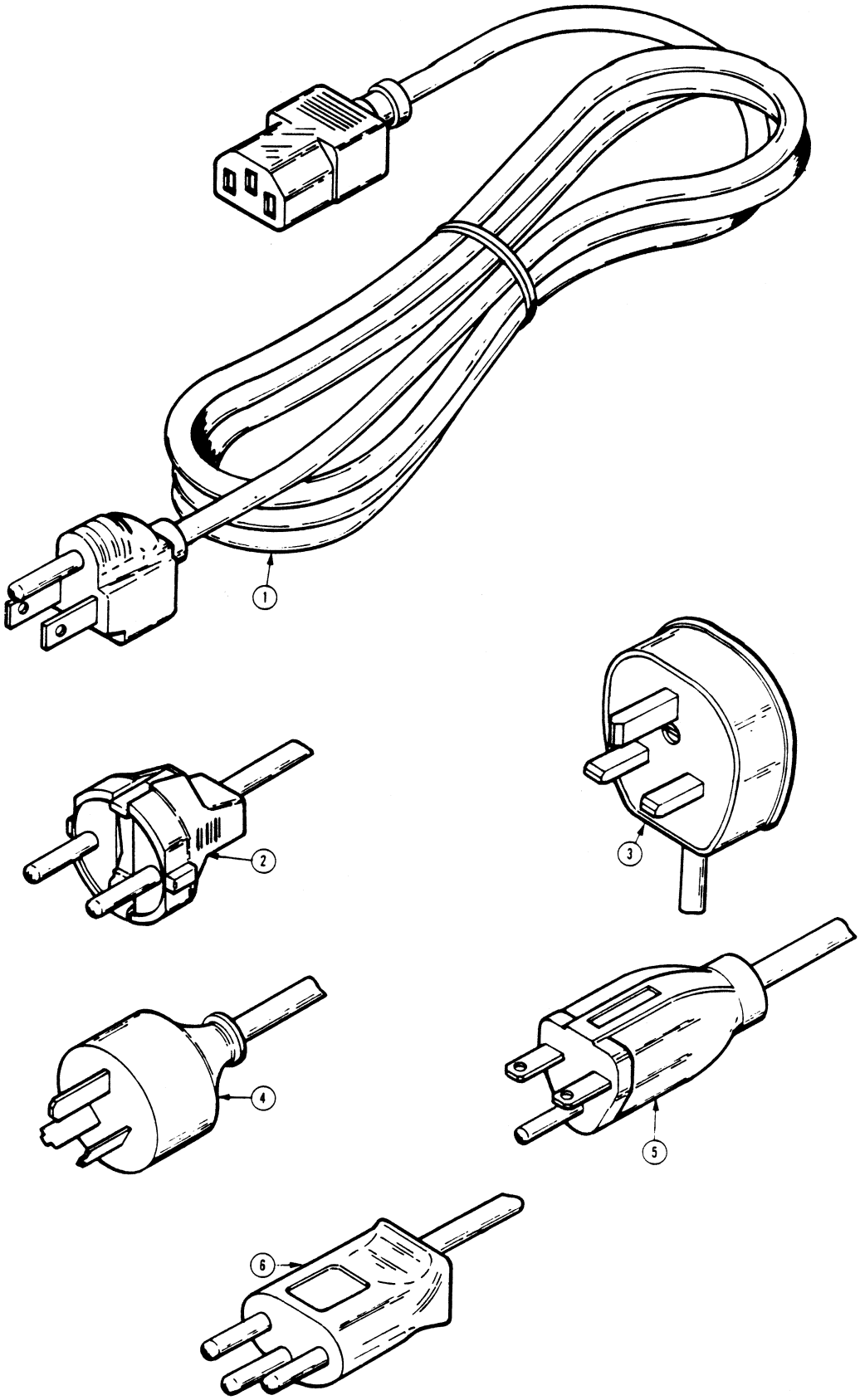

Fig. 6 Accessories
11201 Service Reference Manual

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
6-								
						STANDARD ACCESSORIES		
-1	161-0066-00			1		CABLE ASSY,PWR,:3,18AWG,115V,98.0 L	16428	CH8481, FH8481
-2	161-0066-09			1		CABLE ASSY,PWR,:3,0.75MM SQ,220V,99.0 L (OPTION A1 ONLY)	S3109	86511000
-3	161-0066-10			1		CABLE ASSY,PWR,:3,0.75MM SQ,240V,96.0 L (OPTION A2 ONLY)	TK1373	24230
-4	161-0066-11			1		CABLE ASSY,PWR,:3,0.75MM,240V,96.0 L (OPTION A3 ONLY)	S3109	ORDER BY DESCR
-5	161-0066-12			1		CABLE ASSY,PWR,:3,18 AWG,250V,99.0 L (OPTION A4 ONLY)	70903	CH-77893
-6	161-0154-00			1		CABLE ASSY,PWR,:3,0.75MM SQ,240V,6A,2.5M L (OPTION A5 ONLY)	S3109	86515000
	070-6274-00			1		MANUAL,TECH:INSTR,11401/11402 (OPTION 1R ONLY)	80009	070-6274-00
	070-7274-00			1		MANUAL,TECH:INTRODUCTION,11201	80009	070-7274-00
	070-7275-00			1		MANUAL,TECH:USERS REF,11201	80009	070-7275-00
	070-7276-00			1		MANUAL,TECH:PROGRAMMERS REF,11201	80009	070-7276-00
	070-7277-00			1		MANUAL,TECH:PROGRAMMERS QUICK REF,11201	80009	070-7277-00
	070-7279-00			1		MANUAL,TECH:SERVICE REF,11201	80009	070-7279-00
						OPTIONAL ACCESSORIES		
	012-0555-00			1		CABLE,INTCON:3 METERS	80009	012-0555-00
	012-0911-00			1		CABLE,INTCON:144.0 L, RS 232	TK6020	ESF-85249
	012-0991-00			1		CABLE,GPIB:LOW EMI,2 METER	00779	553577-3
	016-0829-00			1		PANEL,BLANK:PLUG-IN HOUSING,11K SERIES	80009	016-0829-00
	067-1264-00			1		FIXTURE,CAL:POWER SUPPLY EXTENDED DIAGNOSTICS	80009	067-1264-00
	067-1267-00			1		FIXTURE,CAL:TROUBLE SHOOTING AID EXTENDER CARD W/CABLES	80009	067-1267-00