

# THE 11801A

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DIGITAL SAMPLING  
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.*

### **Instrument Serial Numbers**

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

B010000	Tektronix, Inc., Beaverton, Oregon, USA
G100000	Tektronix Guernsey, Ltd., Channel Islands
E200000	Tektronix United Kingdom, Ltd., London
J300000	Sony/Tektronix, Japan
H700000	Tektronix Holland, NV, Heerenveen, The Netherlands

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

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# General Information

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The *11801A Digital Sampling Oscilloscope Service Reference* is designed for use by qualified service personnel. It contains information necessary to check, troubleshoot, and maintain the 11801A Digital Sampling Oscilloscope.

Troubleshooting is primarily based upon internal power-on diagnostics. These diagnostics isolate problems to the field replaceable unit (FRU) level. Defective FRUs not detected by diagnostics are isolated using other means. Once the faulty FRU is identified, use the instructions provided in this manual to remove and replace it. The removal and immediate replacement of the faulty FRU allows a minimum of downtime for the user. Section 5, Replaceable Parts, gives a complete list of the FRUs in this instrument.

First-time users are encouraged to read the *11801A Digital Sampling Oscilloscope Tutorial*. This is a tutorial that will help you to learn the basic functions of the 11801A.

This section gives safety information and information about installing and removing a sampling head, applying power, proper environmental conditions, shipping the instrument, and instrument options.

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## 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 instrument power cord. To avoid electric shock, plug the power cord into a properly wired receptacle before connecting 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.

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### **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 a fuse which is identical in type, voltage rating, and current rating to the fuse specified in Section 5, Replaceable Parts.

### **Electrostatic Discharge**

The input diodes used in the sampling heads are very susceptible to damage from overdrive signal or DC voltages, and from electrostatic discharge. Never apply a voltage outside the range printed on the front of the sampling head. Operate the oscilloscope only in a static-controlled environment.



*Applying a voltage outside the range printed on the sampling head can result in damage. Static electricity is also a hazard.*



*Connect the wrist strap provided with the instrument to the **ANTISTATIC CONNECTION**.*

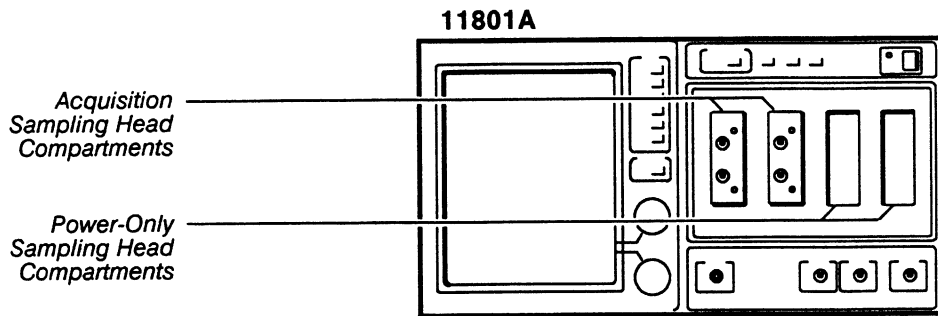
*Switching coupling to DC when more than  $\pm 1.5$  V is present at the External Trigger input will exceed the peak input voltage specification, and may damage the trigger circuit. (X1 Attenuation).*

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## Sampling Head Installation and Removal

To avoid damage to the oscilloscope, set the ON/STANDBY switch to STANDBY before installing or removing sampling heads.

The SD-Series sampling head slides into the one of the front panel compartments of the 11801A Digital Sampling Oscilloscope. The figure below shows the front panel of the 11801A Digital Sampling Oscilloscope and the locations of the sampling head compartments.



**Figure 1-1** – Sampling Head Compartments in the 11801A Digital Sampling Oscilloscope

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With the ON/STANDBY switch set to STANDBY, place the sampling head in a compartment and slowly push it in with firm pressure. Once the sampling head is seated, turn the lock-down screw to tighten the sampling head in place.



*Never install or remove a sampling head when the ON/STANDBY switch is ON.*

To remove the sampling head, set the ON/STANDBY switch to STANDBY. Turn the lock-down screw to loosen the sampling head, and then slowly pull out the sampling head.



## 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.

### WARNING

**AC POWER SOURCE AND CONNECTION.** *The instrument 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.*

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

*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 connection to the instrument's input or output terminals.*

## Power Cord Information

A power cord with appropriate plug configuration is supplied with each instrument. 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

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## Memory Backup Power

There are four batteries within the instrument that allow the retention of volatile memory upon loss of the AC power source. These self-contained power sources provide memory backup power for the following purposes:

- to retain front-panel settings and to continue recording the number of hours of instrument on-time and power-on sequences
- to retain stored settings
- to retain **Time & Date** parameters
- to retain Time Base Cal Constants (these are regenerated automatically if lost)

The batteries have a nominal shelf life of approximately five years.

## Operating Environment

The following environmental requirements are provided so that you can ensure proper functioning and extend the operation of the instrument.

### Operating Temperature

The instrument 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.

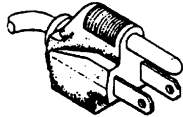
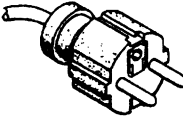
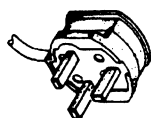

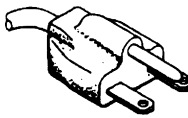
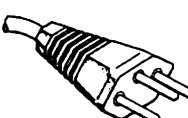
### Ventilation Requirements

The fan draws air through the side panels of the instrument and blows air out through the rear to cool the instrument. To ensure that this cooling process occurs properly, allow at least two inches clearance on both sides and the rear of the instrument. The top and bottom of the instrument do not require ventilation clearance.



*If air flow is restricted, then the instrument's power supply may temporarily shut down.*

**Table 1-2 – Power-Cord and Plug Identification**

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

<sup>1</sup>ANSI – American National Standards Institute

<sup>2</sup>NEMA – National Electrical Manufacturers' Association

<sup>3</sup>IEC – International Electrotechnical Commission

<sup>4</sup>CEE – International Commission on Rules for the Approval of Electrical Equipment

<sup>5</sup>BSI – British Standards Institute

<sup>6</sup>AS – Standards Association of Australia

<sup>7</sup>SEV – Schweizerischer Elektrotechnischer Verein

<sup>8</sup>VDE – Verband Deutscher Elektrotechniker

<sup>9</sup>SEMKO – Swedish Institute for Testing and Approval of Electrical Equipment

<sup>10</sup>UL – Underwriters Laboratories

<sup>11</sup>CSA – Canadian Standards Association

<sup>12</sup>ETSA – Electricity Trust of South Australia

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## Packaging for Shipment

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

Also, if the instrument is to be shipped to a Tektronix service center for service or repair, attach a tag to the instrument showing the following:

- Owner of the instrument (with address)
- Name of person to contact at your firm
- Complete instrument type and serial number
- If possible, furnish complete system firmware versions as displayed in the **Instrument 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, package the instrument 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 instrument dimensions. This allows for cushioning.
- Step 2: Wrap the instrument with polyethylene sheeting or equivalent material to protect the finish.
- Step 3: Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the instrument, allowing three inches on each side.
- Step 4: Seal the carton with shipping tape or with an industrial stapler.
- Step 5: Mark the address of your local Tektronix service center and your return address on the carton in one or more prominent locations.

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## Instrument Options

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

**Option 1R** – adds slide rails and rackmounting hardware to convert the benchtop instrument to a standard 19-inch rackmount version. 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 check electrical specifications, examine measurement limits and to manually set all internal adjustments listed in Table 2-1. This procedure provides a logical sequence of check and adjustment steps intended to return the oscilloscope to specified operation following repair, or for performing a comprehensive performance verification procedure to verify that the oscilloscope meets specifications. To functionally test the oscilloscope, simply perform the checks for the parts in Table 2-1 which have a "yes" indication in the Functional Test column. The Specifications or Measurement Limits are given at the beginning of each part. Refer to the *11801A Digital Sampling Oscilloscope User Reference* for more information about specifications and oscilloscope operation. The Setup in each part provides information concerning test equipment setup or interconnection. Refer to Table 2-2 for more information concerning test equipment used in the setups.

Note that the different parts of the Checks and Adjustment procedures can be run in any order, with the exception that Part 1 (Sampling Head Calibration) must always precede other parts which use an operational sampling head (i.e., does not apply to parts using the Calibration Head). Also, if a different type of sampling head is used, and enhanced accuracy mode operation is desired, then a repeat sampling head calibration is required for each additional sampling head type.

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

Part and Description	Measurement Limits ( <i>Examine</i> )	Specifications ( <i>Check</i> )	Adjustments ( <i>Adjust</i> )	Functional Test
Part 1 Sampling Head	none	none	none	yes
Part 2 Power-On Diagnostics	none	none	none	yes
Part 3 Extended Diagnostics	none	none	none	yes
Part 4 Power Supply				no
Voltage Supply	+ 4.85 V to + 5.25 V	none	none	
Voltage Reference	+ 5.15 V to + 5.25 V	none	R800 + 5.2 V Ref for + 5.20 V	
Regulator Reference	+ 9.95 V to + 10.05 V	none	R830 + 10 V Ref for + 10.00 V	
Part 5 Display				
Cutoff	visible	none	A8 CRT Driver board SCREEN adjustment on transformer until display appears	no

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

<b>Part and Description</b>	<b>Measurement Limits (Examine)</b>	<b>Specifications (Check)</b>	<b>Adjustments (Adjust)</b>	<b>Functional Test</b>
<b>Part 5 Display (cont)</b>				
Convergence	primary colors are not separated in the white grid		CONVERGENCE, R210, for optimum convergence of red, green, and blue.	
Focus	focused grid pattern		A8 CRT Driver board FOCUS adjustment on transformer for optimum focus on white grid pattern.	
Vertical Size and Position	align with tic marks		VERT SIZE, L321, and VERT POS, R311, for optimum alignment	
Horizontal Size, Linearity and Position	align with tic marks and for optimum appearance		H-SIZE, R501, H-LIN, R502, and H-POS, R500, for optimum alignment and linearity	
Gray Scale	white at the top of the display and gray at the bottom, and the right side of the display is cut off		A8 CRT Driver board SCREEN adjustment on transformer; RED, R200; GREEN, R201, and BLUE; R203, are adjusted for cutoff and color balance	
Color Impurity	no severe color impurities in red, green, and blue display		Cycle power on and off	
Part 6 Real Time Clock	1,000,000 $\mu$ s $\pm 5 \mu$ s		Real Time Clock for 1,000,000 $\mu$ s	no
Part 7 Vertical Reference Voltage	none	$5 \pm 200 \mu$ V and $-5 \pm 200 \mu$ V	none	no
Part 8 Horizontal Reference Clock	none	200,000 kHz $\pm 5$ kHz	none	no



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

<b>Part and Description</b>	<b>Measurement Limits (Examine)</b>	<b>Specifications (Check)</b>	<b>Adjustments (Adjust)</b>	<b>Functional Test</b>
<b>Part 9 Vertical Accuracy</b>				
Vertical Gain	none	$\pm 1.2\%$	none	yes
Offset Accuracy	none	$\pm 2$ mV	none	yes
Vertical Linearity	none	$\pm 1\%$	none	no
<b>Part 10 System Vertical RMS Noise</b>	none	none	none	no
<b>Part 11 Sweep Rate Accuracy</b>	none	none	none	yes
<b>Part 12 Triggering</b>				
2 GHz Sensitivity	40 mV p-p at 200 MHz	250 mV display	none	yes
800 MHz Sensitivity	150 mV p-p at 800 MHz	150 mV display	none	
100 MHz Sensitivity	250 mV p-p at 2.0 GHz	50 mV display	none	
<b>Part 13 Internal Clock</b>				
Rise Time	$\leq 2.5$ ns	$\leq 2.5$ ns	none	yes
Frequency	100 kHz $\pm 3\%$	100 kHz $\pm 3\%$	none	
Duty Cycle	50% $\pm 3\%$	none	none	
<b>Part 14 Calibrator Output</b>				
Rise Time	Approximately 300 ps	Approximately 300 ps	none	yes
Peak-to-peak Amplitude	250 mV $\pm 10\%$	250 mV $\pm 10\%$	none	

## Test Equipment

The Table 2-2 (Test Equipment), contains suggested test equipment for use in this manual. Procedure steps are based on the test equipment examples given, but you may substitute other equipment with similar specifications. The use of different equipment may alter test results, setup information, and related connectors and adapters.

**Table 2-2 – Test Equipment**

<b>Description</b>	<b>Minimum Specification</b>	<b>Examples of Applicable Test Equipment</b>
High Frequency Sine Wave Generator	10 MHz to 10 GHz	WILTRON 6759B Opt 2
Sampling Head	SD-Series	Any Tektronix SD-Series Sampling Head
Digital Voltmeter (w/test leads)	≤0.008% Accuracy	TEKTRONIX DM 5120 with a TM 500-Series Power Module
Frequency Counter	One Part in 1,000,000 Accuracy	TEKTRONIX DC 5010 Universal Counter/Timer with a TM 5000-Series Power Module
Calibration Head		TEKTRONIX Calibration Head 067-1413-00
Precision Voltage Source		DATA PRECISION 8200
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
Coaxial Cable, 50 Ω (3 required)	50 Ω, 36-inch, male BNC connectors	Tektronix Part 012-0482-00
Coaxial Cable, RF	RF cable, 12 in., SMA connectors	Tektronix Part 174-1364-00
	RF cable, 8.5 in., SMA connectors	Tektronix Part 174-1120-00

**Table 2-2 – Test Equipment (cont)**

<b>Description</b>	<b>Minimum Specification</b>	<b>Examples of Applicable Test Equipment</b>
<b>Adapters</b>	BNC female-to-male Dual Banana	Tektronix Part 103-0090-00
	BNC male-to-female Dual Banana	Tektronix Part 103-0035-00
	SMA male-to-BNC female (5 required)	Tektronix Part 015-1018-00
	SMA male-to-BNC female (3 required)	Tektronix Part 015-1018-00
	SMA female-to-BNC male	Tektronix Part 013-0126-00
	SMA male-to-N male	Tektronix Part 015-0369-00
<b>Power Divider, 50 Ω</b>	6 dB load isolation, 50 Ω, SMA connectors	Tektronix Part 015-1014-00
<b>Termination, 50 Ω</b>	Impedance, 50 Ω; accuracy, within 2%; connectors, SMA	Tektronix Part 015-1022-00
<b>Attenuator, 10X</b>	20 dB attenuation, 50 Ω, one male and one female	Tektronix Part 011-0059-02
<b>Attenuator, 2X</b>	50 Ω, SMA, one male and one female	Tektronix Part 015-1001-00
<b>Power Supplies Troubleshooting Fixture</b>		TEKTRONIX 067-1264-00 Extended Diagnostics 11000-Series Power Supplies troubleshooting fixture
<b>Pickoff, 10X</b>		Picosecond Pulse Labs 5520A
<b>Power Meter</b>		HP 436A
<b>Power Sensor</b>		HP 8485A
<b>Alignment Tool</b>	Plastic hex	Tektronix Part 003-0301-00
	Insulated slot	Tektronix Part 003-0675-01
	Square Tip (ceramic)	Tektronix Part 003-1400-00

**Table 2-2 – Test Equipment (cont)**

<b>Description</b>	<b>Minimum Specification</b>	<b>Examples of Applicable Test Equipment</b>
Magnetic Screwdriver	Holder for Torx head tips	Tektronix Part 003-0293-00
Torx Head Screwdriver	#10 tip	Tektronix Part 003-0814-00
	#15 tip	Tektronix Part 003-0966-00
	#20 tip	Tektronix Part 003-0866-00
External Loopback Connector	RS-232-C connector	Tektronix Part 013-0198-00
Shorting Strap	Two alligator clips on a short pigtail conductor	
Integrated Circuit Extracting Tool	IC Insertion-Extraction Pliers, 28-pin type	General Tool P/N U505BG or equivalent
Board Removal Tools	Straight-slot screwdriver, large	
	Torx-drive screwdriver. T-7, T-8, T-10, T-15, T-20, T-25	
	Allen (hex) Wrench, 1/16-inch	
	Nutdrivers, 3/16-inch, 1/4-inch, 7/16-inch	
	Needle-nose pliers	
Small Ruller	Half inch rullings	

---

## Using These Procedures

Some parts begin with a setup illustration that shows what test equipment is needed and how to connect it. The other parts require only a calibrated SD Series Sampling Head. Refer to Table 2-2 (Test Equipment), on the preceding pages for an example of the test equipment for each part.

### Conventions in this Manual

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) and sampling head.
- **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 and 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 these procedures. Comprehensive descriptions of menus and oscilloscope features are located in the *11801A Digital Sampling Oscilloscope User Reference*.

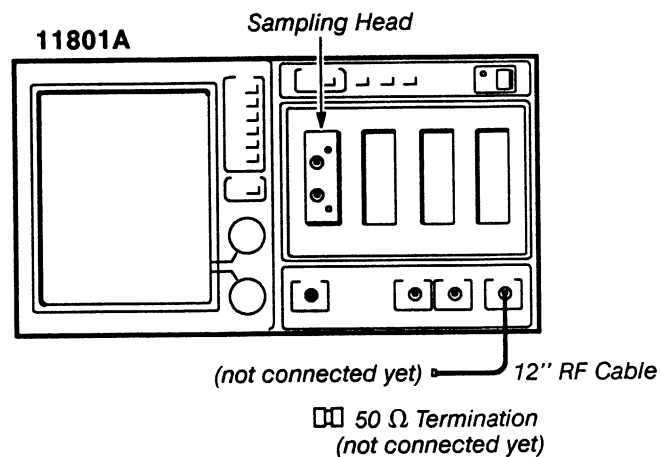
### Tutorial Manual

The *11801A Digital Sampling Oscilloscope Tutorial* is strongly recommended to familiarize the first-time user with oscilloscope controls and features.

## Part 1 Sampling Head

This part shows the setup and lists the test procedure for calibrating Loop Gain and Offset Null. Note that this is an optional enhanced accuracy procedure, and fine tunes internal channel processing circuitry in conjunction with any operational sampling head type being used (the 067-1413-00 calibration head is a service device and does not require system calibration). This procedure also Initiates a built-in 11801A program which causes the mainframe to remember which sampling head type was used in the calibration. In this way, pre-calibrated heads can be interchanged without requiring recalibration. Note that enhanced mode calibrations will reset to default settings whenever the unit is switched off.

### Setup to Calibrate a Sampling Head



*Setup to Calibrate a Sampling Head*

### Procedure to Calibrate a Sampling Head

- Step 1: Power-up and Initialize as follows:

Set the ON/STANDBY switch to ON ..... rocker / press  
 UTILITY button ..... press  
     **Initialize** (in major menu) ..... touch  
     **Initialize** (verify) ..... touch

- Step 2: Set up first Automatic Calibration as follows:

Press the UTILITY button ..... press  
     **Page to Enhanced Accuracy** ..... press  
     **Loop Gain** (in major menu) ..... touch  
     Identify **Mainframe** ..... touch  
     Identify Channel (2) ..... touch  
     **Automatic Calibrate** (in pop-up menu) ..... touch

- Step 3: Perform the Gain calibration as follows:

Connect the CALIBRATOR output to the sampling head input to be calibrated (2).

- Select **Proceed** (in the Loop Gain pop-up menu) ..... touch
- Store Constants (in pop-up menu) ..... touch

- Step 4: Set up second Automatic Calibration as follows:

Disconnect the calibration cable from the sampling head input.

- Offset Null** (in major menu) ..... touch
- Automatic Calibrate** (in pop-up menu) ..... touch

- Step 5: Perform the Offset Null calibration as follows:

Connect a 50  $\Omega$  termination to the sampling head input.

- Select **Proceed** (in pop-up menu) ..... touch
- Store Constants** (in pop-up menu) ..... touch
- Exit** (in pop-up menu) ..... touch

- Step 6: Repeat Steps 1 through 5 for all sampling head compartments and channels being tested.

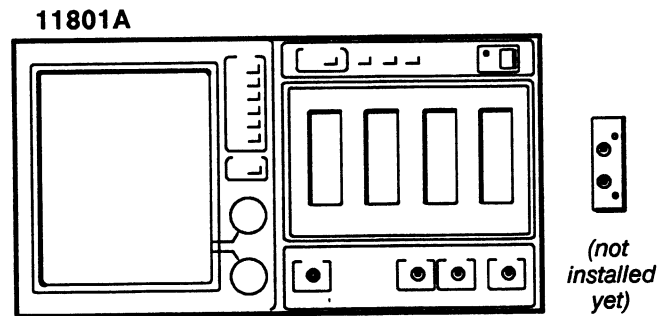
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## Part 2 Power-On Diagnostics

This part should be performed within the ambient temperature range of +18° and +28°C, when a performance check at peak operating conditions is required.

### Setup to Invoke Power-On Diagnostics

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Setup to Invoke Power-On Diagnostics

---

#### Procedure to Invoke Power-on Diagnostics

- Step 1: Check that the sampling head is not yet installed, and that the ON/STANDBY switch is in the STANDBY position.
- Step 2: Remove the top and bottom covers from the oscilloscope (unless you are only performing a functional test).
- Step 3: Install an SD Series sampling head in the left sampling head compartment marked CH 1/CH 2.
- Step 4: With the oscilloscope's rear panel PRINCIPAL POWER SWITCH set to OFF, connect the oscilloscope to a suitable power source.
- Step 5: Set the rear panel PRINCIPAL POWER SWITCH to ON and then set the oscilloscope's front panel ON/STANDBY switch to ON.

When the oscilloscope is first installed, the rear panel PRINCIPAL POWER SWITCH should be set to and left in the ON position. From then on, use the front panel ON/STANDBY switch to perform all subsequent power switching.

- Step 6: Monitor the following diagnostic run functions, and note the range of possible results.

**Diagnostics** – Each time the front panel ON/STANDBY switch is set to ON, the oscilloscope performs Kernel diagnostics on its microprocessor subsystems, followed by Self-Test diagnostics on most all of its major circuits. Failures from either of these two sets of diagnostics may cause the oscilloscope to enter the **Extended Diagnostics** menu as described next in this part.

When Kernel diagnostics begin, the **Diagnostics in Progress** and **Comm Test in Progress** messages are displayed on the screen. If the oscilloscope is being powered-on from a cold condition, then the diagnostics may be completed before the CRT is warmed up and able to display these messages. Diagnostic routines are then performed in parallel on each of the oscilloscope's microprocessor



subsystems (Display, Executive, Time Base, and Mainframe Acquisition). Following successful execution of their Kernel diagnostics, Acquisition microprocessors attempt to communicate with the Time Base microprocessor and the Time Base and Display microprocessors attempt to communicate with the Executive microprocessor.

Successful completion of Kernel diagnostics is indicated by the start of Self-Test diagnostics. A failure of Kernel diagnostics will be indicated by the message, **Dsy Kernel Failure**, or **Comm Test in Progress** displaying on the screen (for Display kernel failures) and/or by a single high-low beep and illuminated menu button indicators (for Executive kernel failures).

**Self-Test Diagnostics** – These begin by displaying **Self-Test in Progress** (when the Display microprocessor has successfully communicated with the Executive microprocessor). Pattern changes on the display and the flashing of the display indicate a test in progress. The Self-Test diagnostics are successfully completed when the oscilloscope returns to normal operation. Any failures cause the oscilloscope to produce a double high-low beep, and then to display the **Extended Diagnostics** menu on the screen. Faulty field replaceable units (FRUs) may then be identified by touching the **(?)Help** label. If any errors occur, record the error codes for the failed circuit block(s), and then refer the oscilloscope to a qualified service person.

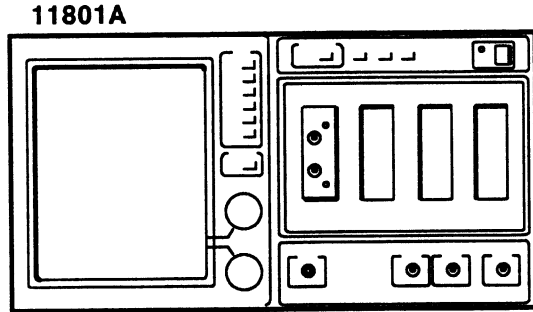
Front panel controls are active during the Self-Test diagnostic sequence; however, any disturbance of these controls causes a test failure. If such a failure occurs, the oscilloscope automatically enters the Extended Diagnostics mode and displays the **Extended Diagnostics** menu. Touch the **Exit** label twice to remove this menu. Note that if the diagnostics detect a fatal fault, it may not be possible to exit the menu.

**Power-on Diagnostics Complete** – This state is signified when the oscilloscope returns to normal operation. If the oscilloscope passes Power-on diagnostics, the front-panel settings that were in effect at the last power-off are restored.

**Part 3  
Extended  
Diagnostics**

The Extended Diagnostics perform more extensive testing than the Self-Test diagnostics. They can be used to assist troubleshooting, particularly in service environments.

**Setup to Invoke Extended Diagnostics**



*Setup to Invoke Extended Diagnostics*

If the oscilloscope entered the normal operating mode without any diagnostic failures, perform the following steps to enter the Extended Diagnostics mode. No inputs or I/O cables should be attached to the oscilloscope for these tests.

**Procedure to Invoke Extended Diagnostics**

- Step 1: With the sampling head installed as illustrated, check initial conditions as follows:

Set the oscilloscope ON/STANDBY switch to ON . . . . . press  
 Check sampling head Select button is OFF . . . . visual check of indicator



*Turning the power off (that is, setting the ON/STANDBY switch to STANDBY or the PRINCIPAL POWER SWITCH to OFF) during the execution of the Extended Diagnostic tests which deal with the Executive processor's NVRAM tests may result in losing stored settings or other data stored in NVRAM. However, this does not seriously affect oscilloscope operation.*

- Select the UTILITY button . . . . . press
- Page to Enhanced Accuracy** (in major menu) . . . . . touch
- Page to Utility2** (in major menu) . . . . . touch
- Extended Diagnostic** (in major menu) . . . . . touch
- Extended Diagnostic** (in pop-up menu) . . . . . touch
- Select **All**, and then **Run** to start the tests . . . . . touch

- Step 2: Check that all tests have executed and have a Pass status. Then make the following selections in the order shown:

- Executive** (if not already highlighted) ..... touch
  - Block** (in major menu) ..... touch
  - External I/O** (in pop-up menu) ..... touch
  - Input/Output** (in pop-up menu) ..... touch
  - Area** (in major menu) ..... touch
  - GPIB** (in major menu) ..... touch
  - Routine** (in major menu) ..... touch

- Step 3: Select and run the following tests:

- Select **Run** to start the **Intrpt Reset** test ..... touch
  - Select **Reset Status**, and then **Run** to start the test ..... touch
  - Select **Data Lines**, and then **Run** to start the test ..... touch
  - Select **Interrupt**, and then **Run** to start the test ..... touch

- Step 4: Check that all four of the previous tests have executed and passed. Then exit as follows:

- Select **Exit** twice to exit Extended Diagnostics ..... touch

## Part 4 Power Supply

This part shows the setup and lists the procedure to examine the Measured Voltage Supply, and to check/adjust the Voltage Reference and the Regulator Reference (see Fig. 2-1, 2-2, and 2-3).



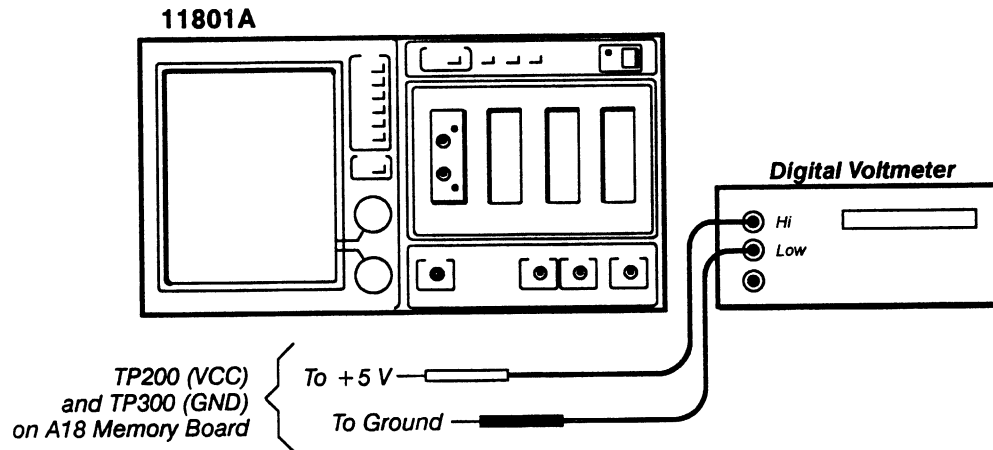
*This procedure should only be performed if the instrument is out of measurement limits and maintenance is required. If the oscilloscope is already within limits, proceed to Part 5 (Display).*

### Measurement Limits

The measurement limits for this part are as follows:

- Measured Voltage Supply limits must be within + 4.85 V and + 5.25 V
- Voltage Reference must be within + 5.15 V and + 5.25 V
- 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: Set the oscilloscope ON/STANDBY switch to ON, and initialize as follows:

UTILITY button ..... press  
**Initialize** (in major menu) ..... touch  
**Initialize** (in verification pop-up menu) ..... touch

- Step 2: With the oscilloscope top and bottom covers removed, refer to Section 5 and locate the A18 Memory board.

- Step 3: Connect the digital multimeter to TP200 and TP300 as indicated in the setup illustration (see also Fig. 2-1).
- Step 4: Check that the Digital Voltmeter reads within the limits of +4.85 V and +5.25 V.

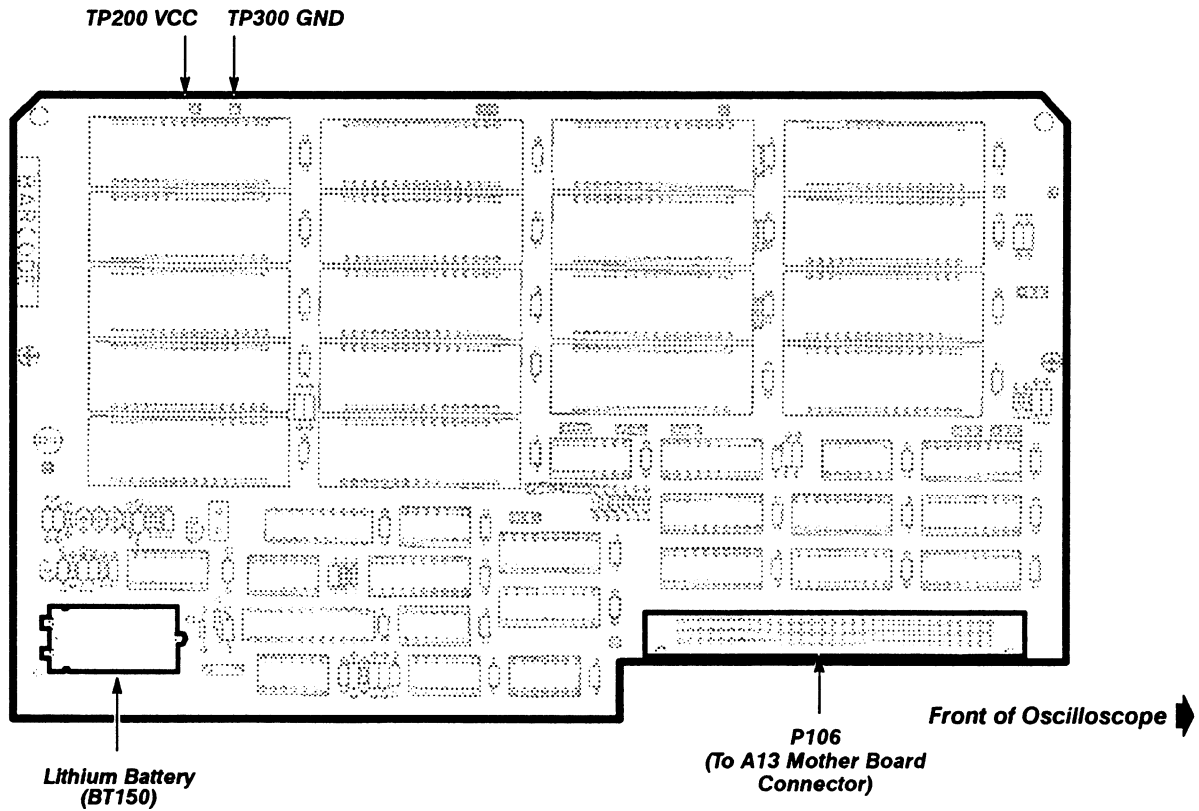
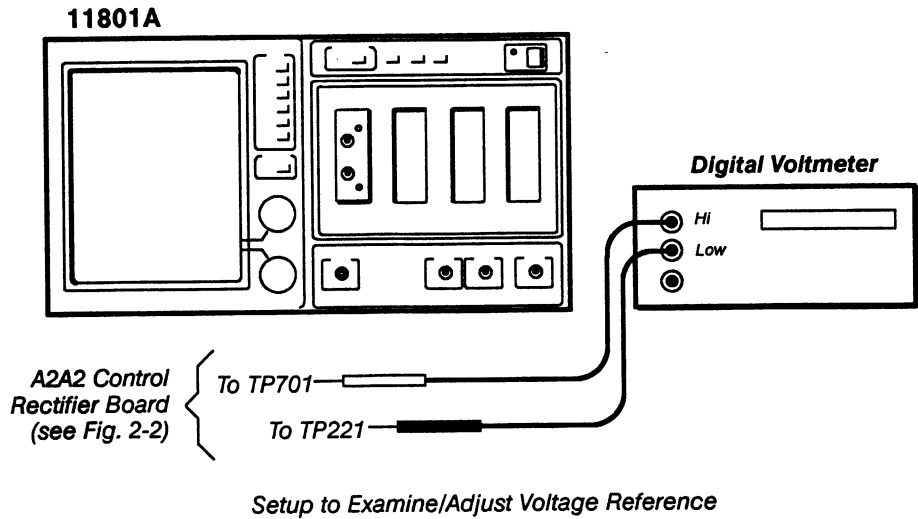


Figure 2-1 — A18 Memory Board Test Point Locations

Setup to Examine/Adjust Voltage Reference



*This procedure should only be performed if maintenance is required. This is not necessary for verifying instrument specifications.*

**Procedure to Examine/Adjust Voltage Reference**

- Step 1: Perform the following settings in the order listed:
  - 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 rear panel PRINCIPAL POWER SWITCH to ON.
  
- Step 2: With the Digital Voltmeter set to DC Voltage and connected as indicated in the setup diagram, check that the multimeter reads within the limits of +5.15 and +5.25 V.



*DO NOT attempt to change the following adjustment setting if the reading is within the stated limits. Proceed to Part 5, Display.*



*Use extreme caution when making the following adjustment due to the dangerous potentials present.*

- Step 3: *Adjust* the +5.2 V Ref adjustment R800 on the A2A2 Control Rectifier board to +5.20 V.
- Step 4: Remove the Digital Voltmeter leads from the test points.
- Step 5: Set the rear panel PRINCIPAL POWER SWITCH to OFF.
- Step 6: Disconnect the oscilloscope from the power source.
- Step 7: Remove all test leads and the TP830/831 shorting strap.
- Step 8: Replace the Power Supply module using the instructions in Section 3, Maintenance.
- Step 9: Set the rear panel PRINCIPAL POWER SWITCH to ON, and the front panel ON/STANDBY switch to ON.

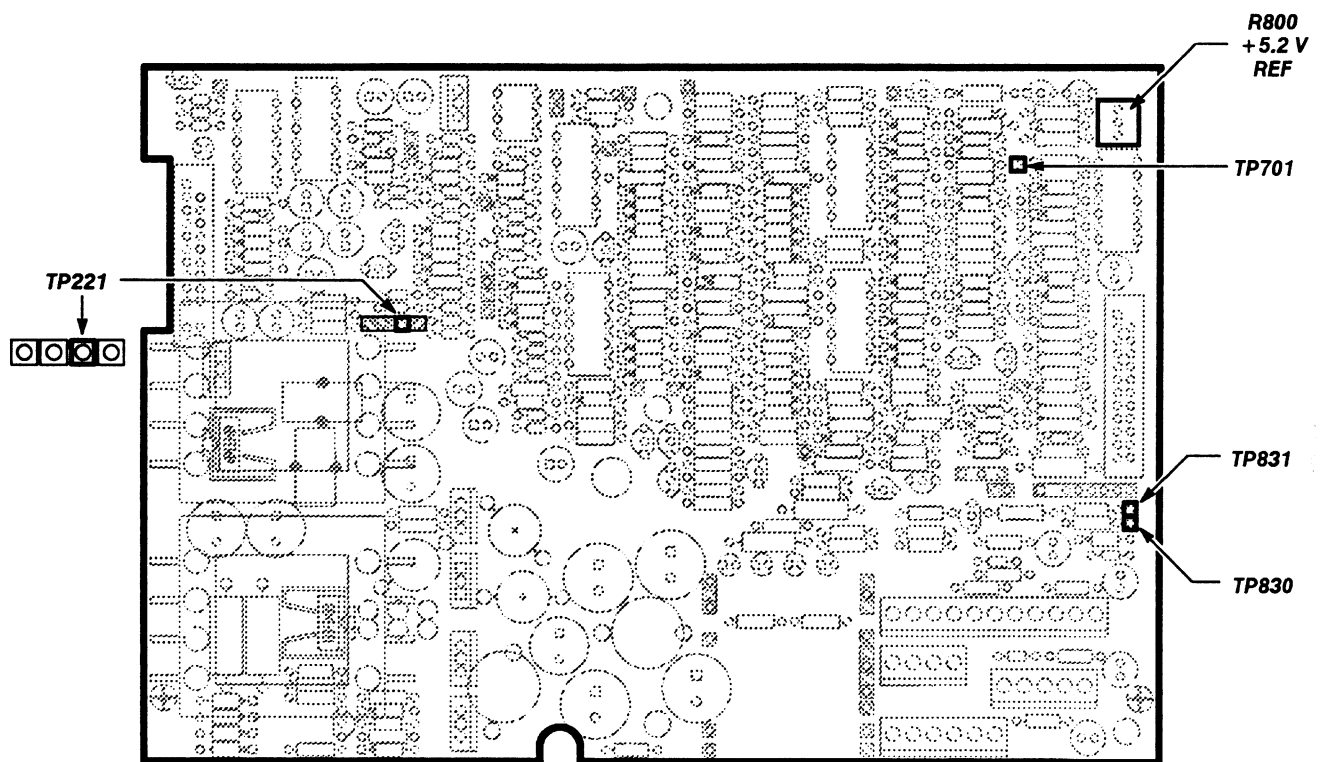
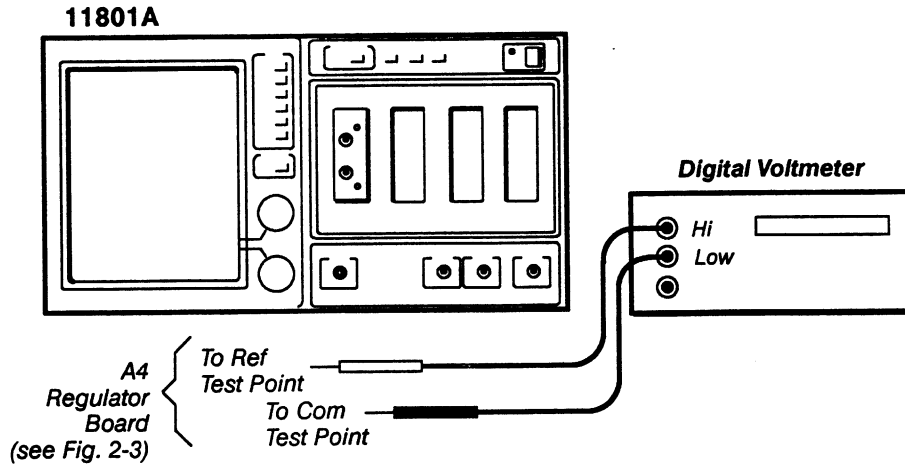


Figure 2-2 – A2A2 Control Rectifier Board Test Point and Adjustment Locations

Setup to Examine/Adjust Regulator Reference



Setup to Examine/Adjust Regulator Reference

Procedure to Examine/Adjust Regulator Reference

- Step 1: Make the connections shown in the setup and Figure 2-3 diagrams. Check that the oscilloscope power is ON.
- Step 2: With the Digital Voltmeter in DC Voltage mode, check the Voltmeter for a reading within the limits of +9.95 V and +10.05 V.



*DO NOT attempt to make the following adjustment to R830 if the reading is within the stated limits. Instead, proceed to Step 4.*

**WARNING**

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

- Step 3: *Adjust the R830 + 10 V Ref adjustment on the A4 Regulator board to +10.00 V.*
- Step 4: Remove the test leads.
- Step 5: Initiate Power-On Diagnostics (see Part 2).



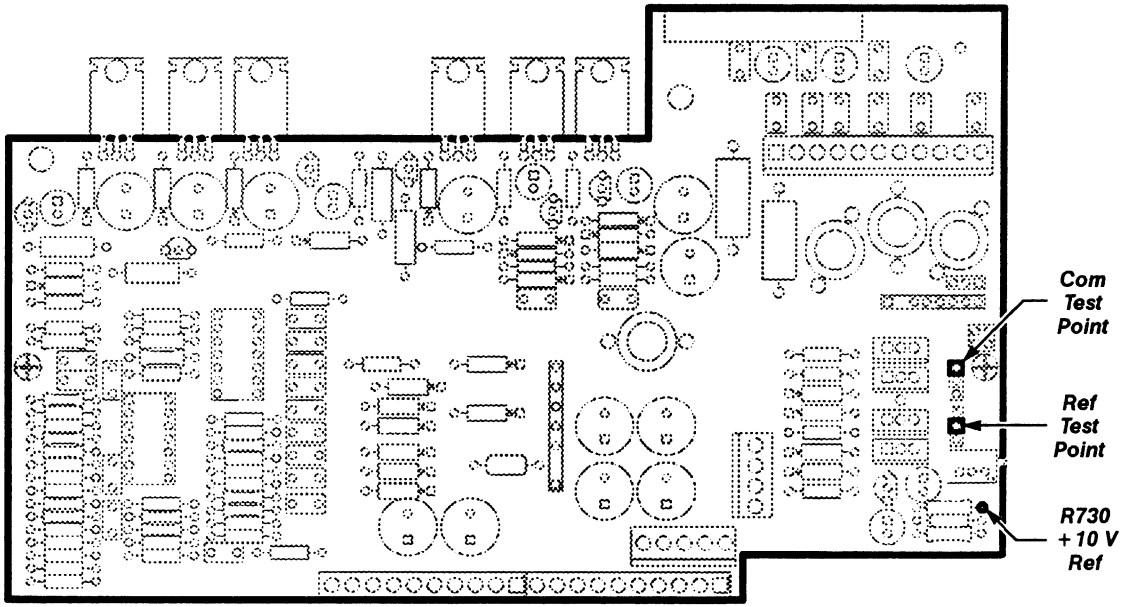


Figure 2-3 — A4 Regulator Board Test Point and Adjustment Locations

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## Part 5 Display

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



*The adjustments in this part only affect the visual aspects of the CRT display and you should only perform these adjustments when the CRT, A7 CRT Socket board or A8 CRT Driver board components are replaced. These adjustments do not affect oscilloscope accuracy since all measurements are made on the acquired data, not the displayed data. Unless alignment or brightness difficulties are apparent, proceed to Part 6, Real Time Clock.*

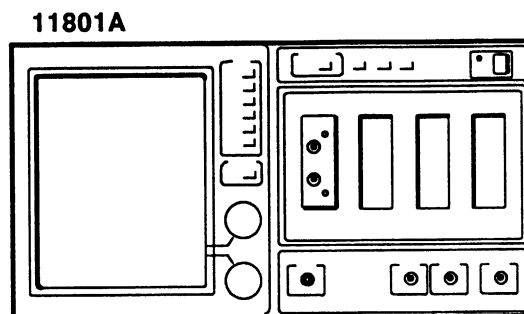
For all *Examine* steps in this part, if the display parameter examined is within the stated limits, then do not perform the *Adjust* step following that *Examine* step. Instead, proceed to the step following the *Adjust* step.

### Measurement Limits

The measurement limits are set on the CRT as follows:

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

### Setup to Examine/Adjust the Display



Setup to Examine/Adjust the Display

---

### Procedure to Examine/Adjust the Display

**WARNING**

Use extreme caution when performing the following adjustment.

- Step 1: Perform the following settings in the order listed:  
11801A  
ON/STANDBY ..... STANDBY
- Step 2: Remove the top and bottom cabinet panel covers.
- Step 3: Remove the three screws that secure the CRT cover, and then remove the cover.
- Step 4: Remove the two screws that secure the cover that shields the A7 CRT Socket board (CRT Socket board cover).
- Step 5: Set the ON/STANDBY switch to ON.
- Step 6: *Examine* that the display is visible.
- Step 7: *Adjust* the SCREEN adjustment, located on the transformer mounted to the A8 CRT Driver board, clockwise until the display appears.
- Step 8: Press the UTILITY button.
- Step 9: Touch **Extended Diagnostic**, then touch **Extended Diagnostic** in the **Verify Diagnostics** pop-up menu.
- Step 10: Touch **Block** and then **Front Panel**.
- Step 11: Touch **Area** and then **Test Pattern**.
- Step 12: Touch **Routine** and then **White Grid**.
- Step 13: Touch **Run** in the major menu.
- Step 14: *Examine* that the primary colors (red, green, and blue) are not separated in the white grid pattern.

**WARNING**

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

- Step 15: *Adjust* the CONVERGENCE adjustment, R210, on the A7 CRT Socket board for the optimum vertical convergence of the red, green, and blue colors.
- Step 16: *Examine* that the grid pattern is focused.
- Step 17: *Adjust* the Focus adjustment, located on the transformer mounted on the A8 CRT Driver board, for the optimum focus of the white grid pattern.

- Step 18: *Examine* that the grid is aligned with the top and bottom tic marks along the inside vertical edge of the front panel bezel. To eliminate any parallax error, look directly ahead at the CRT, and then align the top of the grid with the top vertical tic mark and the bottom of the grid with the bottom tic mark.
- Step 19: *Adjust* the VERT SIZE, L321, and VERT POS, R311, adjustments on the A8 CRT Driver board to align the grid with the tic marks along the inside vertical edge of the front panel bezel.
- Step 20: *Examine* that the grid is aligned with the horizontal tic marks at the top and bottom of the front panel bezel and that the grid boxes are of uniform length throughout the grid pattern.
- Step 21: *Adjust* H SIZE, R501, H LIN, R502, and H POS, R500 on the A8 CRT Driver board for best overall linearity and position. Use the horizontal tic marks at the top and bottom of the front panel bezel to align the grid.
- Step 22: H-SIZE, H-LIN, and H-POS adjustments interact, so you may need to repeat Steps 19 and 20 until they are all correctly adjusted.
- Step 23: Touch **Exit** to return to the **Routine** menu of the **Extended Diagnostic** menu structure.
- Step 24: Touch **Gray Scale** in the **Routine** menu.
- Step 25: Touch **Run** in the major menu.
- Step 26: *Examine* that the color scale is white at the top, gray at the bottom, and the background on the right side of the display is cut off (that is, the vertical raster lines are not visible on the right side of the display).



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

- Step 27: *Adjust* the Red, R200, Green, R201, and Blue, R203, adjustments on the A7 CRT Socket board fully counterclockwise.
- Step 28: *Adjust* the SCREEN adjustment, located on the transformer that is mounted on the A8 CRT Driver board, so that the bottom block of the gray scale is visible but the background on the right side of the display is still cut off.
- Step 29: Note which color (red, green, or blue) appears more prominently in the display. **DO NOT** adjust this color in the following step.
- Step 30: *Adjust* the RED, R200, GREEN, R201, or BLUE, R203, adjustments on the A7 CRT Socket board for a pure white to gray scale display. Only adjust the colors that appear not to be prominent. For example, if the display appears to be more red, then adjust the GREEN and BLUE adjustments.

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

- Step 31: Touch **Exit** to return to the **Extended Diagnostic** menu structure.
- Step 32: Touch **Red Display**, and then touch **Run**.
- Step 33: *Examine* the red display for any severe color impurities.
- Step 34: Touch **Exit** to return to the **Extended Diagnostics** menu structure.
- Step 35: Touch **Green Display** and then touch **Run**.
- Step 36: *Examine* the green display for any severe color impurities.
- Step 37: Touch **Exit** to return to the **Extended Diagnostic** menu structure.
- Step 38: Touch **Blue Display** and then touch **Run**.
- Step 39: *Examine* the blue display for any severe color impurities.
- Step 40: If any of the color displays (that is, the **Red Display**, **Green Display**, or **Blue Display**) showed severe color impurities, then perform the following to restore the color purity:
  - Ensure that the oscilloscope environment is free of all external magnetic fields. For example, a magnetic screwdriver near the oscilloscope could cause color impurities on the screen.
  - Set the ON/STANDBY switch to STANDBY.
  - Wait 10 seconds, then set the ON/STANDBY switch to ON.
  - *Examine* the color displays again, and verify that the color impurities are removed.

**Note:** When the oscilloscope is moved in the earth's magnetic field, color impurities will appear on the display. This is normal. To remove the impurity, repeat Step 40.

- Step 41: Set the ON/STANDBY switch to STANDBY.
- Step 42: Replace the CRT Socket board cover and the CRT cover.

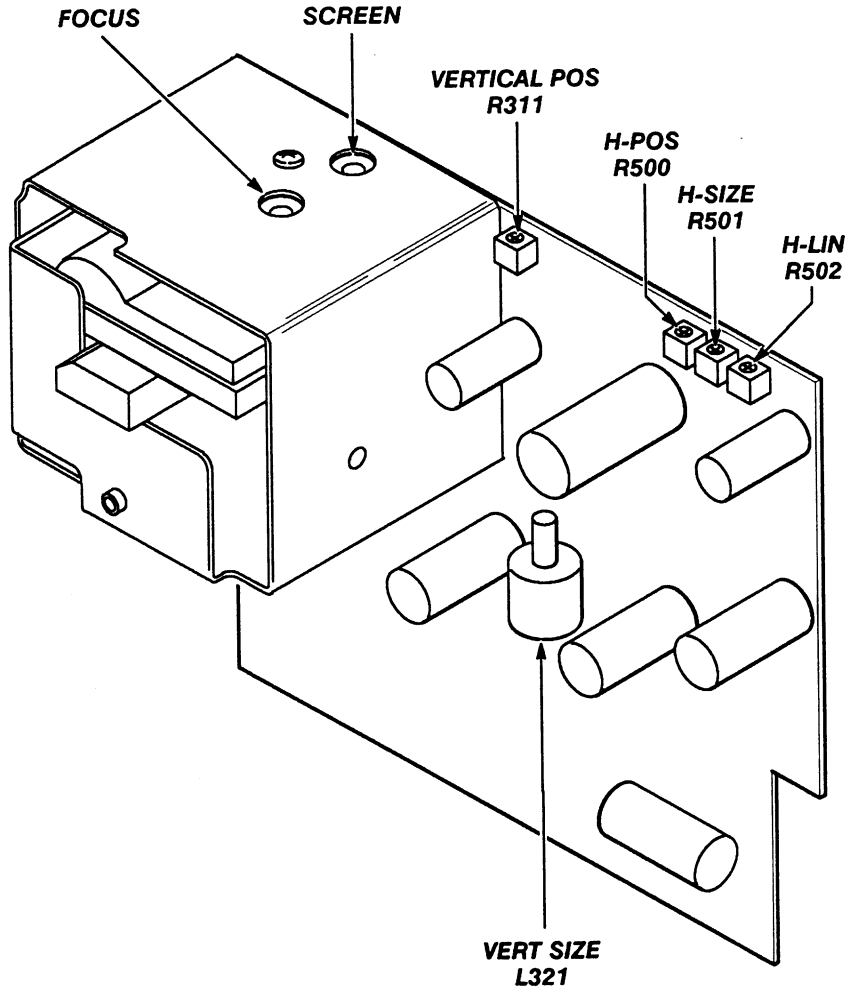


Figure 2-4 – A8 CRT Driver Board Adjustment Locations

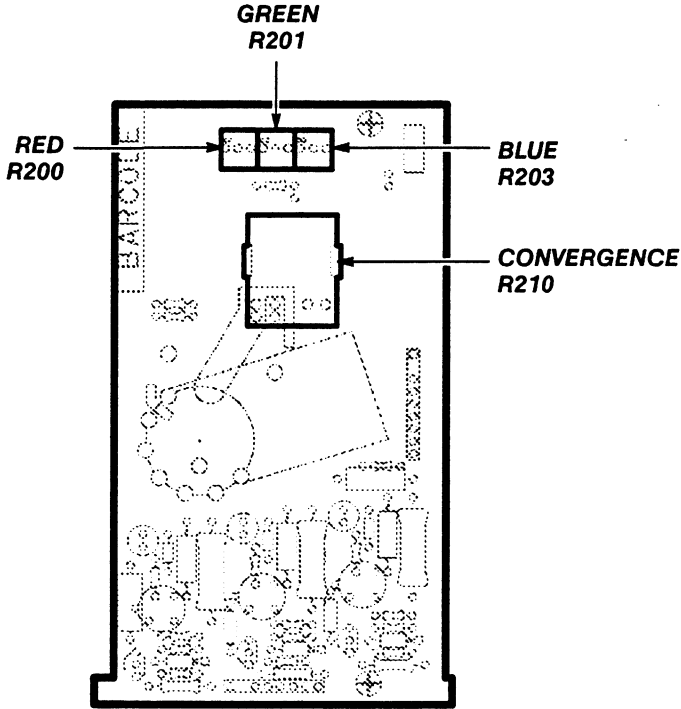


Figure 2-5 – A7 CRT Socket Board Adjustment Locations

**Part 6**  
**Real Time Clock**

This part verifies the correct operation and accuracy of the oscilloscope's input/output systems (see Fig. 2-6).

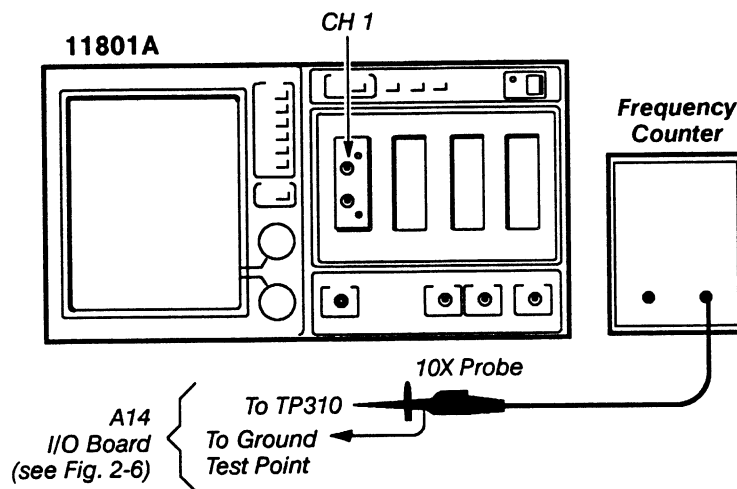


*This procedure should be performed only if maintenance is required. Its use is not necessary for verifying instrument specifications.*

**Measurement Limits**

The measurement limit for the real time clock is 1,000,000  $\mu$ s  $\pm$ 5  $\mu$ s.

**Setup to Examine/Adjust Real Time Clock**



Setup to Examine/Adjust Real Time Clock

**Procedure to Examine/Adjust Real Time Clock**

Step 1: Initialize the oscilloscope settings as follows:

- UTILITY button ..... press
- Initialize** (in major menu) ..... touch
- Initialize** (in verification pop-up menu) ..... touch

Step 2: Perform the following operations in the order given:

- Set the front panel ON/STANDBY switch to STANDBY.
- Remove the L bracket on the front of the card cage.
- Remove both plastic retaining strips from the top of card cage.
- Remove the A17 Main Processor board, and then install it in the fourth slot from the outer edge.
- Remove the A29 Memory Expansion board, and then install it in the third slot.



- Remove the A14 Input/Output (I/O) board, and then install it in second slot.
- Move the A18 Memory board from the first slot to the fifth slot.
- Reconnect all the cables to A14 I/O board.
- Set the oscilloscope front panel ON/STANDBY switch to ON.

Step 3: Connect the Frequency Counter as indicated in the setup diagram (see also Fig. 2-6), and set the controls as follows:

Frequency counter

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

Step 4: Make the following oscilloscope selections:

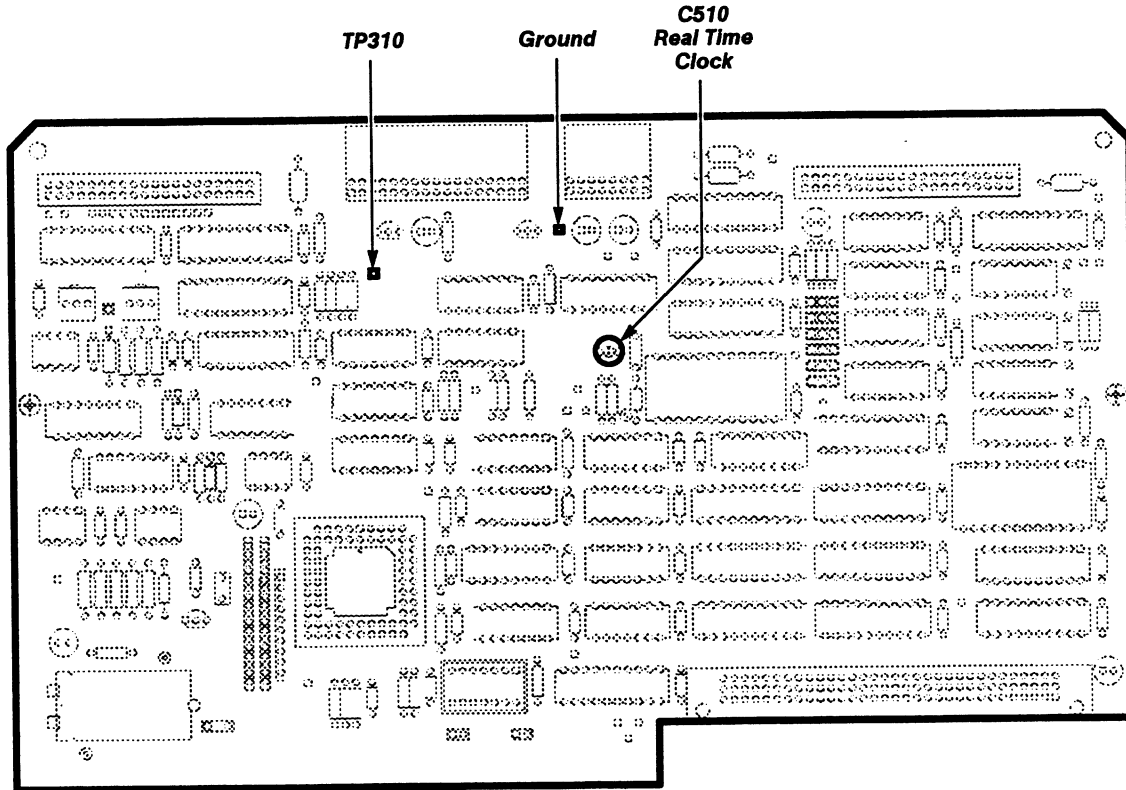
UTILITY button ..... press  
**Page to Enhanced Accuracy** (in major menu) ..... touch  
**Page to Utility2** (in major menu) ..... touch  
**Extended Diagnostics** (in major menu) ..... touch  
**Extended Diagnostics** (in pop-up menu) ..... touch  
**Block** (in major menu) ..... touch  
**Input/Output** (in pop-up menu) ..... touch  
**Area** (in major menu) ..... touch  
**Real Time Clk** (in pop-up menu) ..... touch  
**Routine** (in major menu) ..... touch  
**Calibrate** (in pop-up menu) ..... touch  
**Run** (in major menu) ..... touch

Step 5: *Examine* that the frequency counter reads within the limits of 999,995  $\mu$ s and 1,000,050  $\mu$ s.



*DO NOT attempt to optimize the adjustment setting if the period is within the stated limits. Proceed to Step 8.*

- Step 6: *Adjust* the Real Time Clock adjustment C510 for 1,000,000  $\mu$ s.
- Step 7: Remove the frequency counter from the power module.
- Step 8: Set the oscilloscope ON/STANDBY switch to STANDBY.
- Step 9: Replace the circuit boards (rearranged in Step 1) to their original positions.



**Figure 2-6** — A14 I/O Board Test Point and Adjustment Locations

**Part 7**  
**Vertical Reference**  
**Voltage**



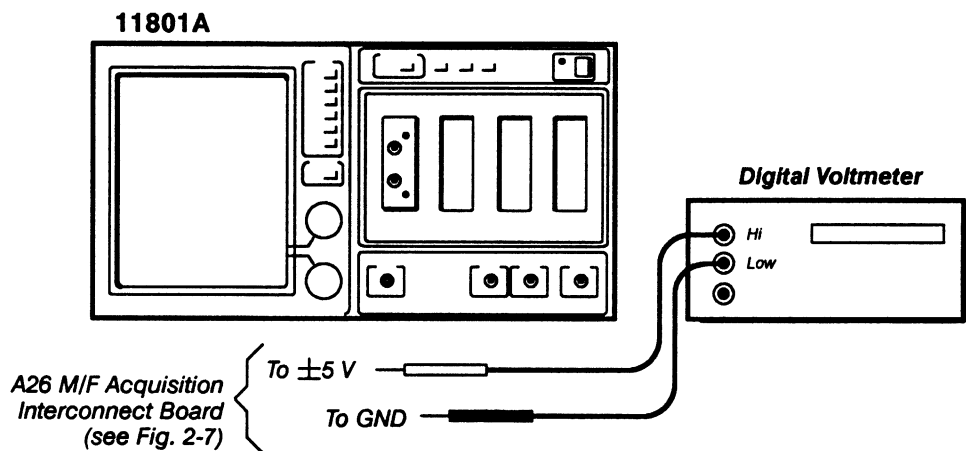
This part checks that the vertical reference voltage is at  $\pm 5$  V at J63C on the A26 M/F Acquisition Interconnect board (see Fig. 2-7).

*This procedure should only be performed if maintenance is required. This procedure is not necessary for verifying instrument specifications.*

**Specifications**

The measured voltage must be within the limits of  $5\text{ V} \pm 200\ \mu\text{V}$  and  $-5\text{ V} \pm 200\ \mu\text{V}$ .

**Setup to Check Vertical Reference Voltage**



Setup to Check Vertical Reference Voltage

**Procedure to Check Vertical Reference Voltage**

- Step 1: Initialize the oscilloscope settings as follows:
  - UTILITY button ..... press
  - Initialze** (in major menu) ..... touch
  - Initialze** (in verification pop-up menu) ..... touch
- Step 2: Connect the Digital Voltmeter to the +5 V reference point and GND on the A26 Mainframe (M/F) Acquisition Interconnect board.
- Step 3: Set the Voltmeter for DC Voltage, and *check* for a reading of +5 V,  $\pm 200\ \mu\text{V}$ .
- Step 4: Connect the Digital Voltmeter to the -5 V reference point and GND on the A26 M/F Acquisition Interconnect board.
- Step 5: Set the Voltmeter for DC Voltage, and *check* for a reading of -5 V,  $\pm 200\ \mu\text{V}$ .



If the reading noted in Steps 3 and 5 are outside the stated limits, then servicing of the oscilloscope is required before continuing to Part 8 (Horizontal Reference Clock).

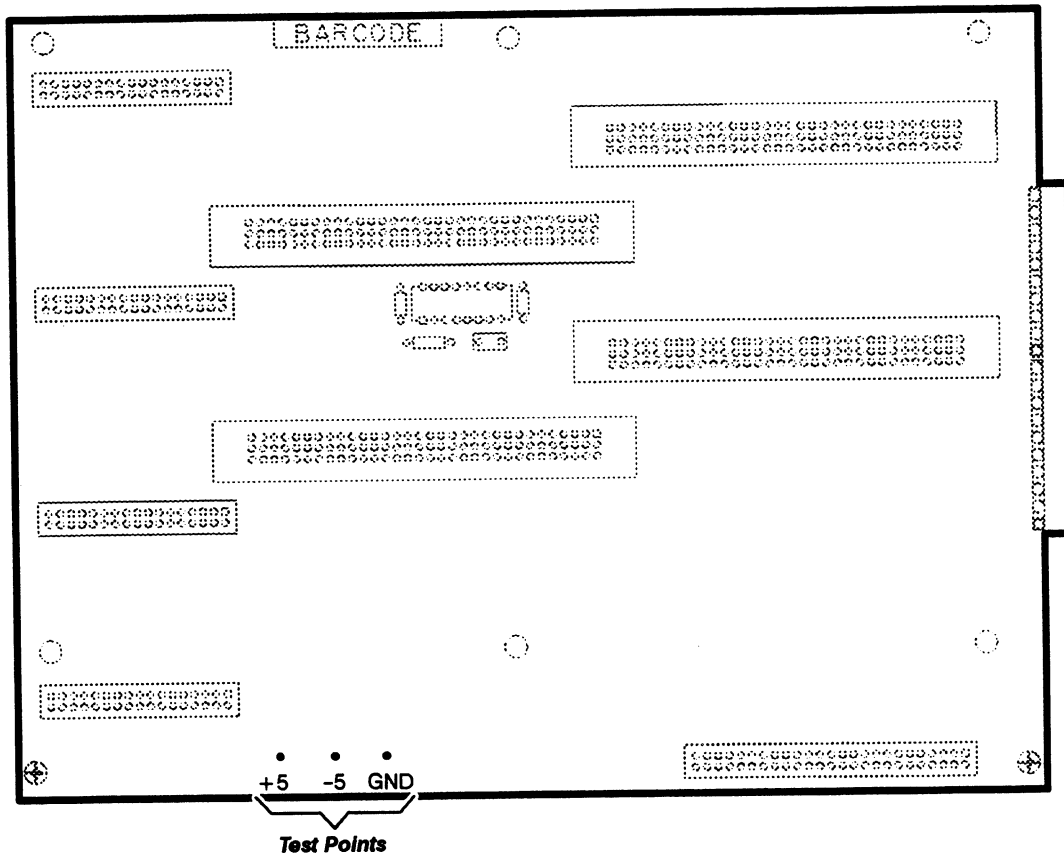


Figure 2-7 – A26 MIF Acquisition Interconnect Board Test Point Locations

## Part 8 Horizontal Reference Clock



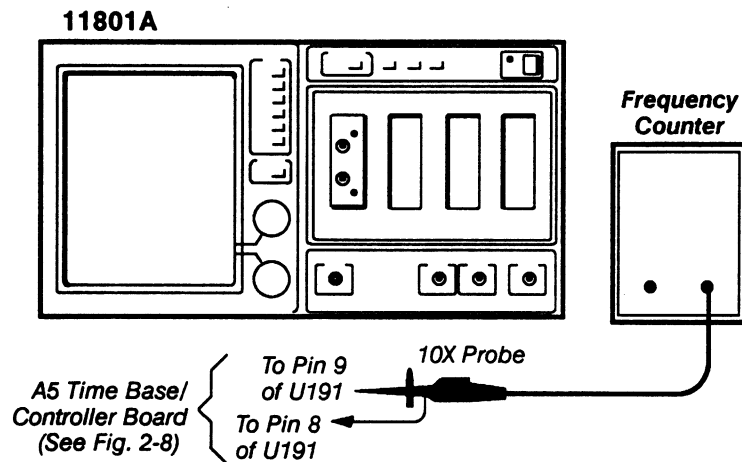
This part verifies the correct operation and accuracy of the oscilloscope's horizontal reference clock (see Fig. 2-8).

*This procedure should only be performed if maintenance is required. This procedure is not necessary for verifying instrument specifications.*

### Specifications

The operational frequency specification for the horizontal reference clock is 200,000 kHz,  $\pm 5$  kHz.

### Setup to Check Horizontal Reference Clock



Setup to Check Horizontal Reference Clock

### Procedure to Check Horizontal Reference Clock

- Step 1: Initialize the oscilloscope settings as follows:

UTILITY button .....	press
<b>Initialize</b> (in major menu) .....	touch
<b>Initialize</b> (in verification pop-up menu) .....	touch

- Step 2: Perform the following operations in the order listed:

11801A

- Set the front panel ON/STANDBY switch to STANDBY.
- Set the oscilloscope on its right side (as viewed from facing the front of the oscilloscope).
- Set the oscilloscope front panel ON/STANDBY switch to ON.

- Step 3: Set the Frequency Counter controls/output as follows:

Frequency counter

Mode ..... Frequency A  
Trigger ..... AC  
Slope ..... + (positive)  
Attenuation ..... 1X  
Termination ..... 1 M $\Omega$

- Step 4: At U191 on the A5 Time Base/Controller board, touch the 10X Probe to pin 9 and the ground probe to pin 1.
- Step 5: Check that the frequency counter reads within the limits of 199,995 kHz and 200,005 kHz.

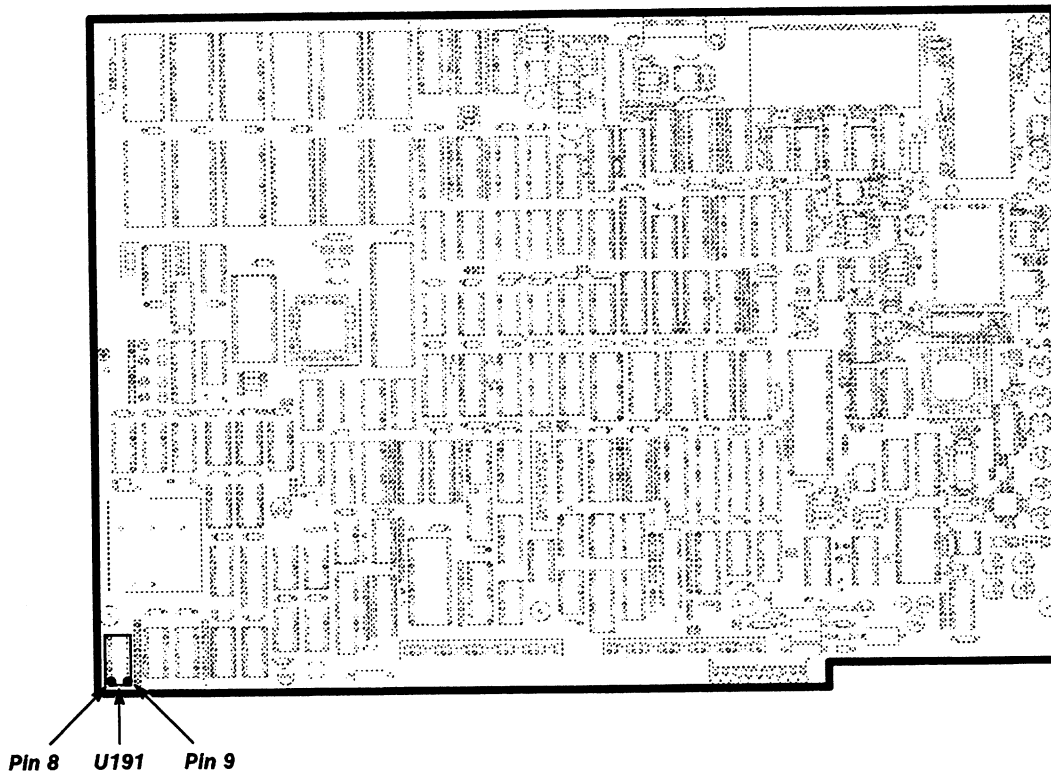
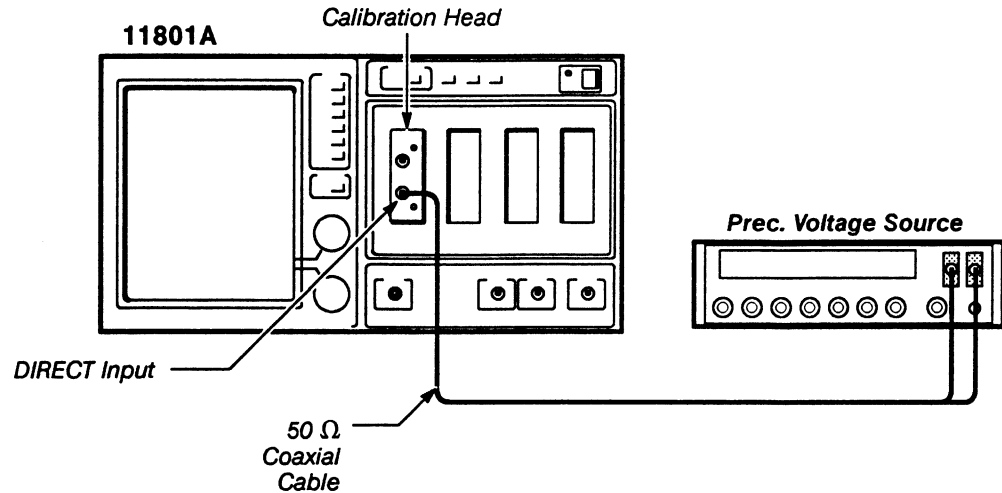


Figure 2-8 – A5 Time Base/Controller Board Test Point Locations

**Part 9**  
**Vertical Accuracy**

This part shows the setups and lists the procedures to check the vertical accuracy of the oscilloscope.

**Setup to Check Vertical Gain**



Setup to Check Vertical Gain

**Procedure to Check Vertical Gain**

- Step 1: Install a Calibration Head (067-1413-00) into the position shown in the setup diagram (CH 1/CH 2 slot). If the unit was in Standby mode, set the power switch to ON.

**Note:** If powering up from a cold start, The diagnostics will report an error using the Calibration Head. The report will indicate a **Time Base** error. To clear this, exit the diagnostics. Then, ignore the subsequent time base calibration failure notice and continue with the following steps.

- Step 2: Initialize the mainframe as follows:

UTILITY button .....	press
<b>Initialize</b> (in major menu) .....	touch
<b>Initialize</b> (in verification pop-up menu) .....	touch

- Step 3: Trigger the oscilloscope as follows:

TRIGGER button .....	press
<b>Source</b> (in major menu) .....	touch
<b>Internal Clock</b> (in pop-up menu) .....	touch

- Step 4: Identify the trace as follows:

<b>Def Tra</b> icon .....	touch
Identify Channel (2) .....	touch
Select <b>Enter Desc</b> .....	touch

- Step 5: Set the mainframe Vert Offset as follows:
  - Vert size icon ..... touch
  - Set **Vert Size:M6** to 2 mV/div ..... dial / upper knob
  
- Step 6: Set Averaging as follows:
  - Acquire Desc** (in major menu) ..... touch
  - Average N** (in pop-up menu) ..... touch
  
- Step 7: Select the Mean Measurement as follows:
  - MEASURE button ..... press
  - Measurements** (in major menu) ..... touch
  - Mean** (in the **Measurements** pop-up menu) ..... touch
  - Compare & References** (in major menu) ..... touch
  - Save Current Meas Values as References** (in pop-up menu) .... touch
  - Compare off** (to **on** in pop-up menu) ..... touch
  
- Step 8: Refer to the setup diagram and connect the Voltage Source to the DIRECT input of the Calibration Head.
  
- Step 9: Set the Voltage source to 8 mV.
  - Select **Remove/Clr Trace** (in major menu) ..... touch
  - Select **Clear Trace** (in pop-up menu) ..... touch
  
- Step 10: Wait for averaging to complete. Then, check that the  $\Delta$ Mean value is to be within 7.8 mV (lower spec) and 8.2 mV (upper spec).

**Note:** Averaging will complete faster if you exit the measurement menu and then return when averaging is complete. Alternatively, use the dial to move the Main Size setting two notches higher than the default setting.
  
- Step 11: Change the polarity of the voltage differential coming from the precision voltage Source. Check that the  $\Delta$ Mean value is between -7.8 mV and -8.2 mV.
  
- Step 12: Refer to Table 2-3 and check actual results against the table specifications for the setting levels indicated.



Table 2-3 – Voltage Source Settings

Sens.	Source V	Lower Spec	Upper Spec
5 mV/div	-20 mV	-20.5 mV	-19.5 mV
10 mV/div	-40 mV	-41.0 mV	-39.0 mV
20 mV/div	-80 mV	-82 mV	-78 mV
50 mV/div	-200 mV	-205 mV	-195 mV
100 mV/div	-400 mV	-410 mV	-390 mV
200 mV/div	-800 mV	-820 mV	-780 mV
5 mV/div	20 mV	19.5 mV	20.5 mV
10 mV/div	40 mV	39.0 mV	41.0 mV
20 mV/div	80 mV	78 mV	82 mV
50 mV/div	200 mV	195 mV	205 mV
100 mV/div	400 mV	390 mV	410 mV
200 mV/div	800 mV	780 mV	820 mV

**Note:** Up to now, you have been working with trace 1, and internal mainframe acquisition measurement channel 1. Use the following steps to verify the vertical accuracy through internal acquisition measurement channel 2, using trace 2.

- Step 13: Initialize the mainframe as follows:

UTILITY button ..... press  
**Initialize** (in major menu) ..... touch  
**Initialize** (in verification pop-up menu) ..... touch

- Step 14: Trigger the oscilloscope as follows:

TRIGGER button ..... press  
**Source** (in major menu) ..... touch  
**Internal Clock** (in pop-up menu) ..... touch

- Step 15: Define the first trace as follows:

**Def Tra** icon ..... touch  
 Identify Channel (1) ..... touch  
 Select **Enter Desc** ..... touch

Note that **Trace 1** has been selected at the base of the screen (just above **M5 Main**).

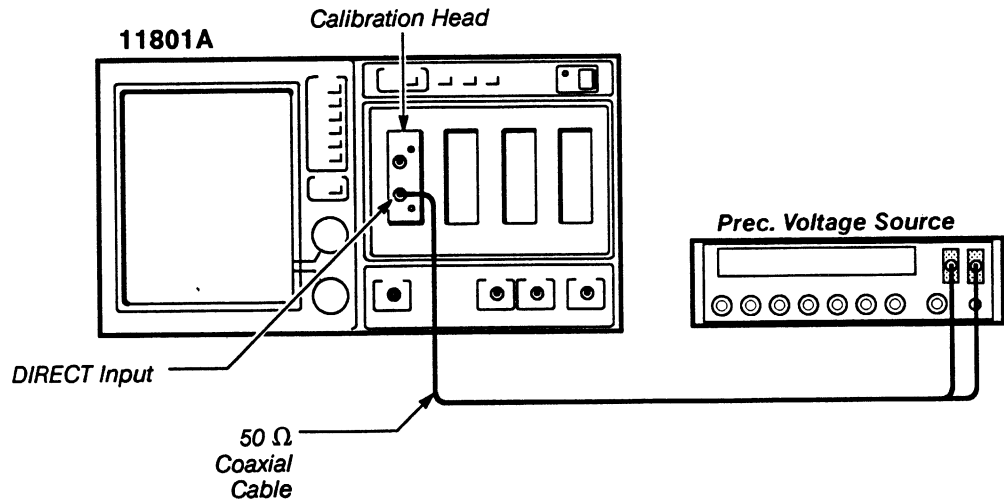
- Step 16: Define the second trace as follows:

Def Tra icon ..... touch  
 Identify Channel (2) ..... touch  
 Select **Enter Desc** ..... touch

Note that **Trace 2** has now been selected at the base of the screen (just above **M6 Main**).

- Step 17: Repeat steps 5 through 12.
- Step 18: Power down the oscilloscope. Move the Calibration Head to the first slot (CH 1/CH 2) and repeat Steps 1 through 17.

**Setup to Check Offset Accuracy**



Setup to Check Vertical Gain

**Procedure to Check Offset Accuracy**

- Step 1: This second vertical accuracy test uses the same setup preliminaries as the previous test. The Calibration Head/Time Base error will only re-appear if you have activated power-up diagnostics. If so, exit diagnostics and, in either case, continue from here.
- Step 2: Initialize the mainframe as follows:
  - UTILITY button ..... press
  - Initialize** (in major menu) ..... touch
  - Initialize** (in verification pop-up menu) ..... touch
- Step 3: Trigger the oscilloscope as follows:
  - TRIGGER button ..... press
  - Source** (in major menu) ..... touch
  - Internal Clock** (in pop-up menu) ..... touch

Step 4: Define the trace as follows:

**Def Tra** icon ..... touch  
 Identify Channel (2) ..... touch  
 Select **Enter Desc** ..... touch

Step 5: Set Averaging as follows:

**Acquire Desc** (in major menu) ..... touch  
**Average N** (in pop-up menu) ..... touch  
 Select **Exit** ..... touch

Step 6: Select the Mean Measurement as follows:

MEASURE Button ..... press  
**Measurements** (in major menu) ..... touch  
**Mean** (in pop-up menu) ..... touch  
**Compare & Reference** (in major menu) ..... touch  
**Save Current Meas Values as References** (in pop-up menu) touch  
**Compare off** (to on / in pop-up menu) ..... touch  
 Select **Exit** ..... touch

Step 7: Set the Vertical Size and Offset as follows:

Vertical size icon ..... touch  
 Adjust the **Vert Size: M6** to 10 mV/div ..... dial / upper knob  
**Vert Offset: M6** (in major menu) ..... touch  
 Key in 400 mV (**400m**) on the pop-up display ..... touch  
 Select **Enter** ..... touch

Check that **400 mV** has now entered into the display below **Vert Offset: M6**.

Step 8: Connect the Voltage Source to the DIRECT input of the Calibration Head.

Step 9: Adjust the Voltage Source to 400 mV.

Step 10: Wait for averaging to complete. Then, check the  $\Delta$ Mean value to be within 2 mV of 400 mV (offset).

Step 11: Repeat Steps 2 through 10 for the offset values shown in Table 2-4.

**Table 2-4 – Vertical Offset Test Values**

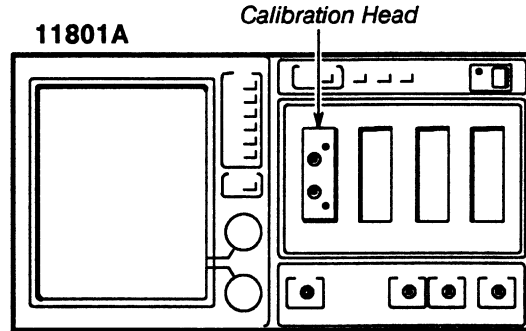
<b>Sens.</b>	<b>Source V/ Vert Offset</b>	<b>Lower Spec</b>	<b>Upper Spec</b>
10 mV/div	1 V	0.998 V	1.002 V
10 mV/div	2 V	1.998V	2.002 V
10 mV/div	-400 mV	-402 mV	-398 mV
10 mV/div	-1 V	-1.002 V	-0.998 V
10 mV/div	-2 V	-2.002V	-1.998 V

- Step 12: Power down the oscilloscope. Move the Calibration Head to the first slot (CH 1/CH 2) and repeat Steps 1 through 11.

**Part 10**  
**System Vertical**  
**RMS Noise**

This part uses the RMS measurement function to measure the noise on the trace from a sampling head compartment.

**Setup to Examine Vertical RMS Noise**



*Setup to Check Vertical Gain*

**Procedure to Examine Vertical RMS Noise**

- Step 1: Install the Calibration Head (067-1413-00) into the position shown in the setup diagram. If the unit was in standby mode, set the ON/STANDBY switch to ON.

**Note:** *If powering up from a cold start, The diagnostics will report an error using the Calibration Head. The report will indicate a **Time Base** error. To clear this, exit the diagnostics. Then, ignore the subsequent time base calibration failure notice and continue with the following steps.*

- Step 2: Initialize the mainframe as follows:
  - UTILITY button ..... press
  - Initialize** (in major menu) ..... touch
  - Initialize** (in verification pop-up menu) ..... touch
- Step 3: Trigger the oscilloscope as follows:
  - TRIGGER button ..... press
  - Source** (in major menu) ..... touch
  - Internal Clock** (in pop-up menu) ..... touch
- Step 4: Identify the trace as follows:
  - Def Tra icon ..... touch
  - Identify Channel (2) ..... touch
  - Select **Enter Desc** ..... touch

- Step 5: Set the mainframe Vert Offset as follows:

Vert Size icon ..... touch  
 Set **Vert Size:M6** to 2 mV/div ..... dial / upper knob

- Step 6: Set the record length as follows:

**Horizontal Desc** (in major menu) ..... touch  
**Main Record Length** (in pop-up menu) ..... touch  
 Set **Main Record Len** to 5120 points ..... adjust / upper knob

- Step 7: Store the trace as follows:

STORE/RECALL button ..... press  
**Store Trace** (in major menu) ..... touch  
**Trace 1** (in pop-up menu) ..... touch  
**Recall Trace** (in major menu) ..... touch  
**STO 1** (in pop-up menu) ..... touch

- Step 8: Measure the Mean value as follows:

MEASURE button ..... press  
**Measurements** (in major menu) ..... touch  
**Mean** (in pop-up menu) ..... touch  
**Exit Menu** (in pop-up menu) ..... touch

**Note:** Record (write down) the mean value for use in the next step.

- Step 9: Define the trace to be stored as follows:

**Def Tra** icon ..... touch  
**Stored Traces** (in pop-up menu) ..... touch  
**Stored 1** (in pop-up menu) ..... touch  
 Enter xxx (STO1 – mean value) ..... touch  
**Enter Desc** (in pop-up menu) ..... touch

- Step 10: Measure the RMS value as follows:

MEASURE button ..... press  
**Measurements** (in major menu) ..... touch  
**RMS** (in pop-up menu) ..... touch  
 Check that RMS is  $\leq 200 \mu\text{V}$ .  
**Exit Menu** (to exit) ..... touch

- Step 11: Erase the test traces as follows:

STORE/RECALL button ..... press  
**Delete Trace** (in major menu) ..... touch  
**All Traces** (in pop-up menu) ..... touch  
**Delete Selected Traces** (in pop-up menu) ..... touch

- Step 12: Repeat Steps 4 through 11 at the sensitivities listed in Table 2-5, and check the resulting RMS against the matching specification value in the table.

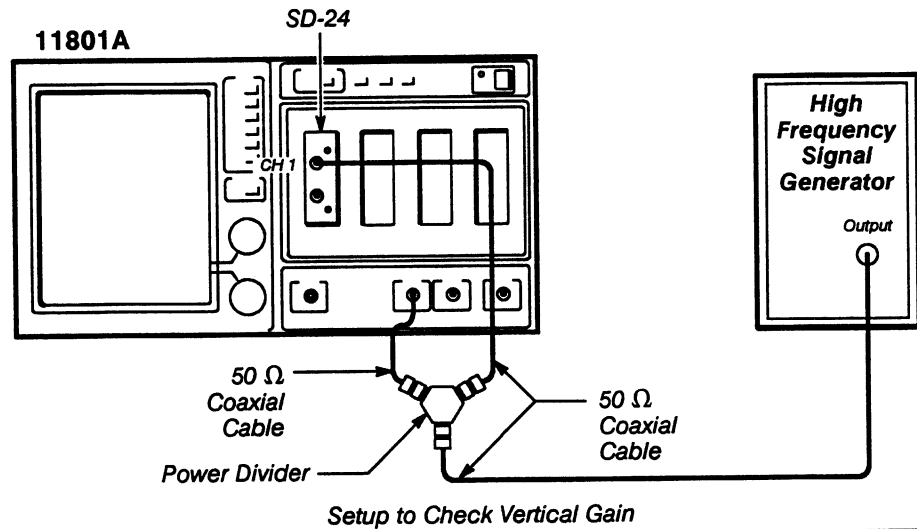
**Table 2-5 – Sensitivity Settings**

<b>Sensitivity</b>	<b>Specification</b>
5 mV/div	500 $\mu$ V
10 mV/div	1 mV
20 mV/div	632 $\mu$ V
50 mV/div	1.58 mV
100 mV/div	3.16 mV
200 mV/div	6.32 mV

## Part 11 Sweep Rate Accuracy

This part shows the setups and uses the procedures to check the Sweep Rate Accuracy.

### Setup to Examine Sweep Rate Accuracy



#### Procedure to Examine Sweep Rate Accuracy

- Step 1: Install the SD-24 Sampling Head into the compartment shown in the setup diagram (CH 1/CH 2 slot). If the unit was in standby mode set the ON/STANDBY switch to ON.
- Step 2: Initialize the mainframe as follows:
 

UTILITY button .....	press
<b>Initialize</b> (in major menu) .....	touch
<b>Initialize</b> (in verification pop-up menu) .....	touch
- Step 3: Set the horizontal record length as follows:
 

<b>Horizontal Desc</b> (in major menu) .....	touch
<b>Main Record Length</b> (in pop-up menu) .....	touch
Set <b>Main Record Len</b> to 1024 points .....	adjust / upper knob
- Step 4: Identify the trace as follows:
 

<b>Def Tra</b> icon .....	touch
Identify <b>Mainframe</b> .....	touch
Identify Channel (1) .....	touch
Select <b>Enter Desc</b> .....	touch



- Step 5: Engage high precision calibration mode as follows:

UTILITY button ..... press  
**Page to Enhanced Accuracy** ..... touch  
**Time Base Cal Mode** (in major menu) ..... touch  
**High Prec** (in pop-up menu) ..... touch  
**Exit** (in pop-up menu) ..... touch

**Sweep Rate Accuracy 2 ns/div**

- Step 6: *Adjust* the Sweep Rate to 2 ns/div.

Horizontal icon ..... touch  
 Set **Main Size** to 2 ns/div ..... adjust / upper knob

- Step 7: *Adjust* the Signal Generator to the following settings:

Frequency ..... 55 MHz  
 Amplitude ..... 1.0 V rms

**Note:** Check that selected Sampling Head channel (1) indicator is flashing. If not, select channel (1) by pressing select button.

- Step 8: Turn mainframe averaging on.

WAVEFORM button ..... press  
**Acquire Desc** (in major menu) ..... touch  
**Average N On** (in pop-up menu) ..... touch  
 Select **Exit** (in the pop-up menu) ..... touch

**Note:** Position the display so the sine wave is centered on the screen. To ensure accurate period measurement, the display must be a full cycle.

- Step 9: Obtain Period as follows:

MEASURE button ..... press  
**Measurement** (in major menu) ..... touch  
**Period** (in pop-up menu) ..... touch  
**Exit Menu** (in pop-up menu) ..... touch

- Step 10: *Examine* that the period is between 18.172 ns and 18.192 ns.

**Sweep Rate Accuracy 1 ns/div**

- Step 11: *Adjust* the Sweep Rate Accuracy to 1 ns/div.

Horizontal ( ↔ ) icon ..... touch  
 Set **Main Size** to 1 ns/div ..... adjust / upper knob

- Step 12: *Adjust* the Signal Generator to the following settings:  
Frequency ..... 110 MHz  
Amplitude ..... 1.0 V rms
- Step 13: Press the UTILITY button and adjust the lower knob for a display showing a full waveform.
- Step 14: Press the MEASURE button and check for a period interval between 9.079 ns and 9.101 ns.

**Sweep Rate Accuracy 100 ps/div**

- Step 15: Use the upper control knob to adjust the Sweep Rate Accuracy to 100 ps/div.
- Step 16: *Adjust* the Signal Generator to the following settings:  
Frequency ..... 1 GHz  
Amplitude ..... 2.0 V p-p (1.4 V rms)
- Step 17: Press the UTILITY button and adjust the lower knob for a display showing a full waveform.
- Step 18: Press the MEASURE button and check for a period interval between 949 ps and 963 ns.

**Sweep Rate Accuracy 10 ps/div**

- Step 19: *Adjust* the Signal Generator to the following settings:  
Frequency ..... 800 MHz  
Amplitude ..... 2.0 V p-p (1.4 V rms)
- Step 20: Invoke smoothing as follows:  
WAVEFORM button ..... press  
    **Sampling Head Fnc's** (in major menu) ..... touch  
    **Smoothing On** (in pop-up menu) ..... touch  
    **Exit** (in pop-up menu) ..... touch
- Step 21: Adjust the Main Size as follows:  
Horizontal icon ..... touch  
    Set the **Main Size** to 10 ps/div. .... adjust / upper knob
- Step 22: Set the **Main Pos** control (lower knob) so that the zero crossing of the waveform occurs on the center graticule.
- Step 23: *Adjust* the Vertical Size as follows:  
Vertical icon ..... touch  
    Set **Vert Size** to 100 mV ..... adjust / upper knob

Step 24: Activate the cursors as follows:  
**Cursors** icon ..... touch

Step 25: Read the  $\Delta v$  located in the major menu.  $\Delta v$  should be within  
 -488 mV and -540 mV or +488 mV and +540 mV.

Step 26: Touch **Exit** (in the major menu).

**Sweep Rate Accuracy 1 ps/div**

Step 27: *Adjust* the Signal Generator to the following settings:

Frequency ..... 800 MHz  
 Amplitude ..... 2.0 V p-p (1.4 V rms)

Step 28: Set the Main Size as follows:

Horizontal icon ..... touch  
 Set **Main Size** to 1 ps/div ..... adjust / upper knob

Step 29: Set the **Main Pos** control (lower knob) so that the zero crossing of  
 the waveform occurs on the center graticule.

Step 30: *Adjust* the Vertical Size as follows:

Vertical icon ..... touch  
 Set **Vert Size** to 10 mV ..... adjust / upper knob

Step 31: Turn the mainframe Average on.

WAVEFORM button ..... press  
**Acquire Desc** (in major menu) ..... touch  
**Average N** (in pop-up menu) ..... touch  
 Select **Exit** (in pop-up menu) ..... touch

Step 32: Activate the cursors as follows:

**Cursors** icon ..... touch

Step 33: Read the  $\Delta v$  located in the major menu.  $\Delta v$  should be within  
 -41.14 mV and -61.72 mV.

Step 34: Touch **Exit** (in the major menu).

## Part 12 Triggering

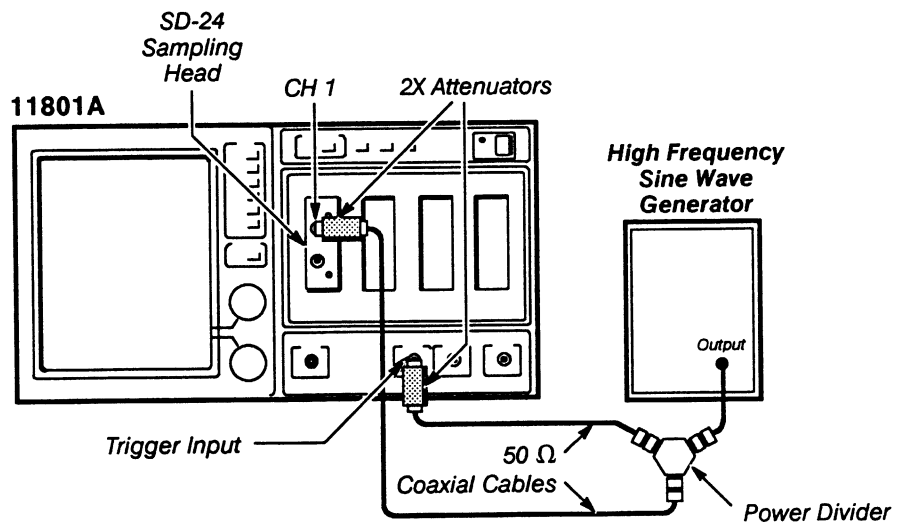
This part verifies the correct operation and accuracy of the oscilloscope's trigger system.

### Specifications

The specifications for triggering using the external trigger are as follows:

- 100 mV p-p at 200 MHz
- 150 mV p-p at 800 MHz
- 250 mV p-p at 2.0 GHz

### Setup to Check Triggering



Setup to Check Triggering

### Procedure to Check Triggering

- Step 1: Install the SD-24 Sampling Head into the position shown in the setup diagram (CH 1/CH 2 slot). If the unit was in standby mode, set the ON/STANDBY switch to ON.
- Step 2: Initialize the mainframe as follows:
  - UTILITY button ..... press
  - Initialize (in major menu) ..... touch
  - Initialize (in verification pop-up menu) ..... touch
- Step 3: Adjust the high frequency generator as follows:
  - 100 mV p-p at 200 MHz
- Step 4: On the Sampling Head, press the Channel 1 select button.

Step 5: Make the following CSA selections:

- AUTOSET button ..... press
- MEASURE button ..... press
- Measurement** (in major menu) ..... touch
- Peak-Peak** (in pop-up menu) ..... touch
- WAVEFORM button ..... press
- Sampling Head Fnc's** (in major menu) ..... touch
- Smoothing On** (in pop-up menu) ..... touch
- Exit** (in pop-up menu) ..... touch

Step 6: *Check waveform for stable triggering. Using AUTOSET, repeat procedure for the following frequency generator settings:*

- 150 mV p-p at 800 MHz
- 250 mV p-p at 2.0 GHz

## Part 13 Internal Clock

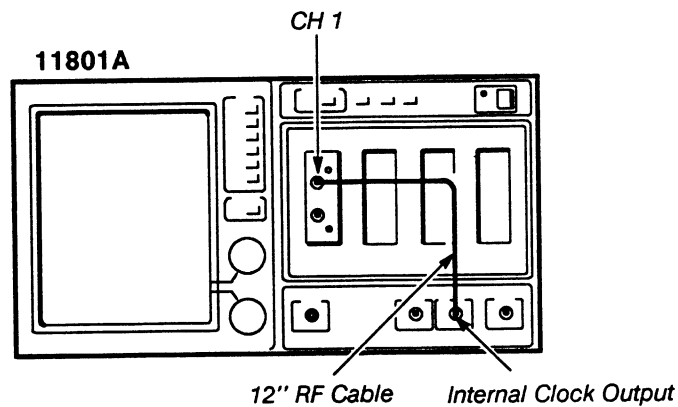
This part verifies the correct operation and accuracy of the oscilloscope's input/output systems.

### Measurement Limits

The measurement limits of the internal clock pulse are as follows:

- rise time  $\leq 2.5$  ns
- frequency of 100 kHz  $\pm 3\%$  accuracy
- duty cycle 50%  $\pm 3\%$

### Setup to Examine Internal Clock



Setup to Examine Internal Clock

### Procedure to Examine Internal Clock

- Step 1: Install the SD-24 Sampling Head into the position shown in the setup diagram (CH 1/CH 2 slot). If the unit was in standby mode, set the ON/STANDBY switch to ON.
- Step 2: Initialize the mainframe as follows:
  - UTILITY button ..... press
  - Initialize** (in major menu) ..... touch
  - Initialize** (in verification pop-up menu) ..... touch
- Step 3: Trigger the oscilloscope as follows:
  - TRIGGER Button ..... press
  - Source** (in pop-up menu) ..... **Internal Clock**
- Step 4: On the Sampling Head, press the Channel 1 select button.
- Step 5: On the oscilloscope, press the AUTOSSET button.

Step 6: Check the rise time as follows:

- MEASURE button ..... press
- Measurements** (in the major menu) ..... touch
- Rise** (in the pop-up menu) ..... touch
- Check that  $\Delta\text{Rise}$  is  $\leq 2.5$  ns.
- Exit Menu** (in pop-up menu) ..... touch

Step 7: Change the sweep rate as follows:

- Horizontal (  $\leftrightarrow$  ) icon ..... touch
- Adjust **Main Size** to 5  $\mu\text{s}/\text{div}$ . ..... adjust / upper knob

Step 8: Check the frequency as follows:

- MEASURE button ..... press
- Measurements** (in major menu) ..... touch
- Frequency** (in pop-up menu) ..... touch
- Check that the frequency is 100 kHz  $\pm 3\%$ .
- Exit Menu** (in pop-up menu) ..... touch

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## Part 14 Calibrator Output

This part verifies the correct operation and accuracy of the oscilloscope's calibrator.

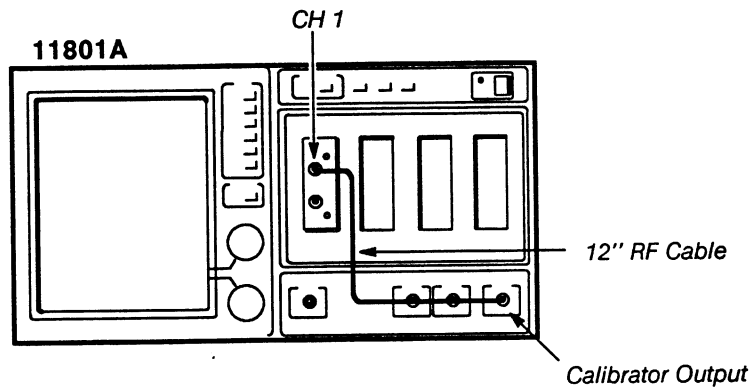
### Measurement Limits

The measurement limits of the calibrator are as follows:

- rise time approximately 300 ps
- approximately 250 mV  $\pm 10\%$

### Setup to Examine Calibrator

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Setup to Examine Calibrator Output

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### Procedure to Examine Calibrator

- Step 1: Install the SD-24 Sampling Head into the position shown in the setup diagram (CH 1/CH 2 slot). If the unit was in standby mode, set the ON/STANDBY switch to ON.
- Step 2: Initialize the mainframe as follows:
  - UTILITY button ..... press
  - Initialize** (in major menu) ..... touch
  - Initialize** (in verification pop-up menu) ..... touch
- Step 3: Trigger the oscilloscope as follows:
  - TRIGGER Button ..... press
  - Source** (in pop-up menu) ..... **Internal Clock**
- Step 4: On the Sampling Head, press the Channel 1 select button.
- Step 5: On the oscilloscope, press the AUTOSSET button.



Step 6: Check the rise time and peak-to-peak amplitude as follows:

MEASURE button . . . . . press

**Measurements** (in the major menu) . . . . . touch

**Rise** (in the pop-up menu) . . . . . touch

**Peak-Peak** (in the pop-up menu) . . . . . touch

Check that  $\Delta$ **Rise** is approximately 300 ps

Check that **peak-to-peak** amplitude is 225–275 mV (250 mV  $\pm$ 10%)



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# Maintenance

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This section contains information for performing preventive maintenance, corrective maintenance, and diagnostic troubleshooting on the 11801A Digital Sampling Oscilloscope.

## Preventive Maintenance

Regular maintenance can prevent instrument breakdown and may improve the reliability of the instrument. The environment in which the instrument operates will determine the frequency of 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 instrument. When the instrument is operated 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 instrument or replacing any parts.*

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

### Cleaning the Instrument

The instrument should be cleaned as often as operating conditions require. Dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket and prevents efficient heat dissipation. Dirt also provides an electrical conduction path which may cause the instrument to fail. The side panels reduce the amount of dust that reaches the interior of the instrument. Keep the side panels in place for safety and cooling.

**CAUTION**

*Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. 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** – dust on the instrument 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. Dirt which remains can be removed with a soft cloth dampened in a mild detergent and water solution. Do not use abrasive cleaners.

**CRT**—faceplates are cleaned with a soft, lint-free cloth dampened with denatured alcohol.

**Interior**—cleaning should seldom be necessary. To clean the interior, blow off the dust with dry, low-velocity air (approximately 5 lb/in<sup>2</sup>). 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.



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

*The high-voltage circuits should receive special attention. Excessive dirt in these circuits may cause high-voltage arcing and result in improper instrument operation.*

### **Visual Inspection**

The instrument 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 instrument; therefore, correcting the cause of overheating is important to prevent the damage from reoccurring.

### **Periodic Electrical Adjustment**

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

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## Corrective Maintenance

Corrective maintenance consists of module and board replacement procedure for repairing the instrument.

### Power Supply Voltage Hazard

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

#### **WARNING**

*All metal components, including any metal-faced ones, in the Power Supply module should be considered hazardous. This is because 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 instrument is not grounded. Do not remove the ground wire (green-yellow) that connects the Power Supply module chassis to the instrument.*

### Ordering Parts

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

- instrument type
- instrument serial number
- a description of the part
- Tektronix part number

### Static-Sensitive Device Classification

#### **CAUTION**

*Static discharge can damage any semiconductor component in this instrument.*

This instrument contains electrical components that are susceptible to damage from static discharge. See 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**

<b>Semiconductor Classes</b>	<b>Relative Susceptibility Levels<sup>1</sup></b>
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

<sup>1</sup>Voltage discharged from a 100 pF capacitor through a resistance of 100 Ω.

Observe the following precautions to avoid damage:

- 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.
- Discharge the static voltage from your body by wearing a wrist strap while handling these components. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel. We recommend using the static control mat, Refer to Table 2-2 for the part numbers of these test equipment.
- Keep the work station surface free of anything that can generate or hold a static charge.
- Keep the component leads shorted together whenever possible by storing them in conductive foam or rails.
- 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**

The following table 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, and the second column lists the figures that you should reference for the location of connector and screw locations discussed in the procedure to remove/replace this FRU.

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

<b>FRU to be Removed/ Replaced</b>	<b>Figures to Reference During Removal</b>	<b>Page</b>
Power Supply Module	Figure 3-2	Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector Plate . . . . . 3-13
	Figure 3-3	A2A2 Control Rectifier Board Connectors Locations . . . . . 3-14
Fan Motor	Figure 3-2	Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector Plate . . . . . 3-13
Cathode Ray Tube (CRT)	Figure 3-5	Removing and Replacing the Cathode Ray Tube . . . . . 3-19
	Figure 3-12	Removing and Replacing the A8 CRT Driver Board . . . . . 3-31
	Figure 3-15	Removing and Replacing the A10 Front Panel Button Board . . . . . 3-34
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram . . . . . 3-55
Acquisition Unit	Figure 3-23	Removing and Replacing the A19 Strobe/TDR Buffer Board . . . . . 3-46
	Figure 3-26	Removing and Replacing the A26 M/F Acquisition Interconnect Board . . . . . 3-49
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram . . . . . 3-55
Batteries	Figure 3-10	Removing and Replacing the A5 Time Base/Controller Board . . . . . 3-28
	Figure 3-19	Removing and Replacing the A14 I/O Board . . . . . 3-39
	Figure 3-22	Removing and Replacing the A18 Memory Board . . . . . 3-45
A1 Mainframe (M/F) Strobe Drive Board	Figure 3-8	Removing and Replacing the A1 M/F Strobe Drive Board . . . 3-25
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram . . . . . 3-55
A3 Mainframe (M/F) Power Connect Board	Figure 3-2	Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector Plate . . . . . 3-13
	Figure 3-3	A2A2 Control Rectifier Board Connectors Locations . . . . . 3-14
	Figure 3-9	Removing and Replacing the A4 Regulator Board . . . . . 3-26
	Figure 3-10	Removing and Replacing the A5 Time Base/Controller Board . . . . . 3-28
	Figure 3-19	Removing and Replacing the A14 I/O Board . . . . . 3-39
	Figure 3-23	Removing and Replacing the A19 Strobe/TDR Buffer Board . . . . . 3-46

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

<b>FRU to be Removed/ Replaced</b>	<b>Figures to Reference During Removal</b>	<b>Page</b>
A4 Regulator Board	Figure 3-2	Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector Plate ..... 3-13
	Figure 3-3	A2A2 Control Rectifier Board Connectors Locations ..... 3-14
	Figure 3-9	Removing and Replacing the A4 Regulator Board ..... 3-26
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram ..... 3-55
A5 Time Base/Controller Board	Figure 3-10	Removing and Replacing the A5 Time Base/Controller Board ..... 3-28
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram ..... 3-55
A7 CRT Socket Board	Figure 3-11	Removing and Replacing the A7 CRT Driver Board ..... 3-29
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram ..... 3-55
A8 CRT Driver Board	Figure 3-5	Removing and Replacing the Cathode Ray Tube ..... 3-19
	Figure 3-12	Removing and Replacing the A8 CRT Driver Board ..... 3-29
	Figure 3-15	Removing and Replacing the A10 Front Panel Button Board ..... 3-34
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram ..... 3-55
A9 Touch Panel Assembly	Figure 3-5	Removing and Replacing the Cathode Ray Tube ..... 3-19
	Figure 3-15	Removing and Replacing the A10 Front Panel Button Board ..... 3-34
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram ..... 3-55
A10 Front Panel Control Board	Figure 3-5	Removing and Replacing the Cathode Ray Tube ..... 3-19
	Figure 3-15	Removing and Replacing the A10 Front Panel Button Board ..... 3-34
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram ..... 3-55
A11 Front Panel Button Board	Figure 3-5	Removing and Replacing the Cathode Ray Tube ..... 3-19
	Figure 3-15	Removing and Replacing the A10 Front Panel Button Board ..... 3-34
	Figure 3-16	Removing and Replacing the A11 Front Panel Button Board ..... 3-35
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram ..... 3-55
A12 Rear Panel Assembly	Figure 3-5	Removing and Replacing the Cathode Ray Tube ..... 3-19
	Figure 3-17	Removing and Replacing the A12 Rear Panel Assembly ... 3-37
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram ..... 3-55



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

FRU to be Removed/ Replaced	Figures to Reference During Removal	Page
A13 Mother Board	Figure 3-7	Top View of the Card Cage . . . . . 3-24
	Figure 3-18	Removing and Replacing the A13 Mother Board . . . . . 3-38
	Figure 3-19	Removing and Replacing the A14 I/O Board . . . . . 3-39
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram . . . . . 3-55
A14 Input/Output (I/O) Board	Figure 3-7	Top View of the Card Cage . . . . . 3-24
	Figure 3-19	Removing and Replacing the A14 I/O Board . . . . . 3-39
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram . . . . . 3-55
A15 Memory Manager Unit (MMU) Board	Figure 3-7	Top View of the Card Cage . . . . . 3-24
	Figure 3-19	Removing and Replacing the A14 I/O Board . . . . . 3-39
	Figure 3-20	Removing and Replacing the A15 MMU Board . . . . . 3-41
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram . . . . . 3-55
A17 Main Processor Board	Figure 3-7	Top View of the Card Cage . . . . . 3-24
	Figure 3-21	Removing and Replacing the A17 Main Processor Board . . . . . 3-43
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram . . . . . 3-55
A18 Memory Board	Figure 3-7	Top View of the Card Cage . . . . . 3-24
	Figure 3-22	Removing and Replacing the A18 Memory Board . . . . . 3-45
A19 Strobe/TDR Buffer Board	Figure 3-23	Removing and Replacing the A19 Strobe/TDR Buffer Board . . . . . 3-46
	Figure 3-26	Removing and Replacing the A26 M/F Acquisition Interconnect Board . . . . . 3-49
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram . . . . . 3-55
A20-A23 Head Interconnect Boards	Figure 3-23	Removing and Replacing the A19 Strobe/TDR Buffer Board . . . . . 3-46
	Figure 3-24	Removing and Replacing the A20-A23 Head Interconnect Boards . . . . . 3-47
	Figure 3-25	Removing and Replacing the Front Subpanel Assembly . . . 3-48
	Figure 3-26	Removing and Replacing the A26 M/F Acquisition Interconnect Board . . . . . 3-49
	Figure 3-28	Removing and Replacing the A24/A27 Acquisition Analog Boards . . . . . 3-51
	Figure 3-29	Removing and Replacing the A25/A28 Acquisition MPU Boards . . . . . 3-52
Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram . . . . . 3-55	

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

<b>FRU to be Removed/ Replaced</b>	<b>Figures to Reference During Removal</b>	<b>Page</b>
A26 Mainframe (M/F) Acquisition Interconnect Board	Figure 3-23	Removing and Replacing the A19 Strobe/TDR Buffer Board ..... 3-46
	Figure 3-25	Removing and Replacing the Front Subpanel Assembly ... 3-48
	Figure 3-26	Removing and Replacing the A26 M/F Acquisition Interconnect Board ..... 3-49
	Figure 3-27	Top View of the A26 M/F Acquisition Interconnect Board ... 3-50
	Figure 3-28	Removing and Replacing the A24/A27 Acquisition Analog Boards ..... 3-51
	Figure 3-29	Removing and Replacing the A25/A28 Acquisition MPU Boards ..... 3-52
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram ..... 3-55
A24/A27 Acquisition Analog Boards	Figure 3-23	Removing and Replacing the A19 Strobe/TDR Buffer Board ..... 3-46
	Figure 3-26	Removing and Replacing the A26 M/F Acquisition Interconnect Board ..... 3-49
	Figure 3-28	Removing and Replacing the A24/A27 Acquisition Analog Boards ..... 3-51
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram ..... 3-55
A25/A28 Acquisition MPU Boards	Figure 3-23	Removing and Replacing the A19 Strobe/TDR Buffer Board ..... 3-46
	Figure 3-26	Removing and Replacing the A26 M/F Acquisition Interconnect Board ..... 3-49
	Figure 3-29	Removing and Replacing the A25/A28 Acquisition MPU Boards ..... 3-52
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram ..... 3-55
Firmware ICs	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram ..... 3-55
Serial Data Interface (SDI) IC	Figure 3-19	Removing and Replacing the A14 I/O Board ..... 3-39
	Figure 3-31	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram ..... 3-55
	Figure 3-32	IC Insertion-Extraction Tool ..... 3-57
Fuses	Figure 3-37	Fuse Locations ..... 3-89

**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 3-30 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 and rotate the cover fasteners a quarter turn counter-clockwise.

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

All connector names are labeled on the circuit board and/or on the connectors themselves.

**WARNING**

*To avoid electric-shock hazard and instrument damage, always disconnect the oscilloscope from its power source before removing or replacing FRUs. For sampling head removal or replacement, switch the front panel ON/STANDBY switch to STANDBY.*

### 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 instrument on its left (handle) side, as viewed from the front.
- 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: Reposition the J820 jumper from its two outer (right side) pins to its two inner (left side) pins, without dropping the jumper.
- Step 8: Replace the bottom cover. Turn the instrument 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.



*Do not install or remove a sampling head while the power is on; since doing so may damage the instrument and/or the sampling head.*

- Step 10: To turn the power off while the ON/STANDBY power switch is disabled, use the rear panel PRINCIPAL POWER SWITCH.

To return to normal operation of the ON/STANDBY Power Switch, follow the preceding steps in reverse order.

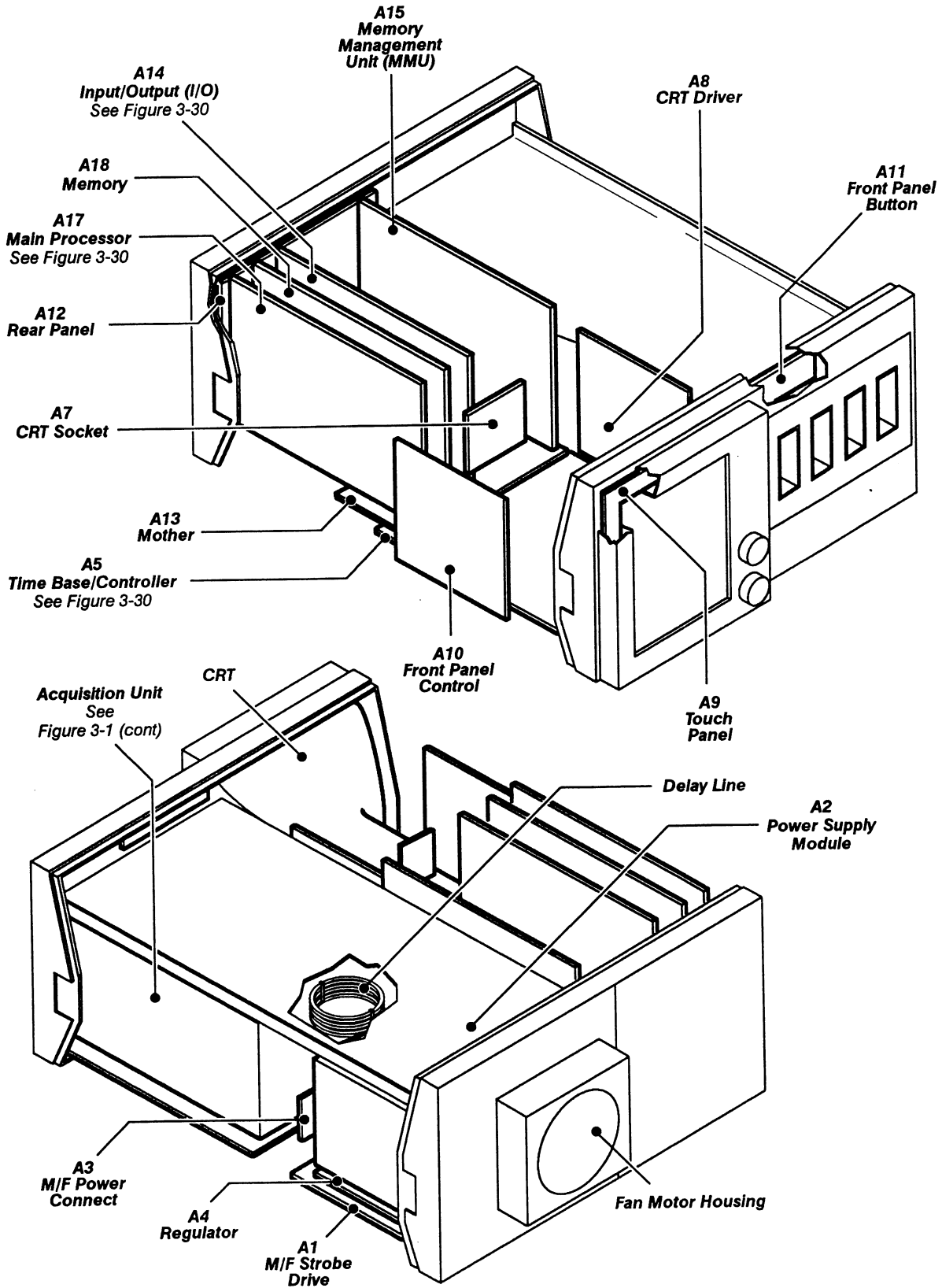


Figure 3-1 – Field Replaceable Units (FRU) Locator

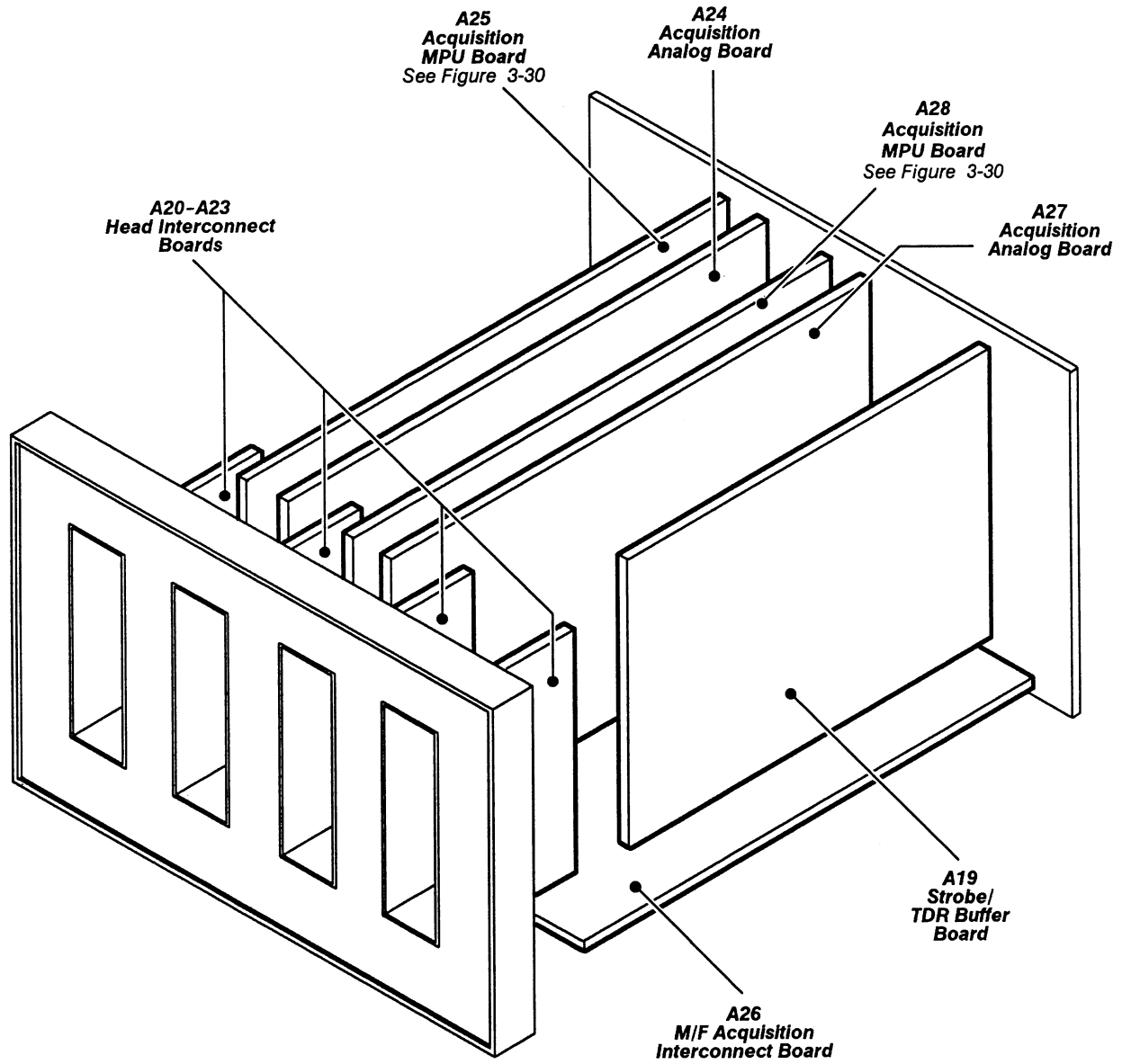


Figure 3-1 – Field Replaceable Unit (FRU) Locator (cont)

### 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 A3 M/F Power Connect board or the A4 Regulator board.

See Figure 3-2 and Figure 3-3 for connector and screw locations.

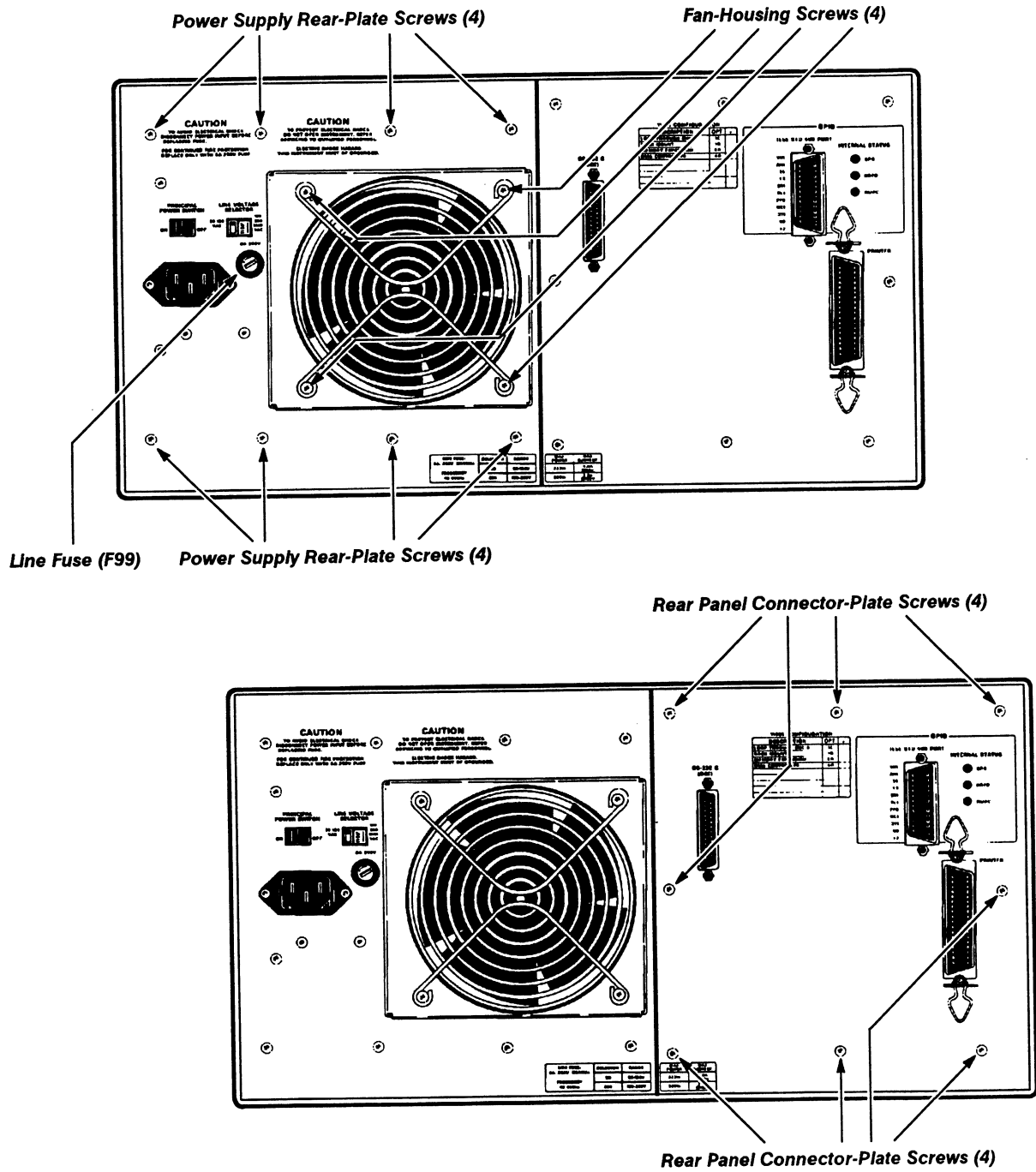


Figure 3-2 — Removing the Power Supply Module, Fan Housing, and Rear Panel Connector Plate

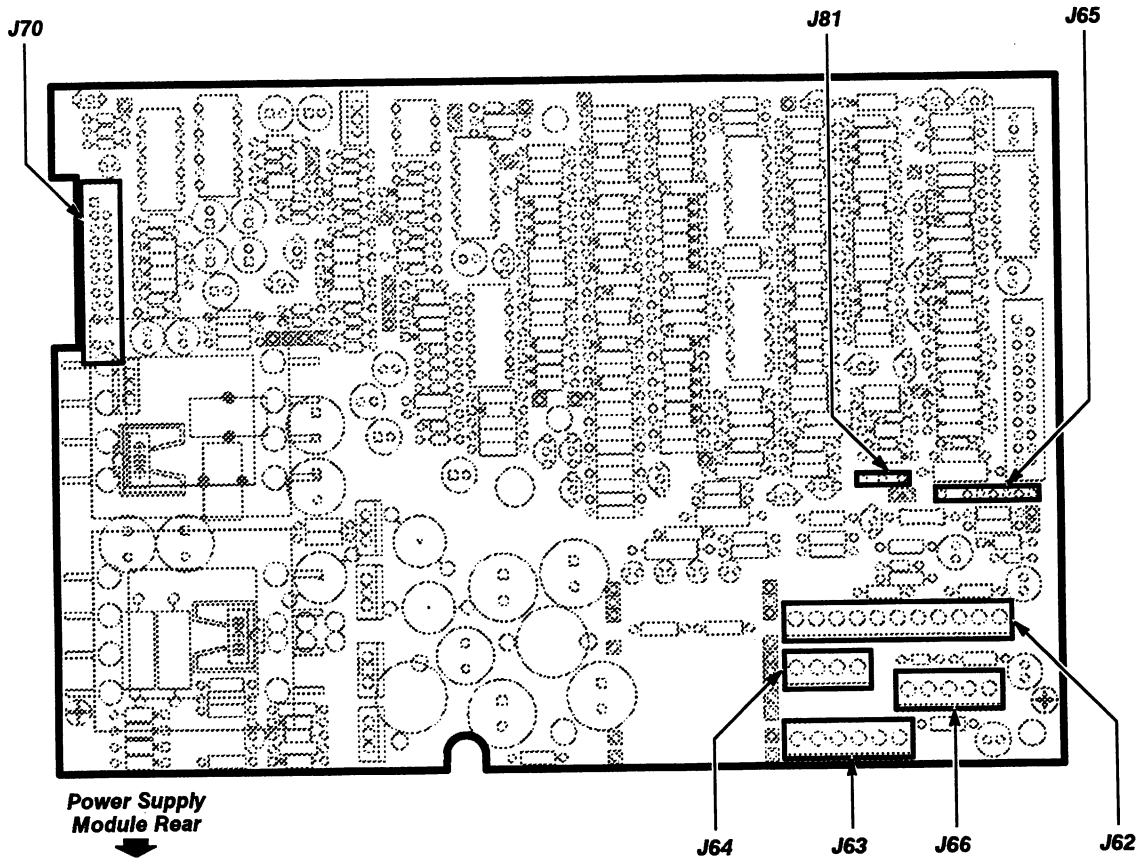


Figure 3-3 – A2A2 Control Rectifier Board Connector Locations

To remove the Power Supply module from the oscilloscope, proceed as follows:

- Step 11: Turn the instrument on its left side (as viewed facing the rear panel). The Power Supply module will now be at the bottom of the instrument.
- Step 12: Remove the eight Torx head screws that secure the power supply module.
- Step 13: Carefully pull the Power Supply module partially out of the instrument. Stop short of stretching taut or binding the wires connecting to the A2A2 Control Rectifier board connectors.



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

- Step 14: Remove the wire connectors from the pins on the A2A2 Control Rectifier board.
- Step 15: Remove the chassis ground (green-yellow) wire that is connected to the Power Supply module from the chassis of the instrument.
- Step 16: 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 part of the opening in the instrument.*

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

### Fan Motor Removal/Replacement

See Figure 3-2 for connector and screw locations.

Remove and replace the fan motor as follows:

- Step 1: Using a pencil or tape, mark the top of the fan motor housing for later use in determining the positioning of the motor. Remove the four screws securing the housing to the rear of the instrument 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 (+) and the brown wire is (-).
- Step 4: Remove the fan motor.

**Note:** *Observe the position in which the motor was mounted. Ensuring 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 noting 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



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

### Cathode Ray Tube (CRT) Removal/Replacement

**WARNING**

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

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

See Figures 3-1, 3-4, 3-5, 3-6, 3-7, 3-13, and 3-31 for module, connector, screw, and index locations.

Remove the CRT as follows:

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

**CAUTION**

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

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

- Step 8: Remove the two plastic circuit board guides from the top of the card cage.
- Step 9: Remove the two Torx head screws that secure the A7 CRT Socket board cover. Use a short Torx head screwdriver to remove the rear-most Torx head screw.
- Step 10: Remove the A7 CRT Socket board cover.
- Step 11: Slowly pull the A7 CRT Socket board towards the rear of the instrument to unplug the A7 CRT Socket board from the CRT.

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

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

**WARNING**

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

- Step 12: Disconnect connector J54 from the A8 CRT Driver board. Note the position of the multi-pin connector's index triangle to ensure that you can correctly replace the connector.
- Step 13: Remove the four Torx head screws that secure the CRT to the top of the instrument chassis. Two of the screws are removed from the front of the front panel chassis, and two of the screws are removed from behind the front panel casting.
- Step 14: Remove the top CRT support bar from the instrument. The CRT support bar is unattached once the four Torx head screws securing the top of the CRT are removed.
- Step 15: Remove the four Torx head screws that secure the CRT to the bottom of the instrument chassis. Two of the screws are removed from the front of the front panel chassis, and two of the screws are removed from behind the front panel casting.
- Step 16: Remove the bottom CRT support bar from the instrument.

**CAUTION**

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

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

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

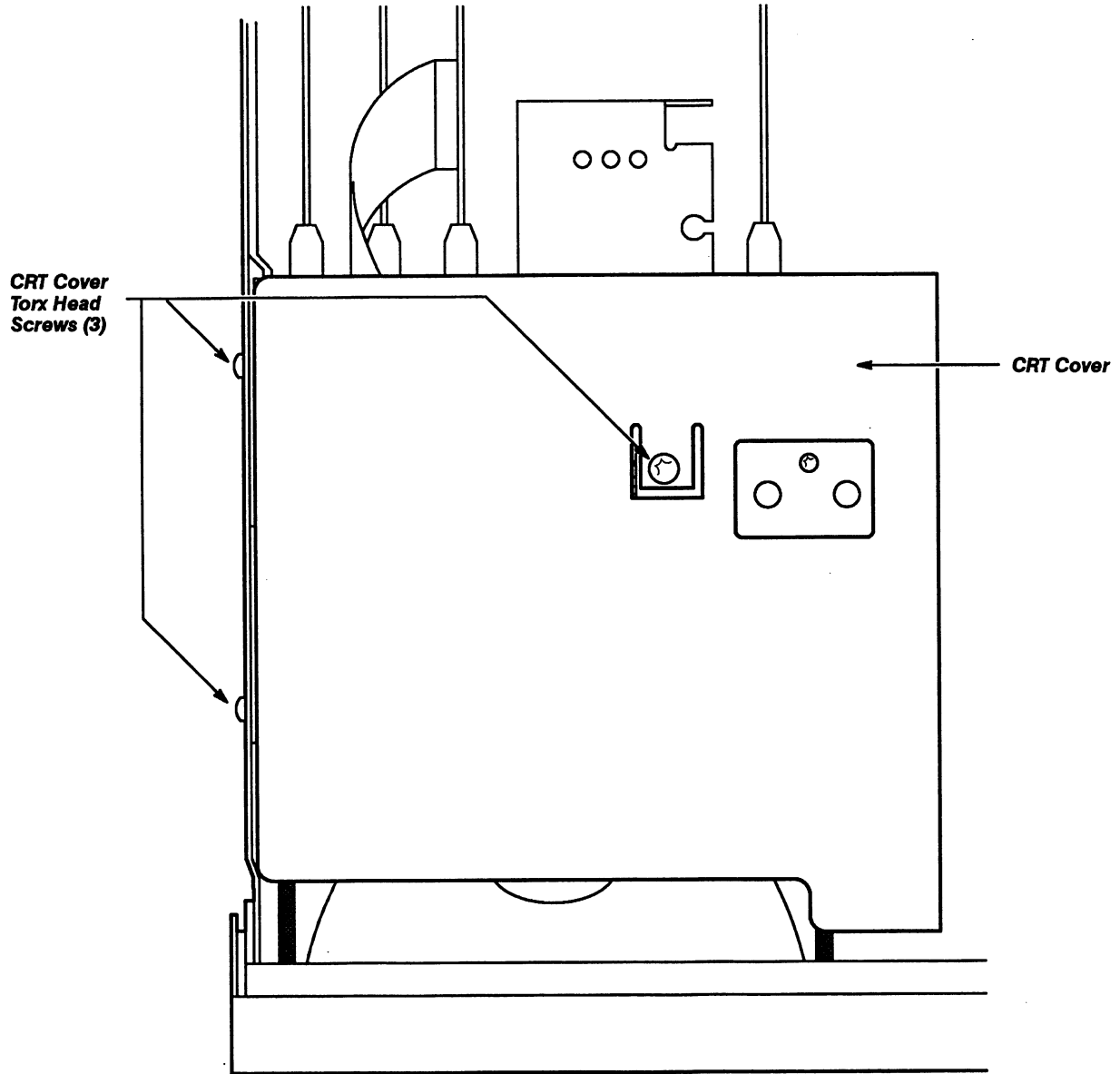


Figure 3-4 – Removing/Replacing the CRT Cover

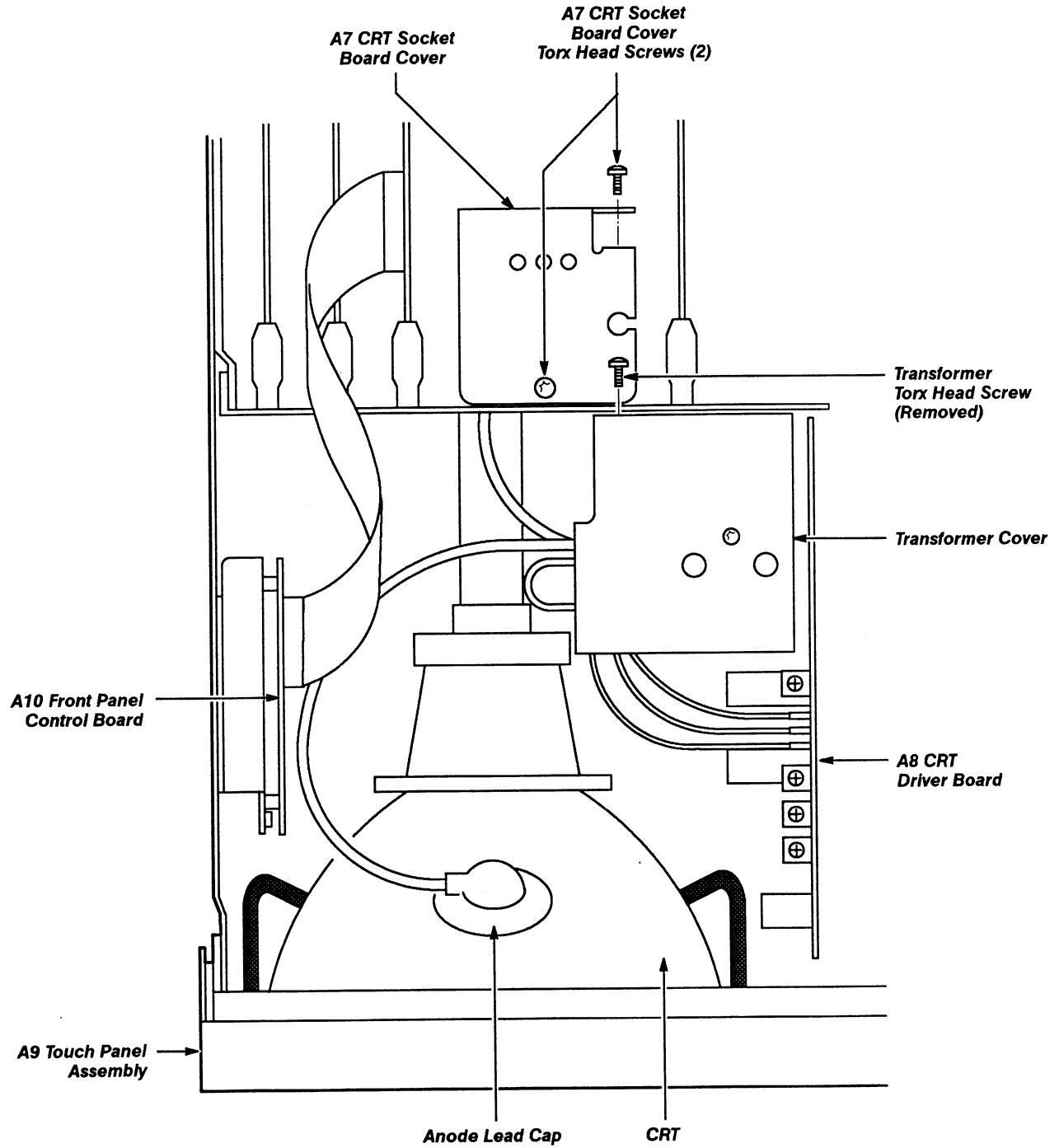


Figure 3-5 – Removing/Replacing the Cathode Ray Tube

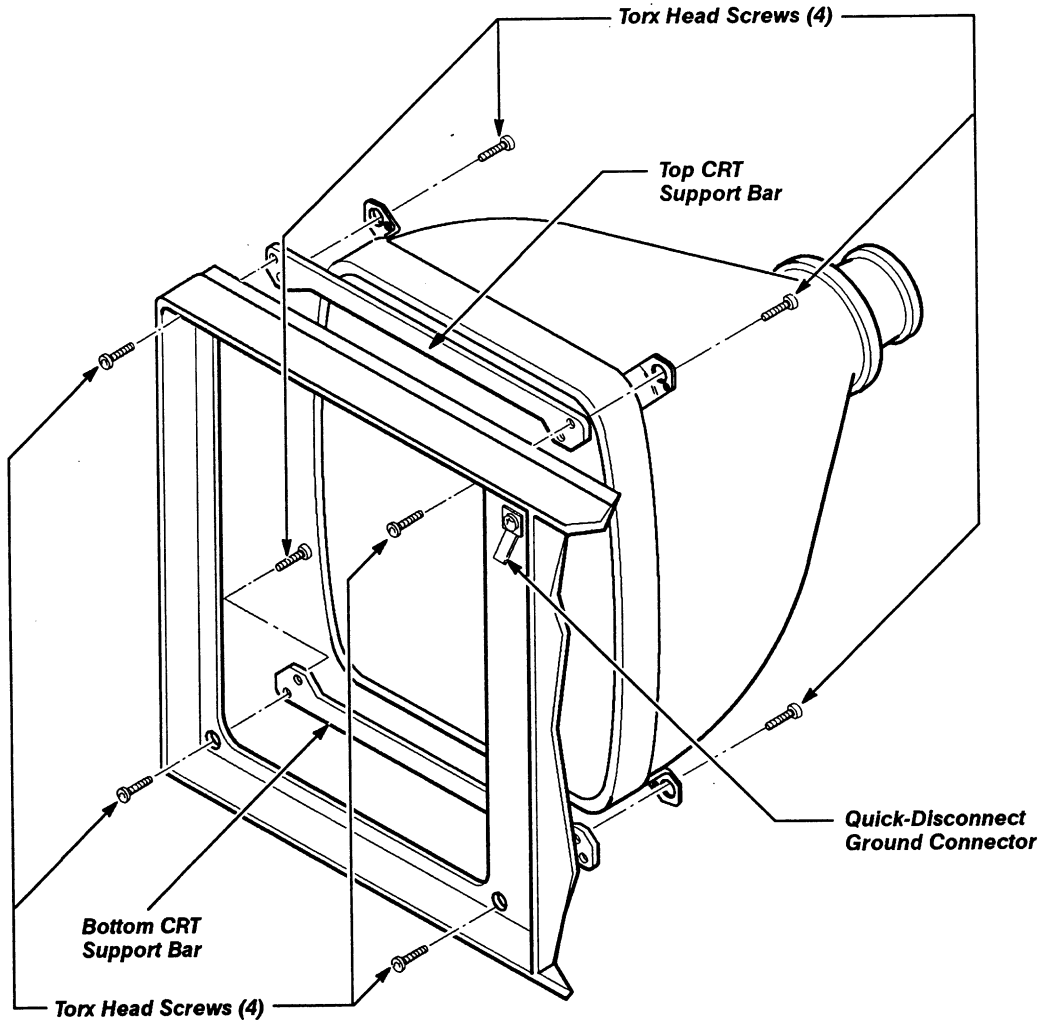


Figure 3-6 – Removing/Replacing the CRT Torx Head Screws

**Note:** Replacing the CRT will require that the instrument be readjusted.

**Acquisition Unit Removal/Replacement**

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

Remove and replace the Acquisition unit as follows (the Acquisition Unit can be removed with the instrument in the normal upright position for all steps):



*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, move each cover towards the end of the instrument where it is located. (The front cover moves forward and the rear cover moves backward.) Moving the clip about 1/8-inch will release the cover. Then, the cover can be removed from the instrument.*

- Step 1: Remove the bolt from the top of the chassis, just behind the front casting.
- Step 2: Remove the trim covers from the right side (as viewed from the front of the instrument).
- Step 3: Remove the two Torx head screws holding the frame section and remove the frame section.
- Step 4: Remove connectors J10 on the A26 M/F Acquisition Interconnect board and J34 on the A19 Strobe/TDR Buffer board. Note the position of the connector's index triangles to ensure that the multi-pin connectors can be correctly replaced.
- Step 5: Remove connectors J29A, J30A, J32, J33A, and J33B on the A19 Strobe/TDR Buffer board.
- Step 6: Grab between the two sampling head slots and gently pull out the Acquisition unit a few inches.
- Step 7: Disconnect the gray ground wire from the rear of the Acquisition unit.
- Step 8: Remove the Acquisition unit.



*Be careful not to pinch any interconnecting wires while replacing this unit.*

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

### Battery Disposal and First Aid

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

- two batteries (in the U500 and U511 RAM sockets) on the A5 Time Base/Controller board
- one battery (BT130) on the A14 I/O board
- one battery (BT150) on the A18 Memory board

See Figures 3-10, 3-19, and 3-22 respectively, 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 of 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 monofluoride, BR 2/3 A
- **Solvent (electrolyte):** Gamma Butyrolactone is of low toxicity. It can cause some eye and respiratory irritation. The solvent may be released during venting, according to the manufacturer. (Venting is an out gassing of battery material.) This is usually caused by short circuiting (for more than a few seconds) or by overheating.
- **Solute:** LIBF4

Table 3-3 lists the emergency procedures to follow should 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. Venting will usually last only a few seconds.

#### FRU Board and Assembly Removal

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

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

And the following two boards which plug onto the A26 M/F Acquisition Interconnect board (See Fig. 3-1 for the locations of these boards in the Acquisition unit):

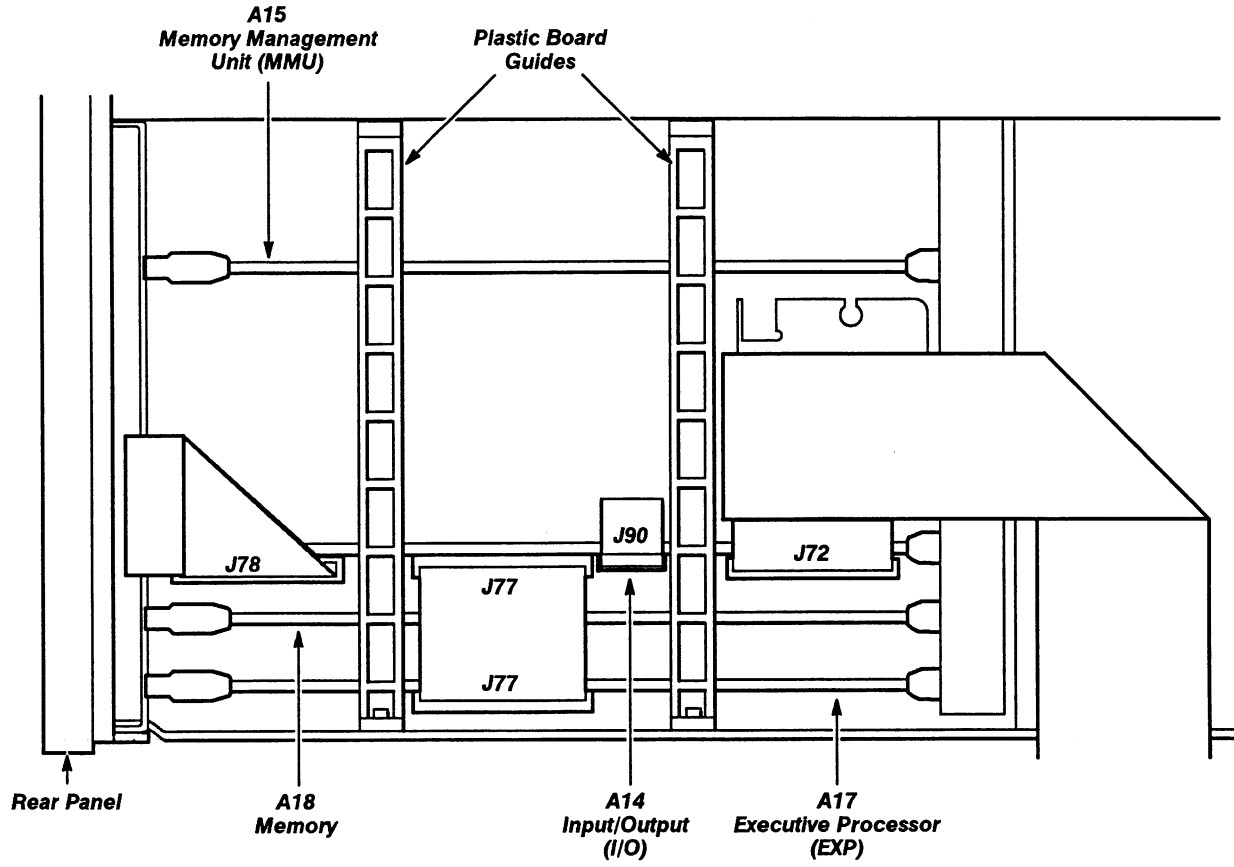
- A24/A27 Acquisition Analog
- A25/A28 Acquisition MPU

Feed-through connectors join the plug-on boards to the A13 Mother board and the A26 M/F Acquisition Interconnect board.

#### CAUTION

*After removing a board from the instrument, 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.*



◀ Rear of Oscilloscope

Figure 3-7 – Top View of the Card Cage

**A1 M/F Strobe Drive Board**—removal and replacement steps are listed below. See Figures 3-8 and 3-31 for connector, screw, and index locations.

- Step 1: Place the instrument in the inverted position and remove the bottom panel.
- Step 2: Remove connectors; J16, J27, J28, J33A, J33B, J35, J36, J37, J38, and J39 from the A1 M/F Strobe Drive board. Then remove connectors J10, J18, and J34 from the A1 M/F Strobe Drive board. Note the position of connector's from the A1 M/F Strobe Drive board index triangle to ensure that the connectors can be correctly replaced.

**Note:** Record the positions of the connectors to ensure that the connector can be correctly replaced.

- Step 3: Remove the five Torx head screws and carefully lift the board, disconnecting it from the J19 connector on the A1 M/F Strobe Drive board.

To replace the A1 M/F Strobe Drive board, perform the previous steps in reverse order.

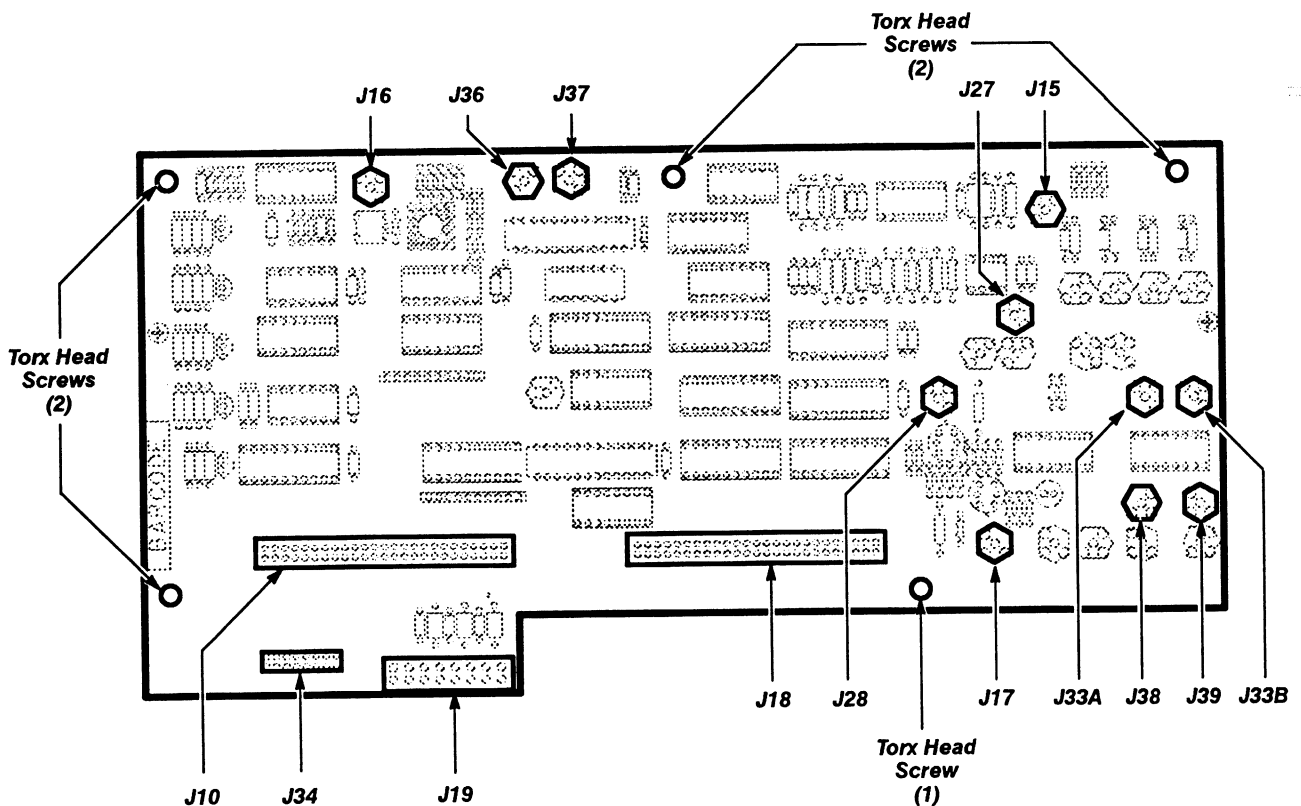


Figure 3-8 – Removing and Replacing the A1 M/F Strobe Drive Board

**A3 M/F Power Connect board**—removal and replacement steps are listed below. See Figures 3-2, 3-3, 3-9 and 3-19 for connector, screw, and index locations.

- Step 1: Remove the Power Supply module as described earlier in this section.

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

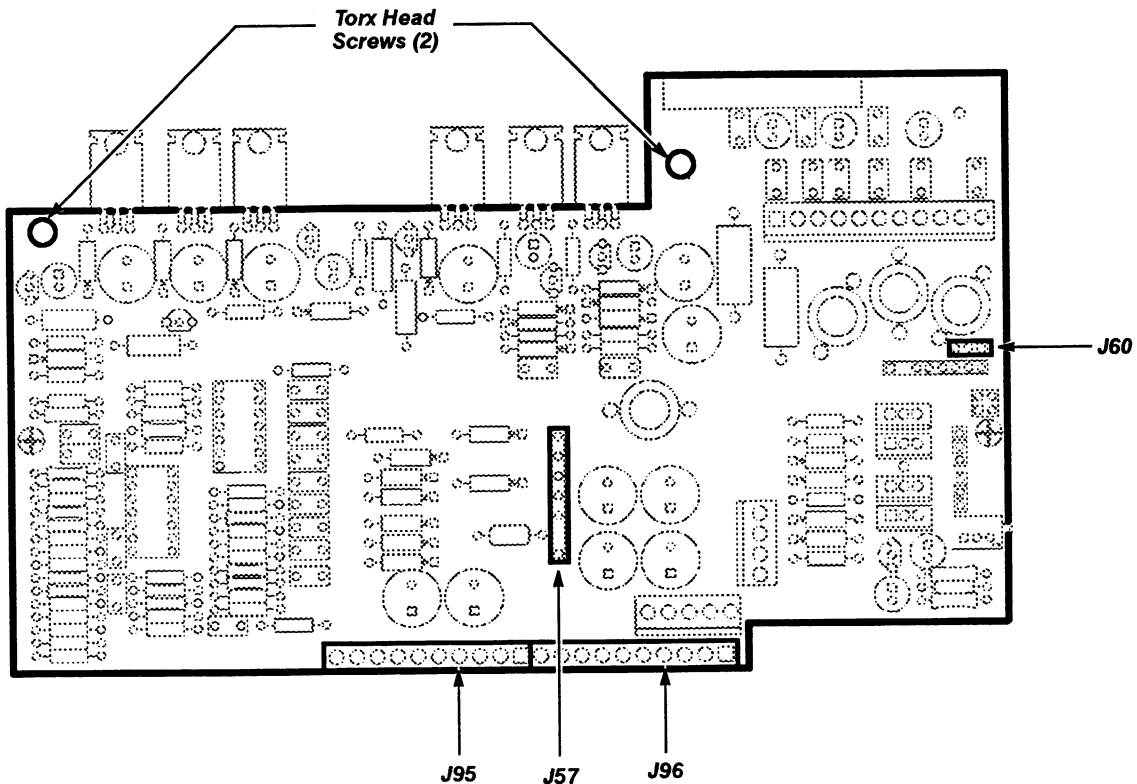
*Record the positions of all connectors to ensure that the connectors can be correctly replaced.*

- Step 2: Remove the A1 M/F Strobe Drive board.
- Step 3: Remove the A5 Time Base/Controller board.
- Step 4: Remove the A4 Regulator board.
- Step 5: Disconnect J90 from the A14 Input/Output board.

To replace the A3 M/F Power Connect board, perform the previous steps in reverse order.



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



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

**A4 Regulator board**—removal and replacement steps are listed below. See Figures 3-2, 3-3, 3-9, and 3-31 procedures for removal for connector, screw, and index locations.

- Step 1: Remove the Power Supply module. (See Power Supply Module Removal, in this section.)
- Step 2: Set the instrument 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 A3 M/F Power Connect board through interconnecting pins.*

- Step 5: Carefully disconnect the J95 and J96 pins from the A4 Regulator board by pulling the A4 Regulator board toward the rear.
- Step 6: Remove the A4 Regulator board.

To replace the A4 Regulator board, perform the previous steps in reverse order.

**Note:** *Match the index triangle on the multi-pin connectors with the corresponding square pad on the circuit board.*

**A5 Time Base/Controller board**—removal and replacement steps are listed below. See Figures 3-10, and 3-31 for connector, screw, and index locations.

- Step 1: Place the instrument in the inverted position.
- Step 2: Remove connectors J16, J29A, J30A, J32, J35, J91, Ext A and Presc (if Prescaler is present) from the A5 Time Base/Controller board. Then remove connectors J18 and J83 from the A5 Time Base/Controller board. Note the position of the multi-pin connector's index triangles to ensure that the connectors can be correctly replaced.

**Note:** Record the positions of the connectors and the receptacles to ensure that these connectors and receptacles will be positioned correctly when reinstalled.

- Step 3: Remove the six Torx head screws holding the board in place.
- Step 4: Remove the A5 Time Base/Controller board.

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

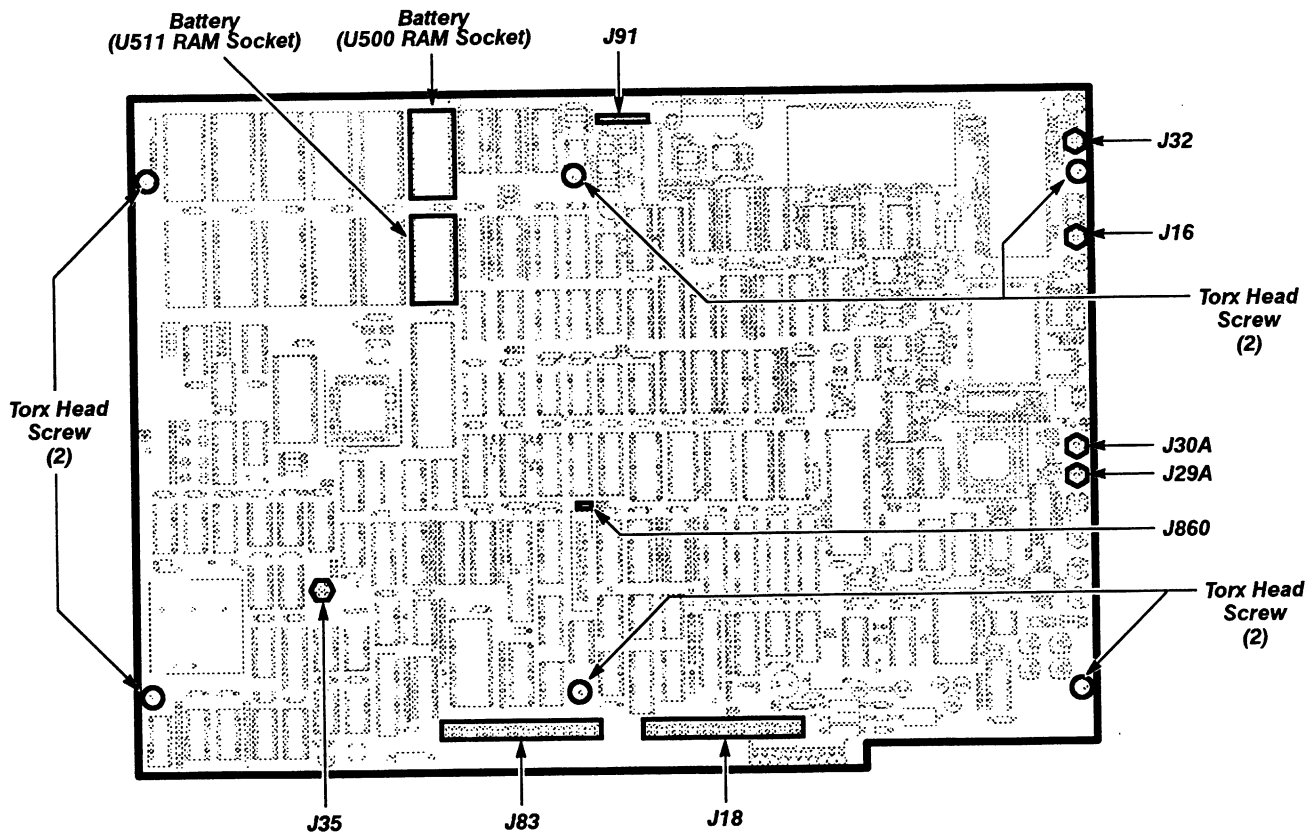


Figure 3-10 — Removing and Replacing the A5 Time Base/Controller Board

**A7 CRT Socket Board and A8 CRT Driver Board** – See Figures 3-1, 3-4, 3-5, 3-7, 3-11, 3-12, 3-13, 3-15, and 3-31 for board, connector, screw, and index locations.

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

- Step 1: Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover.
- Step 2: Remove the two plastic circuit board guides on top of the card cage.
- Step 3: Remove the two Torx head screws that secure the A7 CRT Socket board cover, and then remove the A7 CRT Socket board cover.
- Step 4: Slowly pull the A7 CRT Socket board toward the rear of the instrument to unplug the A7 CRT Socket board from the CRT.
- Step 5: Disconnect connectors J53 and J56 on the A7 CRT Socket board. Note the positions of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.

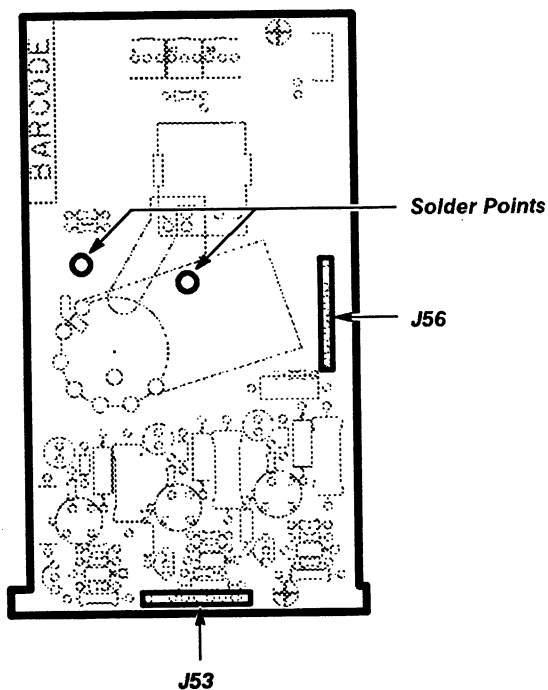
**WARNING**

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

- Step 6: Use a non-conducting tool to pry up the anode lead cap. This rubber cap is located on the upper part of the CRT, behind the front casting. Using a non-conducting tool, release the spring clip inside the cap and remove the anode. Insert one blade of a pair of needle-nose pliers against the anode, and touch the other blade to the top of the front casting to ground the anode to the chassis.
- Step 7: Remove the single Torx head screw that secures the A8 CRT Driver board to the instrument chassis. Use either of the following methods to remove the Torx head screw:
  - Remove the Torx head screw with a very short handled T-15 Torx head screwdriver. Ensure that you do not strike the CRT while removing the screw.
  - Remove the A10 Front Panel Control board. Then, use a Torx head screwdriver that has an extension length inserted in it to remove the Torx head screw. Access the screw from the hole in the left side of the instrument chassis. Ensure that you do not strike the CRT while removing the screw.
- Step 8: Remove the single Torx head screws that secures the transformer, on the A8 CRT Driver board, to the instrument chassis. This screw is located at the rear of the transformer. The A8 CRT Driver board is now unattached to the instrument chassis.

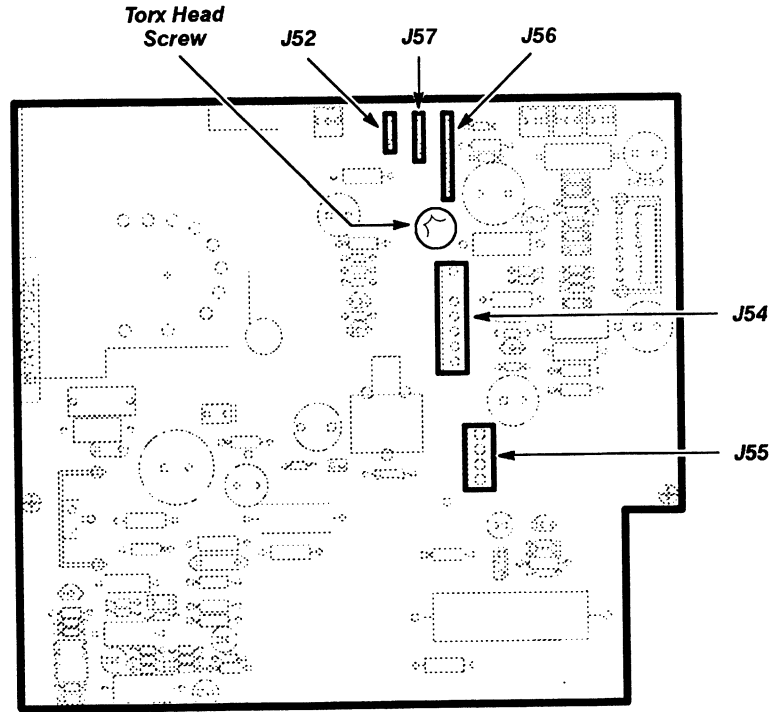
- Step 9: Disconnect connectors J52, J56, and J57 from the A8 CRT Driver board. Note the position of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.
- Step 10: Lift the A8 CRT Driver board partially out of the instrument chassis.
- Step 11: Disconnect connectors J54 and J55 from the A8 CRT Driver board. Note the position of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.
- Step 12: Remove the A8 CRT Driver board and the A7 CRT Socket board.
- Step 13: Unsolder the two wires that connect the A8 CRT Driver board to the A7 CRT Socket board (the two boards are now separated).

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



**Figure 3-11** – Removing/Replacing the A7 CRT Socket Board





**Figure 3-12** — Removing/Replacing the A8 CRT Driver Board

**A9 Touch Panel Assembly**—removal and replacement steps are listed below. See Figures 3-5, 3-15 and 3-31 for connector, screw, and index locations.

Remove and replace the A9 Touch Panel assembly as follows:

- Step 1: Set the instrument on its right side. (The CRT will now be at the top.)
- Step 2: Use a 1/16-inch allen wrench to loosen the small allen screws in each of the two control knobs.
- Step 3: Slowly remove the two control knobs so that you do not lose the small allen screws inside the knobs.
- Step 4: Remove the two Torx head screws at the bottom of the A9 Touch Panel Assembly.
- Step 5: Lift up on the bottom of the A9 Touch Panel Assembly, and swing the assembly outward.

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

- Step 6: Disconnect the black ground wire from the quick-disconnect ground connector on the front panel casting.
- Step 7: Disconnect connector J73 from the A10 Front Panel Control board. Note the position of multi-pin connector's index triangles to ensure that you can correctly replace this connector. Carefully remove the wire cable through the slot provided in the front casting.

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

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

**Note:** *Feed 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.*

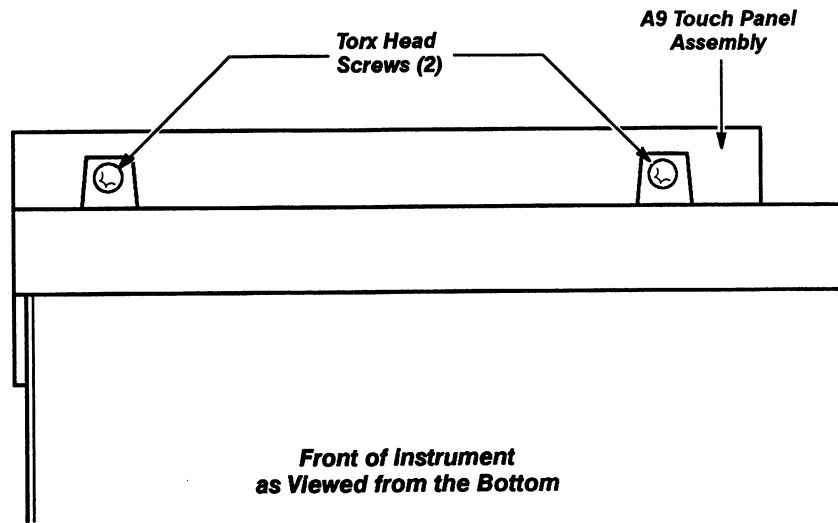


Figure 3-13 – A9 Touch Panel Assembly Torx Head Screws

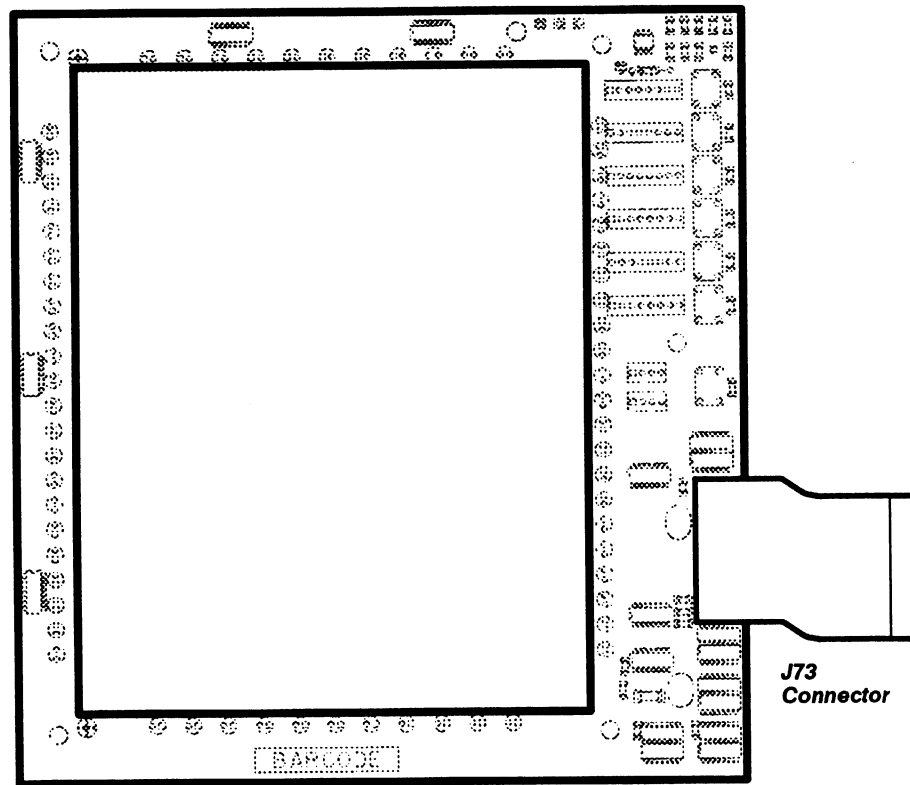


Figure 3-14 – Removing/Replacing the A9 Touch Panel Assembly

**A10 Front Panel Control board**—removal and replacement steps are listed below. See Figures 3-5, 3-11, 3-15 and 3-31 for connector, screw, and index locations.

- Step 1: Remove the CRT shield. (Refer to Cathode Ray Tube Removal in this section; following Steps 1 and 2.)
- Step 2: 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 3: Remove the two Torx head screws at the upper edge of the board.
- Step 4: Lift the board away from the guides at its bottom and remove it.

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

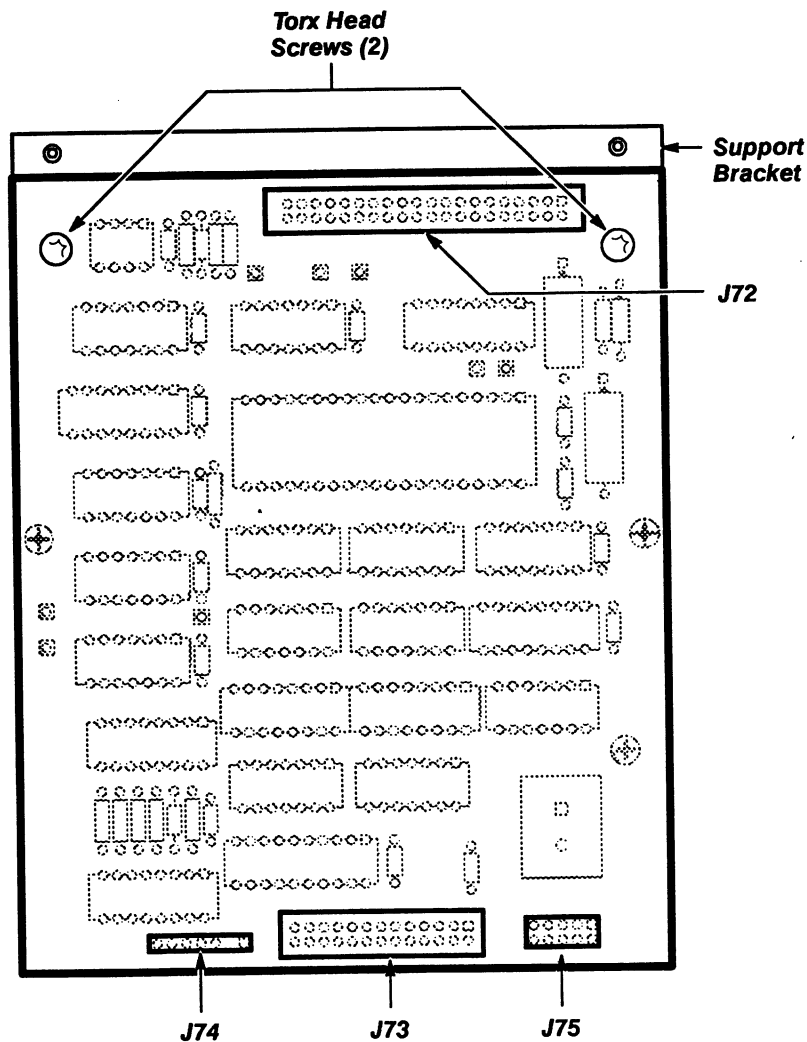
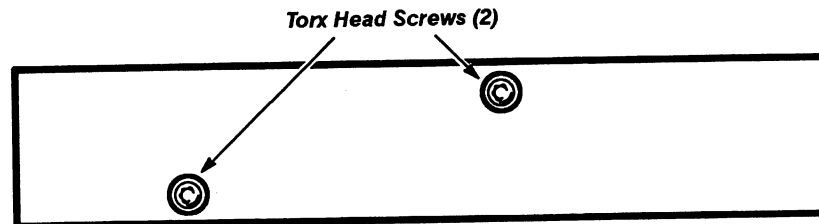


Figure 3-15 – Removing/Replacing the A10 Front Panel Control Board

**A11 Front Panel Button board**—removal and replacement steps are listed below. See Figures 3-5, 3-11, 3-15, 3-16 and 3-31 for connector, screw, and index locations.

- 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 J75 from the A10 Front Panel Control board. Note the position of connector index triangles for correct replacement.
- Step 3: Remove the two Torx head screws from the A11 Front Panel Button board, which is located at the top and near the inside center of the front casting.
- Step 4: Remove the A11 Front Panel Button board.

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



**Rear View of the A11 Front Panel button Board**

**Figure 3-16** — Removing and Replacing the A11 Front Panel Button Board

**A12 Rear Panel Assembly**—removal and replacement steps are listed below. See Figures 3-2, 3-17 and 3-31 for connector, screw, and index locations.

- 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 back from the instrument. Remove connector J78 from the top of the A12 Rear Panel assembly. Remove the grounding wire. 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 plate:
  - two bail brackets, screws, and washers from the PRINTER connector
  - two posts from the GPIB connector
  - posts, lockwashers, 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.



*The metal covers on the PRINTER and on 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 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.

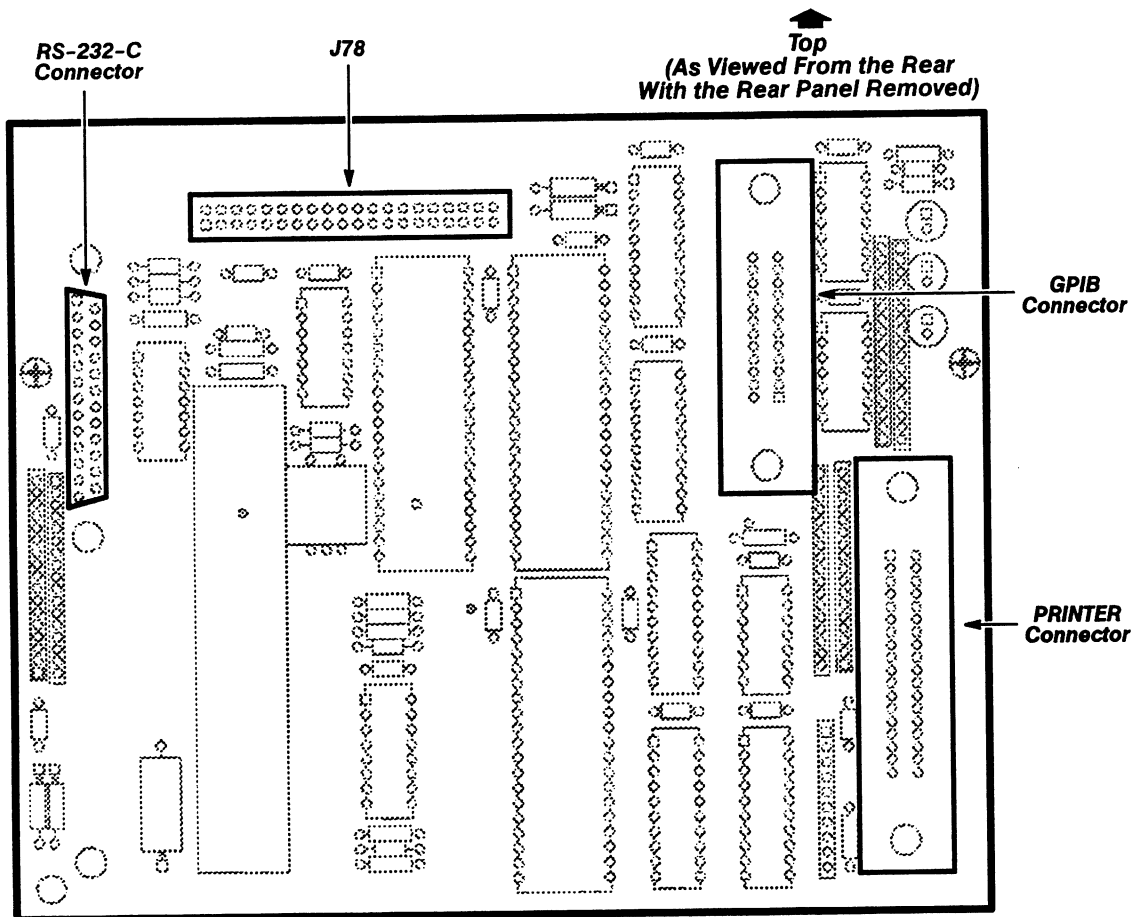


Figure 3-17 – Removing and Replacing the A12 Rear Panel Assembly

**A13 Mother board**—removal and replacement Steps are listed below. See Figures 3-7, 3-18 and 3-31 for connector, screw, and index locations.

- Step 1: Remove the three Torx head screws that secure the crt cover, and then remove the crt cover. Remove the card cage retainer from the top front of the card cage by removing the card cage's two screws. Remove both circuit board guides from the top of the card cage. The other ends of the guides contain slots which attach to the edge of a metal bracket. Both ends of the guides can be pried loose.
- Step 2: Remove the A14 I/O, A15 MMU, A17 Executive 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, perform the previous steps in reverse order.



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

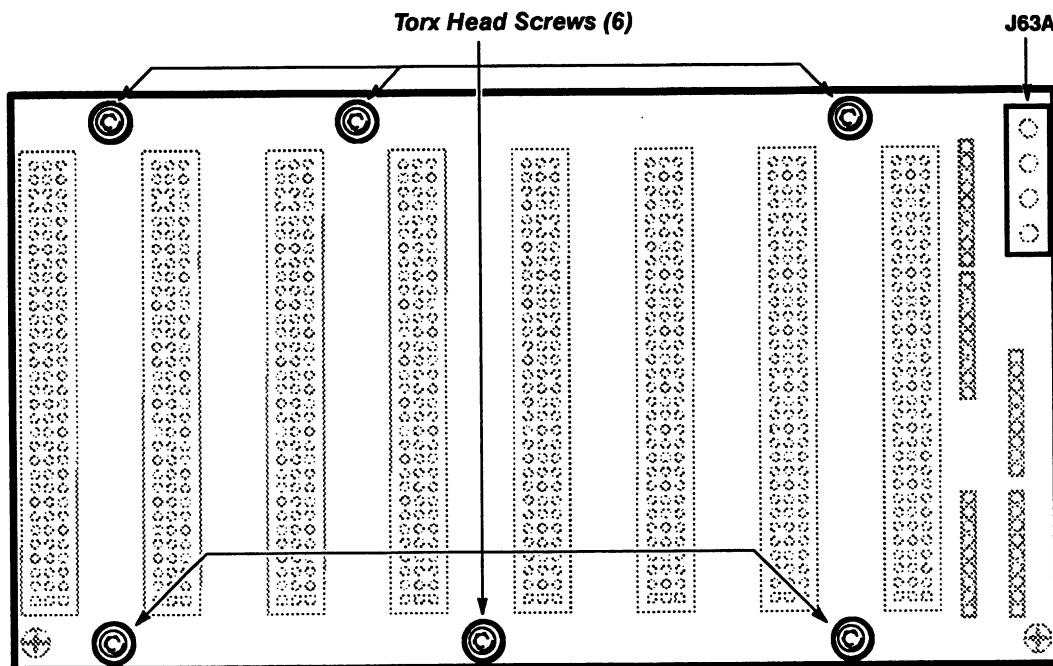


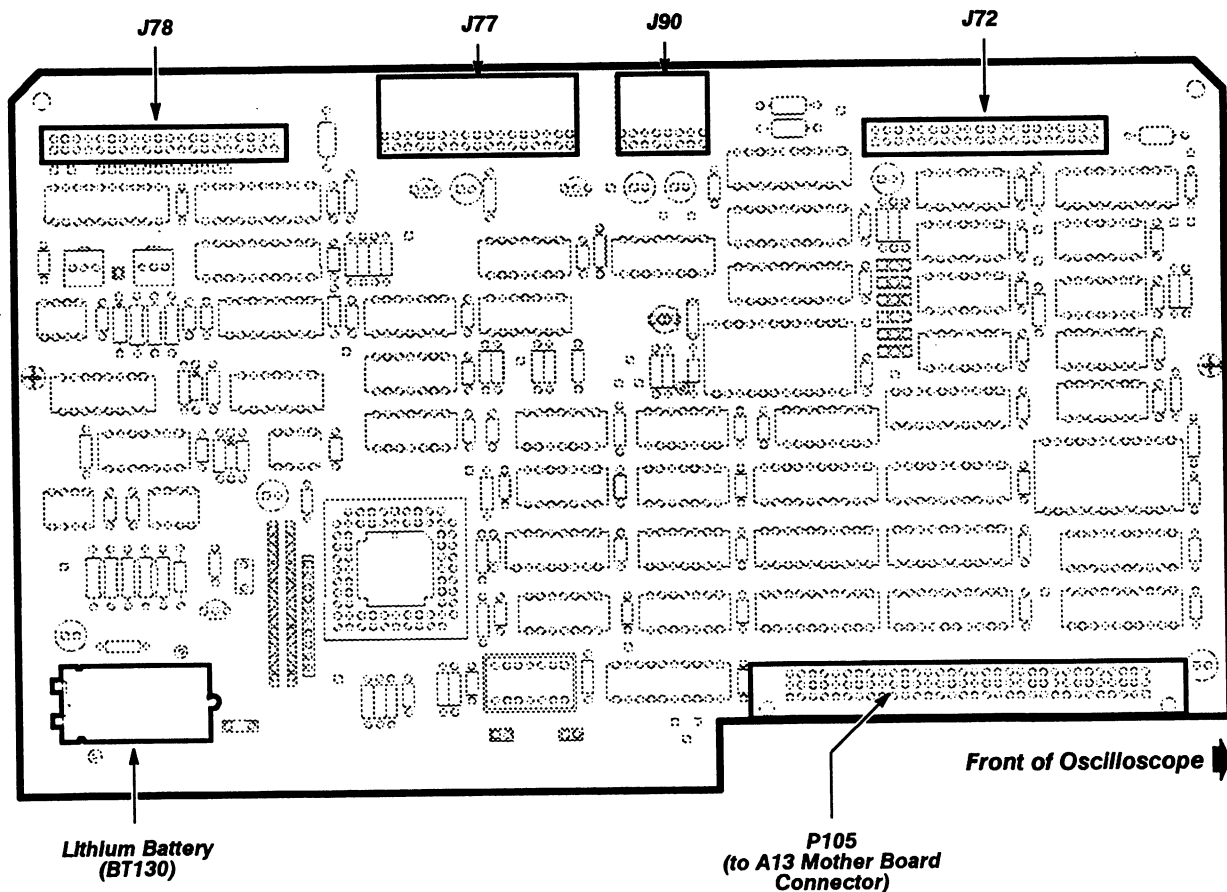
Figure 3-18 – Removing/Replacing the A13 Mother Board



**A14 Input/Output (I/O) Board**— See Figures 3-4, 3-7, 3-19, and 3-31 for board, connector, screw, and index locations.

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

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



**Figure 3-19** — Removing/Replacing the A14 I/O Board

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

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

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

**WARNING**

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

**A15 Memory Management Unit (MMU) Board**— See Figures 3-4, 3-7, 3-19, 3-20, and 3-31 for board, connector, screw, and index locations.

Remove and replace the A15 MMU board as follows:

- Step 1: Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover.
- Step 2: Remove both of the plastic board guides from the top of the card cage. The guides are retained by two small catches located in two holes in the left bracket of the card cage. The other ends of the guides contain slots which attach to the edge of a metal bracket. Both ends of the guides can be pried loose.
- Step 3: Disconnect connectors J52, J53, J57, and J83 from the A15 MMU board. Note the position of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.
- Step 4: 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.*

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

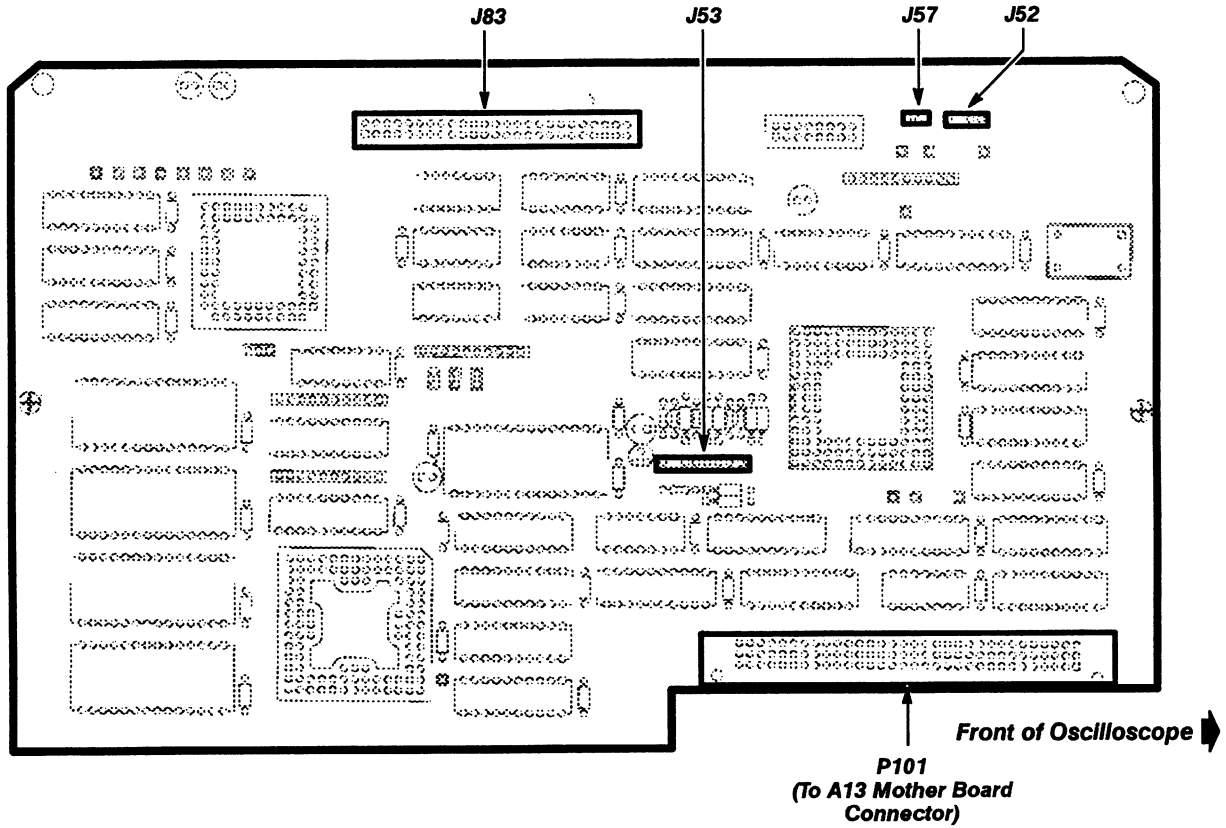


Figure 3-20 – Removing and Replacing the A15 MMU Board

**A17 Executive Processor (EXP) Board**— See Figures 3-4, 3-7, 3-21, and 3-31 for board, connector, screw, and index locations.

Remove and replace the A17 Executive Processor board as follows:

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

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

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

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

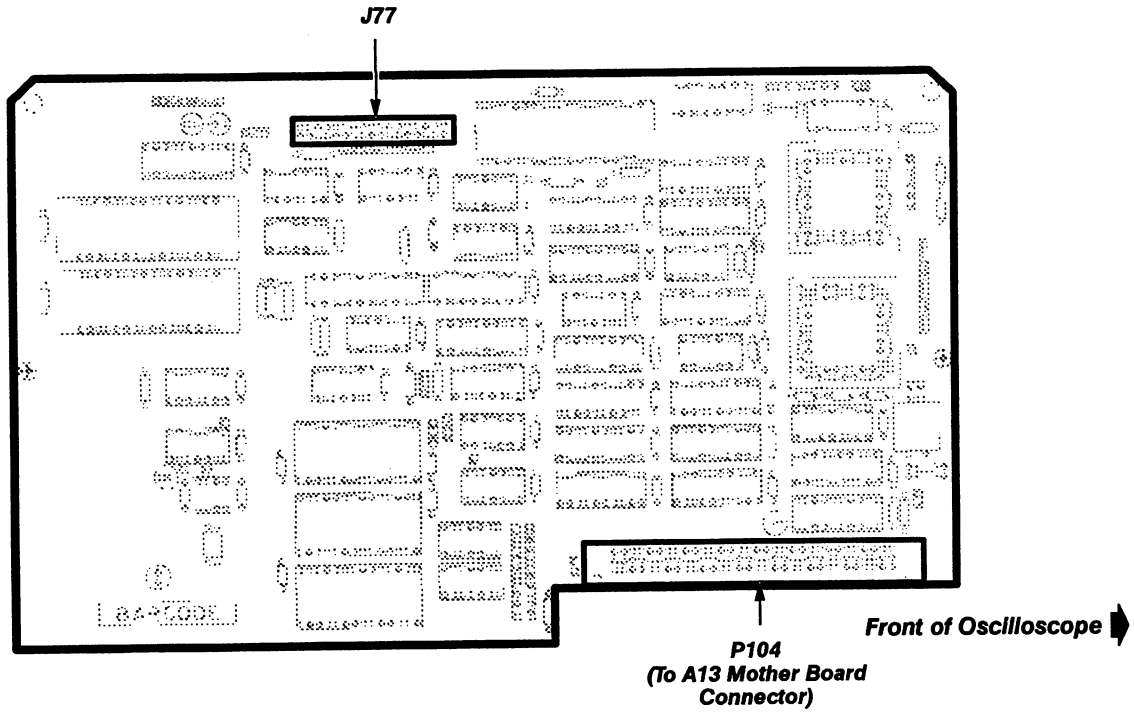


Figure 3-21 — Removing/Replacing the A17 Executive Processor Board

**A18 Memory Board**— See Figures 3-4, 3-7, 3-21, 3-22, and 3-31 for board, connector, screw, and index locations.

Remove and replace the A18 Memory board as follows:

- Step 1: Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover.
- Step 2: Remove both of the plastic board guides from the top of the card cage. The guides are retained by two small catches located in two holes in the left bracket of the card cage. The other ends of the guides contain slots which attach to the edge of a metal bracket. Both ends of the guides can be pried loose.
- Step 3: Disconnect connector J77 from the A17 Executive Processor board. Note the position of the multi-pin connector's index triangle to ensure that you can correctly replace this connectors.
- Step 4: Lift the white, hinged tabs at the front and rear edges of the board. Pull the tabs upward until the A18 Memory board separates from the A13 Mother board.
- Step 5: Remove the A18 Memory board.

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

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

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

**WARNING**

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

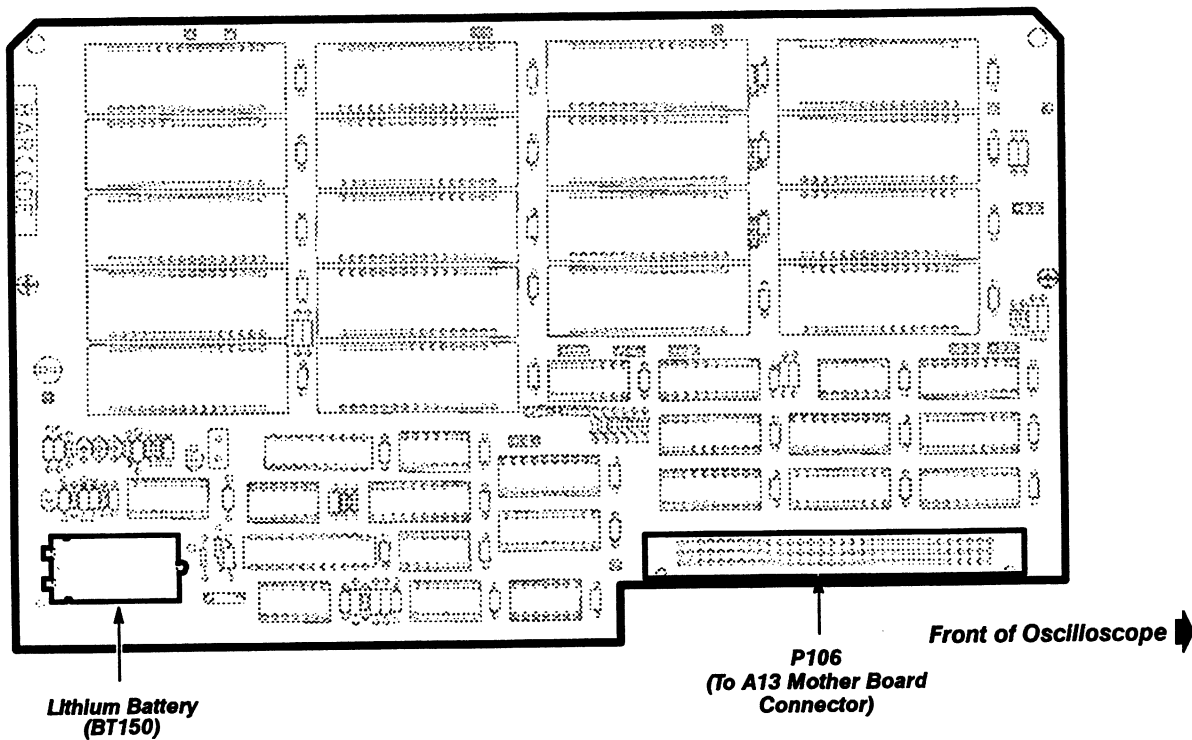


Figure 3-22 – Removing/Replacing the A18 Memory Board

**A19 Strobe/TDR Buffer board**—removal and replacement steps are listed below. See Figures 3-23, 3-26, and 3-31 for connector, screw, and index locations.

- Step 1: Remove the Acquisition unit and position the Acquisition unit in the upright position.
- Step 2: Remove the two Torx head screws on each black retaining brace located at the top of the Acquisition unit to remove these braces.
- Step 3: Remove connectors J1B, J2B, J3A, J3C, J4A, J4B, J4C, J29A, J30A, J32, J33A, J33B, and J34 from the A19 Strobe/TDR Buffer board.

**Note:** Record the positions of the connectors and the receptacles to ensure that the connector and receptacles can be correctly replaced.

- Step 4: Remove J10 from the A26 M/F Acquisition Interconnect board.
- Step 5: Remove the two Torx head screws on the bottom of the A19 Strobe/TDR Buffer board, and gently pull out the board.

To replace the A19 Strobe/TDR board by following the previous steps in reverse order.

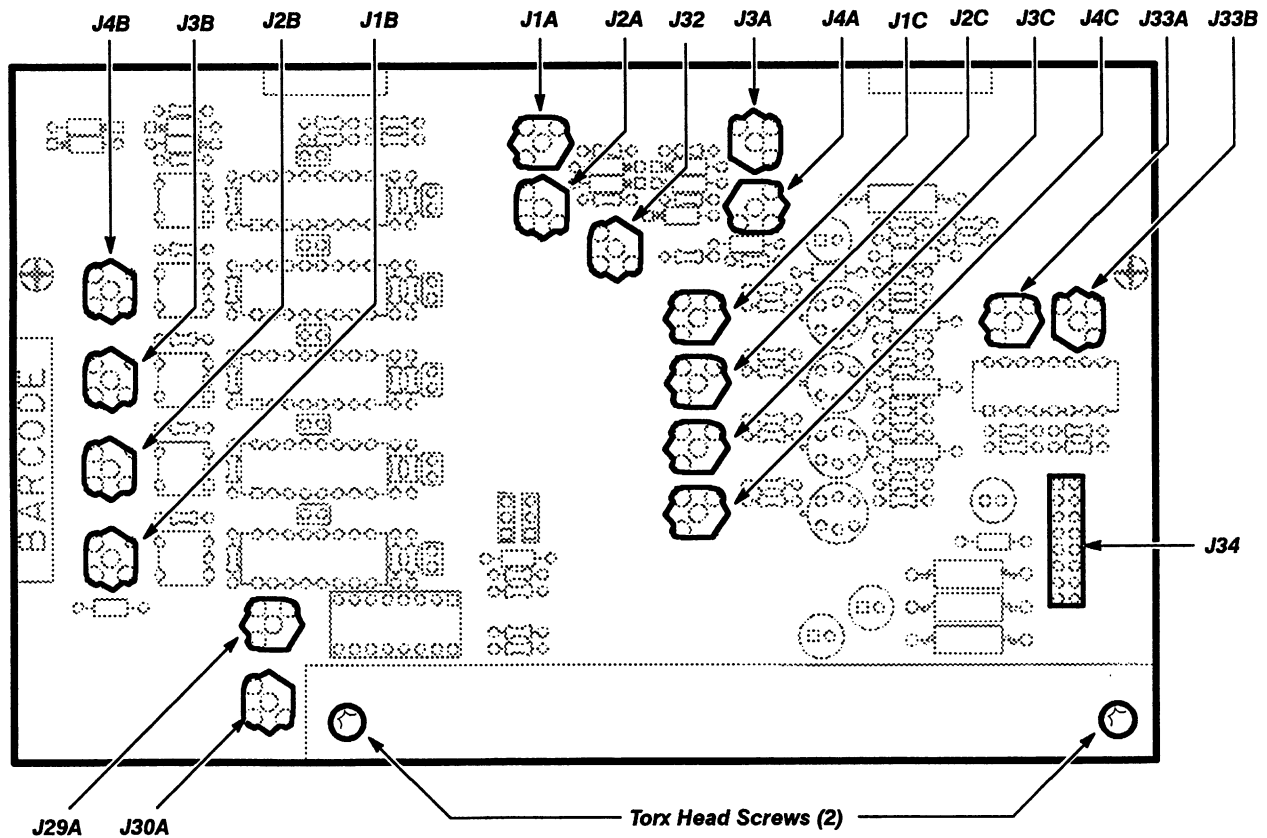
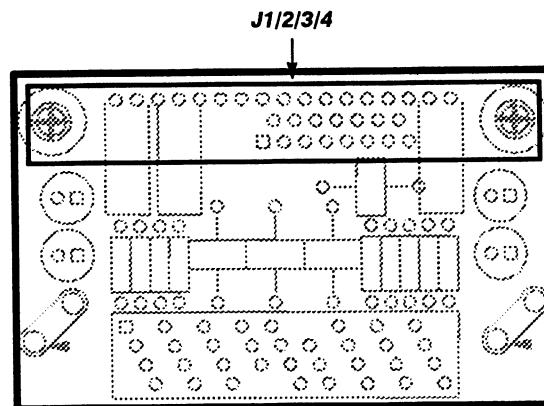


Figure 3-23 — Removing and Replacing the A19 Strobe/TDR Buffer Board



**A20-A23 Head Interconnect board**—removal and replacement steps are listed below. See Figures 3-23, 3-24, 3-25, 3-26, 3-28, 3-29, and 3-31 for connector and screw locations.

- Step 1: Remove the Acquisition unit and position the Acquisition unit in the upright position.
- Step 2: Remove the two Torx head screws on each black retaining brace located at the top of the Acquisition unit.
- Step 3: Remove the A24/A27 Acquisition Analog boards, the A25/A28 Acquisition MPU boards, and the A19 Strobe/TDR Buffer board.
- Step 4: Remove the four screws holding the top of the front subpanel of the Acquisition unit.
- Step 5: Remove the four screws on the gold-colored locking bar located on the top front of the Acquisition unit.
- Step 6: Turn the Acquisition unit in the inverted position and repeat Steps 2 and 3 on the bottom of the Acquisition unit.
- Step 7: Disconnect the connectors from the A26 M/F Acquisition Interconnect board connector. Note the position of the multi-pin connector's index triangle to ensure that the connector can be correctly replaced.
- Step 8: Remove the Front Subpanel assembly with the A20–A23 Head Interconnect boards intact.
- Step 9: Remove the bottom Torx head screw from within the sampling head compartment that contains the head interconnect board you are attempting to remove.
- Step 10: Turn the Front Subpanel assembly around so that the open compartments face away from you.

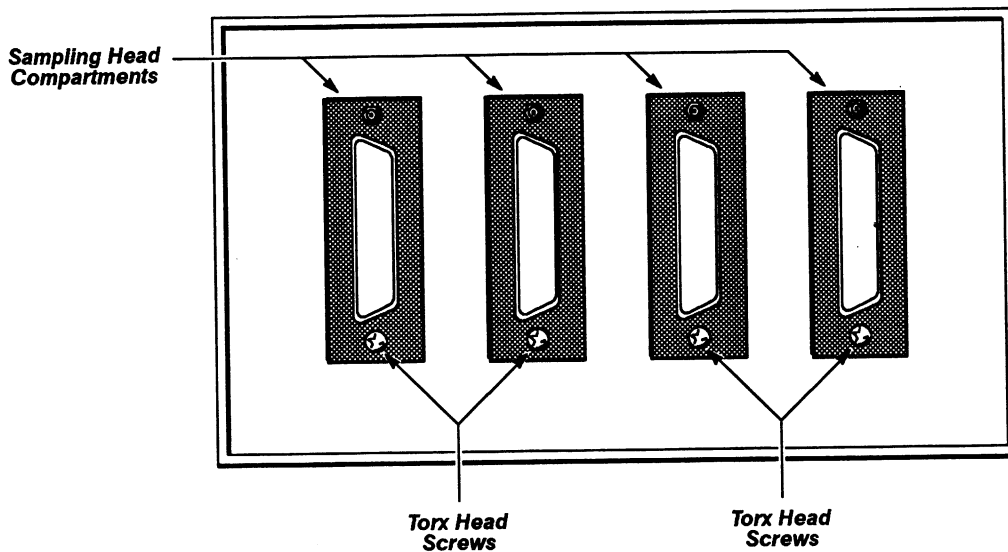


**Figure 3-24** — Removing and Replacing the A20-A23 Head Interconnect Board

- Step 11: Remove the top nut that retains the sampling head compartment to the head interconnect board you are attempting to remove.
- Step 12: Remove the head interconnect board by slightly prying up on the tabs that are keeping it in place, and slowly remove the board(s) from the J1/2/3/4 connector.

To replace the A20-A23 Head Interconnect boards, perform the previous steps in the reverse order.

Front View of Front Subpanel Assembly



Rear View of Front Subpanel Assembly

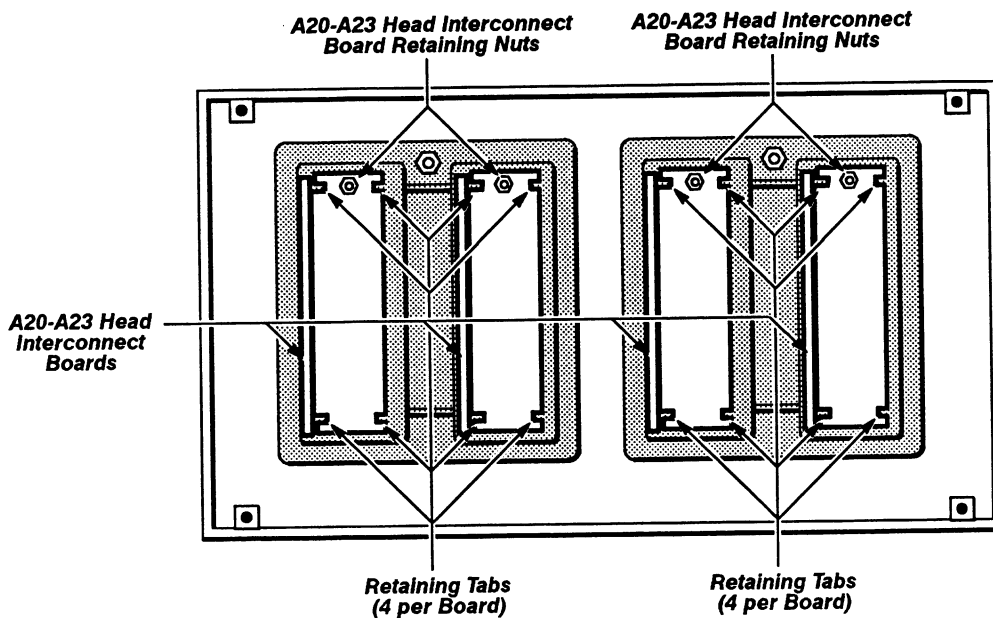
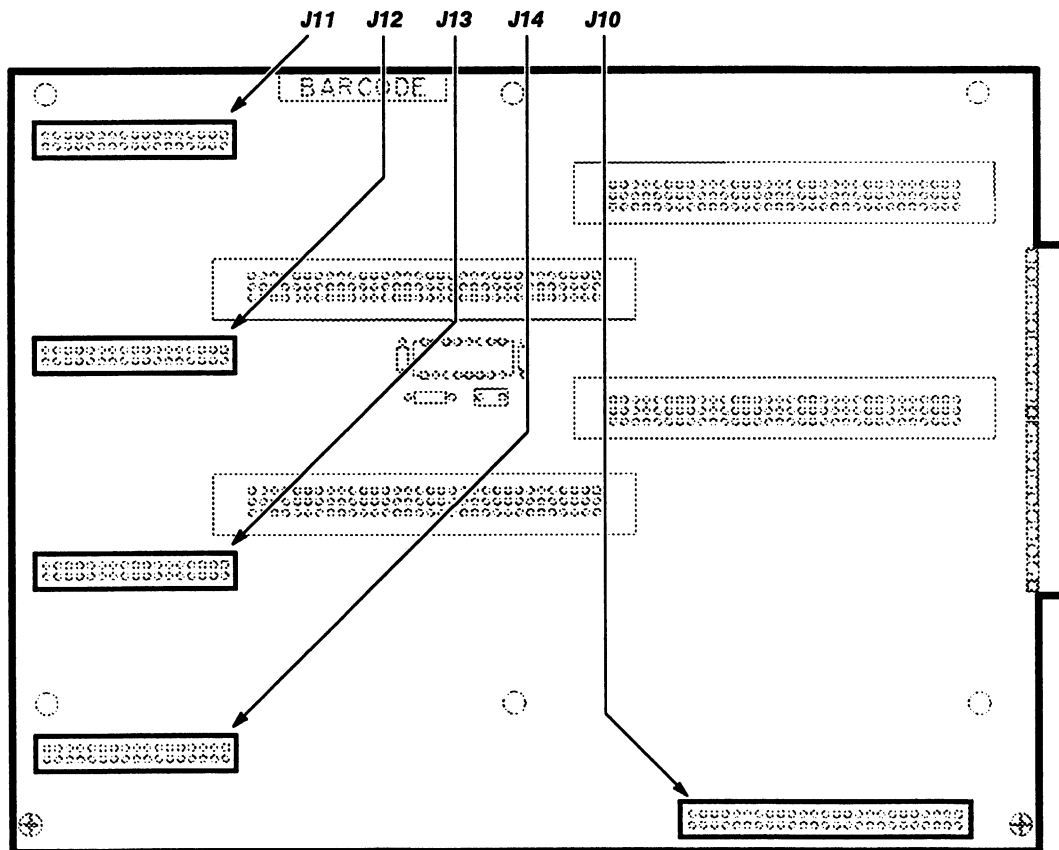


Figure 3-25 – Removing and Replacing the Front Subpanel Assembly

**A26 M/F Acquisition Interconnect board**—removal and replacement Steps are listed below. See Figures 3-23, NO TAG, 3-26, 3-27, 3-28, 3-29, and 3-31 for connector, screw, and index locations.

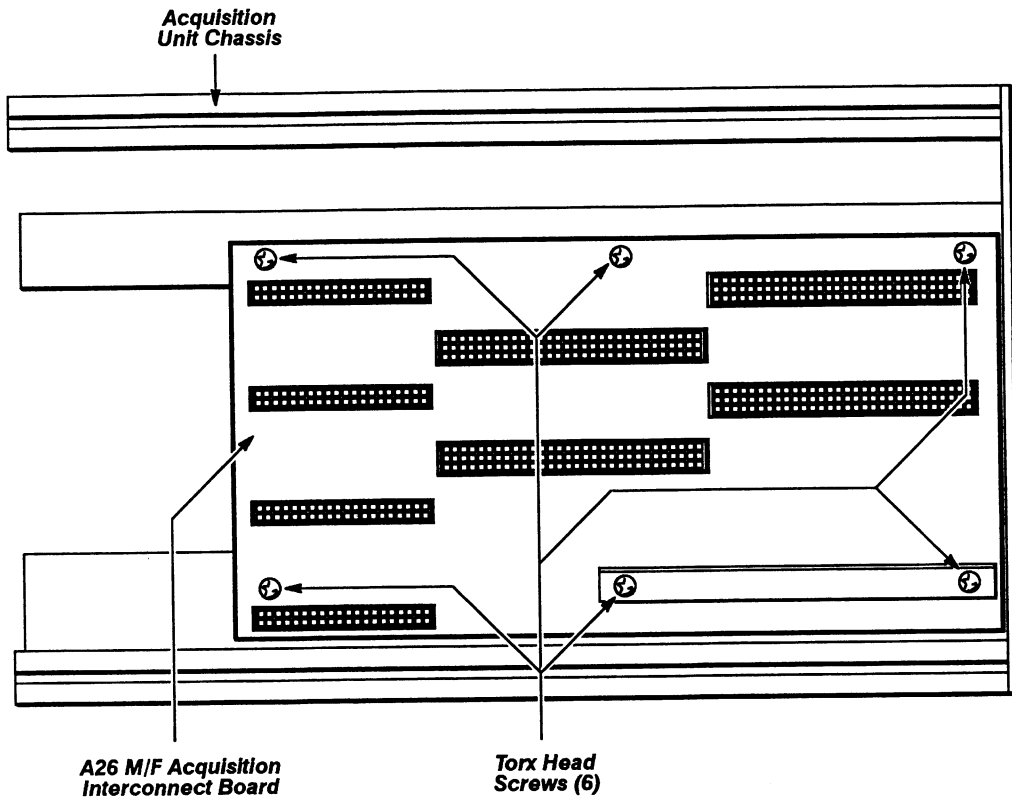
- Step 1: Remove the Acquisition unit as and position the Acquisition unit in the upright position.
- Step 2: Remove the A24/A27 Acquisition Analog board, the A25/A28 Acquisition MPU board and the A19 Strobe/TDR Buffer board.
- Step 3: Remove the four screws on the gold colored retaining brace holding the top of the Front Subpanel assembly of the Acquisition unit.
- Step 4: Remove the four screws on the gold colored locking bar located on the top front of the Acquisition unit.
- Step 5: Turn the Acquisition unit in the inverted position and repeat Steps 2 and 3 on the bottom of the Acquisition unit.
- Step 6: Disconnect connectors J13 and J14 on the A26 M/F Acquisition Interconnect board. Note the position of the multi-pin connector's index triangle to ensure that the connector can be correctly replaced.



**Figure 3-26** — Removing and Replacing the A26 M/F Acquisition Interconnect Board

- Step 7: Remove the Front Subpanel assembly with the head interconnect boards intact.
- Step 8: Remove the six Torx head screws to remove the A26 M/F Acquisition Interconnect board.

To replace the A26 M/F Acquisition Interconnect board, perform the previous steps in the reverse order.



**Figure 3-27** – Top View of the A26 Mainframe Acquisition Interconnect Board

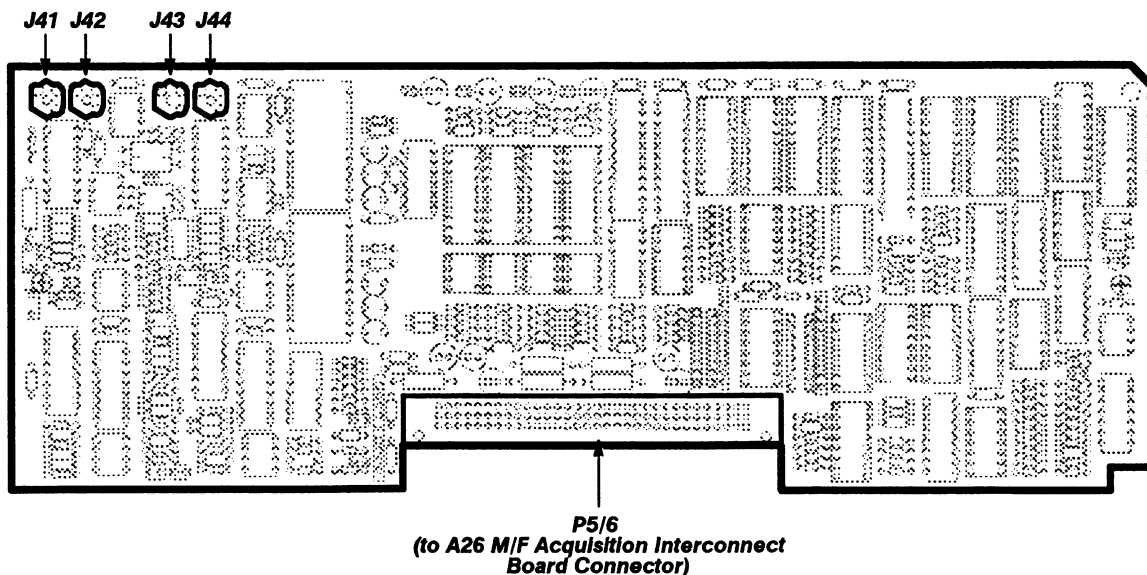
**A24/A27 Acquisition Analog board**—removal and replacement steps are listed below. See Figures 3-23, 3-26, 3-28, and 3-31 for board guide, screw, and index locations.

- Step 1: Remove the Acquisition unit and position the Acquisition unit in the upright position.
- Step 2: Remove the two Torx head screws on each black retaining brace located at the top of the Acquisition unit to remove these braces.
- Step 3: Remove connectors J41, J42, J43 and J44 from the A24/A27 Acquisition Analog board.
- Step 4: Pull up on the hinged white tabs until the board separates from connector P6.

To replace the A24/A27 Acquisition Analog board, perform the previous steps in reverse order.

**Note:** Insert the edges of the board into the plastic guides. Lower the board into position.

Check that connector is seated onto the A26 M/F Acquisition Interconnect board connector. Push down firmly on the A24/A27 Acquisition Analog board to connect this connector to the A26 M/F Acquisition Interconnect board.



**Figure 3-28** – Removing and Replacing the A24/A27 Acquisition Analog Board

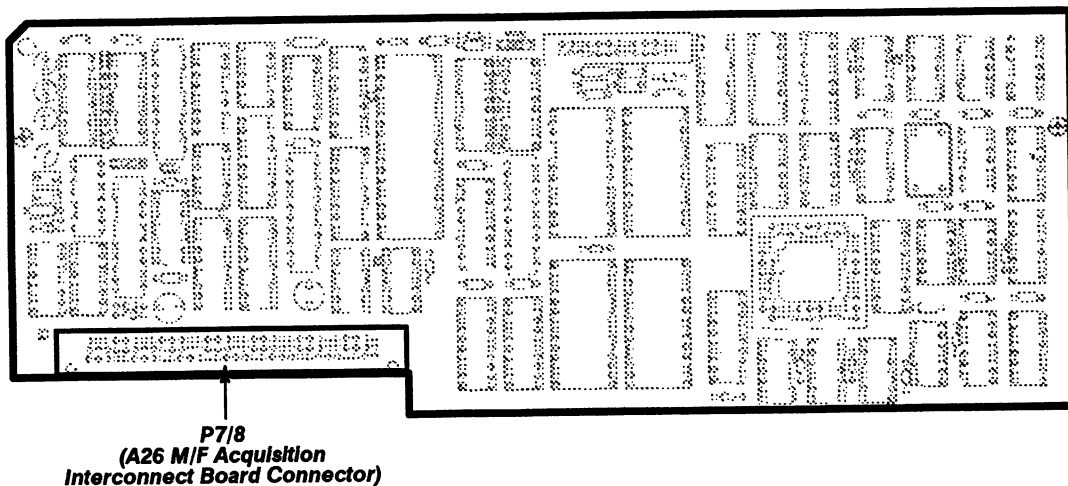
**A25/A28 Acquisition MPU board**—removal and replacement steps are listed below. See Figures 3-23, 3-26, 3-29, and 3-31 for board guide, screw, and index locations.

- Step 1: Remove the Acquisition unit and position it in the upright position.
- Step 2: Remove the two Torx head screws on each black retaining brace located at the top of the Acquisition unit to remove these braces.
- Step 3: Pull up on the hinged white tabs until the board separates from connector P8 on the A26 M/F Acquisition Interconnect board.

To replace the A25/A28 Acquisition MPU board, perform the previous steps in reverse order.

**Note:** Insert the edges of the board into the plastic guides. Lower the board into position.

Check that the connector is seated onto the A26 M/F Acquisition Interconnect board connector. Push down firmly on the A25/A28 Acquisition MPU board to connect this connector to the A26 M/F Acquisition Interconnect board.



**Figure 3-29** – Removing and Replacing the A25/A28 Acquisition MPU Board

### FRU IC Removal

The procedures for removing and replacing the FRU ICs in the oscilloscope are outlined in this section.

**Serial Data Interface Integrated circuits (“Slam-Pack” ICs)** – U330 is mounted on the A14 I/O board. See Figure 3-30 for the location of this IC. It has a raised, ridged, heat sink cover. The IC is oriented to its socket 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. An example of the IC is shown in Figure 3-31.

To remove the Serial Data Interface IC, proceed as follows:

- Step 1: Remove the A14 I/O board.
- Step 2: Hold the heat sink cover in place and unfasten the retaining clip by moving the retaining clip across the tabs, while pushing down slightly on the cover.



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

- Step 3: Remove the cover slowly to prevent the IC from falling out. Note the position of the index of the IC for later use before removing the IC.
- Step 4: Remove the IC with tweezers.



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

Replace the Serial Data Interface IC as follows:

- Step 5: Using tweezers, place the beveled corner of the replacement IC against the index spring (the original positioning of this index was noted earlier).



*Do not damage the spring with the beveled corner. (Shorting of the two corner contacts could result.)*

- Step 6: Arrange the other corners, with the tweezers, to fit evenly at the edges of the socket.
- Step 7: Set the cover flat on the IC with the cover's end tabs properly aligned with, but not in, the mating recesses in the socket.
- Step 8: Push down on the cover, keeping it flat on the IC and slide the cover end tabs into place. Hold it there while moving the retaining clip over the tabs at the other end of the cover.
- Step 9: Slightly pull on the cover to check that the cover is secure.
- Step 10: Replace the A14 I/O board.

FRU IC Detail

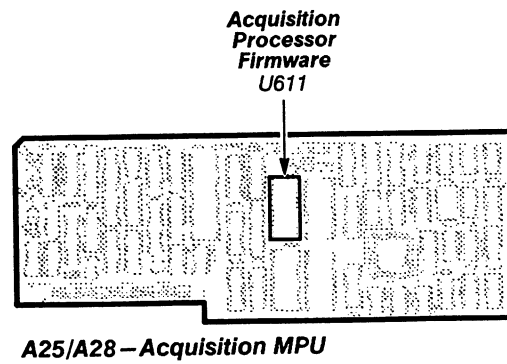
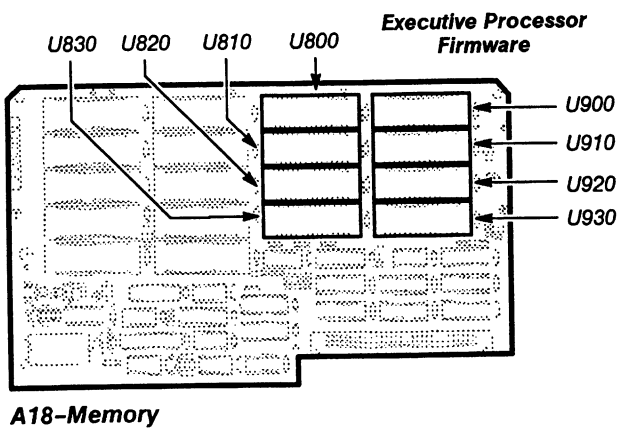
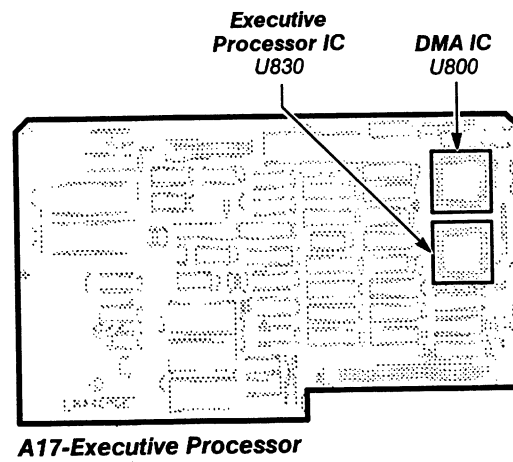
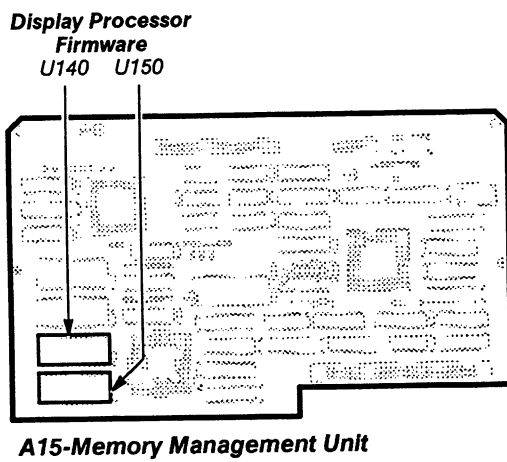
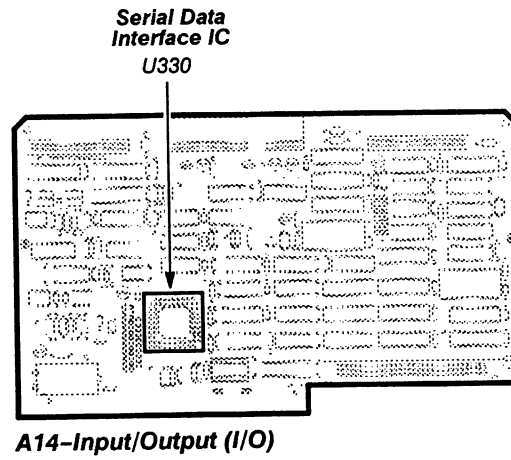
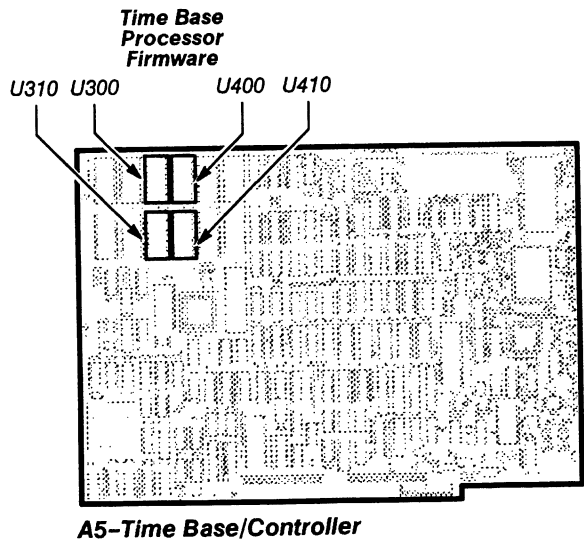


Figure 3-30 – FRU IC Detail



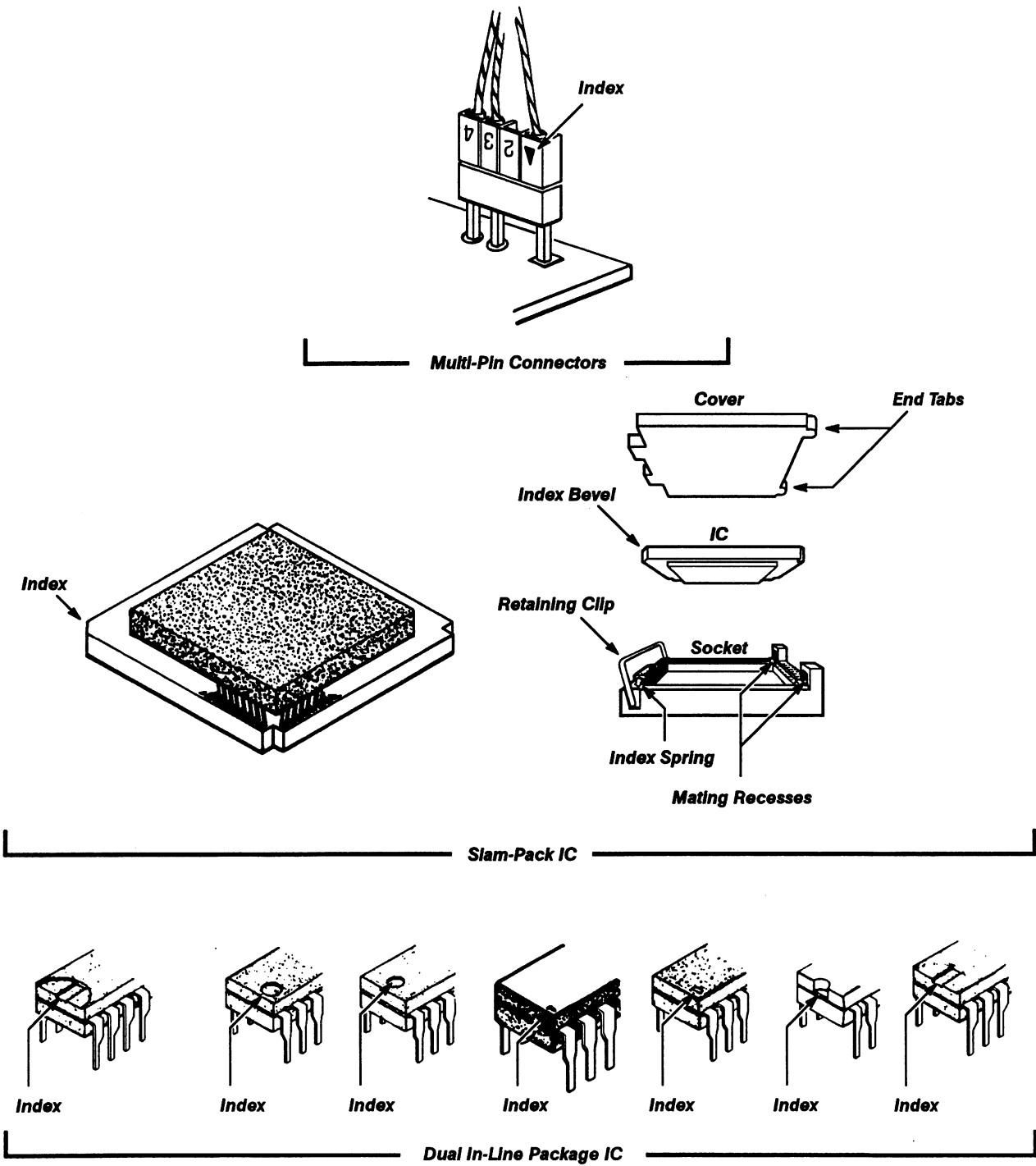


Figure 3-31 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram

**Note:** Match the index triangle on the multi-pin connectors with the corresponding square pad on the circuit board.

**Firmware integrated circuits (“Dual In-Line Package” ICs)**—The firmware ICs are located on six separate boards (see Fig. 3-30 for the IC locations on each circuit board). The boards and their respective firmware (FW) are:

- **A5 Time Base/Controller board**—Time Base Processor FW (U300, U310, U400 and U410)
- **A15 MMU board**—Display Processor FW (U140 and U150)
- **A18 Memory board**—Main Processor FW (U800, U810, U820, U830, U900, U910, U920 and U930)
- **A25/A28 Acquisition MPU board**—Acquisition Processor FW (U611)

All of the ICs listed above are ordered by a single Tektronix part number, as a single firmware kit. (**Each IC cannot be ordered separately.**) For the 11801A, the firmware kit number is 020-1889-00.

To remove and replace the firmware ICs in your oscilloscope, following these procedures:

**WARNING**

*Dangerous shock hazards may be exposed when the instrument covers are removed. Before proceeding, ensure that the oscilloscope PRINCIPAL POWER SWITCH is in the OFF position. Then, disconnect the instrument from the power source. Disassembly should only be attempted by qualified service personnel.*

**CAUTION**

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

**Firmware Upgrade Procedure**—is outlined in the following steps:

- Step 1: Prepare the instrument for the firmware upgrade procedure as follows:
  - Set the PRINCIPAL POWER SWITCH to OFF, and remove the power cord.
  - Place the instrument on its right side (if not already in this position) to provide access to the boards upgraded in the firmware upgrade procedure that follows.
- Step 2: Access boards within the card cage as follows:
  - Ensure that the PRINCIPAL POWER SWITCH is set to OFF and the power cord is disconnected.
  - Remove the instrument's top panel cover.
  - Remove the two plastic board guides from the top of the card cage (at the left rear of the instrument).
  - Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover (see Fig. 3-4).
- Step 3: Upgrade the A15 MMU board firmware as follows:

- Remove the A15 MMU board from the card cage. The A15 MMU board is typically located farthest from the outside (left side) of the instrument.
- Locate the two firmware ICs, U140 and U150.



Ensure pin 1 is positioned correctly when replacing components.

**Note:** Use the IC Insertion-Extraction Pliers shown in Figure 3-32 for removing and replacing the ICs. (Refer to Table 2-2, Test Equipment for the part number of these pliers.)

Do not use the label on the IC for an index because it may be applied incorrectly. (See Fig. 3-31 for the correct location of the index on the IC.)

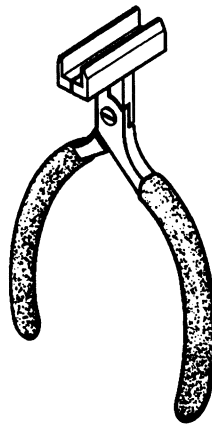


Figure 3-32 – IC Insertion-Extraction Tool

- Remove U140 and replace it with the upgraded IC. The last two-digit portion of the part number on the replacement IC should be the same as, or higher than, that on the removed IC. Ensure that pin 1 is oriented correctly.
  - Similarly replace U150 with the upgraded IC.
- Step 4: Upgrade the A18 Memory board firmware as follows:
- Remove the A18 Memory board from the card cage. The A18 Memory board is typically located one slot from the outside (left side) of the instrument.
  - On the A18 Memory board, replace the following ICs:
 

U800	U900
U812	U910
U820	U920
U830	U930

In each case, the last two-digits of the part number on the replacement IC should be the same as, or higher than, that on the removed IC. Again, ensure that pin 1 is oriented correctly.

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

Step 5: Upgrade the A5 Time Base/Controller board firmware as follows:

- Locate U300, U310, U400 and U410 on the A5 Time Base/Controller board (see Fig. 3-30). These components are found near the bottom front of the instrument with the instrument positioned on its right side.
- Replace U300, U310, U400 and U410 on the A5 Time Base/Controller board.

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. Again, ensure that pin 1 is oriented correctly.

Step 6: Upgrade the A25/A28 Acquisition MPU board firmware as follows:

- Remove the Acquisition unit from the instrument.
- Remove the A25/A28 Acquisition MPU board from the Acquisition unit (see Fig. 3-1 for the exact location of these boards in the Acquisition unit).
- Locate U611 on the A25/A28 Acquisition MPU board (see Fig. 3-28 in this section). This board is located in the card cage.
- Replace U611 on the A25/A28 Acquisition MPU board.

The last two-digit portion of the part number on the replacement IC should be the same as, or higher than, that on the removed IC. Ensure that pin 1 is oriented correctly.

Step 7: Verify the instrument serial number as follows:

- Locate the manufacturing jumper, J860, on the A5 Time Base/Controller board (see Fig. 3-10), and install the terminal connector link.
- Connect a power cord to the instrument.
- Connect a terminal or controller to the oscilloscope. Refer to the *11801A User Reference* for more information on this connection.
- Set the PRINCIPAL POWER SWITCH and ON/STANDBY switch to ON.
- Set necessary communication parameters; for example, baud rate.
- After the instrument is powered-on, to establish communication from the terminal or controller, enter the following commands (<CR> is the return key):

e<CR>  
v<CR>

- Verify that the serial number on the instrument's front panel matches the mainframe ID number in the **Identify** pop-up menu in the UTILITY major menu.

- If the numbers do not match, then enter the command:

uid main:"BXXXXXX" <CR>

where **XXXX** corresponds to the serial number digits found on the front panel serial number marker.

- Verify that the proper ID is now displayed in the **Identify** pop-up menu, in the Utility major menu.

Step 8: Remove the procedure setup as follows:

- Set the PRINCIPAL POWER SWITCH to OFF.
- Remove the J860 manufacturing jumper on the A5 Time Base/Controller board.
- Replace the bottom instrument cover, and set the instrument upright.

Step 9: Perform the final power-on and verification as follows:

**Note:** *You must now perform the power-on sequence again for the instrument to recognize the new manufacturing jumper configuration.*

- Set the PRINCIPAL POWER SWITCH and ON/STANDBY switch to ON.
- Verify that the instrument powers-on and successfully completes the Self-Test diagnostics.

**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 as a reference when you are removing and/or replacing cables between these units.

**Interconnecting Pins**

Two methods of interconnection are used to electrically connect circuit boards 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.

Two types of connectors are used for these interconnecting pins. 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 is used which 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 & SMB)**—use color coding of wires, which may be helpful to connect a Peltola connector to its socket on a circuit 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. (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**—are arranged so that the pin connectors used to connect the wires to the interconnecting pins are clamped to the ends of the associated leads.

Some of the pin connectors are grouped together and mounted in a plastic holder. The overall result is that these connectors are installed and removed as a multi-pin connector.

Pin 1 on multi-pin connectors is designated with a triangle (or arrowhead). A triangle, dot, or square printed on circuit boards denotes pin 1. When a connection is made to a circuit board, the position or orientation of the triangle on the multi-pin holder is determined by the index (triangle, dot or square) printed on the circuit board. Most board, mounted connectors have a square pad for pin 1. (See Fig. 3-30.)

**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 circuit board.*

*Align the plug in the multi-pin holder with the gap between the circuit board pins. The connector is then ready to be installed.*

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-colored ribbon cables may have the number of their connectors stamped on them.

The ribbon connectors have the following two functions:

- 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. Strain is then felt between the wires and the top of the connector. This releases most of the strain which would otherwise be felt on the wire connections.
- 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. The connector then separates from its holder easily.

**Note:** To remove these ribbon connectors, grasp the pull-tab (fastened into the connector, if there) and pull it loose from the holder.

If there isn't a pull-tab present in the connector, grasp the ends of the connector instead. Pull it 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 (and the respective part containing this check) to perform.

**Table 3-4 – Checks Required After FRU Replacement**

<b>FRU Replaced</b>	<b>Checks Required</b>	
A1 Strobe Drive Board	Part 2 Part 3 Part 13	Power-On Diagnostics Extended Diagnostics Internal Clock
A3 M/F Power Connect Board	Part 2 Part 3	Power-On Diagnostics Extended Diagnostics
A4 Regulator Board	Part 2 Part 3 Part 4 Part 7 Part 9 Part 10 Part 11 Part 12	Power-On Diagnostics Extended Diagnostics Power Supply Vertical Reference Voltage Vertical Accuracy System Vertical RMS Noise Sweep Rate Accuracy Triggering
A5 Time Base Controller Board	Part 2 Part 3	Power-On Diagnostics Extended Diagnostics
A8 CRT Driver Board	Part 5	Display
A9 Touch Panel Assembly	Part 2 Part 3	Power-On Diagnostics Extended Diagnostics
A10 Front Panel Control Board	Part 2 Part 3	Power-On Diagnostics Extended Diagnostics
A11 Front Panel Button Board	Part 2 Part 3	Power-On Diagnostics Extended Diagnostics



**Table 3-4 – Checks Required After FRU Replacement (cont)**

<b>FRU Replaced</b>	<b>Checks Required</b>	
A12 Rear Panel Board	Part 2 Part 3	Power-On Diagnostics Extended Diagnostics
A13 Mother Board	Part 2 Part 3	Power-On Diagnostics Extended Diagnostics
A14 Input/Output Board	Part 2 Part 3 Part 6	Power-On Diagnostics Extended Diagnostics Real Time Clock
A15 MMU Board	Part 2 Part 3	Power-On Diagnostics Extended Diagnostics
A17 Executive Processor Board	Part 2 Part 3	Power-On Diagnostics Extended Diagnostics
A18 Memory Board	Part 2 Part 3	Power-On Diagnostics Extended Diagnostics
A19 Strobe/TDR Buffer Board	Part 2 Part 3 Part 11 Part 13	Power-On Diagnostics Extended Diagnostics Sweep Rate Accuracy Internal Clock
A20-A23 Head Interconnect Boards	Part 2 Part 9 Part 10	Power-On Diagnostics Vertical Accuracy System Vertical RMS Noise
A26 M/F Acquisition Interconnect Board	Part 2 Part 3 Part 7	Power-On Diagnostics Extended Diagnostics Vertical Reference Voltage
A24/A27 Acquisition Analog Boards	Part 2 Part 3 Part 9 Part 10	Power-On Diagnostics Extended Diagnostics Vertical Accuracy System Vertical RMS Noise
A25/A28 Acquisition MPU Boards	Part 2 Part 3	Power-On Diagnostics Extended Diagnostics

**Table 3-4 – Checks Required After FRU Replacement (cont)**

<b>FRU Replaced</b>	<b>Checks Required</b>	
Firmware ICs	Part 2	Power-On Diagnostics
	Part 3	Extended Diagnostics
Cathode Ray Tube (CRT)	Part 5	Display
Power Supply Module	Part 2	Power-On Diagnostics
	Part 3	Extended Diagnostics
	Part 4	Power Supply
	Part 7	Vertical Reference Voltage
	Part 9	Vertical Accuracy
	Part 10	System Vertical RMS Noise
	Part 11	Sweep Rate Accuracy

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## 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. The primary means for troubleshooting is to use the error index code output from the Kernel diagnostics and cross-reference them to the suspect circuit boards in the following tables, or to use the built-in FRU help function available in Extended Diagnostics. In addition, conventional troubleshooting techniques are described at the end of this section to help identify a faulty A4 Regulator board, CRT, Power Supply module, A13 Mother board, or A8 CRT Driver board.

### Diagnostics Overview

Each subsystem processor (Executive, Display, Time Base, and Acquisition) executes a set of Kernel diagnostics prior to the Self-Tests diagnostics. After the Acquisition processor has verified its support circuitry, it tries to establish communication with the Time Base processor. After the Time Base processor has verified its critical support circuitry, and after it has attempted to communicate with the Acquisition processor, the Time Base processor attempts to communicate with the Executive processor. Likewise, the Display processor attempts to communicate with the Executive processor after successfully executing its Kernel diagnostics.

After a processor has successfully completed its Kernel diagnostics and established communications with the next order processor (for example, Acquisition-to-Time Base and Time Base-to-Executive), then Self-Tests diagnostics execute to verify the more global functionality of the processor's hardware system. 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 a diagnostic menu. Extended diagnostics contains tests which are a superset of the Self-Tests.

The Kernel diagnostics (low-level Self-Tests diagnostics) and Self-Tests/Extended Diagnostics produce and format error index codes differently, so they are covered separately. Kernel diagnostics error index codes for each subsystem are produced and read quite differently from each other.

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).

### Kernel Diagnostics

Kernel diagnostics are executed each time the front panel ON/STANDBY switch is set to ON. The oscilloscope performs power-on diagnostics on its microprocessor subsystems and Self-Tests diagnostics on all of its major circuits.

When Kernel diagnostics begin, the messages **Diagnostics in Progress** and **Comm Test in Progress** are displayed. If the oscilloscope is being powered-on from a cold condition, then the diagnostics may complete before the CRT is warmed up and able to display these messages.

Diagnostic routines are performed in parallel on each of the instrument's processor subsystems: Display, Executive, Time Base, and Acquisition. Following successful execution of their Kernel diagnostics, the Acquisition processor

attempts to communicate with the Time Base processor and the Time Base and Display processors attempt to communicate with the Executive processor.

The Executive processor will continue Self-Tests diagnostics even if it is the only processor which has successfully completed its Kernel diagnostics.

In the case where the Display processor has not communicated successfully with the Executive processor, the message indicating that Self-Tests diagnostics are beginning will not appear on the screen. Kernel diagnostic failures may be indicated by the message, **Dsy Kernel Failure**, or **Comm Test In Progress** on the screen and/or a single high-low beep and illuminated menu buttons.

If either the Display, Time Base, or Acquisition processors do not successfully pass their communications stage, then the oscilloscope automatically enters Extended Diagnostics at the end of the Self-Tests diagnostics. If the Display processor is at fault, then the Extended Diagnostic menu will not appear on the screen.

The Kernel diagnostic tests execute concurrently in all three subsystem processor circuits at power-on. Hardware critical to diagnostic operation is verified, such as ROM, RAM, DMAs, timers, and interrupt control circuitry. For the Executive Processor, this requires checking basic operation for most boards in the card cage (that is, those boards plugged in to the A13 Mother board). The last step of Kernel diagnostics for the Display, Time Base, and Acquisition processors, is to verify communication. Within each processor, all Kernel diagnostics must execute without failures before the Self-Tests diagnostics can execute. However, the Executive processor continues with its Self-Tests diagnostics despite a communication failure encountered with the Display and/or Time Base processors; and the Time Base processor does not halt when it has a communication failure with the Acquisition processor.

Since the condition of the instrument is unknown at power-on, when a kernel failure occurs, Kernel diagnostics in the Executive, Time Base, and Acquisition processors do not attempt to display error index codes. Instead, these processors generate hexadecimal (hex) numbers that are read as a series of binary bits, such as XXX1 0101 (hex error code 15<sub>hex</sub>) for the Executive processor or 0100 (hex error code 4<sub>hex</sub>) for the Time Base processor or 10 (hex error code 2<sub>hex</sub>) for the Acquisition processor, from either internal test points or LEDs. Refer to Tables 3-10, 3-15 and 3-16 for more information and examples of these hex error codes.

The Display kernel diagnostics display an error message on the screen giving the name of the test that failed. For example, the following message indicates that the DMA 0 test failed:

**Dsy Kernel Failure  
DMA 0**

If the error message does not appear on the screen, the error index code can be obtained from the status LEDs and pins on the A15 Memory Management Unit board (see Fig. 3-31).

### Self-Tests/Extended Diagnostics

Refer to Part 2 Power-On Diagnostics for information about Self-Tests/Extended Diagnostics.

**The Extended Diagnostics menu structure** – determines the format of the error index codes. The Extended Diagnostics menus are in a four-level hierarchy with the Subsys (that is, the Subsystem) menu at the highest level. This four-level Subsystem, Block, Area and Routine menu hierarchy generates the error index codes. Each subsystem in the Subsystem menu can be selected and tested if there are functional processor(s) and communication paths. Each subsystem is broken into a number of parts or circuit blocks in the Block menu for the selected subsystem. In a similar manner each block is broken into a number of circuit areas in the Area menu, the third level. The fourth and lowest menu level is the Routine menu, which contains the smallest test unit that can be selected and executed.

**Extended Diagnostics error index codes** – are five digit codes whose first character indicates the subsystem tested. The last four digits are hexadecimal (*hex*) numbers that indicate the Block, Area, Routine, and specific failure mode. For example, E2321 is decoded as follows:

- E Subsystem – Executive
- 2 Block name – Front Panel
- 3 Area name – Soft Keys
- 2 Routine name – Column Open
- 1 Failure Identity – specific failure mode

Table 3-5 lists the subsystem character of an Extended Diagnostic error index code:

**Table 3-5 – Extended Diagnostics Error Index Code Descriptions**

Description	Meaning
E	Executive
D	Display
T	Time Base
m	Main Acq

Front panel controls are active during the Self-Tests diagnostics sequence and any disturbance may cause a test failure; forcing the oscilloscope into the Extended Diagnostics mode. Touch the **(E)Exit** label twice in succession to remove the Extended Diagnostics menu and resume normal operation. In situations where the Display, Time Base, or Acquisition processors have failed their kernel diagnostics, exiting diagnostics to normal operation will not be possible.

After the Self-Tests/Extended Diagnostic programs have executed, any resultant error index codes appear on the display next to the associated subsystem name in the Extended Diagnostics menu. Each subsystem that had a failure gives the first error encountered and the number of failures in the subsystem.

To get a more complete list of the error index codes in a subsystem, touch the selector of a failed subsystem (if the failed subsystem is not already selected) and then touch the Block selector. Touching the Area and then Routine selectors shows the lowest level test routines in the selected Block. The currently selected Subsystem, Block, Area, and Routine are shown below their labels at the bottom of the Extended Diagnostics menu. Several function and operating mode selectors are also available at the bottom of the screen. When certain test routines are selected some of these operating modes are non-selectable. And, when some of the operating modes are set to certain states, some of the test routines may become non-selectable.

The function and mode operators are:

- **(?)Help**—displays a list of FRUs for the currently selected routine. If the routine had a failure, then the error index code for that routine is also displayed. The FRUs are normally listed as the most-to-least probable cause for errors in the routine. In some cases, the FRUs are listed according to their ease-of-replaceability to minimize the time required to identify the faulty FRU.

Within this menu, you can scan forward to the next routine or to the next failure by touching the appropriate selectors in the lower portion of the screen (which functions like a simple keypad). Scanning continues in a circular fashion through all available subsystems.

Upon exiting this menu, the instrument returns to the same menu level (that is, Subsystem, Block, Area and Routine) that it was before the help function was invoked. However, the displayed menu may be different if any scanning was performed.

- **(-)Delete**—places an execution mark on the currently selected menu name (in the upper menu area) and all items beneath it, down to the Routine level. This inhibits the actual execution of these routines, when **(r)Run** is invoked.

Visually, execution marks are displayed on the screen as an asterisk (\*) immediately to the left of the menu name (in the upper menu area). If one, but not all, menu names in a menu are marked with an asterisk, then the name of the menu at the next highest level (that is, from Area to Block) is preceded by an execution mark of a minus (-).

- **(+)Add**—removes the execution mark, if present, on the currently selected menu name and all execution marks on items (that is, blocks, areas, or routines) below the currently selected menu name (down to the Routine level). The execution mark, if present, will change from an asterisk (\*) or minus (-) to a space.
- **(D)Debugger**—normally can not be selected and is used by qualified service personnel only.
- **E(Exit)**—terminates Extended Diagnostics and returns the instrument to normal operating mode, but only if this selector is touched twice in succession. The first touch causes a confirmation prompt to appear at the top

of the screen; the second touch causes the actual termination of the Extended Diagnostics.

- **(p)Loop**—toggles On and Off. When On, the selected test(s) is executed continuously with the number of iterations displayed.
- **(t)Terse**—toggles On and Off. When On, tests in the loop mode execute at the fastest rate, but the iteration (i.e. Loop) readout is not updated until the test is stopped (by touching the screen or a button).
- **(x)All**—toggles On and Off. When On, all tests in the current menu are selected to execute when started.
- **(s)Stop on Err**—toggles On and Off. When On, testing stops after the first failed test completes.
- **(r)Run/(q)Quit**—starts or stops the currently selected tests.

### **Diagnostic Menus**

The upper portion of the display screen is used to display diagnostic menus. Menus are comprised of menu items and menu fields. Menu items are rows of items that can be selected, while menu fields are columns of status information.

There are four tiers of menus which may appear in the menu area (only one is present at any given time); the Subsystem, Block, Area and Routine menus. Upon entry into any menu, there is always one menu item which is selected. And, only one menu item can be selected at any given time.

The following field descriptions apply for Subsystem, Block, Area and Routine menus.

Subsystem, Block and Area menus are divided into the following four fields: Execution Mark, Title, Error Index Code, and Failure Count. The Routine menu has these and three additional test result fields.

- **Execution Mark**—is a one character field preceding the Title field and succeeding the keystroke selector identification. The three values of this field and their meanings are as follows:
  - ' ' All routines in this Subsystem, Block or Area are available for execution
  - '\*' No routines in the Subsystem, Block or Area are available for execution
  - '-' One or more routines in the Subsystem, Block or Area are available for execution

Refer to the Delete and Add descriptions for further information.

- **Title field**—contains the name of individual hardware Subsystems, Blocks, Areas or Routines.
- **Error Index Code field**—contains an index code. The index field may contain one of five types of status (indicating one of four types of tests), providing the following information:
  - "pass" An automatic test has executed and did not fail.

“Yxxxx”	A test has failed and the failure encountered in subsystem Y is xxxx. This index code contains one digit each for Subsystem identification, Block identification, Area identification, Routine identification, and a Test identification that gives some specific information about the failure.
“****”	An automatic test has not yet been executed. When the test does execute, the test will provide <b>pass</b> or Yxxxx failure status.
“- - - -”	The test requires you to perform some type of test set-up using the RS-232-C loopback connector. When executed, this status provides <b>pass</b> or Yxxxx failure status. To execute this test, you must select it.
” ” (blank)	This status indicates that the test requires action from the user (such as the front panel verification tests), or that the test is for stimulus only (such as the manual calibration tests). This status does not provide failure status. To execute this test, select it individually.
“????”	This status indicates that an option was found that was not present in the current instrument configuration or that a subsystem was found that did not have a working communication path.

- **Failure Count field** – indicates the total number of routine failures (one per routine) currently encountered in the Subsystem, Block or Area. Thus, the Failure Count will never be more than the total number of routines in the subsystem. If no tests have been executed or no failures have occurred, then this field is blank. Since the failure count field is an indication of all routines that have failures, it is possible to have a failure field count greater than the loop count (for example, there may be five routine failures after the first loop).

A field display of **65535+** indicates that the Failure Count field has gone beyond 65534 and that an overflow condition has occurred.

The following field descriptions apply only to Routine menus.

- **Test Results fields** – contain information useful for troubleshooting. One of the following formats are used:
  - test address, expected data, and actual data
  - expected data lower bound (minimum), expected data upper bound (maximum) and actual data

**Hardcopy of a diagnostic menu** – is made when the hardcopy button on the front panel is pressed. The hardcopy is sent to a printer attached to the PRINTER port. Screen hardcopies can also be obtained from other menus (for example, help menus, interactive test menus, and hardware debugger menus).

After a hardcopy is output, a Form Feed is issued to the printer. If no printer is attached or the printer can not print (for example, if the printer is off line or if the



printer is out of paper,) then the following warning is shown in the Input/Prompt area:

**Hardcopy absent or off line.**

The hardcopy function is unavailable for some tests requiring human interaction, such as touch panel interactive tests, various display tests, and CRT/touch panel calibration patterns.

The knobs control the screen intensity during the four main diagnostics menu levels. The TOUCH PANEL ON/OFF buttons enables/disables the touch panel from responding to user touches.

**Diagnostic Terminal Mode (RS-232-C)**

The RS-232-C port drives a terminal which conforms to the ANSI 3.64 standard. In this mode, the terminal provides a screen-driven, interactive human interface.

This mode is useful when either the display or touch panel is not functioning properly, or when it is desired to remotely use the diagnostics with a modem and phone link.

There are several single terminal keystroke commands which are equivalent to front panel buttons or are terminal-only commands; all of which do not appear on any of the display screens. The following terminal keystrokes do appear on the screen and are shown in quotes:

- **'B' < baud rate > < cr >** – this keystroke, followed by the baud rate and carriage return) allows you to change the default baud rate to any one of the allowable product baud rates. The default power-up baud rate is determined from the position of two internal jumpers located on the A14 I/O board (300, 1200, 9600, 19200). (The Default setting is for 9600 baud.)
- **'T'** – this keystroke toggles the screen output between the current screen display and an ANSI compatible terminal. The terminal should initially be set in its ANSI mode.
- **'K'** – this keystroke toggles the screen output between the current screen display and a Tektronix 4x05 terminal (4105, 4205).
- **'L'** – this keystroke toggles the screen output between the current screen display and a Tektronix 4x07 terminal (4107, 4207).
- **'H'** – this keystroke produces a hardcopy of the current diagnostic menu as described earlier.
- **'O'** – this keystroke disables/enables the touch panel from responding to the user's touches. It is equivalent to the TOUCH PANEL ON/OFF button.
- **'Q'** – this keystroke, when used in interactive test menus, stops and starts the display information in the keypad prompt area. This keystroke is equivalent to the ACQUISITION RUN/STOP button in those menus.

To gain access to the terminal mode diagnostics, the instrument must be in the Extended Diagnostic mode.

To exit the terminal mode, either recycle the power, enter the (Exit) keystroke twice to begin normal operation, or enter the appropriate 'L', 'T', or 'K' keystroke to transfer the screen output back to the instrument display.

**System Mode (GPIB & RS-232-C)**

The Self-Tests diagnostics and Extended Diagnostics are accessible using the two commands listed in Table 3-6.

**Table 3-6 – System Mode Commands**

<b>Header</b>	<b>Argument</b>	<b>Notes</b>
<b>TEST</b>		Set-only
<b>TEST</b>	<b>[XTND]</b>	Set-only
<b>TEST</b>	<b>[MAN]</b>	Set-only
<b>DIAG?</b>		Query-only

The **TEST** command invokes Self-Tests diagnostics or Extended Diagnostic execution. The **TEST** command without arguments initiates Self-Tests diagnostics. The **TEST** command with argument **XTND** initiates Extended Diagnostics.

Refer to the *11801A Digital Sampling Oscilloscope Programmer Reference* manual for more information on **TEST** and **DIAG** command syntax and usage.

The return of one of two event codes listed in Table 3-7, to the GPIB and RS-232-C ports, signals that diagnostic testing is complete.

**Table 3-7 – Event Code Descriptions**

<b>Event Code</b>	<b>Explanation</b>
460	Self-Tests or Extended Diagnostics were completed successfully
394	Self-Tests or Extended Diagnostics were completed and failed

In either case, a GPIB/RS-232-C controller may obtain pass/fail information through the **DIAG?** query.

The **TEST** command with argument **MAN** initiates the Extended Diagnostics similarly to entering Extended Diagnostics through the front panel **UTILITY** menu. The primary use of this command is to provide the remote operator a convenient way of accessing the diagnostics through the normal RS-232-C interface so that the operator can use the Diagnostic Terminal Mode to do remote testing.

**WARNING**

*The **TEST** command with argument **MAN** violates normal GPIB protocols in that, when used, the instrument becomes non-responsive to further GPIB commands until normal operation is resumed.*

The **DIAG?** query returns pass/fail information from the most recent invocation of Self-Tests diagnostics or Extended Diagnostics. Examples of possible responses and explanations, are as follows:

**DIAG PASSED: NONE**

This response indicates that the Self-Tests diagnostics or Extended Diagnostic operation did not detect any test faults.

**DIAG FAILED: E1311, E1711, E1721, E1731**

This response indicates that the Extended Diagnostic operation detected test faults.

**DIAG FAILED: E1311, D1211, T1431**

This response indicates that the Self-Tests diagnostics or Extended Diagnostic operation detected test faults.

**DIAG BYPASSED**

This response indicates that a power-on has occurred and that Self-Tests diagnostics were bypassed through a jumper on the A14 I/O board.

**Battery Testing**

The oscilloscope holds four lithium batteries to provide power when the instrument is turned off. The following discussions provide criteria for determining if a battery has exceeded its lifetime, and is thus producing incorrect instrument operation. (A battery's lifetime will typically exceed five years.) If the battery voltage measures (at 20°C) equal to or greater than the voltages given, then the circuit should operate correctly from 0°C to 50°C. (These voltage measurements are taken with the instrument power off.)

Battery BT130 provides power for the real time clock on the A14 I/O board. If the clock begins to lose time rapidly when the instrument is turned off or the diagnostics report that the **Real Time Clk (E42XX)** has failed, the battery should be tested. If the battery voltage measures less than 2.7 V, then the most likely source of the problem is the battery and you should follow the instructions for battery disposal earlier in this section.

Battery BT150 provides power for the nonvolatile RAM (NVRAM) on the A18 Memory board. If the diagnostics consistently reports an **NVRAM Battery (E141X)** failure over multiple power-ons, then the battery should be tested. If the battery voltage measures less than 2.7 V, then the most likely source of the problem is the battery and you should follow the instructions for battery disposal earlier in this section.

Sockets for devices U500 and U511 provide power for the NVRAM on the A5 Time Base/Controller board. If the diagnostics consistently reports a **Static RAM Battery (T1331)** failure over multiple power-ons, then the batteries should be tested. If either one of the battery voltages measures less than 2.1 V, as measured on pin 28 (Vcc), follow the instructions for battery disposal earlier in this section. (It is recommended that both batteries be replaced at the same time.)

**Note:** *Turning the instrument off while Extended Diagnostics is executing one of the NVRAM memory tests may cause failure of the NVRAM battery test. If the diagnostics report an NVRAM battery failure, then exit the diagnostics. This will rewrite the confidence words into the NVRAM. Turn off the instrument for at least one hour. Then, turn the instrument back on. If the diagnostics still indicate an NVRAM battery failure, then the battery should be tested.*

### Clearing NVRAM

Before a power-up Self-Test begins—but just after the Executive processor has run its Kernel Diagnostics—the front panel buttons are scanned by the Executive processor. If the Executive processor senses that the WAVEFORM and TRIGGER buttons, and only these two buttons, are pressed in (i.e., closed) during this time, then the Executive processor resets its NVRAM to a default state. This essentially destroys all stored settings (there are no stored waveforms in NVRAM). When this occurs, the NVRAM is initialized by filling all but a few locations with a default value. The following items are left intact after the NVRAM is reset:

- Number of instrument power-ons (POWERON?)
- Instrument power-on time (UPTIME?)
- Mainframe serial number (UID? MAIN)

### Field Replaceable Unit (FRU) Guide

This section correlates Kernel Diagnostic error index codes with the components or boards suspected of causing each error. Suspect FRU(s) for Self-Test/Extended Diagnostics error index codes are identified by using the built-in FRU help function (?)**Help**, described under Self-Test/Extended Diagnostics.

The FRU(s) in the Suspect board category in the following error index tables are listed in most-to-least probable cause order. If any diagnostic errors occur, inspect the suspect FRU for loose connections and components. Then, repeat the Diagnostic test. If any diagnostic errors occur again, replace the suspect FRU(s) with a known good FRU or FRUs. Check that the new FRU is configured exactly like the old one and that any installed firmware matches the version in the old FRU.

The error index codes and tests are divided into four groups based on the four processor subsystems: Executive, Display, Time Base, and Acquisition. Each subsystem group has a table of kernel diagnostic error index codes. In addition, the Executive has a table of manual test error index codes, which help extend the confidence level of instrument functionality.

If necessary, kernel error index codes for the Executive and Display can be read as TTL logic levels on circuit board pins using a logic probe.

Abbreviations of FRU names – are listed in Table 3-8.

**Table 3-8 – Board FRUs**

FRU	Board	Board No
STROBEDR	M/F Strobe Driver board	(A1)
MFPOWERRR	M/F Power Connect board	(A3)
REG	Regulator board	(A4)
TBC	Time Base/Controller board	(A5)
CRTSOC	CRT Socket board	(A7)
CRTDR	CRT Driver board	(A8)
TOUCH	Touch Panel assembly	(A9)
FPCTRL	Front Panel Control board	(A10)
FPBUT	Front Panel Button board	(A11)
REAR	Rear Panel assembly	(A12)
MOTHER	Mother board	(A13)
IO	Input/Output board	(A14)
MMU	Memory Management Unit board	(A15)
EXP	Executive Processor board	(A17)
MEM	Memory board	(A18)
STROBEBUF	Strobe/TDR Buffer board	(A19)
HEAD	Head Interconnect board	(A20–A23)
ACQANALOG	Acquisition Analog board	(A24/A27)
ACQMPU	Acquisition MPU board	(A25/A28)
MFACQCON	M/F Acquisition Interconnect board	(A26)

Abbreviations of component and module names – are listed in Table 3-9.

**Table 3-9 – Component Module FRUs**

FRU	Board
CRT	Cathode Ray Tube
FW	Executive, Display, Time Base, or Acquisition Firmware
SDI	Serial Data Interface IC
BATTERY	Lithium Battery
PS	Power Supply Module

**Note:** The Executive, Display, Time Base, and Acquisition firmware is packaged in a single firmware (FW) kit; the individual parts are not available as separate components.

**Executive Subsystem Error Index Codes** – are listed in Table 3-10 along with the suspected FRUs.

**Table 3-10 – Executive Processor Kernel Error Index Codes**

Error Index <sub>hex</sub>	Hybrid/IC FRUs	Suspect Board FRUs
1F – 1D		MEM, EXP
1C – 19	FW	MEM
18 – 16		IO, EXP
15		EXP
14		EXP, MEM
13		FPCTRL, IO, MPU
12		IO, EXP
11		IO, EXP
10 – 0E		REAR, IO, MPU
0D		MMU, EXP
0C		EXP, MEM
0B		REAR, IO, EXP

Bit patterns for the above hexadecimal error index codes are displayed with the front panel MENUS LEDs in bottom-to-top bit order. The STORE/RECALL 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<sub>hex</sub> causes the STORE/RECALL and TRIGGER LEDs to light.

The status LEDs (DS306 and DS307) on the A17 Executive Processor board will flash while the Kernel diagnostic tests are executing. If a kernel failure is detected, then one or both LEDs will remain on. Table 3-11 lists the various LED configurations and their significance.

Reading the Executive processor subsystem error bits from the A17 Executive Processor board test points TP201 (MSB) to TP205 (LSB) is also possible. See Figure 3-33 for the location of these test points and status LEDs. The bits are high (+5 V) true.

**Table 3-11 – Executive Processor Status LED Configuration**

<b>DS307</b>	<b>DS306</b>	<b>Significance</b>
ON	ON	Power-On
ON	OFF	Kernel Tests Executing
OFF	ON	Kernel Tests Failed
OFF	OFF	Kernel Tests Finished

Table 3-12 lists the Executive processor manual tests and verification procedures. If the conditions specified in the verification procedure listed are not met, then the suspect FRUs can be found using the (?) **Help** function.

These tests are performed manually and produce no error index code displays. They are included to help you locate faulty boards that possibly the Kernel or Self-Test diagnostics did not locate. Interconnections, such as the A13 Mother boards cables and the power supply boards are not listed; however, these interconnections are considered as possible problem sources.

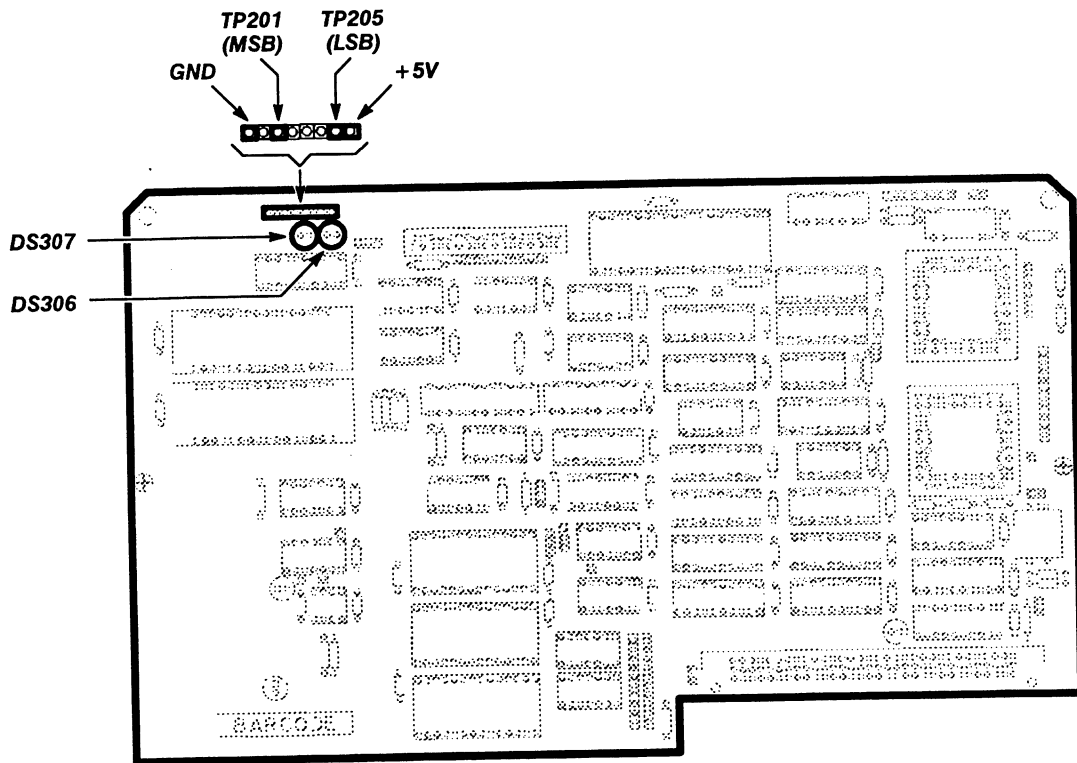


Figure 3-33 — A17 Executive Processor Board Test Point and Status LED Locations



Table 3-12 – Executive Processor Manual Tests

Test	Verification Procedure
<b>Front Panel</b>	
Verify	
Hard Keys	<p>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.</p> <p>This test requires operator interaction and can be executed only in the <b>Routine</b> pop-up menu with the <b>All</b> and <b>Loop</b> modes set to <b>Off</b>. Once this test is invoked, you can press any of the hard keys on the instrument 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.</p>
Soft Keys	<p>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.</p> <p>This test requires operator interaction and can be executed only in the <b>Routine</b> pop-up menu with the <b>All</b> and <b>Loop</b> modes set to <b>Off</b>. Once this test is invoked, you can touch any of the soft keys in the instrument and verify that a touch box is drawn around the soft key on the screen and that an audio click is generated.</p>
Knobs	<p>This test allows you to turn either of the knobs and verify their operation. This test verifies knob movement with visual feedback.</p> <p>This test requires operator interaction and can be executed only in the <b>Routine</b> pop-up menu with the <b>All</b> and <b>Loop</b> modes set to <b>Off</b>. Once this test is invoked, you can turn either of the knobs on the instrument and verify that the corresponding knob pointer on the screen rotates and that the associated counter value changes.</p>
<b>Front Panel</b>	
Test Pattern	
Gray Scale Green Grid White Grid Red Display Green Display Blue Display HV Reg Dsply	<p>These tests allow you to examine and adjust the CRT adjustments pertaining to color.</p> <p>These tests require operator interaction and are only executable in the <b>Routine</b> pop-up menu with the <b>All</b> and <b>Loop</b> modes set to <b>Off</b>. Once one of the tests is invoked, the operator can examine/adjust the CRT by following the procedure outlined in Section 2, Checks and Adjustments.</p>

Table 3-12 – Executive Processor Manual Tests (cont)

Test	Verification Procedure
<b>Internal I/O</b>	
Tone Gen	
Ramp Tone	<p>This test verifies the capability of the instrument to generate tones through its internal speaker.</p> <p>This test requires operator interaction and can be executed only in the <b>Routine</b> pop-up menu with the <b>Loop</b> mode set to <b>On</b> and the <b>Terse</b> and <b>All</b> mode set to <b>Off</b>. After invoking this test, you should verify that a high-speed clicking sound occurs.</p>
<b>Real Time Clk</b>	
Calibrate	<p>This test allows you to check and adjust the Real Time Clock period.</p> <p>This test requires operator interaction and can be executed only in the <b>Routine</b> pop-up menu with the <b>All</b> and <b>Loop</b> modes set to <b>Off</b>. Once this test is invoked, you can examine/adjust the real time clock period following the procedure outlined in Part 6, Real Time Clock in Section 2, Checks and Adjustments.</p>
<b>External I/O</b>	
Printer	
Pattern	<p>This test prints a set of patterns (all printable ASCII characters) to help you verify the external printer interface.</p> <p>This test requires operator interaction and can be executed only in the <b>Routine</b> pop-up menu with the <b>All</b> mode set to <b>Off</b>. Before executing this test, you should connect a Centronics-compatible printer to the PRINTER connector on the rear panel of the instrument.</p>
<b>RS-232</b>	
Extern Loop	<p>This test verifies parts of the external RS-232-C interface.</p> <p>This test requires operator interaction and can be executed only in the <b>Routine</b> pop-up menu with the <b>All</b> mode set to <b>Off</b>. Before executing this test, you should connect an external loopback connector to the RS-232-C connector on the rear panel of the instrument.</p>
<b>GPIB</b>	
Inrpt Reset Reset Status Data Lines Interrupt	<p>These tests verify the Executive processor interface to the internal GPIB circuitry. The major external GPIB functions are not tested.</p> <p>This test requires operator interaction and can be executed only in the <b>Routine</b> pop-up menu with the <b>All</b> and <b>Loop</b> modes set to <b>Off</b>. Before executing this test, you should disconnect the instrument from the GPIB connector.</p>

**Display subsystem error index codes** – are listed in Table 3-13 along with the suspect FRUs.

**Table 3-13 – Display Processor Kernel Error Index Codes**

<b>Error Index<sub>hex</sub></b>	<b>Suspect Hybrid/ IC FRUs</b>	<b>Suspect Board FRUs</b>
1 - 4	FW	MMU
5 - 7		MMU

The name of the first Display kernel test that fails is displayed on the screen. The Display processor error index codes is read from the A15 MMU board test points DIAG0 (LSB) to DIAG2 (MSB). The bits are high (+5 V) true.

The status LEDs (DS201 and DS200) on the A15 MMU board will flash while the Kernel diagnostic tests are executing. If a kernel failure is detected, then one or both LEDs will remain on. Table 3-14 lists the various LED configurations and their significance. See Figure 3-34 for the location of these test points and status LEDs.

**Table 3-14 – Display Processor Status LED Configuration**

<b>DS200</b>	<b>DS201</b>	<b>Significance</b>
ON	ON	Power-On
ON	OFF	Kernel Tests Executing
OFF	ON	Kernel Tests Failed
OFF	OFF	Kernel Tests Finished

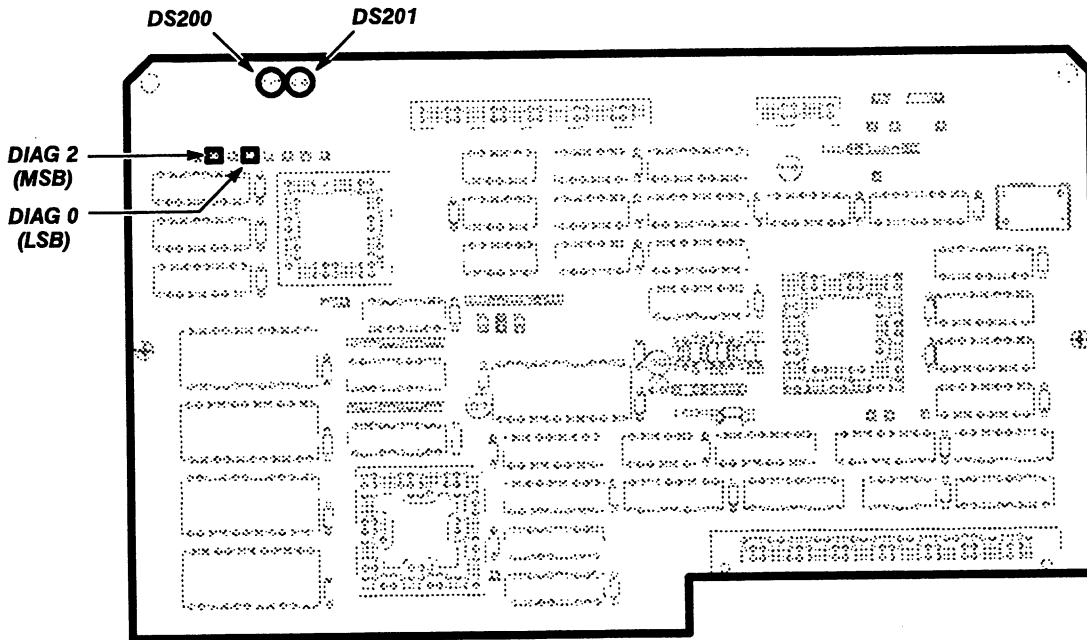


Figure 3-34 – A15 MMU Board Test Point and Status LED Locations

Time Base processor error index codes – are listed in Table 3-15.

Table 3-15 – Time Base Processor Kernel Error Index Codes

Error Index <sub>hex</sub>	Suspect Hybrid/ IC FRUs	Suspect Board FRUs
1		TBC
2 – 3	FW	TBC
4 – 7		TBC
8 – A		TBC, MMU
B		TBC
C		TBC, MMU

The error index code bits of the first Time Base kernel test that fails are read from the A5 Time Base/Controller board status LEDs ST4 (MSB), ST3, ST2 and ST1 (LSB). The bits are true (one) when the LED is on. Also, status LEDs ST5 and ST6 indicate when the test is executing and when the test has failed, respectively. See Figure 3-35 for the location of these status LEDs.

The patterns from the status LEDs are applicable only when the Time Base is executing or stopped in Kernel diagnostics.

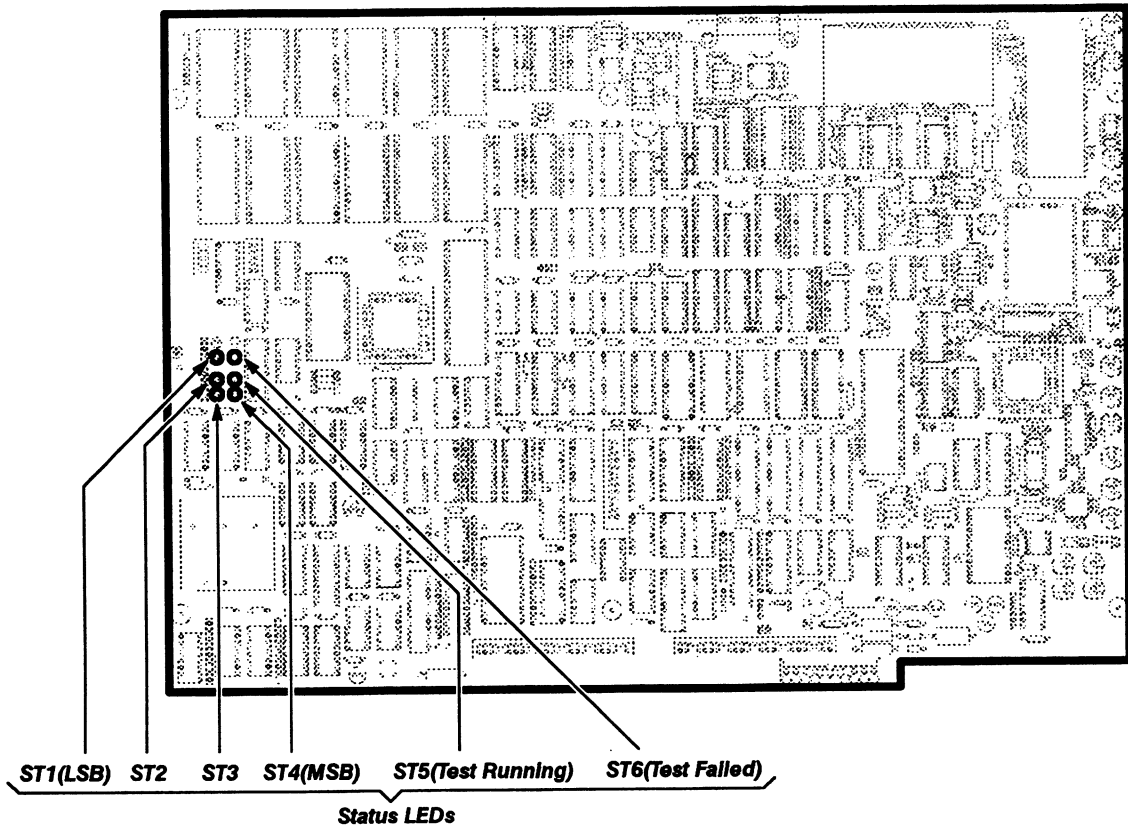


Figure 3-35 – A5 Time Base/Controller Board Status Pins

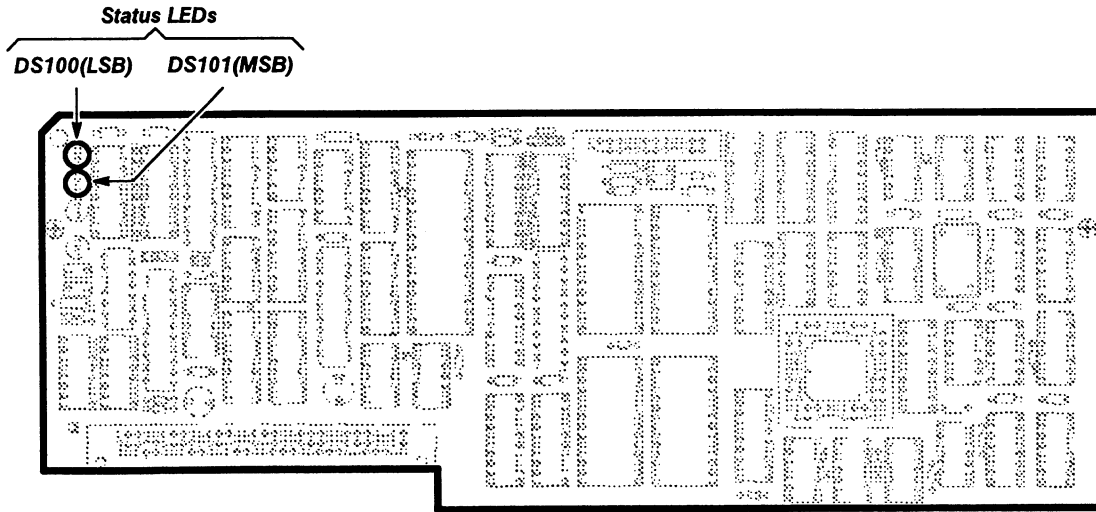
Acquisition processor error index codes—are listed in Table 3-16.

Table 3-16 – Acquisition Processor Kernel Error Index Codes

Error Index <sub>hex</sub>	Suspect Hybrid/ IC FRUs	Suspect Board FRUs
1	FW	ACQMPU
2		ACQMPU
3		ACQMPU, TBC, STROBEDR, MFACQCON

The error index code bits of the first Acquisition kernel test that fails are read from the A25/A28 Acquisition MPU board status LEDs, DS101 (MSB) and DS100 (LSB). See Figure 3-36 for the location of these status LEDs.

The patterns from the status LEDs are applicable only when the Acquisition is executing or stopped in Kernel diagnostics.



**Figure 3-36** — A25/A28 Acquisition MPU Board Status Pins

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## Other Troubleshooting

### Power Supply Module

This procedure requires an Extended Diagnostics power supplies troubleshooting fixture. Refer to Table 2-2 for a complete description of the equipment required.

**Module Troubleshooting**—If any Power Supply module problems are present, they appear when the ON/STANDBY switch is set to ON. If the green light beside the ON label fails to light, then check for the following:

- The PRINCIPAL POWER SWITCH located on the back panel is in the ON position.
- The line cord is connected to a functional power source with the same output voltage set as the LINE VOLTAGE SELECTOR on the back panel.
- The fuse is good. If the fuse is blown, then replace the fuse.
- The fan is exhausting air from the instrument when the ON/STANDBY switch is ON. A defective fan causes an over-temperature shutdown in the power supply.

If these checks fail to correct the problem, connect the Extended Diagnostics 11000-Series Power Supplies Test Fixture to the Power Supply module (refer to the documentation accompanying the test fixture for troubleshooting techniques). The test fixture indicates which power supply voltage source is at fault. To help isolate the source of the problem, set the instruments ON/STANDBY switch to STANDBY, and disconnect the suspected faulty power supply voltage source from the Power Supply module. Set the ON/STANDBY switch to ON. If the test fixture does not record a fault, then you have verified the suspected faulty power source. This procedure is only effective for externally shorted power supplies. Once again, refer to the documentation accompanying the test fixture for more troubleshooting information.

### A4 Regulator Board

This board is implicitly verified; that is, if all the other FRUs pass diagnostic testing, then you can assume that the A4 Regulator board is operating correctly as well.

**CRT, A7 CRT Socket board, or A8 CRT Driver Board**

This procedure requires a test terminal and a compatible RS-232-C serial interface cable. Refer to Table 2-2 for a complete description of the equipment required.

**Module Troubleshooting**—If the oscilloscope powers-on (the ON/STANDBY light is on), but the display gives scrambled information or none at all, then the CRT and A8 CRT Driver board are suspect. The following two procedures help you determine whether the A15 MMU board or one of the CRT units, (either the CRT, the A7 CRT Socket board or the A8 CRT Driver board) is at fault.

- With the power off (ON/STANDBY switch to STANDBY), remove the top cover, then turn the power on. Observe the two LEDs on the A15 MMU board and those on the A17 Executive Processor board in the card cage. These LEDs should flicker on and off until the diagnostic tests are complete and then all turn off. If any of these LEDs remain lit, it indicates a problem with the board on which the LED resides. If all LEDs turn off, then the CRT, A7 CRT Socket board, or the A8 CRT Driver board is suspect.
- With the power off, connect a test terminal (ANSI 3.64-compatible) to the oscilloscopes using an RS-232-C cable. Touch the screen through the full power-on cycle to force a diagnostic error so the instrument enters Extended Diagnostics. On the test terminal type T to display the **EXTENDED DIAGNOSTICS** menu on the terminal display. If the displayed errors are only for the front panel touch screen, then the CRT, the A7 CRT Socket board or the A8 CRT Driver board is at fault. Note any other errors, and use Table 3-5, earlier in this section, to identify the suspect subsystem.



### A13 Mother Board

This board is implicitly verified; that is, if all the other FRUs pass diagnostic testing, then you can assume that the A13 Mother board is operating correctly as well.

### Fuse Testing

The A14 I/O board has four fuses (see Fig. 3-37). F200 supplies +5 V to the A12 Rear Panel board. F800 supplies +5 V to the A10 Front Panel Control board and the A9 Touch Panel board. F600 supplies +15 V 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 +12 V). F602 supplies -15 V to the A14 I/O board, card cage, A10 Front Panel Control board (reduced to -5 V), and A12 Rear Panel board (reduced to -12 V).

- F200 supplies +5 V to the A12 Rear Panel board. If diagnostics report failure of all three ports (RS-232-C, GPIB, and PRINTER), then this fuse is the probable suspect (assuming that the ribbon cable to the A12 Rear Panel board is connected). When tested with a multimeter, this fuse should measure less than 1.5 V.
- F800 supplies +5 V to the A10 Front Panel Control board and the A11 Front Panel board. If the diagnostics report both an A9 Touch Panel board failure and knob failures, then this fuse is one possible source of this problem. When tested with an multimeter, this fuse should measure less than 1  $\Omega$ .
- F600 supplies +15 V to the A14 I/O board temperature sensor and tone generator, the lights of the A11 Front Panel Button board, the A9 Touch Panel board, the A12 Rear Panel board's RS-232 output line drivers, the card cage, and the A17 Executive Processor board's NVRAM. If the NVRAM battery test and the **RS-232 External Loop Back** test fail (but the **Internal Loop Back** test passes), and the A11 Front Panel Button board's lights, temperature sensor, and tone generator are all off, then this fuse is the probable suspect. When tested with an multimeter, this fuse should measure less than 1  $\Omega$ .
- 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 1 $\Omega$ .

The A14 I/O board uses the +15 V and -15 V supplies on board to operate the temperature sensor and the tone generator. Of the other card cage boards, the A18 Memory board uses the +15 V supply to operate the NVRAM circuitry. The information above and Table 3-17 will help you to identify a failure of one of these fuses. If a test fails, then check the fuses.

**CAUTION**

*Using a replacement fuse with an incorrect current rating may cause the ribbon cables to melt and create fire danger during a component fault.*

See Figures 3-2 and 3-37 for the location of the line fuse and the A14 I/O board fuses, respectively.

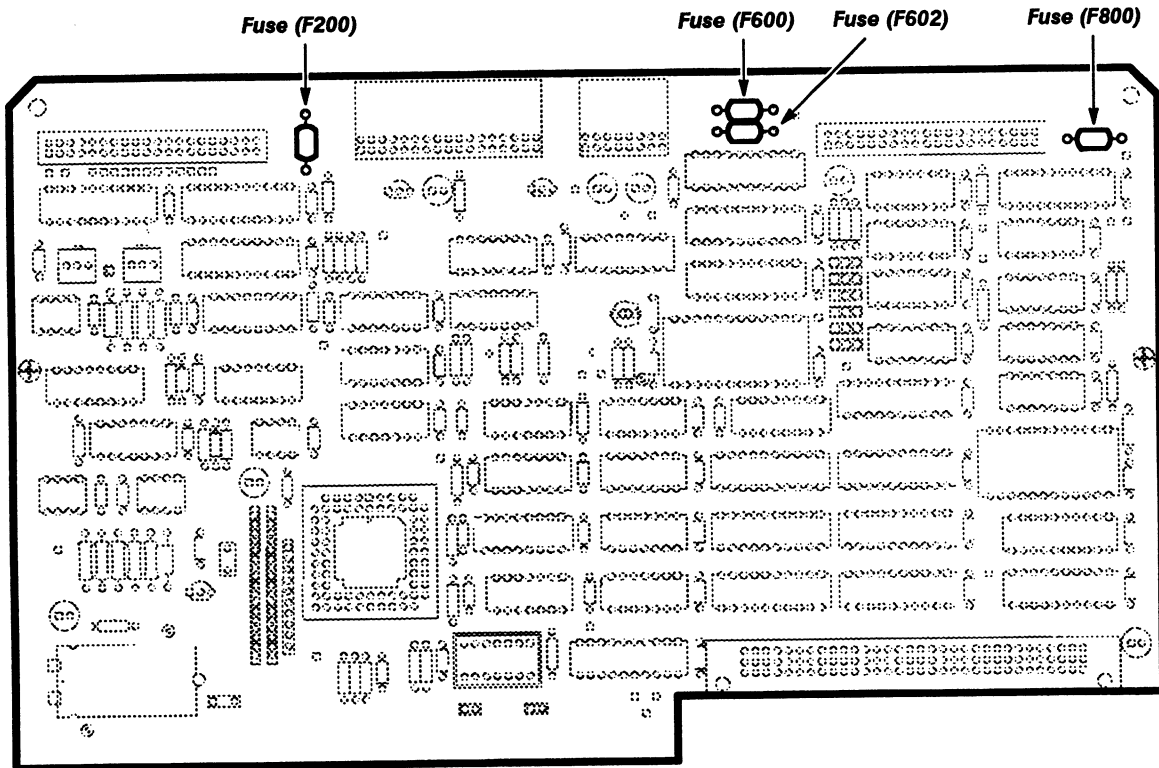
When a fuse must be replaced, unsolder the fuse from the board. Be careful not to damage the solder pads on the board. (It may be helpful to straighten the fuse leads on the rear of the board before removing the leads from their holes in the circuit board.) Refer to Section 5, Replaceable Parts, for the correct value and part number of each fuse.

**Table 3-17 – A14 I/O Board Fuse Failures**

Fuse	Executive Kernel Test Failure (refer to Table 3-10, Executive Subsystem Error Index Codes)	Self-Test/Extended Test Failure	
F200 open	10hex (GPIB Interrupt)		
F800 open	13hex (Front Panel Inter)  <b>Note:</b> <i>The front panel lights do not work so the code must be read from the error status test points (TP200-TP205) on the A17 Executive Processor board.</i>		
F600 open	Passes the Kernel diagnostic tests, but the front panel lights are not lit.	Exec Control            E1411 3 NVRAM                    E1411 3 Battery                   E1411 1 *Data Lines              E1421 1 *Addr/Data               E1431 1 Internal I/O              E3111 1 Temp Sensor              E3111 1 Comparator              E3111 1 *Tone Gen                -- -- *Ramp Tone (works)	
F602 open	13hex (Front Panel Inter)  <b>Note:</b> <i>The tone generator has a very different tone.</i>		

**Note:** *The front panel lights, soft keys, and hard keys do not work.*

*\*indicates a Manual Test forced by the operator. The test is not automatically executed by Self-Test diagnostics.*



**Figure 3-37** – A14 I/O Board Fuse Locator Diagram

### Time Base Calibration Errors

Table 3-18 lists the time base calibration errors that can appear on the oscilloscope screen, and the suspected faulty FRUs that cause the error. The FRUs are listed in the order of most to least likely source of the error.

Time base calibration errors whose error codes are greater than 100, have two different forms; depending on when the error occurs. If the error occurs during power-on then the message will say:

**Time base calibration failed at power up: 2XX**

where 2XX is the error code.

If the error occurs at any other time, then the message will say:

**Time base calibration failed: 1XX**

where 1XX is the error code.

**Table 3-18 – Time Base Calibration Errors**

<b>Error Message</b>	<b>Error Code</b>	<b>Suspect FRU</b>
Minor time base calibration problem:	12	TBC
	14	TBC
	16	TBC
	18	TBC
	24	TBC
	33	TBC
Time base calibration field (at power-on);	101 (201)	TBC
	102 (202)	TBC
	103 (203)	TBC
	111 (211)	TBC
	113 (213)	TBC
	115 (215)	TBC
	117 (217)	TBC
	121 (221)	TBC
	122 (222)	TBC
	123 (223)	TBC
	125 (225)	TBC
	126 (226)	TBC
	131 (231)	TBC
		STROBEBUF
		STROBEDR
	132 (232)	TBC
	134 (234)	TBC
	135 (235)	TBC
	STROBEBUF	
	STROBEDR	
136 (236)	TBC	
137 (237)	TBC	
138 (238)	TBC	
	STROBEBUF	
	STROBEDR, or	
	Sampling Head	

### Acquisition Calibration Errors

When acquisition calibration errors occur, a message will appear on the oscilloscope screen followed by a number that indicates in which Acquisition system the error was detected. Following this number, there will be a string of eight, 4-digit error codes that are used to identify possible faulty FRUs. The following example shows the form that the error message will appear:

**Error detected in acquisition system AA: BBBB, CCCC, DDDD,  
EEEE, FFFF, GGGG, HHHH, IIII**

where the **A** digits represent the number of the Acquisition system, and the **B, C, D, E, F, G, H, and I** digits represent the four digit error codes.

The **B** and **I** digits can be ignored. If any of the **C** or **D** digits are non-zero, then the possible faulty FRUs, from most to least likely, are:

ACQMPU  
MFACQCON  
ACQANALOG  
TBC

If any of the **E, F, G, or H** digits are non-zero, then the possible fault FRUs, from most to least likely, are:

ACQANALOG  
ACQMPU  
MFACQCON



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# Theory of Operation

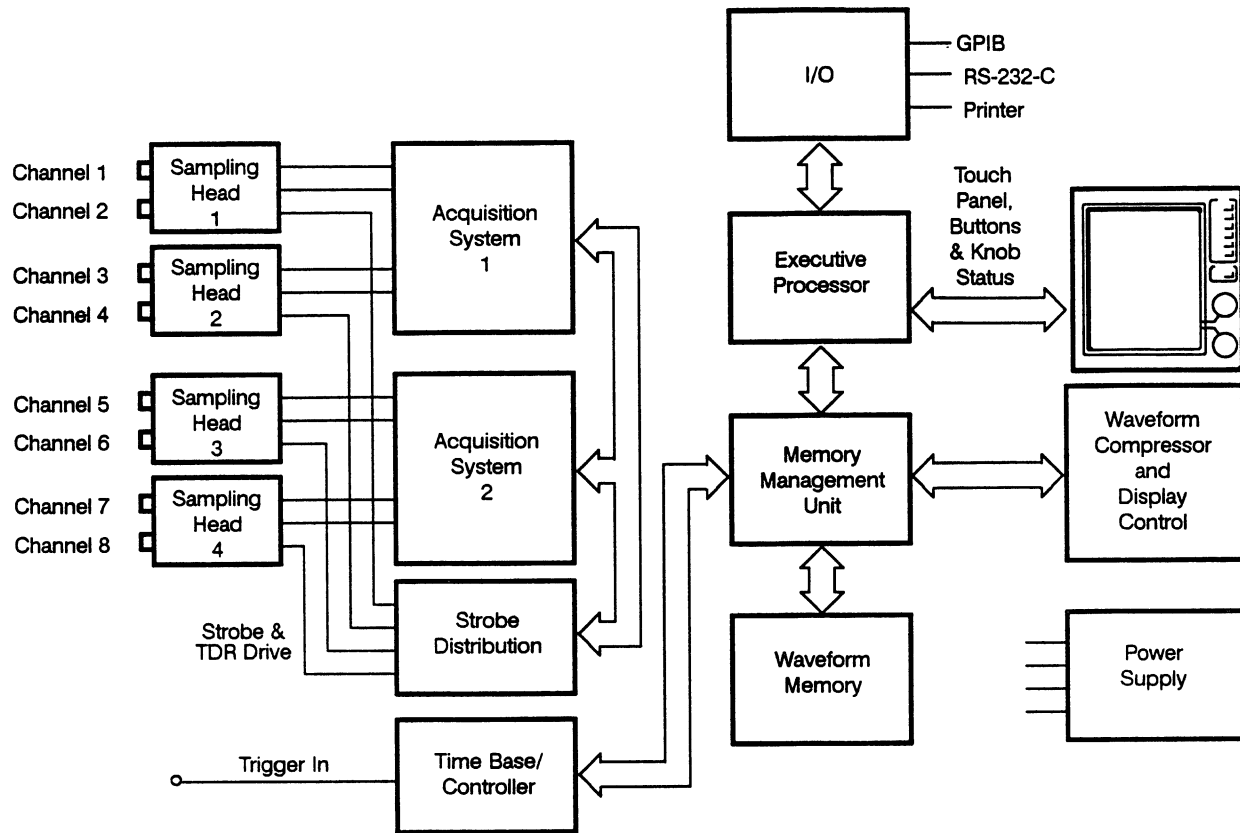
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The Tektronix 11801A is a high resolution digital sampling oscilloscope accommodating up to four input channels through the dual-channel sampling heads. With the SD-24 TDR/Sampling Head, four channels of single-ended TDR or two channels of differential TDR are available as well. Features include:

- sweep rates ranging from 1  $\mu$ s/division to 1 ps/div
- autoset to provide a suitably adjusted display for viewing and further manual adjustment
- windows for viewing expanded sections of a trace
- self-tests 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
- internal delay line for viewing the trigger event

## System Functional Overview

This section describes and illustrates the major functional blocks of the 11801A (see Fig. 4-1).



**Figure 4-1 – 11801A-System Functional Block Diagram**

### Acquisition System Block

The 11801A contains an Acquisition system, which supports two dual-channel sampling heads and contains two data acquisition and measurement channels.

Since the Acquisition system supports four input channels (two dual-channel heads), and contains only two measurement channels, the four input channels are multiplexed into the two measurement channels through an analog multiplexer. Either one of the sampling head input channels can be independently connected to either of these two measurement channels.

Several calibration signals are also supplied to each multiplexer, although these signals are used only for Self-Tests and diagnostics.

### Strobe Distribution Block

The Strobe Distribution block acts as an interface between the Time Base/Controller and the Acquisition systems.

The Time Base/Controller generates a strobe pulse which is regenerated by the Strobe Distribution block to drive all the sampling heads in parallel.



### **Time Base/Controller Block**

The Time Base/Controller block is comprised of:

- a microprocessor with local RAM and ROM
- the time base and trigger circuits
- interfaces to the memory management unit (MMU) and Acquisition systems

### **Trigger Select Block**

The Trigger Select block selects the desired trigger signal to be sent to the Time Base/Controller block.

### **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 diagnostic Self-Tests on the instrument 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 instrument boards. The EXP generates commands and status signals to control on-board devices and I/O devices, such as GPIB and RS-232-C interfaces, that help process data and help control the rest of the instrument.

### **Memory Management Unit Block**

The memory management unit (MMU) arbitrates requests for access to the Waveform Memory from three sources:

- the EXP
- the Time Base/Controller
- the display system

This arbitration allows all three systems transparent access to the Waveform Memory.

### **Waveform Memory Block**

Waveform Memory is shared between:

- the EXP
- the Display
- the Time Base/Controller

While the main function of the Waveform Memory is the storage of waveform data and waveform related information, the shared memory is also used to pass messages between the Executive, Display and Time Base/Controller processors. Eventually, all acquired waveforms are transferred from the Acquisition system memory to the Waveform Memory for display.

### Front Panel Controls

User control of the oscilloscope is primarily through:

- the front-panel major-menu buttons
- the touch panel
- the multifunction knobs

The major menu buttons are the top level menu selections for the instrument. Touching an icon, menu item, or waveform selects that particular icon, menu item, or waveform, respectively. The multifunction knobs control the function of the particular item that is selected.

### I/O Block

The I/O block provides a GPIB port, RS-232-C port, and a PRINTER port for interfacing various I/O devices to the instrument.

### Waveform Compressor and Display Control Block

The display 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 system produces a display by:

1. transferring waveform data from the Waveform Memory
2. compressing it into 512 horizontal pixels
3. converting it to 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 draws a vector between the maximum and minimum — even in “dots” mode. The only difference between dots and vectors is that in vector mode the vectors are extended vertically to meet the vector on the next scan line.

**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 instrument:

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.

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## Typical Waveform Processing Cycle

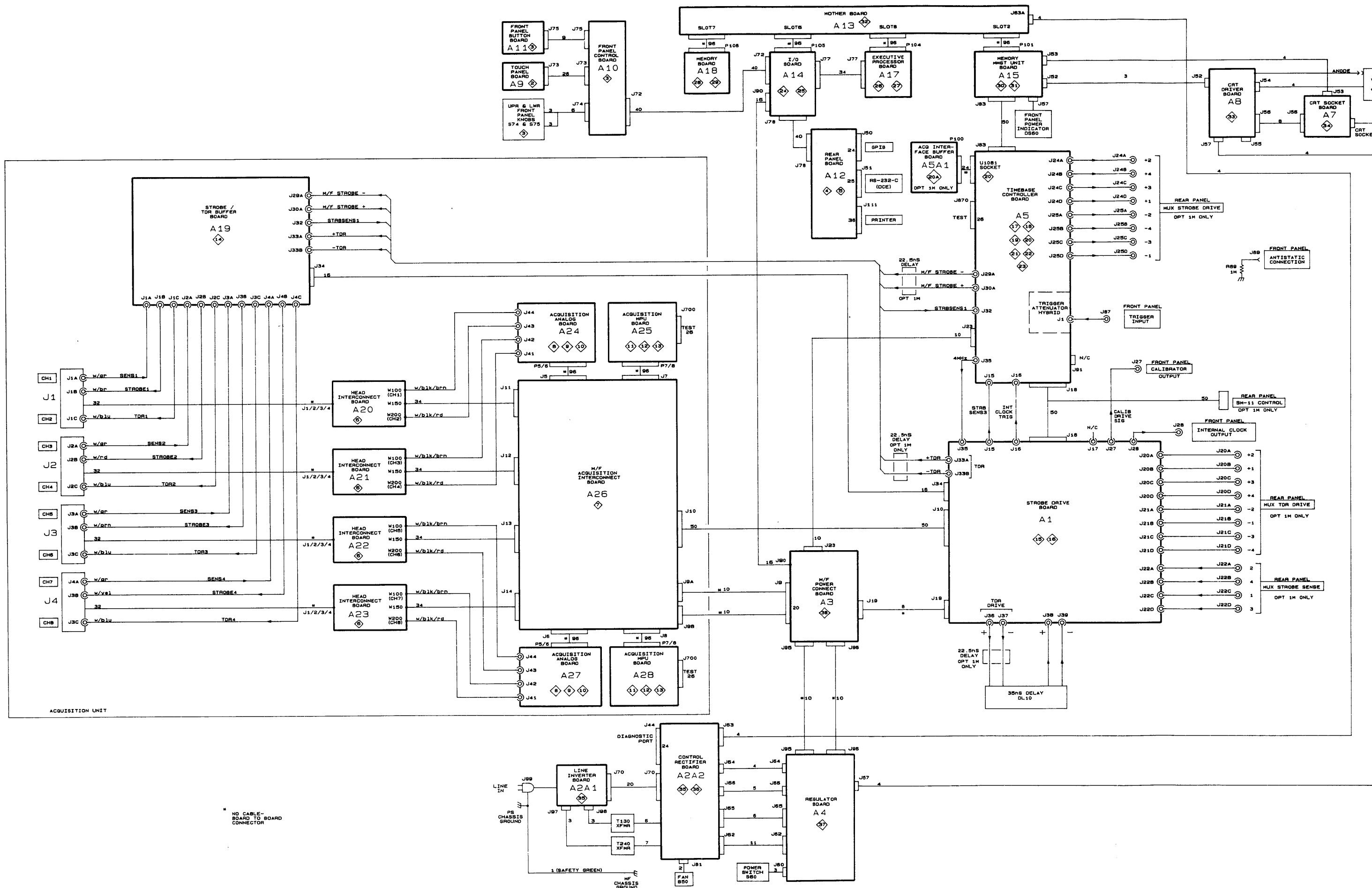
The following is a brief overview of how the oscilloscope acquires, processes, and displays a waveform from the input channels:

1. Analog input signals are connected to the sampling head inputs.
2. The Time Base/Controller block produces precisely timed strobe signals based on the trigger signal.
3. These strobe signals are distributed to the sampling head channels and instruct the sampling heads when to take samples of the input signal.
4. The Acquisition systems take the output of the sampling heads, amplify or attenuate the signals, and apply any offset based on the vertical size and position controls.
5. The output of the amplifiers are applied to analog-to-digital (A/D) converters, which convert the sampled voltages to digital codes and then store these codes in the acquisition system memory.
6. Once all the samples in a waveform have been acquired, the Time Base/Controller then transfers these samples from the Acquisition system memory to the Waveform Memory, through the waveform data direct memory access (DMA).
7. The EXP processes information from the human interfaces (that is; the menus, icons, buttons, and knobs that you interact with to control the oscilloscope).
8. The EXP sends commands to the display system so that the function that the user selected is displayed.
9. When instructed by the EXP, the display system receives the waveform data from waveform memory and converts it to a unique vertical raster-scan format for a display based on the user's settings.

## Detailed Block Diagram Descriptions

This section describes and illustrates the 11801A block diagram (see Fig. 4-2).

Figure 4-2. 11801A Detailed Block (Cabling) Diagram



\* NO CABLE-BOARD TO BOARD CONNECTOR

### A1 M/F Strobe Drive Board

The A1 M/F Strobe Drive board consists of:

- the data buffers circuitry
- the address latch circuitry
- the function decoder circuitry
- the internal clock rate generator circuitry
- the control buffers circuitry

See Figure 4-3 for a block diagram of this board.

**The data buffers circuitry** – buffers the A5 Time Base/Controller board’s address and data buses with bidirectional buffers, and the A5 Time Base/Controller board’s control lines with octal buffers.

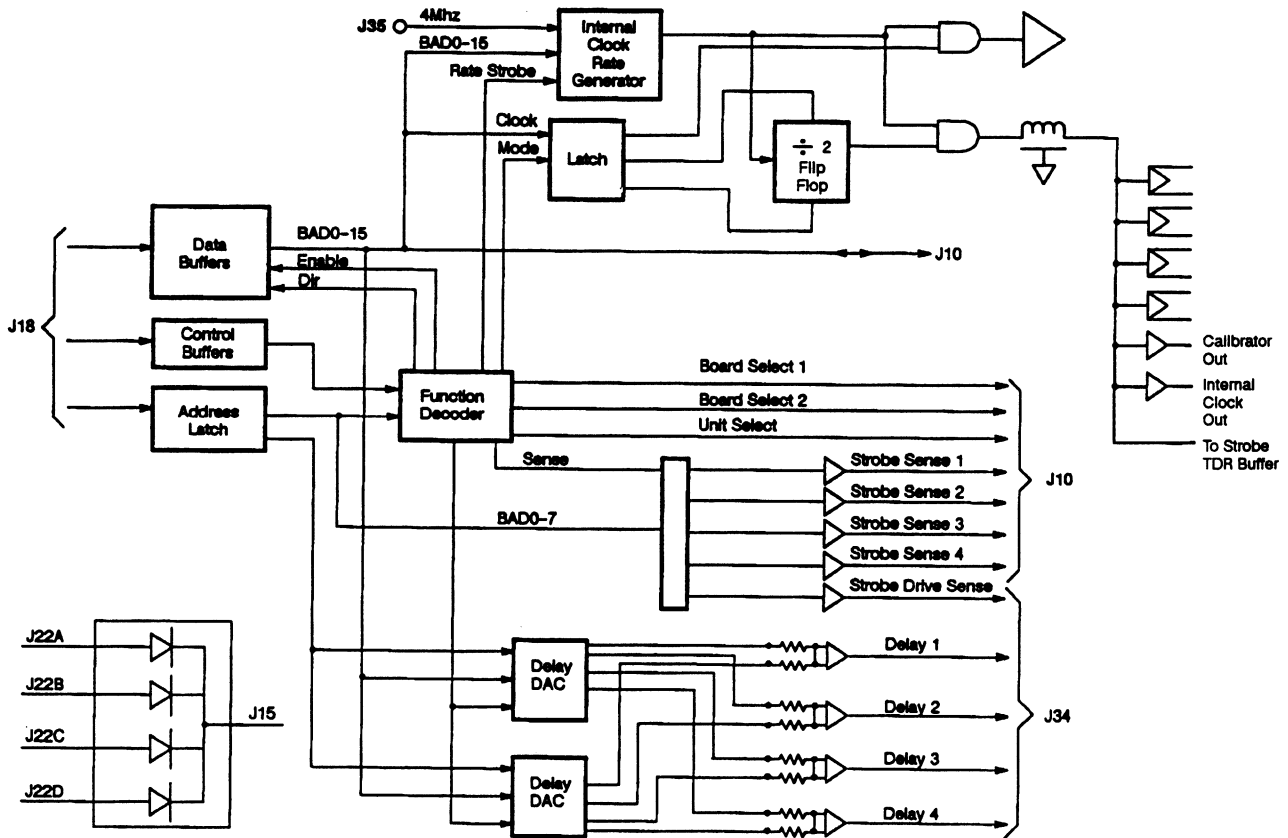


Figure 4-3 – A1 M/F Strobe Drive Board Block Diagram

**The address latch block** – buffers and latches the address for the A5 Time Base/Controller board to use.

**The function decoder circuitry** – partially decodes this latched address and enables the data buffers, if the address is on this board or the A24/A27 & A25/A28 Acquisition system boards (controlled through this board). The function decoder also selects the appropriate direction of the data buffers to perform a read or write operation.

**The internal clock rate generator circuitry** – is a 16-bit programmable counter that is tied to the  $\div 2$  flip-flop, which produces the square wave output. The overall division ratio of this block can be programmed from  $2^2$  to  $2^{17}$ . The internal clock rate generator is programmed at power-on to provide a 100 KHz output given a 4 MHz input on jumper J35.

**The control buffer circuitry** – buffers the control signals sent to the A1 M/F Strobe Drive board from the A5 Time Base/Controller board.

#### **A3 M/F Power Connect Board**

The A3 M/F Power Connector board consists of built-in connectors that connect the power supply voltages from the A4 Regulator board to the:

- A1 M/F Strobe Drive board
- A5 Time Base/Controller board
- A26 M/F Acquisition Interconnect board

The A3 M/F Power Connect board also supplies  $\pm 15$  V power to the A14 Input/Output (I/O) board through a 16-pin ribbon cable.

### 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

See Figure 4-4 for a block diagram of this board.

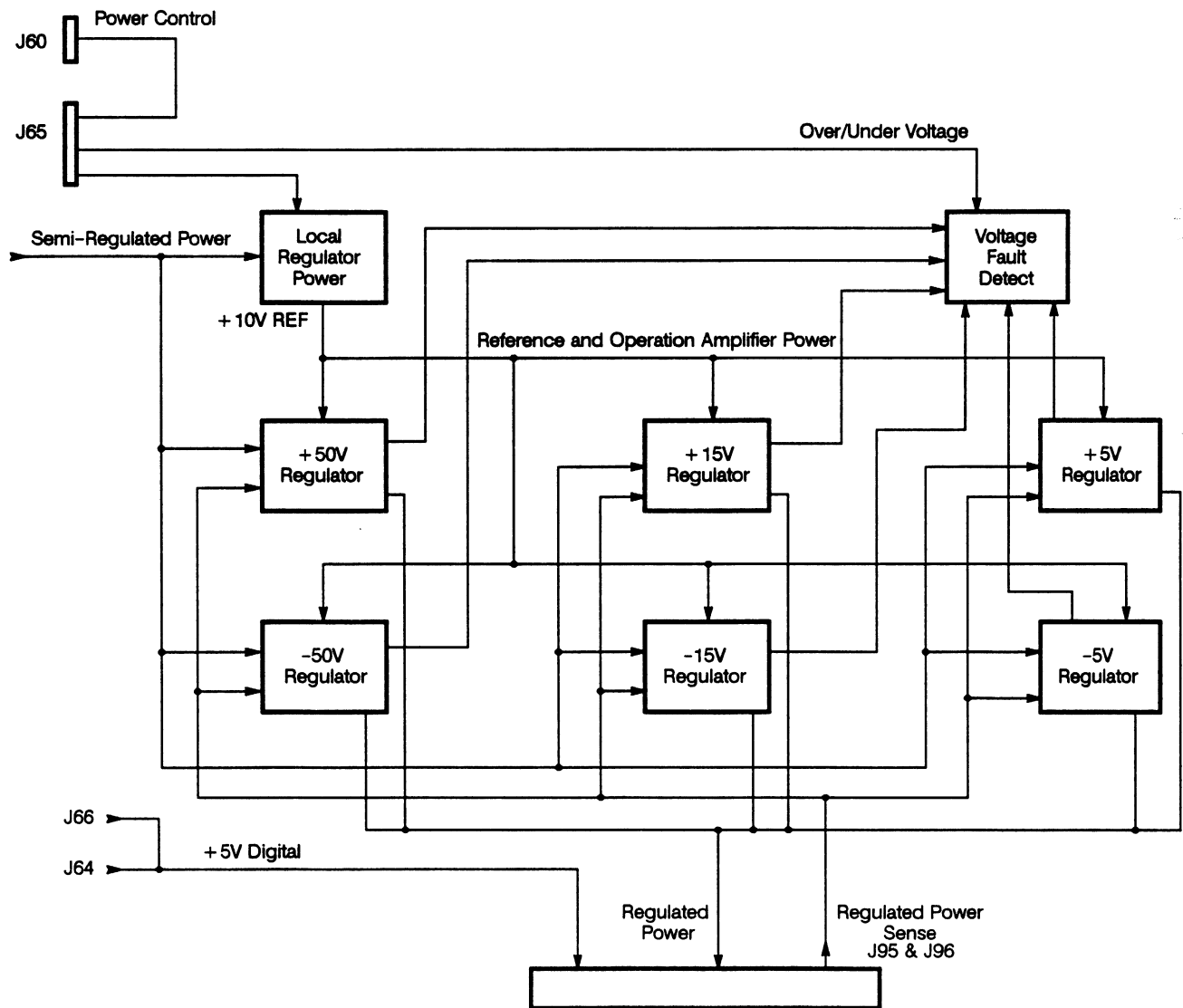


Figure 4-4 – A4 Regulator Board Block Diagram



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 V supply generates the -10 V supply
- +10.0 REF is used as a reference voltage.

**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.

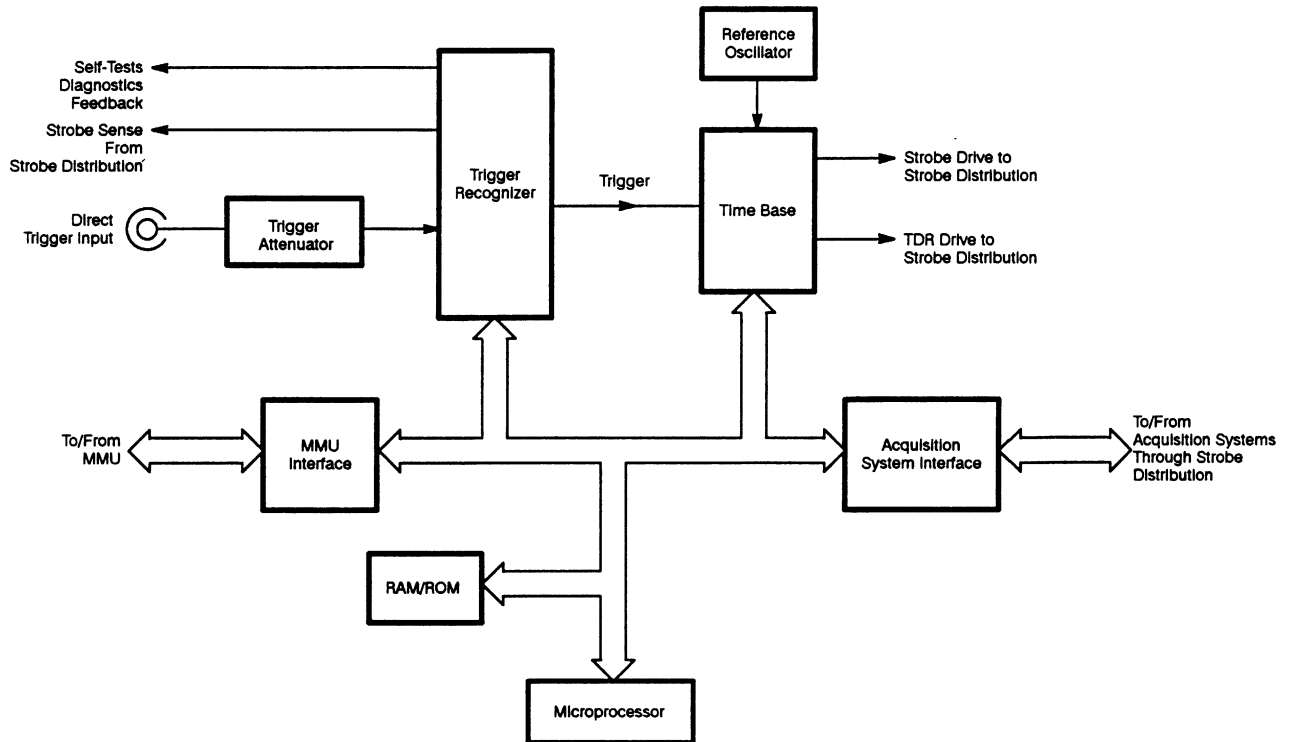
### A5 Time Base/Controller Board

The A5 Time Base Controller board consists of:

- a microprocessor (MPU)
- the RAM/ROM
- the trigger circuitry
- the Time Base circuitry
- the Acquisition system interface
- the memory management unit (MMU) interface
- See Figure 4-5 for the block diagram of this board.

**The microprocessor**—controls the time base and trigger circuitry in response to commands from the Executive Processor, performs local on-line calibration of the time base, schedules waveform acquisitions, and manages the Acquisition system and waveform data transfers.

**RAM/ROM memory**—resides within the microprocessor's 1 Mbyte of address space. The upper 256 kbytes is reserved as ROM, the lower 128 kbytes of static RAM is provided for dynamic data storage and local non-volatile memory. There are 32 kbytes of memory provided communication and waveform storage for the oscilloscope's 8 channels, and another 32 kbytes for the Strobe Distribution block of the oscilloscope and multiplexers. There are 512 kbytes of memory is assigned as communication and primary waveform storage. Another 32 kbytes is used to map the communication buffer of the parallel interface with the memory management unit, and the remaining 32 kbytes is divided into I/O space and time base control.



**Figure 4-5** – A5 Time Base/Controller Board Block Diagram

**The trigger circuitry**—is comprised of the trigger recognizer and gated voltage control oscillator. The trigger circuits accept trigger signals from the trigger attenuator. The strobe sense signal and internal feedback signals are used in the Self-Tests diagnostic process, but are not normally used for data acquisition.

The trigger recognizer recognizes a valid direct trigger signal and outputs this signal to the voltage controlled oscillator which sets the timing for the strobe signal.

The direct trigger input allows programmed slope and level selecting.

If auto trigger mode is selected, the timebase will generate its own trigger signal after 50 ms. If normal trigger mode is selected, the 11801A will wait for trigger signals.

**The time base circuitry**—is a very precise slewing delay generator. It accepts triggers from the reference oscillator, generates a precise delay, and outputs a strobe-drive pulse.

The time base circuitry consists of a TECL integrated circuit (IC), which contains three six-bit high-speed counters; and a CMOS IC, which contains a 48-bit programmable strobe delay generator.

On the first sample of the waveform, the sample is taken immediately after a starting delay. Subsequent samples are delayed by a small additional amount, called the dot delay. The dot delay is programmed and stored into the strobe delay register. Each sample is delayed by one delay more than the previous

sample. The dot delay can vary from 10 fs to 20 ns depending on the horizontal size and the number of points in the waveform record.

The sampling interval (incremental delay between samples) is the total acquisition time (time/division  $\times$  10 divisions) divided by the number of points acquired.

**The Acquisition system interface** – contains 16 kbytes of RAM (physically located on the A25/A28 Acquisition MPU board) that is shared between the Acquisition system and the Time Base/Controller. This RAM is mapped into the microprocessors memory space so that it can be accessed as any other RAM – either by the microprocessor itself or the DMA controller.

This shared memory allows the microprocessor to transfer waveforms from the Acquisition system to the Waveform Memory using DMA. It also provides a mailbox structure for commands and data passed between the two systems.

**The memory management unit (MMU) interface** – interfaces the Time Base/Controller to the EXP and the Waveform Memory. This interface allows the EXP to send commands to the microprocessor through the Time Base/Controller and provides the path for waveform transfers from the Acquisition system to the Waveform Memory.

### A7 CRT Socket Board

The A7 CRT Socket board is an interface from the A15 MMU board to the CRT. The A7 CRT Socket board consists of the following circuits:

- red, green, and blue video amplifiers
- RED, GREEN, and BLUE cutoff adjustments
- CONVERGENCE adjustment

See Figure 4-6 for a block diagram of this board.

**Red, green, and blue video amplifiers**—are three identical high speed video amplifiers that drive the three cathodes (R, G, and B; red, green, and blue, respectively) of the CRT. Each of the three colors can be programmed to display 64 different levels. This yields a possible 262,144 colors, of which eight can be displayed on the screen at any time.

**Red, green, and blue adjustments**—control the cutoff point; that is, the point at which a certain color becomes invisible.

**Convergence adjustment**—controls the vertical convergence of the red, green, and blue deflection beams.

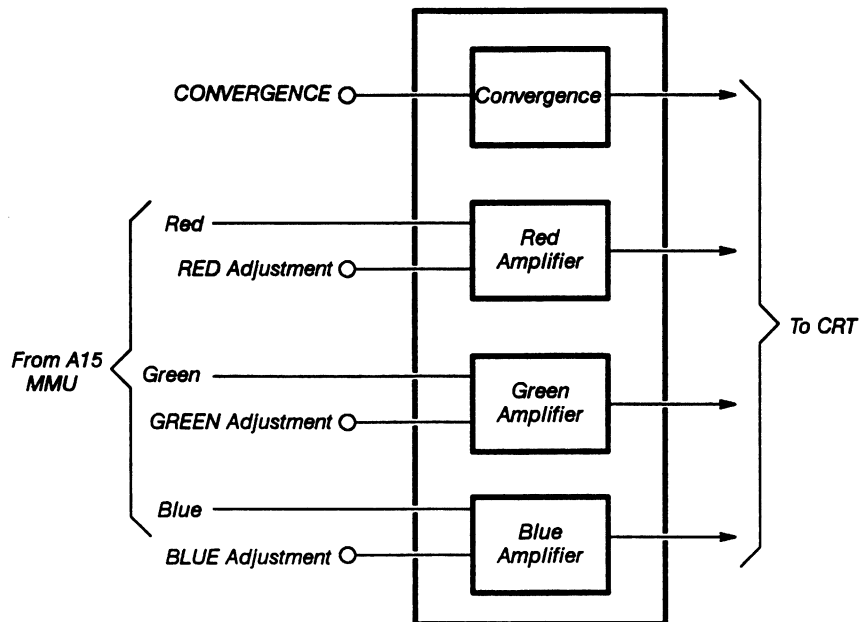


Figure 4-6 – A7 CRT Socket Board Block Diagram

### **A8 CRT Driver Board**

The A8 CRT Driver board consists of the following circuits:

- Horizontal sweep circuitry
- Vertical sweep circuitry
- High voltage and grid voltage generator circuitry
- Degauss circuit
- Beam current limit circuit
- Grid bias circuit

The A8 CRT Driver board circuitry drives the raster scan CRT. The VIDEO and SYNC signals from the A15 MMU board generate the Z-axis signal, sweep signals, and grid bias voltages for the CRT.

See Figure 4-7 for a block diagram of this board.

**Horizontal sweep circuitry**—generates the sweep current for the horizontal deflection yoke. The horizontal driver includes an oscillator, a voltage ramp generator, a high-gain amplifier, and a flyback generator. These components provide sweep synchronization, horizontal deflection, and linearity.

The horizontal adjustments, H-SIZE, H-POS, and H-LIN, allow you to optimize the appearance of the display.

**Vertical sweep circuitry**—produces a deflection current that sweeps the video beam from the bottom to the top of the CRT. This circuit also produces a flyback signal to the flyback transformer that is in parallel with the deflection yoke.

The vertical adjustments, VERT SIZE and VERT POS, set the vertical size and position of the display.

**High voltage and grid voltage generator circuitry**—consists of the flyback transformer from the flyback waveform, which generates the 16 kV CRT anode potential and other bias voltages. This transformer is in parallel with the yoke and also supplies some of the sweep current for the yoke winding.

The SCREEN adjustment provides the cutoff point; that is, the point where no information is visible on the display screen. The FOCUS adjustment provides manual focusing of the display image.

**Degauss circuit**—removes magnetic fields, that are induced by magnetic sources from the color steel aperture grille at each power-on.

The Degauss circuit produces an exponentially decaying sine wave with a frequency of approximately 3.7 kHz. This waveform is applied to the degauss coils that are located on both sides of the CRT. The decayed oscillation through the coils causes a magnetic field to be induced in the CRT steel aperture grille. This magnetic field saturates the steel, and then forces the stored magnetic field down to zero; as the steel is driven around its hysteresis curve.

**Beam current limit circuit**—limits the average power to the CRT to below 15 W. An amplifier circuit compares the sum of the anode current and the FOCUS adjustment current to a reference current of 0.72 mA. If the sum of the two currents exceed the reference current, then the three video amplifiers on the A7 CRT Socket board are disabled.

**Grid bias circuit**—provides -40 V of grid bias to the A7 CRT Socket board. At power-off, the grid is supplied with -90 V until the focus circuit discharges a high voltage. This prevents a bright spot from appearing at the center of the screen at power-off.

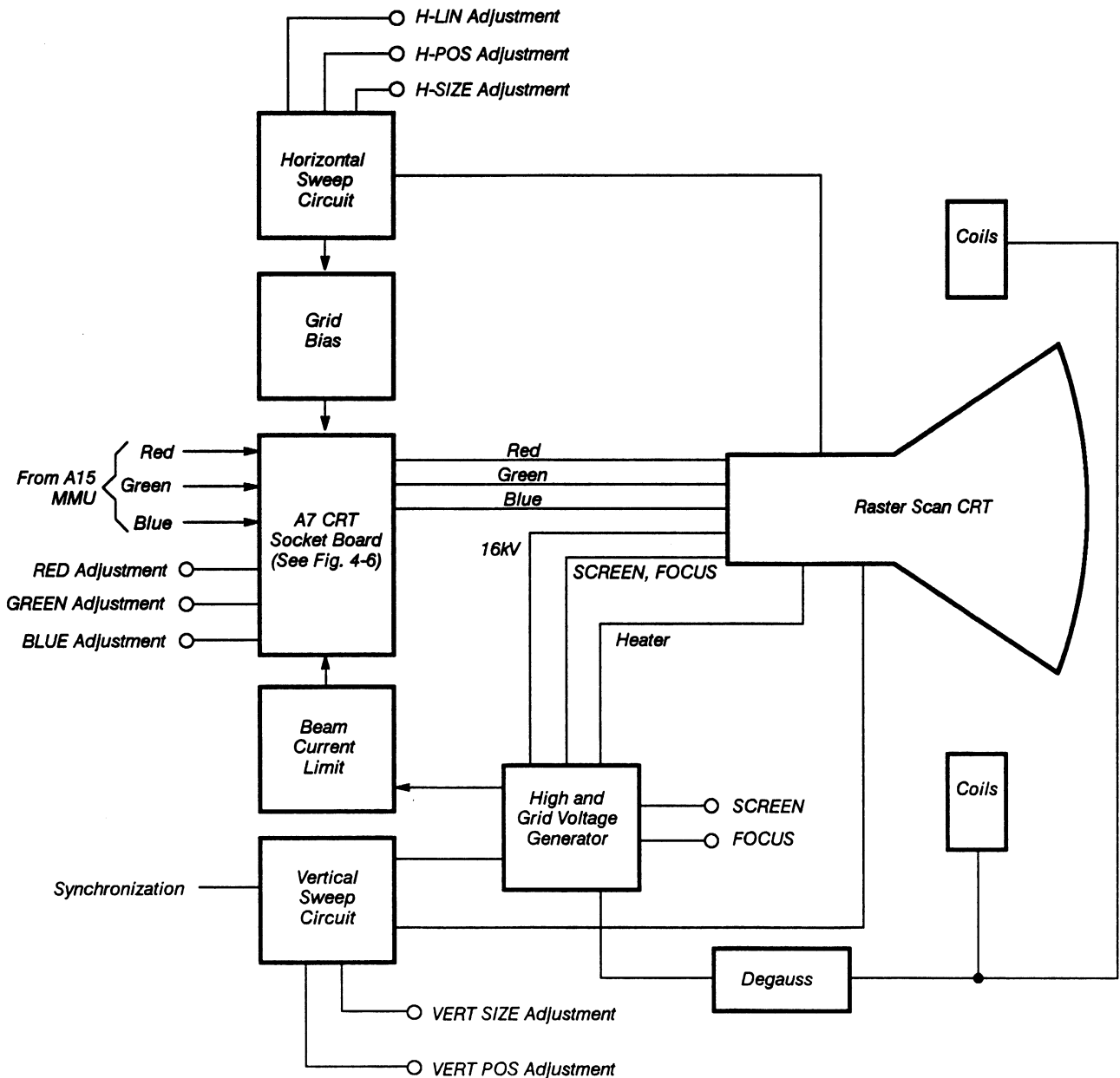


Figure 4-7 – A8 CRT Driver Board Block Diagram

**A9, A10, and A11 Front Panel Boards**

The A9, A10, and A11 Front-Panel Circuit boards specifically consist of the:

- 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. These three functions interface to the Executive processor through a general purpose programmable keyboard and display controller IC on the A10 Front Panel Controller board.

The keyboard function of the 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 the user touches 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 interrupt line is asserted by the display controller. 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 not change in the sensor RAM while the microprocessor is reading it.

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 are driven by the display refresh register output of the A7 Display Controller board. 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. The coarse/fine LEDs are driven by a latch which is controlled by the EXP. 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 (Centronics 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. Control signals DBIN, and WR are used by the GPIB controller IC to determine if the microprocessor is trying to read or write it. The interrupt controllers in the A17 Executive Processor board monitor this interrupt line and will signal the microprocessor to service the GPIB controller IC. The following is required by the GPIB controller IC:

- The receiver section of the GPIB controller IC has a byte of data (Inbyte Register) from the GPIB bus that the microprocessor needs to read.
- The transmitter section register (Outbyte Register) is empty and is ready to receive another byte of data.
- The status of the GPIB bus or the GPIB controller IC has changed and the microprocessor has to be notified.

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 signals of interest are GPIB RQ and GPIB GR. These signals are used by the DMA Controller on the A17 Executive Processor board to communicate with the GPIB controller IC. The DMA can be programmed by the microprocessor to service either the Inbyte register or the Outbyte register.



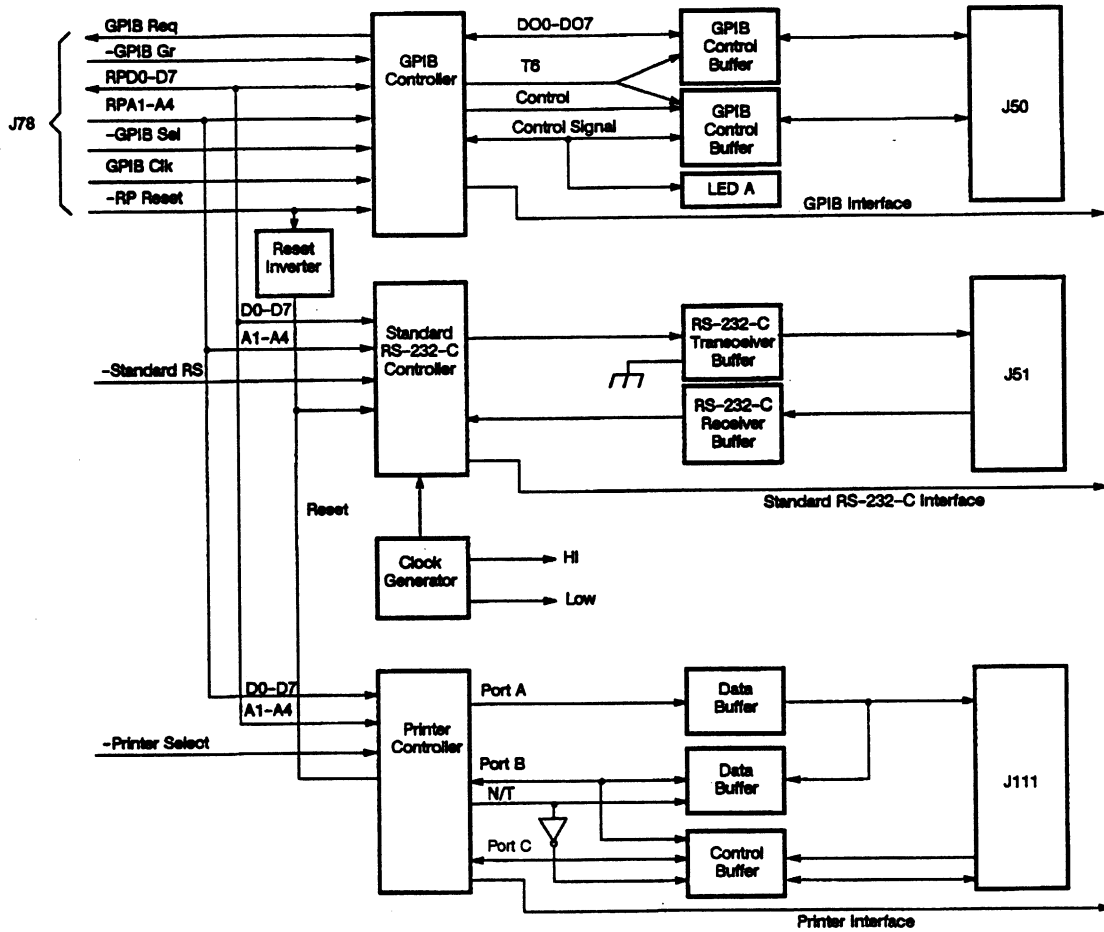


Figure 4-8 – A12 Rear Panel Assembly Block Diagram

The standard RS-232-C controller – is connected to the same data bus and address bus as the GPIB controller IC. The RPD7-RPD0 address lines transfer data to and from the microprocessor. The RPA1-RPA4 address lines are used by the microprocessor 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 RD and WR signals are driven by the microprocessor to signal if the GPIB controller IC is to be read or written into. The controller sets the STD RS INTR (interrupt) line low to request service from the microprocessor. The microprocessor writes a byte into the controller's transmit buffer to transmit data on the RS-232-C bus. The microprocessor reads a byte from the receiver buffer to can 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 from RXD on the RS-232-C bus to parallel data for the microprocessor.

There are transmit and receive buffers which are compatible with the RS-232-C bus. Clear To Send (CTS) and Data Set Ready (DSR) are RS-232-C control signals that can be controlled by the microprocessor. Request To Send (RTS) and Data

Terminal Ready (DTR) are signals that can be read by the microprocessor. The received signal detect (RSD) control signal is always high when power is on. This 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 Printer Sel line is set low by the microprocessor 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. This IC must be initialized by the microprocessor 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
- A17 Executive Processor board
- A18 Memory board

**A14 Input/Output (I/O) Board**

The A14 I/O board contains the following:

- Data buffers
- Timer configuration circuitry
- Real time clock
- Serial data interface (SDI)
- Temp/tone readback buffer
- Tone generator
- GPIB control circuitry

The A14 I/O board is an interface between the Executive Processor (EXP) and devices on the A9, A10, and A11 Front Panel boards, the A12 Rear Panel assembly, and on-board I/O devices. The EXP reads and writes to these I/O devices at specific I/O addresses. These I/O addresses are decoded to produce device select signals which enable the addressed device. Each I/O device is located on I/O address boundaries of at least 100<sub>hex</sub>.

The lower eight bits of the Executive data bus transmit data to and from the various I/O devices. Note that only one I/O device can be accessed at a time.

See Figure 4-9 for a block diagram of this board.

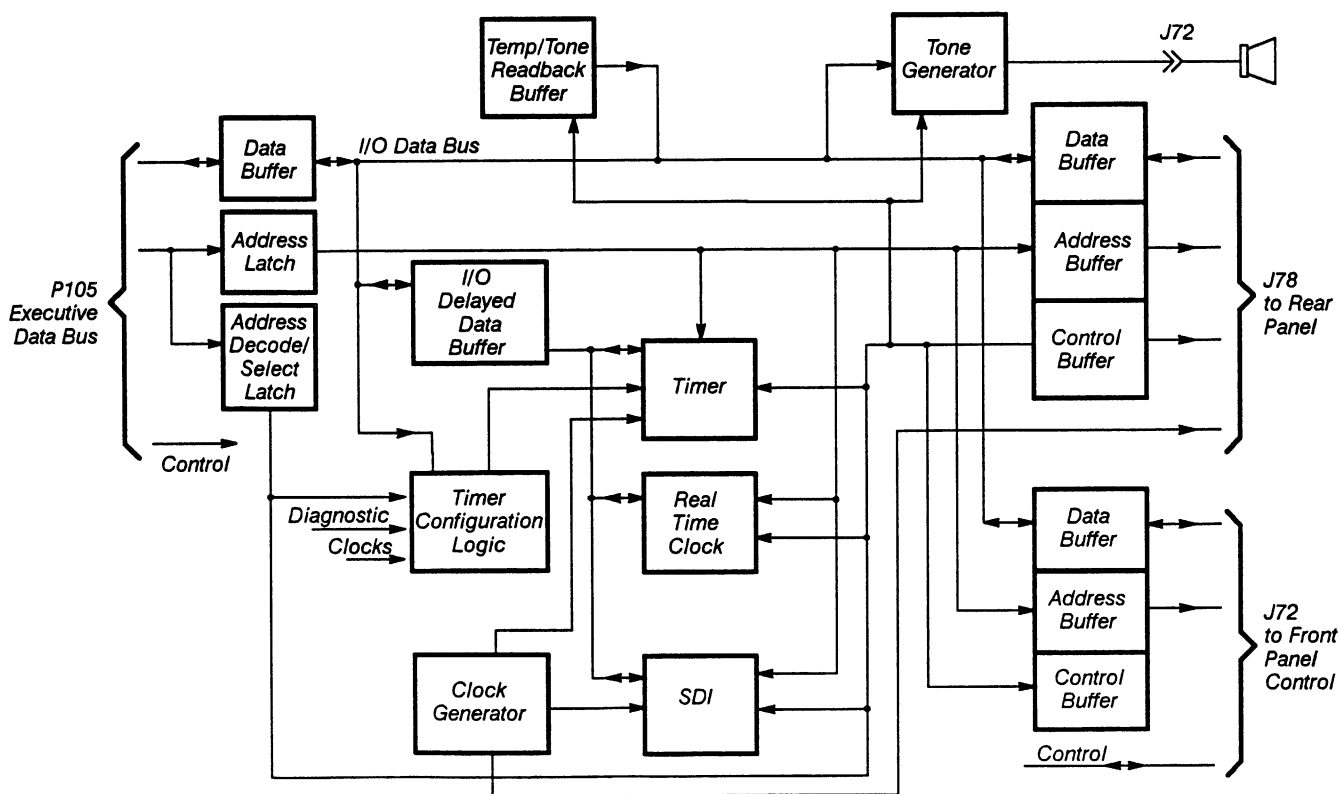


Figure 4-9 – A14 I/O Board Block Diagram

**The I/O data buffer**—buffers the lower eight bits of the Executive data bus from P105. The output of the I/O data bus drives data to the following six on-board devices:

- I/O delayed data buffer
- Rear panel data buffer
- Front panel data buffer
- Tone generator
- Tone/temp readback buffer
- Timer configuration circuitry

**The I/O delayed data buffer**—interfaces between the I/O data bus and the Write Delayed data bus.

**The timer configuration**—is composed of a latch and three two-input data multiplexers built with discrete gates. When a byte of data on the I/O data bus, is latched some of the data bits individually configure counters 1 and 2; allowing the timer to accept different inputs for different system tasks. The operating system uses counter 0 as a real-time clock based on the 2 MHz CLK input from the clock generator; which is always operating at 8 MHz.

**The real time clock**—and its oscillator circuit maintain the current time of day. The EXP sets the real time clock and also interrupts the Executive processor (EXP) every one second to request the EXP to read the time.

**The serial data interface (SDI)**—is a custom IC that interfaces the EXP to both front panel knobs. The EXP controls this IC, and this IC interrupts the EXP when a device requires service.

**The tone generator**—utilizes a DAC and a timer. The timer is equipped with a special current switch and capacitor to set the timer's frequency. The timer outputs a square wave whose frequency is inversely proportional to the digital value written to the temp/tone DAC. Thus, if a zero value is inputted into the DAC, the tone generator produces the highest tone.

**The temp/tone readback buffer**—is an eight-line buffer connected to the I/O data bus, and the EXP uses this buffer to monitor the tone generator.

**A15 Memory Management Unit (MMU) Board**

The A15 MMU board consists of the following:

- MMU IC
- Waveform RAM
- Display interface
- Time Base/Controller interface
- Executive processor (EXP) interface
- Display IC
- Microprocessor
- Bit map RAM
- Waveform display RAM circuitry
- Video DAC

The A15 MMU board coordinates communications among the following three oscilloscope subsystems:

- Display
- Time Base/Controller
- Executive

See Figure 4-10 for a block diagram of this board.

**The MMU IC**—controls all data transfers to and from waveform RAM. The MMU gate array controls high-speed transfers of waveform data and communication messages between waveform RAM and the three subsystem interfaces: the Display, Time Base/Controller and Executive processors. A set of handshaking lines designed to the DMA facilities of each particular subsystem coordinates each subsystem interface.

**The waveform RAM**—consists of 512 K of RAM. The RAM holds waveform data and messages that are read and written by the Time Base/Controller, Display, and Executive subsystems.

**Through the Display Interface**—data is transferred to and from the Display subsystem and to and from the MMU IC. The data is buffered with the bidirectional display data buffers.

**Through the Time Base/Controller Interface**—data is transferred to and from the Time Base/Controller subsystem and to and from the MMU IC.

**The Executive Processor (EXP) Interface**—consists of bidirectional buffers, address mapping programmable array logic (PAL), and interface timing control PALs. This circuitry directs data flow to the EXP from the MMU IC and vice versa.

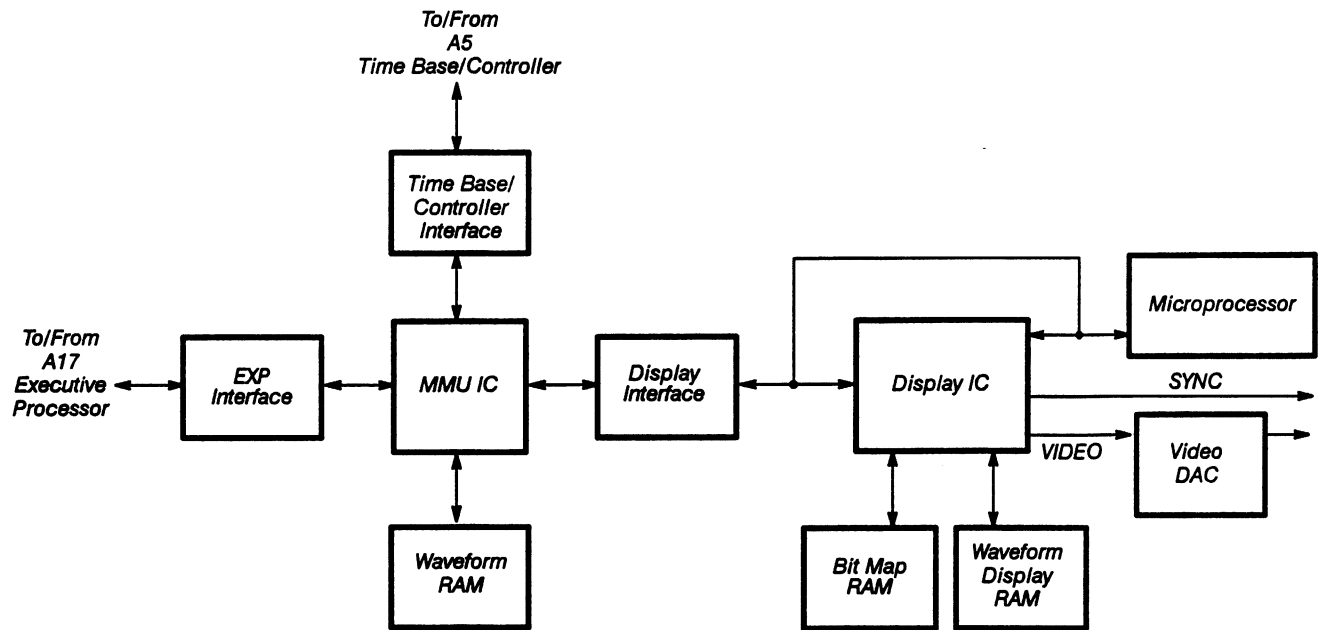


Figure 4-10 – A15 MMU Board Block Diagram

**The Display IC**—consists of the following functional circuits:

- CRT controller
- Video output circuitry
- Compressor circuit

The basic function of the CRT Controller is to produce VIDEO and SYNC signals that indicate to the CRT where to position video information. The controller is virtually automatic in operation and invisible to the firmware programmer; with the exception of several internal registers that must be initialized at power-on.

The video output circuitry is where the hardware recognizes and displays specific data structures, while the raster-scan CRT displays the contents of the bit map.

During the refresh of the screen, the hardware acquires bit map data along with waveform display data to yield a final color index.

The compressor circuit receives a waveform composed of several possible number of data points, and outputs 512 pairs (one minimum and one maximum) to the display.

**The microprocessor**—transforms the entire Display subsystem into an intelligent peripheral dedicated to operating the display. The firmware that controls the Display subsystem executes from ROM in the microprocessor's address space. The clock for this microprocessor operates at a frequency of 8 MHz.

**The bit map RAM**—consists of 256 Kbytes of RAM, divided into 4-bit planes of 65,536 bytes each. Three of the bit planes are for text and the remaining bit plane is for XY, variable persistence, and infinite persistence. Each bit in a plane represents a single pixel of the display. Setting the representative pixel bit in each of the planes controls the color or intensity.

**The waveform display RAM**—consists of 65,536 bytes. These bytes contain the minimum/maximum pairs of values, along with color index and overrange/underrange information.

**The video digital-to-analog converter (DAC)**—converts the digital data from the Display IC into analog data for the A7 CRT Socket board.

### A17 Executive Processor Board

The A17 Executive Processor board consists of the:

- Executive processor (EXP)
- Numeric co-processor circuitry
- Bus buffer circuitry
- Preset circuitry
- Wait state circuitry
- Auxiliary EPROMS
- Interrupt controllers
- DMA Controller

See Figure 4-11 for a block diagram of this board.

**The Executive processor (EXP)**—executes firmware routines stored in EPROMS located on the A18 Memory board to control the operation of the oscilloscope. Along with the numeric co-processor, the EXP does all data processing not directly related to generating the display or digitizing the waveform. When power is first applied to the oscilloscope, the EXP executes local and system diagnostic tests, which are located in the EPROMs on the A18 Memory board.

The EXP performs these functions with three main circuits:

- The clock generator generates the timing signals and synchronized reset signals for the microprocessor
- The microprocessor reads and writes data, generates addresses for I/O and memory devices, and also generates status signals for the bus controller
- The bus controller interprets the microprocessor's status signals and generates the necessary bus control signals for the Executive bus

Address decoders, address latches, and data buffers are all support circuits for I/O operations.

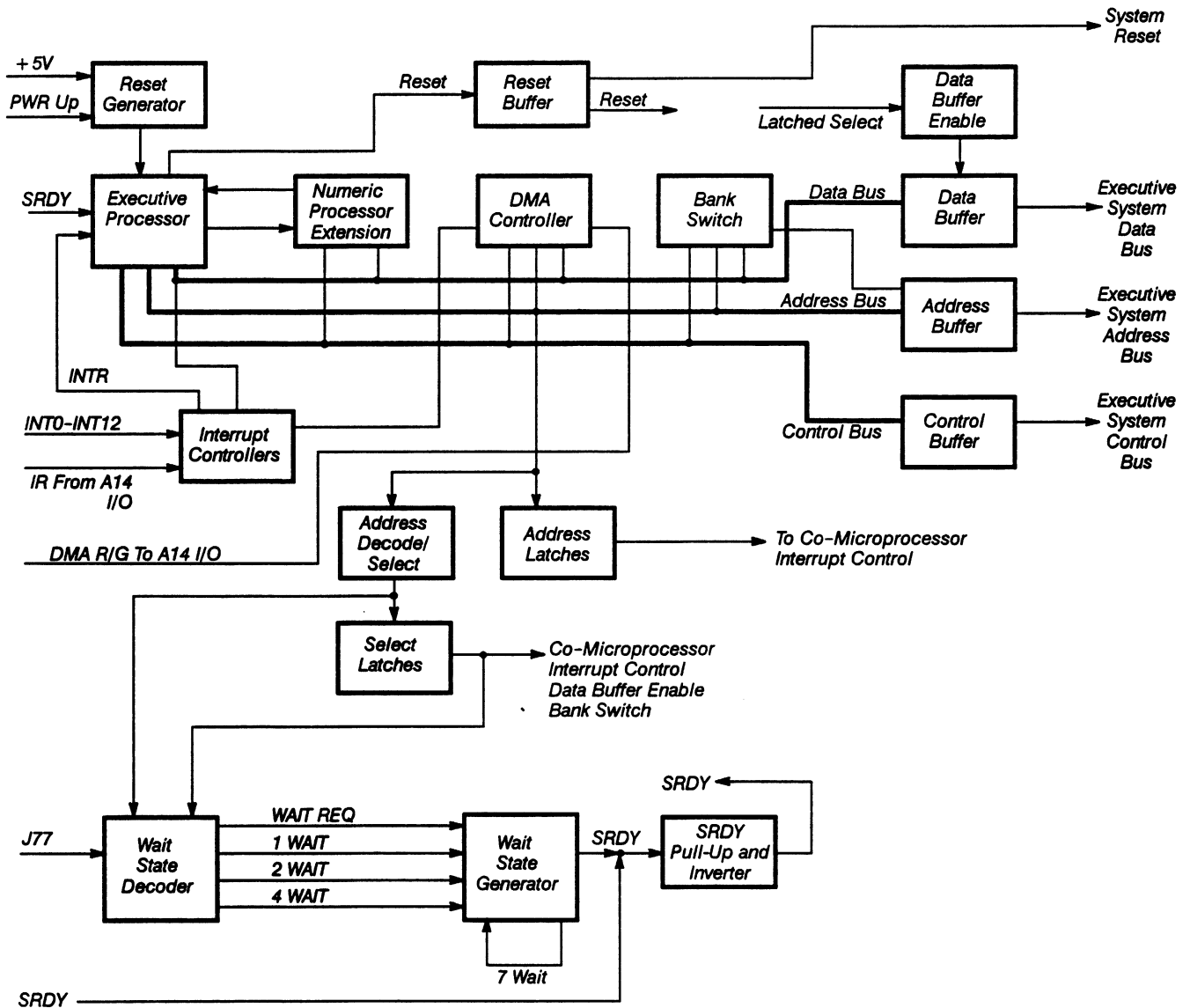


Figure 4-11 – A17 Executive Processor Board Block Diagram

**The numeric co-processor circuitry**—is a high-speed floating-point processor that executes instructions in parallel with the EXP. The EXP programs and controls the numeric co-processor as an I/O device at addresses 0F8<sub>hex</sub> to 0FF<sub>hex</sub>.

**The bus controller circuitry**—consists of a data buffer, an address buffer, and a control buffer that provide command and control signals from the microprocessor to the three Executive busses. The Executive busses consist of the following:

- **The system data bus**—is a bidirectional bus. It allows the microprocessor to fetch instructions from memory, and also to write data to memory and read data from memory. The memory that the microprocessor uses is located on the A18 Memory board.



- **The system address bus**—contains the address of a device when the microprocessor is requesting access to that device. Once the microprocessor has access, the addressed device can then respond to the microprocessor.
- **The system control bus**—contains control signals sent by the microprocessor. These control signals are sent to the devices that the microprocessor addresses, so that the devices can respond at the proper moment in the bus cycle.

**The reset circuitry**—generates synchronized ready and reset control signals.

**The wait state circuitry**—extends the bus cycle so that slower devices have sufficient time to read or write data.

**The interrupt controllers**—constantly monitor the EXP's interrupt lines to ensure that the highest priority interrupt gets serviced first. The Interrupt controllers provide the ability to assign priority levels to all the system's interrupt lines; and conversely, to ignore (mask) any of the interrupt lines as well.

**The DMA controller**—shortens the GPIB transfer time and also the transmission time of waveforms through the GPIB.

### A18 Memory Board

The 18 Memory Board provides the Executive processor (EXP) with system RAM (SRAM), Non-volatile RAM (NVRAM), and EPROM for most operations. Support circuitry for the memories and diagnostic circuitry for troubleshooting are located on-board. All accesses to SRAM, NVRAM, or EPROMs are initiated by the A17 Executive Processor board (specifically by the EXP or the DMA controller). Refer to the discussion of the A17 Executive Processor board, earlier in this section, for bus cycle timing information.

The A18 Memory board consists of the following:

- Address latches
- Address decode and memory select circuitry
- EPROM and system RAM
- Memory data buffers
- Wait state generator
- Wait state diagnostics
- Memory configuration readback
- Non-volatile RAM and battery backup

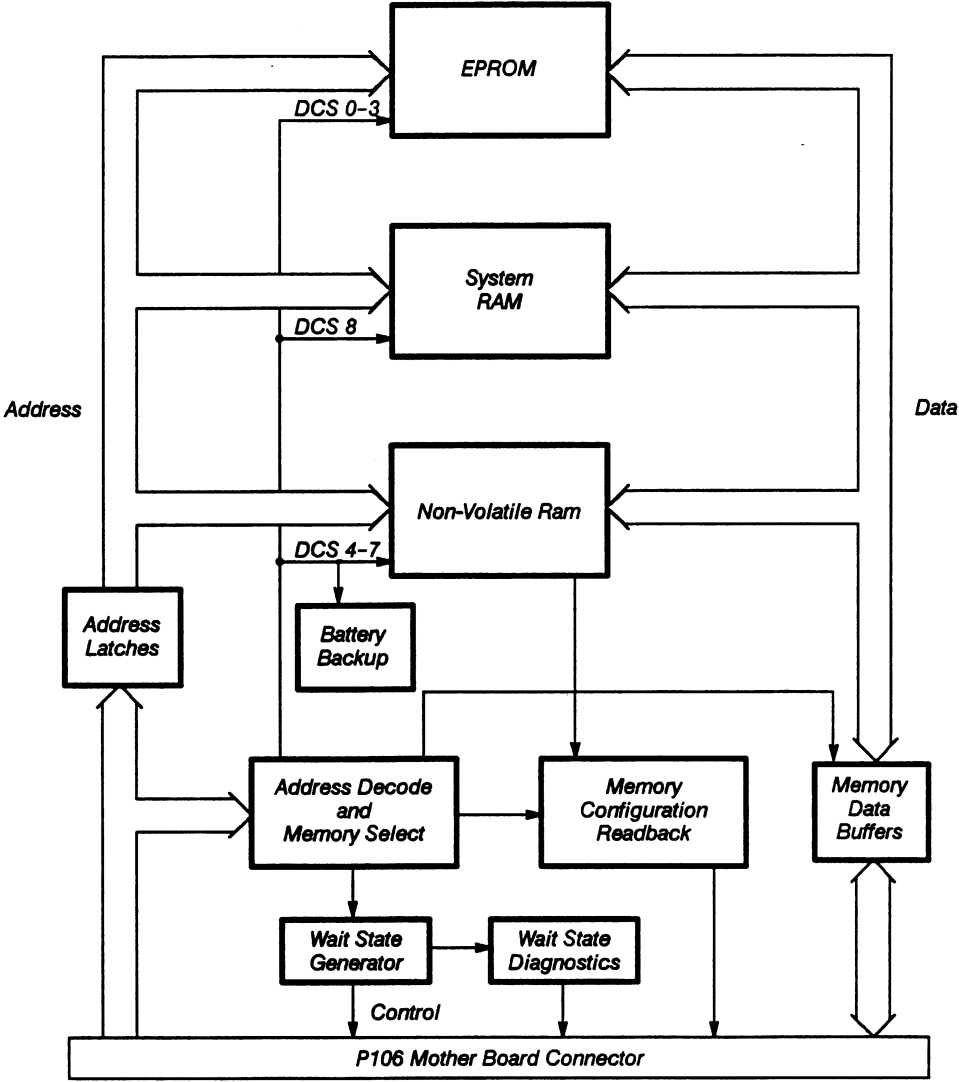


Figure 4-12 – A18 Memory Board Block Diagram

**Address latches** – buffer and hold the address lines for the EPROMs, SRAMs, NVRAMs, and other on-board devices until the end of the bus cycle.

**The address decode and memory select circuitry** – consists of a programmable array logic (PAL) device that decodes the address lines to produce five RAM select signals (DCS4-8) and four EPROM select signals (DCS0-3). DCS8 enables the SRAM, while DCS4-7 enable the NVRAM. All EPROM and RAM select lines are latched, and the latch outputs are normally enabled. While the latch enable signal is high, the latch outputs are responsive to changes on the inputs; and while the latch enable signal is low, the select lines are latched.

The EXP on the A17 Executive Processor board generates the address line inputs, A14-A19. Depending upon the position of a jumper on the A17 Executive Processor board, address lines A20-A23 can be memory bank-select lines or microprocessor address lines.

The memory select circuitry provides latched memory select lines and an enable signal for the memory data buffers.

**The EPROM, System RAM (SRAM), and Non-volatile RAM (NVRAM)** – The EPROMs contain all of the operating system code and diagnostics code for the EXP. All the memories share the latched address bus. The SRAM stores miscellaneous constants that the operating system code uses and produces. The NVRAM contains stored settings and other non-volatile parameters. The memories are organized into high and low-byte pairs. The address decode PAL generates latched chip-select signals. A separate latched chip-select signal selects each of these pair. The memory data buffers buffer the data lines to the Executive data bus.

**The memory data buffers** – drive data between the memories and Executive data bus. Both 8-bit buffers are enabled when all of their inputs are high.

**The wait state generator** – allows the EXP to access memory devices when the EXP is operating at faster clock frequencies. When the EXP is operating at frequencies greater than 8 MHz, the bus cycle time is too short to allow reads or writes to the present memory devices. The wait state generator sets the SRDY line (see Fig. 4-11) on the Executive bus low to signal the EXP to lengthen the bus cycles.

The wait state generator also contains a circuit to generate control signals (similar to those on the Executive bus). These control signals are: early address latch (ELATCH), early memory write control (EMWTC), and early memory read control (EMRDC).

**The wait state diagnostics** – measure the time interval that the wait state generator generates when a one (1) is written to I/O address 8020hex. This causes the wait state diagnostics to connect the SRDY signal to the DIAGNSIG line on the Executive bus. A timer on the A14 I/O board can then measure the length of the wait.

**Memory configuration readback** – allows the diagnostics to read the position of the memory configuration straps and the bank address lines. One bit of the readback data byte also indicates if the battery is at 2.5 V (an early warning of a low battery). The EXP performs an I/O read at address 8040hex to read this information.

**The battery backup** – provide standby power to the non-volatile RAM (NVRAM) during the powered-off periods of the oscilloscope.

### A19 Strobe/TDR Buffer Board

The A19 Strobe/TDR buffer board is comprised of three main circuits:

- the strobe sense select circuitry
- Strobe deskew circuitry
- the TDR buffer and level shift circuitry

See Figure 4-13 for a block diagram of this board.

**The strobe sense select circuitry** – consists of five signal diodes (these diodes are normally off). The diodes carry the four sampling signals (J1A, J2A, J3A, J4A) from the four sampling heads, and the reference strobe signal. When a particular diode is biased on, it allows the selected strobe sense signal to continue out of jumper J32.

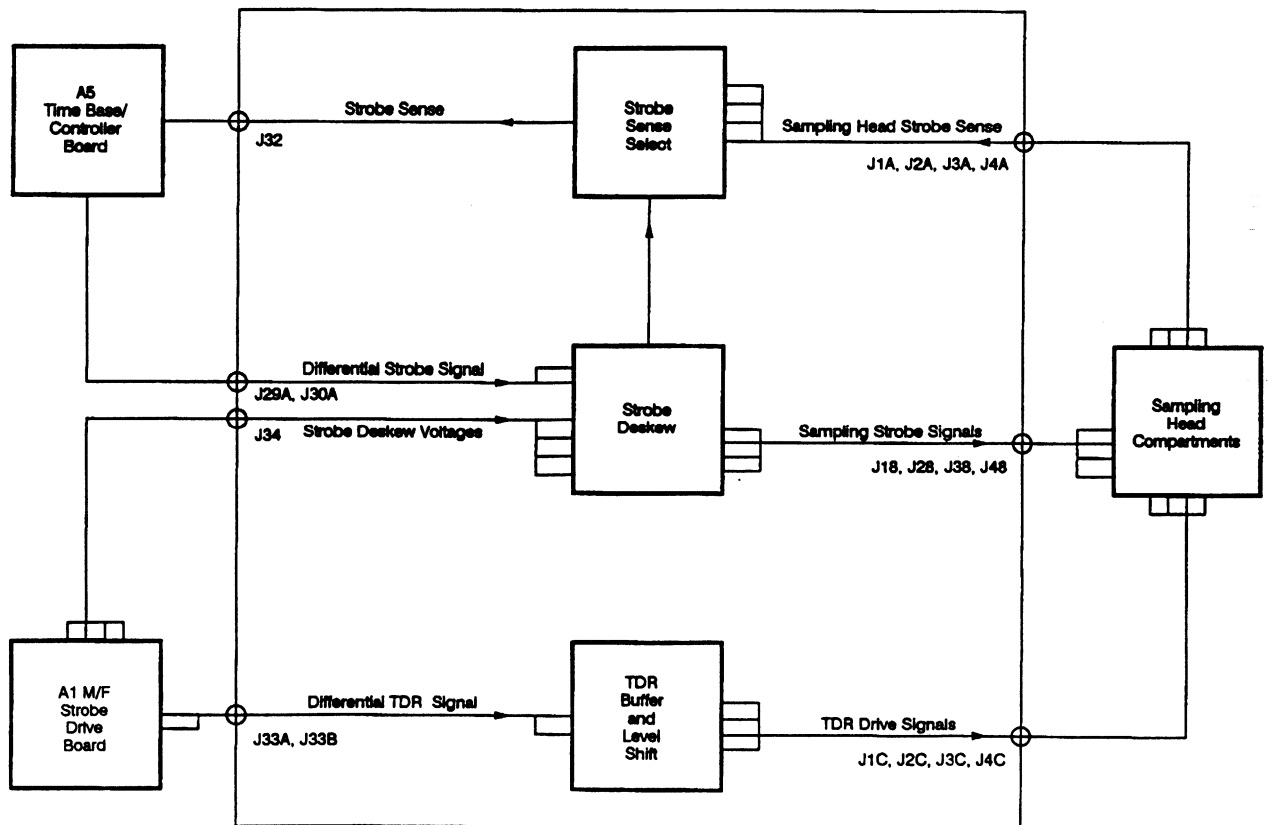


Figure 4-13 – A19 Strobe/TDR Buffer Board Block Diagram

**The strobe deskew circuitry**—corrects the time delay between the sampling strobe signals, which may occur from the mismatch in the external cabling or in the internal cables that distribute the strobe. The repositioning is done with the strobe deskew voltages, which are DC control voltages found on jumper J34. (Power is also supplied to this board through this jumper.) The strobe deskew voltages are generated on the A1 M/F Strobe Drive board and are controlled by the microprocessor on the A5 Time Base/Controller board. The sampling strobe alignment is checked by routing the strobe sense signals to the A5 Time Base/Controller board; where the microprocessor measures and adjusts the time alignment of each sampling head.

**The TDR buffer and level shift circuitry**—consists of an ECL buffer and four dual-transistors that level-shift the TDR signal for proper drive of the TDR pulse generators in the sampling heads.

#### **A20-A23 Head Interconnect Board**

The A20-A23 Head Interconnect boards provide the interface between the sampling head connectors (J13, J14) and the ribbon cable W150 and the coaxial cables W100 and W200. W150 connects to the A26 M/F Acquisition Interface board and carries the control status and power. W100 and W200 connect to the A24/A27 Acquisition Analog board and carries the signal from the sampling heads.

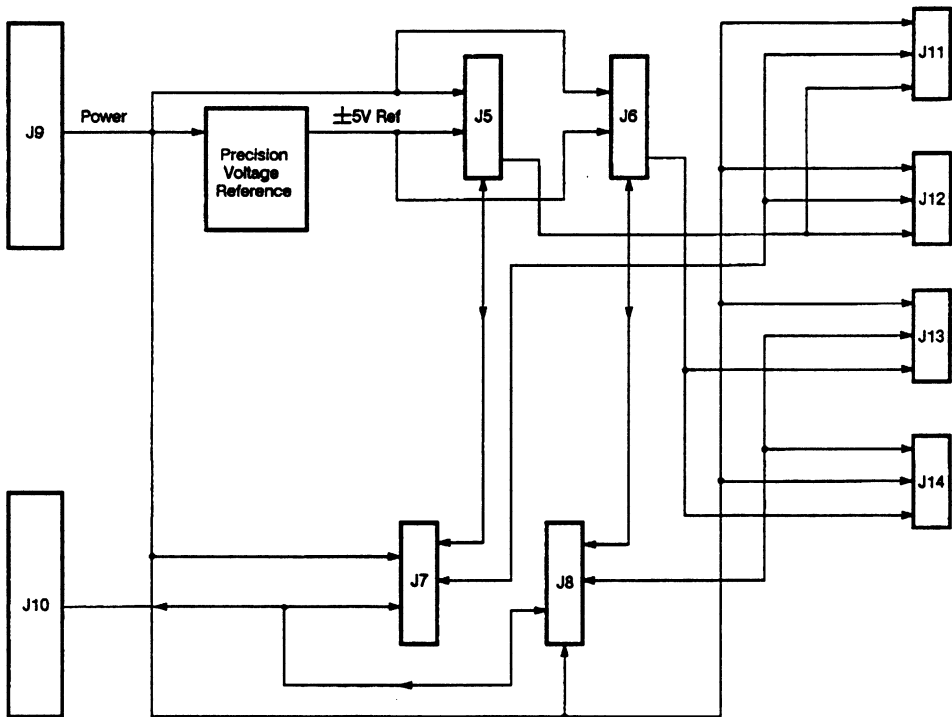
**A26 M/F Acquisition Interconnect Board**

The A26 M/F Acquisition Interconnect board provides and distributes the power to the interconnections between the following boards:

- the A25/A27 Acquisition Analog board
- the A25/A28 Acquisition MPU board
- the A20-A23 Head Interconnect boards

See Figure 4-14 for the block diagram of this board.

The A26 M/F Acquisition Interconnect board also has a precision voltage reference (V) to furnish the  $\pm 5$  voltage reference required by the A24/A27 Acquisition Analog board.



**Figure 4-14** — A26 M/F Acquisition Interconnect Board Block Diagram

### A24/A27 & A25/A28 Acquisition System Boards

The Acquisition system consists of four boards: the A24/A27 Acquisition Analog boards and the A25/A28 Acquisition MPU boards.

The A24/A27 Acquisition Analog board consists of the following major blocks:

- programmable gain amplifiers
- A/D converters
- measurement hardware
- timing and sampling head control

The A25/A28 Acquisition Analog board consists of the following major blocks:

- shared RAM
- time base/controller interface
- microprocessor
- measurement hardware
- timing and sampling head control

See Figure 4-15 and 4-16 for the block diagrams of these boards.

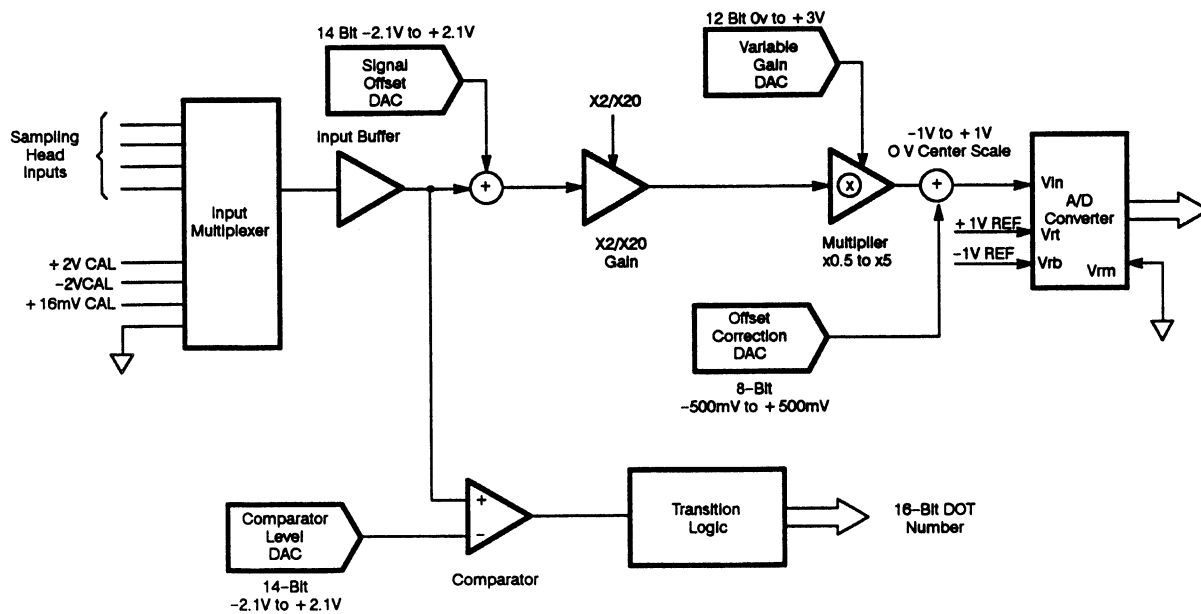
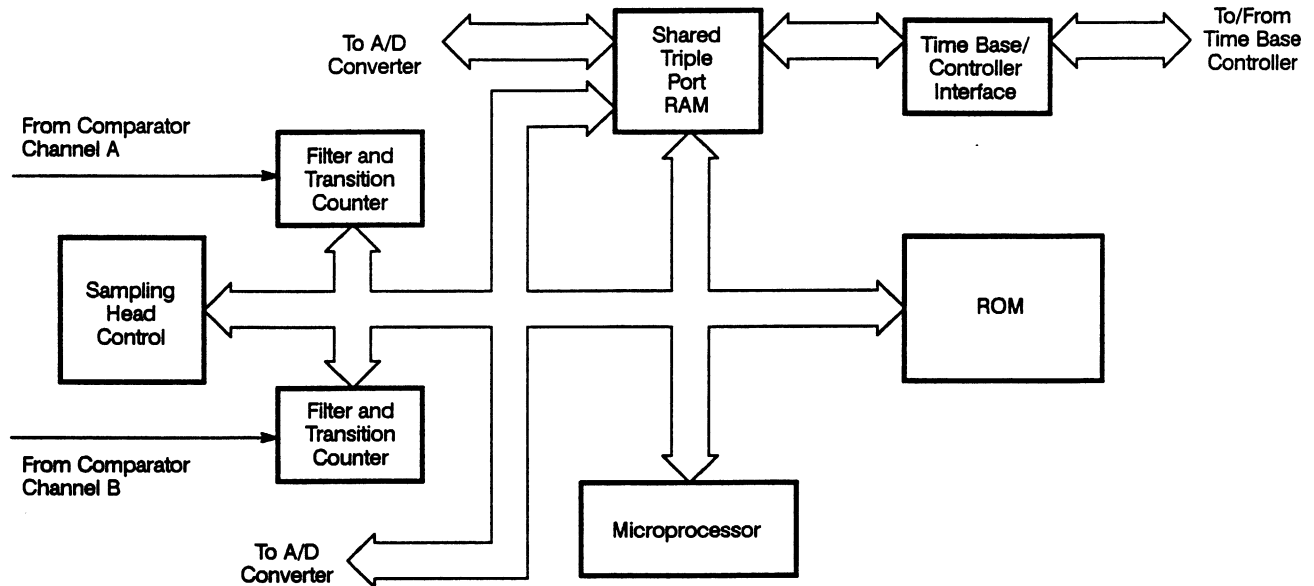


Figure 4-15 — A24/A27 Acquisition Analog Board Block Diagram



**Figure 4-16** – A25/A28 Acquisition MPU Board Block Diagram

**Programmable Gain Amplifiers** – the four sampling head outputs are multiplexed to two amplifier channels through the input multiplexer. The microprocessor selects a sampling head channel to be acquired and connects it to one of the amplifier channels. The programmable gain amplifier then applies offset (**Vert Pos**) and amplifies or attenuates the signal (**Vert Size**). The output of the amplifier is applied to the analog to digital (A/D) converter for conversion to digitized data.

**A/D Converters** – the output of each programmable gain amplifier is applied to an 8-bit flash A/D converter. The converter compares its analog input to two reference voltages (+1 V REF and -1 V REF) and outputs an 8-bit binary number that indicates the relative value of the analog input signal relative to the reference voltages. The digital output from the A/D converters is stored in the shared RAM and made available for transfer to the Waveform Memory through the Time Base/Controller.

**The Measurement Hardware** – has the selected sampling head output from the input multiplexer applied to a precision strobed voltage comparator. This voltage comparator compares the sampling head output voltage to a reference voltage generated by a 14-bit digital-to-analog converter (DAC). The comparator output is then filtered by a filter and transition counter circuit on the A25/A28 Acquisition MPU board to remove false transitions generated by noise and to count the transitions.

When request a hardware timing measurement, such as a propagation delay measurement, the comparator is programmed for the appropriate measurement level and the transition counter is programmed to locate the selected transition number and slope. The hardware counts the strobe pulses that occur from the beginning of the acquisition to the point where the selected transition occurs. This operation is performed on two channels – one for each crossing point the timing



measurement. When the transition points are found, the Acquisition processor reads the sample number from the hardware and stores it in a specific location in the shared memory for the Time Base/Controller. The Time Base/Controller reads these points (from each channel involved in the measurement) subtracts these points, and then multiplies the result by the sampling interval. The result is a measurement of the time between the two threshold points, such as a propagation delay or rise time measurement.

**Timing and sampling head control**—this hardware generates analog control voltages that control several sampling head operating and calibration parameters. For example, the loop gain calibration adjustment is controlled by an analog voltage generated in the oscilloscope for each sampling head channel. In addition, three digital control lines go to each sampling head—one to enable or disable TDR on each channel and one to enable smoothing for both channels in a head.

This circuit block also generates timing signals that control when waveform data is digitized and when the measurement hardware is clocked. The time base sends a strobe pulse to the acquisition system and to the sampling head to initiate a sample. Each acquisition processor can also generate strobe pulses locally for Self-Tests and diagnostic purposes.

**Shared RAM**—exists for the A25/A28 Acquisition MPU board and contains 16 kbytes of shared RAM. This memory is arbitrated on the A25/A28 Acquisition MPU boards between the Acquisition system processor, the Time Base/Controller processor, and the A/D converters on the A24/A27 Acquisition Analog board. All waveform data acquired by the Acquisition system, as well as control and data messages passed between the Acquisition system and the Time Base/Controller, pass through this shared memory.

**Time base/controller interface**—requests from the Time Base/Controller to access the shared memory on the A25/A28 Acquisition MPU boards. Then the shared memory is arbitrated and buffered through the Time Base/Controller interface hardware. This hardware decodes and latches the Time Base/Controller address and generates a wait signal that holds the Time Base/Controller processor in a wait state until a bus cycle can be granted to allow the memory access to complete.

The arbitration logic coordinates requests for access to the shared memory from the A/D converters, the Acquisition system processor and the time base/controller processor.

**A microprocessor**—exists in the Acquisition system, which has 64 kbytes of EPROM for code storage, 16 kbytes of shared RAM and 8 kbytes of unshared RAM. The microprocessor calibrates and manages the programmable gain amplifiers and measurement hardware. The microprocessor also accepts and executes commands from the Time Base/Controller processor, and manages the sampling head digital and analog controls, including scanning the front panel SELECT buttons on the sampling head and driving the front panel LEDs.

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# Replaceable Parts

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This section contains a list of the components that are replaceable for the 11801A. As described below, use this list to identify and order replacement parts.

## Parts Ordering Information

Replacement parts are available from or through your local Tektronix, Inc. service center or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest circuit improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

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

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

## Module Replacement

The 11801A is serviced by module replacement so there are three options you should consider:

- **Module Exchange.** In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1-800-TEKWIDE, ext. 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.

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## 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
					<i>Assembly and/or Component</i>
					<i>Attaching parts for Assembly and/or Component</i> <i>(END ATTACHING PARTS)</i>
					<i>Detail Part of Assembly and/or Component</i>
					<i>Attaching parts for Detail Part</i> <i>(END ATTACHING PARTS)</i>
					<i>Parts of Detail Part</i>
					<i>Attaching parts for Parts of Detail Part</i> <i>(END ATTACHING PARTS)</i>

Attaching parts always appear at the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. Attaching parts must be purchased separately, unless otherwise specified.

### Abbreviations

Abbreviations conform to American National Standards Institute (ANSI) standard Y1.1

**Table 5-1 – Board FRUs**

<b>FRU</b>	<b>Part Number</b>	<b>Description</b>
A1	670-9365-03	M/F Strobe Drive
A2	620-0022-04	Power Supply Assembly
A3	670-9640-00	M/F Power Connect
A4	670-9655-00	Regulator
A5	671-1889-00	Timebase Controller
A7	671-1028-00	CRT Socket
A8	671-1027-00	CRT Driver
A9	614-0882-00	Touch Panel Assembly
A10	670-8847-01	Front Panel Control
A11	671-1130-00	Front Panel Button
A12	671-0013-00	Rear Panel
A13	671-1129-00	Mother
A14	670-8854-01	I/O
A15	671-1023-50	MMU
A17	671-1024-50	Executive Processor
A18	671-1890-00	Memory
A19	671-9879-01	Strobe TDR Buffer
No A#	657-0060-04	Acquisition Module
A20	670-9366-01	Head Interconnect (P/O 657-)
A21	670-9366-01	Head Interconnect (P/O 657-)
A22	670-9366-01	Head Interconnect (P/O 657-)
A23	670-9366-01	Head Interconnect (P/O 657-)
A24	670-9364-03	
A25	670-9363-01	
A26	670-9361-00	M/F Acquisition Interconnect
A27	670-9364-03	Acquisition Analog (P/O 657-)
A28	670-9363-01	Acquisition MPU (P/O 657-)

## CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
01536	TEXTRON INC CAMCAR DIV SEMS PRODUCTS UNIT	1818 CHRISTINA ST	ROCKFORD IL 61108
04348	LAWRENCE ENGINEERING AND SUPPLY INC	500 S FLOWER ST P O BOX 30	BURBANK CA 91503
06383	PANDUIT CORP	17301 RIDGELAND	TINLEY PARK IL 07094-2917
06915	RICHCO PLASTIC CO	5825 N TRIPP AVE	CHICAGO IL 60646-6013
11897	PLASTIGLIDE MFG CORP	2701 W EL SEGUNDO BLVD	HAWTHORNE CA 90250-3318
12327	FREWAY CORP	9301 ALLEN DR	CLEVELAND OH 44125-4632
18677	SCANBE MFG CO DIV OF ZERO CORP	3445 FLETCHER AVE	EL MONTE CA 91731
24931	SPECIALTY CONNECTOR CO INC	2100 EARLYWOOD DR PO BOX 547	FRANKLIN IN 46131
28520	HEYCO MOLDED PRODUCTS	750 BOULEVARD P O BOX 160	KENILWORTH NJ 07033-1721
30010	BICC-VERO ELECTRONICS INC	40 LINDEMAN DR	TRUMBULL CT 06611-4739
53387	MINNESOTA MINING MFG CO	PO BOX 2963	AUSTIN TX 78769-2963
70903	COOPER BELDEN ELECTRONICS WIRE AND C SUB OF COOPER INDUSTRIES INC	2000 S BATAVIA AVE	GENEVA IL 60134-3325
71400	BUSSMANN DIV OF COOPER INDUSTRIES INC	114 OLD STATE RD PO BOX 14460	ST LOUIS MO 63178
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076-9749
74445	HOLO-KROME CO	31 BROOK ST	ELMWOOD CT 06110-2350
75915	LITTELFUSE INC SUB TRACOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016-3049
77900	ILLINOIS TOOL WORKS SHAKEPROOF DIV	ST CHARLES RD	ELGIN IL 60120
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
81041	HOWARD INDUSTRIES DIV OF MSL INDUSTRIES INC	1 NORTH DIXIE HWY PO BOX 287	MILFORD IL 60953
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
92101	SCHULZE MFG	50 INGOLD RD	BURLINGAME CA 94010-2206
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61108-5181
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
TK0588	UNIVERSAL PRECISION PRODUCTS	1775 NW 216TH	HILLSBORO OR 97123
TK0858	STAUFFER SUPPLY CO (DIST)	810 SE SHERMAN	PORTLAND OR 97214
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
TK1319	MORELLIS Q & D PLASTICS	1812 16-TH AVE	FOREST GROVE OR 97116
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 CNTR E AVE	ROCKVILLE CENTRE NY 11570
TK2165	TRIQUEST CORP		
TK2278	COMTEK MANUFACTURING OF OREGON (METALS)		
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.		Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Discont				
1-1	200-2191-00			2	CAP,RETAINER:PLASTIC	80009	200-2191-00
-2	367-0248-01			1	HANDLE,CARRYING:16.341 L,W/CLIP	80009	367-0248-01
-3	426-2098-01			1	FRAME SECT,CAB.:LEFT SIDE (ATTACHING PARTS)	80009	426-2098-01
-4	212-0681-00			2	SCREW,MACHINE:10-32 X 0.25,PNH,STL	83486	ORDER BY DESCR
-5	211-0718-00			1	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-6	200-3759-00			1	COVER,CABINET:TOP,LIFT OFF	80009	200-3759-00
-7	214-0603-02			4	.PIN ASSY,SECRG:W/SPRING WASHER	TK2278	ORDER BY DESCR
-8	386-1151-00			4	.CLAMP,RIM CLENC:SPG STL CD PL	83553	ORDER BY DESCR
-9	386-0227-00			4	.STOP,CLP,RIM CL:	80009	386-0227-00
-10	101-0106-00			2	TRIM,DECORATIVE:LEFT SIDE,FRONT CASTING (ATTACHING PARTS)	80009	101-0106-00
-11	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PNH,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-12	426-2099-01			1	FRAME SECT,CAB.:RIGHT SIDE (ATTACHING PARTS)	80009	426-2099-01
-13	211-0718-00			1	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
-14	212-0681-00			2	SCREW,MACHINE:10-32 X 0.25,PNH,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-15	348-0886-00			4	SHLD GSKT,ELEK:FINGER TYPE,18.310 L	80009	348-0886-00
-16	101-0107-00			2	TRIM,DECORATIVE:RIGHT SIDE,FRONT CASTING (ATTACHING PARTS)	80009	101-0107-00
-17	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PNH,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-18	348-0596-00			4	PAD,CAB.FOOT:0.69 X 0.255 X 0.06,PU	80009	348-0596-00
-19	348-0879-00			4	FOOT,CABINET:BOTTOM,BLUE,POLYCARBONATE (ATTACHING PARTS)	80009	348-0879-00
-20	211-0711-00			4	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-21	200-3415-00			1	COV,CAB LIFTOFF:LOWER,AL,BLUE PAINT	80009	200-3415-00
-22	214-0603-02			4	.PIN ASSY,SECRG:W/SPRING WASHER	TK2278	ORDER BY DESCR
-23	386-1151-00			4	.CLAMP,RIM CLENC:SPG STL CD PL	83553	ORDER BY DESCR
-24	386-0227-00			4	.STOP,CLP,RIM CL:	80009	386-0227-00
-25	348-0875-00			1	FLIPSTAND,CAB.:	80009	348-0875-00



Fig. & Index No.	Tektronix Part No.	Serial/Assembly No.		Qty	12345 Name & Description	Mfr.	
		Effective	Discnt			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	614-0882-00			1	SUBPANEL ASSY:11801A (SEE A9, EXCHANGE ITEM) (ATTACHING PARTS)	80009	614-0882-00
-4	211-0373-00			2	SCREW,MACHINE:4-40 X 0.25,PNH,STL (END ATTACHING PARTS) TOUCH PANEL ASSEMBLY INCLUDES:	80009	211-0373-00
-5	200-3143-01			1	.COVER,CRT SCALE:BEZEL	80009	200-3143-01
-6	333-3907-00			1	.PANEL,FRONT:BEZEL,11801A (ATTACHING PARTS)	80009	333-3907-00
-7	210-0586-00			3	.NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL (END ATTACHING PARTS)	78189	211-041800-00
-8	386-5806-00			1	.FRAME,LENS:TOUCH PANEL (ATTACHING PARTS)	80009	386-5806-00
-9	211-0372-00			4	.SCREW,MACHINE:4-40 X 0.312,PNH,STL (END ATTACHING PARTS)	TK1543	B80-00020-003
-10	-----			1	.CKT BOARD ASSY:TOUCH PANEL (NOT REPLACEABLE, ORDER 614-0882-XX) (ATTACHING PARTS)		
-11	211-0378-00			1	.SCR,ASSEM WSHR:4-40 X 0.375.PNH,STL,CD PL (END ATTACHING PARTS)	80009	211-0378-00
-12	366-0600-00			7	.PUSH BUTTON:0.269 X 0.409,ABS	80009	366-0600-00
-13	131-4763-00			1	CONTACT,ELEC:GROUND,CU BE (ATTACHING PARTS)	80009	131-4763-00
-14	211-0711-00			1	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-15	384-1682-00			2	EXTENSION SHAFT:2.375 L,POLYCARBONATE	80009	384-1682-00
-16	311-2320-00			2	ENCODER,DIGITAL:INCREMENTAL,50PPR,50 DETENT ,QUAD OUTPUT,LOC LUG AT 9 O'CLOCK (ATTACHING PARTS)	TK1869	LA22661
-17	220-0052-00			2	NUT,PLAIN,HEX:M9 X 0.75 (END ATTACHING PARTS)	73743	ORDER BY DESCR
-18	131-1688-00			1	TERM,QIK DISC.:MALE,0.032 X 0.25 BL (ATTACHING PARTS)	00779	42577-4
-19	211-0721-00			1	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
-20	210-0006-00			1	WASHER,LOCK:#6 INTL,0.018 THK,STL (END ATTACHING PARTS)	77900	1206-00-00-0541C
-21	154-0946-00			1	ELECTRON TUBE:CRT,COLOR (V130) (ATTACHING PARTS)	80009	154-0946-00
-22	211-0711-00			4	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-23	381-0469-00			2	BAR,SUPPORT:CRT (ATTACHING PARTS)	80009	381-0469-00
-24	211-0722-00			4	SCREW,MACHINE:6-32 X 0.25,PNH,STL (END ATTACHING PARTS)	80009	211-0722-00
-25	386-5268-07			1	SUBPANEL,FRONT:FINISHED (ATTACHING PARTS)	80009	386-5268-07
-26	211-0718-00			5	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-27	333-3418-00			1	PANEL,FRONT: (ATTACHING PARTS)	80009	333-3418-00
-28	210-0586-00			4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL (END ATTACHING PARTS)	78189	211-041800-00
-29	366-0600-00			4	PUSH BUTTON:0.269 X 0.409,ABS	80009	366-0600-00
-30	260-2275-00			1	SWITCH,ROCKER:SPST,30MA,12V	TK1262	ME010-D
	343-0549-00			1	STRAP,TIEDOWN,E:0.091 W X 4.0 L,ZYTEL	06383	PLT1M
-31	671-1130-00			1	CIRCUIT BD ASSY:FRONT PANEL BUTTON (SEE A11) (ATTACHING PARTS)	80009	671-1130-00
-32	211-0410-00			2	SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL (END ATTACHING PARTS)	93907	ORDER BY DESCR
-33	348-0876-00			2	SHLD GSKT,ELEK:SOLID TYPE,2.480 L	80009	348-0876-00
-34	150-0121-13			1	LIGHT,INDICATOR:5V,GREEN,INCADECENT	80009	150-0121-13
	174-0616-00			1	CABLE ASSY,RF:50 OHM COAX,30.0 L,9-8	80009	174-0616-00
-35	348-0877-00			1	SHLD GSKT,ELEK:SOLID TYPE,1.860 L	80009	348-0877-00
-36	348-0878-00			1	SHLD GSKT,ELEK:SOLID TYPE,7.646 L	80009	348-0878-00



## Replaceable Parts

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No.		Qty	12345 Name & Description	Mfr.	
		Effective	Discont			Code	Mfr. Part No.
2-37	333-3908-00			1	PANEL,FRONT:LOWER,11801A (ATTACHING PARTS)	80009	333-3908-00
-38	210-0586-00			4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
-39	136-0140-00			1	JACK,TIP:BANANA,CHARCOAL GRAY (ATTACHING PARTS)	TK1319	ORDER BY DESCR
-40	210-0465-00			1	NUT,PLAIN,HEX:0.25-32 X 0.375,BRS CD PL	73743	3095-402
-41	210-0223-01			1	TERMINAL,LUG:0.26 ID,LOCKING,BRS TINNED	TK0858	ORDER BY DESCR
-42	210-0895-00			1	WASHER,SHLDR:0.255X0.375X0.105,NYL (END ATTACHING PARTS)	80009	210-0895-00
-43	103-0269-00			3	ADAPTER,CONN:SMA TO PELTOLA	24931	39JR198-1
-44	210-0255-00			1	TERMINAL,LUG:0.391 ID,LOCKING,BRS CD PL	12327	ORDER BY DESCR
	315-0105-00			1	RES,FXD,FILM:1M OHM,5%,0.25W (R89)	80009	315-0105-00

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No.		Qty	12345 Name & Description	Mfr.	
		Effective	Discnt			Code	Mfr. Part No.
3-1	200-3690-00			1	COVER, HV: ALUMINUM (ATTACHING PARTS)	80009	200-3690-00
-2	211-0722-00			1	SCREW, MACHINE: 6-32 X 0.25, PNH, STL	80009	211-0722-00
-3	211-0718-00			2	SCREW, MACHINE: 6-32 X 0.312, FLH, 100 DEG, STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-4	351-0746-00			2	GUIDE, CKT BOARD: NYLON 6.803 L	80009	351-0746-00
-5	407-3438-02			1	BRACKET, CHASSIS: ALUMINUM (ATTACHING PARTS)	80009	407-3438-02
-6	211-0718-00			3	SCREW, MACHINE: 6-32 X 0.312, FLH, 100 DEG, STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-7	670-8847-01			1	CIRCUIT BD ASSY: FRONT PANEL CONTROL (SEE A10) (ATTACHING PARTS)	80009	670-8847-01
-8	211-0711-00			2	SCR, ASSEM WSHR: 6-32 X 0.25, PNH, STL, TORX, T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-9	407-3840-00			1	BRACKET, SUPPORT: (ATTACHING PARTS)	TK2278	ORDER BY DESCR
-10	211-0718-00			2	SCREW, MACHINE: 6-32 X 0.312, FLH, 100 DEG, STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-11	108-1462-00			2	COIL, RF: FXD	80009	108-1462-00
-12	343-0085-00			2	CLAMP, LOOP: 0.312 DIA, NYLON (ATTACHING PARTS)	06915	N5-011
-13	211-0720-00			2	SCR, ASSEM WSHR: 6-32 X 0.50, PNH, STL, TORX, T15 (END ATTACHING PARTS)	01536	829-09487
-14	346-0143-00			1	STRAP, TIEDOWN, E: 14.5 X 0.14, PLASTIC	06383	PLT41
-15	351-0765-00			12	GUIDE, CKT BOARD: NYLON	30010	29-0124D
-16	343-0040-00			1	CLAMP, COIL: (ATTACHING PARTS)	80009	343-0040-00
-17	211-0720-00			1	SCR, ASSEM WSHR: 6-32 X 0.50, PNH, STL, TORX, T15	01536	829-09487
-18	210-0457-00			1	NUT, PL, ASSEM WA: 6-32 X 0.312, STL CD PL (END ATTACHING PARTS)	78189	511-061800-00
-19	119-3839-00			1	DELAY LINE ELEC: 35NS, 2, 50 OHM COAX, TAPED (ATTACHING PARTS)	80009	119-3839-00
-20	211-0722-00			2	SCREW, MACHINE: 6-32 X 0.25, PNH, STL (END ATTACHING PARTS)	80009	211-0722-00
-21	351-0744-00			2	GUIDE, PLUG-IN: POLYAMIDE (ATTACHING PARTS)	80009	351-0744-00
-22	211-0722-00			2	SCREW, MACHINE: 6-32 X 0.25, PNH, STL (END ATTACHING PARTS)	80009	211-0722-00
-23	214-4082-00			2	PIN, GUIDE: 0.850 L, METAL	80009	214-4082-00
-24	210-0007-00			1	WASHER, LOCK: #8 EXT, 0.02 THK, STL	78189	1108-00-00-0541C
	174-1406-00			1	CA ASSY, SP, ELEC: 18, AWG, 6.0 L	80009	174-1406-00
-25	348-0253-00			1	GROMMET, PLASTIC: BLACK, OBLONG, 3.0 X 0.925	TK2165	ORDER BY DESCR
-26	348-0532-00			1	GROMMET, PLASTIC: BLACK, ROUND, 0.625 ID	28520	SB-750-10
-27	671-1028-00			1	CIRCUIT BD ASSY: CRT SOCKET (SEE A7)	80009	671-1028-00
-28	200-3708-00			1	COVER, CKT BOARD: 11403 (ATTACHING PARTS)	80009	200-3708-00
-29	211-0711-00			2	SCR, ASSEM WSHR: 6-32 X 0.25, PNH, STL, TORX, T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-30	386-1559-00			1	SPACER, CKT BD: 0.47 H, ACETAL	80009	386-1559-00
-31	351-0746-00			1	GUIDE, CKT BOARD: NYLON 6.803 L (ATTACHING PARTS)	80009	351-0746-00
-32	211-0722-00			1	SCREW, MACHINE: 6-32 X 0.25, PNH, STL (END ATTACHING PARTS)	80009	211-0722-00
-33	343-0081-00			1	STRAP, RETAINING: 0.125 DIA, NYLON (ATTACHING PARTS)	85480	CPNY-172BK
-34	211-0722-00			1	SCREW, MACHINE: 6-32 X 0.25, PNH, STL (END ATTACHING PARTS)	80009	211-0722-00
-35	255-0334-00			1	PLASTIC CHANNEL: 12.75 X 0.175 X 0.155, NYLON	11897	122-37-2500
-36	211-0711-00			1	SCR, ASSEM WSHR: 6-32 X 0.25, PNH, STL, TORX, T15 (ATTACHING PART TO REAR PANEL GROUND WIRE)	01536	ORDER BY DESCR
-37	386-5369-01			1	PLATE, CONNECTOR: ALUMINUM (ATTACHING PARTS)	80009	386-5369-01
-38	211-0721-00			8	SCREW, MACHINE: 6-32 X 0.375, PNH, STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
	334-6776-00			1	MARKER, IDENT: MKD GPIB	80009	334-6776-00
-39	671-0013-00			1	CIRCUIT BD ASSY: REAR PANEL	80009	671-0013-00

Replaceable Parts

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No.		Qty	12345 Name & Description	Mfr.	
		Effective	Dscont			Code	Mfr. Part No.
3-					(SEE A12, EXCHANGE ITEM) (ATTACHING PARTS)		
-40	129-1085-00			2	SPACER, POST: 0.25 L, 4-40, BRS, 0.25 HEX	TK0588	129-1085-00
-41	214-3106-00			2	HARDWARE KIT: JACK SOCKET	53387	3341-1S
-42	211-0411-00			1	SCR, ASSEM WSHR: 4-40 X 0.5, PNH, STL (END ATTACHING PARTS)	93907	ORDER BY DESCR
-43	214-2476-01			2	HDW ASSY KIT: BAIL LOCK, ELEC CONN RCPT MTG (ATTACHING PARTS)	53387	3475-4
-44	211-0410-00			2	SCR, ASSEM WSHR: 4-40 X 0.437, PNH, STL (END ATTACHING PARTS)	93907	ORDER BY DESCR
-45	386-5269-02			1	SUBPANEL, REAR: PLATED (ATTACHING PARTS)	80009	386-5269-02
-46	211-0718-00			5	SCREW, MACHINE: 6-32 X 0.312, FLH, 100 DEG, STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-47	386-5283-00			2	SUPPORT, CHASSIS: POWER SUPPLY, POLYCARBONATE	80009	386-5283-00
-48	211-0722-00			1	SCREW, MACHINE: 6-32 X 0.25, PNH, STL (ATTACHING PART TO PWR SPLY GROUND WIRE)	80009	211-0722-00
-49	610-0750-00			1	CHASSIS ASSY:	80009	610-0750-00
	407-4028-00			1	BRACKET, SUPPORT: (ATTACHING PARTS)	80009	407-4028-00
	211-0718-00			2	SCREW, MACHINE: 6-32 X 0.312, FLH, 100 DEG, STL	83486	ORDER BY DESCR
	210-0457-00			2	NUT, PL, ASSEM WA: 6-32 X 0.312, STL CD PL (END ATTACHING PARTS)	78189	511-061800-00

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No.		Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Dscont				
4-1	671-1889-00			1	CIRCUIT BD ASSY:TIMEBASE CONTROLLER (SEE A5, EXCHANGE ITEM) (ATTACHING PARTS)	80009	671-1889-00
-2	211-0711-00			6	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-3	671-1027-00			1	CIRCUIT BD ASSY:CRT DRIVER (SEE A8, EXCHANGE ITEM) (ATTACHING PARTS)	80009	671-1027-00
-4	211-0711-00			1	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
-5	211-0722-00			1	SCREW,MACHINE:6-32 X 0.25,PNH,STL (END ATTACHING PARTS)	80009	211-0722-00
-6	159-0235-00			1	CRT DRIVER BOARD ASSEMBLY INCLUDES: .FUSE,WIRE LEAD:0.75A,125V,FAST . (F330)	80009	159-0235-00
-7	407-3824-00			1	.BRACKET,SUPPORT:HV XFMR,0.062 ALUMINUM (ATTACHING PARTS)	80009	407-3824-00
-8	213-0992-00			1	.SCREW,TPG,TF:4-24 X 0.375,PNH,STL	93907	B80-70000-003
-9	211-0711-00			1	.SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-10	671-1129-00			1	CIRCUIT BD ASSY:MOTHER (SEE A13) (ATTACHING PARTS)	80009	671-1129-00
-11	211-0711-00			6	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-12	671-1024-50			1	CIRCUIT BD ASSY:MAIN PROCESSOR (SEE A17, EXCHANGE ITEM)	80009	671-1024-50
-13	156-3812-00			1	.MICROCKT,DGTL:H MOS,MICROPROCESSOR,16 BIT . (U830)	80009	156-3812-00
	156-3821-00			1	.MICROCKT,DGTL:N MOS,PRPHL,DMA CONT,10MHZ . (U800)	80009	156-3821-00
-14	671-1890-00			1	CIRCUIT BD ASSY:MEMORY (SEE A18, EXCHANGE ITEM)	80009	671-1890-00
-15	146-0055-00			1	.BATTERY,DRY:3.0V,1200 MAH,LITHIUM . (BT150)	TK0510	BR-2/3A-E2P
-16	670-8854-01			1	CIRCUIT BD ASSY:INPUT/OUTPUT (SEE A14, EXCHANGE ITEM)	80009	670-8854-01
-17	146-0055-00			1	.BATTERY,DRY:3.0V,1200 MAH,LITHIUM . (BT130)	TK0510	BR-2/3A-E2P
-18	159-0245-00			4	.FUSE,WIRE LEAD:1A,125V,FAST . (F200,F600,F800)	75915	R251001T1
-19	156-2622-00			1	.MICROCKT,DGTL:H MOS,SEMI CUSTOM,STANDARD CEL .L,SERIAL DATA INTERFACE . (U330)	80009	156-2622-00
-20	671-1023-50			1	CIRCUIT BD ASSY:MEMORY MANAGEMENT UNIT (SEE A15, EXCHANGE ITEM)	80009	671-1023-50
-21	670-9655-00			1	CIRCUIT BD ASSY:REGULATOR (SEE A4, EXCHANGE ITEM) (ATTACHING PARTS)	80009	670-9655-00
-22	211-0721-00			2	SCREW,MACHINE:6-32 X 0.375,PNH,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-23	159-0220-00			1	REGULATOR BOARD ASSEMBLY INCLUDES: .FUSE,WIRE LEAD:3A,125V,FAST . (F430)	71400	TRA3
-24	670-9640-00			1	CIRCUIT BOARD:M/F POWER CONNECT (SEE A3) (ATTACHING PARTS)	80009	670-9640-00
-25	211-0408-00			5	SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX (END ATTACHING PARTS)	93907	ORDER BY DESCR
-26	670-9365-03			1	CIRCUIT BD ASSY:M/F STROBE DRIVER (SEE A1, EXCHANGE ITEM) (ATTACHING PARTS)	80009	670-9365-03
-27	211-0711-00			5	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
	020-1889-00			1	COMPONENT KIT:11801A VER	80009	020-1889-00

Replaceable Parts

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective Dscnt	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
4-						
WIRE ASSEMBLIES (SEE MAINT. SECTION FOR CABLING DIAGRAM)						
	174-0562-00		1	CA ASSY, SP, ELEC: 10, 18 AWG, 9.0 L (FROM A4J66 TO A2A2J66)	80009	174-0562-00
	174-0563-00		1	CA ASSY, SP, ELEC: 8, 18 AWG, 8.0 L (FROM A4J64 TO A2A2J64)	80009	174-0563-00
	174-0576-00		1	CA ASSY, SP, ELEC: 50, 28 AWG, 10.3 L, RIBBON (FROM A26J10 TO A1J10)	80009	174-0576-00
	174-0577-00		1	CA ASSY, SP, ELEC: 16, 28 AWG, 7.5 L, RIBBON (FROM A19J34 TO A1J34)	80009	174-0577-00
	174-0580-00		1	CA ASSY, SP, ELEC: 50, 28 AWG, 14.0 L, RIBBON (FROM A18J83 TO A5J83)	80009	174-0580-00
	174-0609-00		1	CABLE ASSY, RF: 50 OHM COAX, 11.0 L, 9-0-5 (FROM A1J35 TO A5J35) (FROM A1J28 TO FRONT PANEL J28)	80009	174-0609-00
	174-0621-00		1	CABLE ASSY, RF: 50 OHM COAX, 13.0 L, 9-1 (FROM A5J32 TO A19J32)	80009	174-0621-00
	174-0623-00		1	CABLE ASSY, RF: 50 OHM COAX, 6.0 L, 9-0 (FROM A19J30A TO A5J30B)	80009	174-0623-00
	174-0624-00		1	CABLE ASSY, RF: 50 OHM COAX, 6.0 L, 9-N (FROM A19J29A TO A5J29B)	80009	174-0624-00
	174-0625-00		1	CABLE ASSY, RF: 50 OHM COAX, 17.5 L, 9-3 (FROM A19J33B TO A1J33B)	80009	174-0625-00
	174-0751-00		1	CABLE ASSY, RF: 50 OHM COAX, 34.0 L, 9-7 (FROM A1J17 TO A6J17)	80009	174-0751-00
	174-0827-00		1	CABLE ASSY, RF: 50 OHM COAX, 17.5 L, 9-03 (FROM A1J33A TO A19J33A)	80009	174-0827-00
	174-1557-00		1	CA ASSY, SP, ELEC: 8, 22 AWG, (4)12.5, (4)11.125 (FROM A10J74 TO ENCODERS S74 AND S75)	80009	174-1557-00
	174-1559-00		1	CA ASSY, SP, ELEC: 8, 26 AWG, 12.0 L (FROM A7J56 TO A8J56)	80009	174-1559-00
	174-1560-00		1	CA ASSY, SP, ELEC: 4, 26 AWG, 21.0 L, RIBBON (FROM A4J57 TO A8J57)	80009	174-1560-00
	174-1561-00		1	CA ASSY, SP, ELEC: 3, 26 AWG, 9.0 L (FROM A8J52 TO A15J52)	80009	174-1561-00
	174-1743-00		1	CA ASSY, SP, ELEC: 4, 18 AWG, 18.5 L (FROM A2A2J63 TO A13J63A)	80009	174-1743-00
	174-1744-00		1	CA ASSY, SP, ELEC: 50, 28 AWG (FROM A10J72 TO A14J72)	80009	174-1744-00
	174-2030-00		1	CABLE ASSY, RF: 50 OHM COAX, 5.0 L, W/BUE JKT (FROM A5J88 TO FRONT PANEL J88)	80009	174-2030-00
	174-2031-00		1	CABLE ASSY, RF: 50 OHM COAX, 6.5 L, W/BUE JKT (FROM A5J87 TO FRONT PANEL J87)	80009	174-2031-00
	175-1726-00		1	CA ASSY, SP, ELEC: 50, 28 AWG, 3.0 L (FROM A5J18 TO A1J18)	80009	175-1726-00
	175-9803-00		3	CA ASSY, SP, ELEC: 7, 26 AWG, 7.5 L, RIBBON (FROM A2A2J65 TO A4J65) (FROM A7J53 TO A15J53) (FROM A5J16 TO A1J16)	80009	175-9803-00
	175-9814-00		1	CA ASSY, SP, ELEC: 34, 3.0 L (FROM A14J77 TO A17J77)	80009	175-9814-00
	175-9857-00		1	CA ASSY, SP, ELEC: 11, 18 AWG, 7.25 L, RIBBON (FROM A4J62 TO A2A2J62)	80009	175-9857-00

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No.		Qty	12345 Name & Description	Mfr.	
		Effective	Discont			Code	Mfr. Part No.
5-	657-0060-04			1	MODULAR ASSY:ACQUISITION DELAY LINE MDL VER 9.0 FIRMWARE (EXCHANGE ITEM)	80009	657-0060-04
-1	384-1756-00			1	.ROD, LOCKING:0.25,SST	80009	384-1756-00
-2	351-0786-00			4	.GUIDE, PLUG-IN:PC,3.167 L	80009	351-0786-00
-3	333-3421-00			1	.PANEL, FRONT:	80009	333-3421-00
-4	386-5475-00			1	.SUBPANEL, FRONT:7.94 X 4.988,AL, FINISHED (ATTACHING PARTS)	80009	386-5475-00
-5	211-0718-00			8	.SCREW, MACHINE:6-32 X 0.312, FLH, 100 DEG, STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-6	348-0235-00			2	.SHLD GSKT, ELEK:FINGER TYPE,4.734 L (ATTACHING PARTS)	92101	ORDER BY DESCR
-7	136-0894-00			2	.SKT, PL-IN ELEK:3.5 X 3.5 X 1.86, ALUMINUM (ATTACHING PARTS)	80009	136-0894-00
-8	210-0458-00			4	.NUT, PL, ASSEM WA:8-32 X 0.344, STL CD PL (END ATTACHING PARTS)	78189	511-081800-00
-9	670-9366-01			4	.CIRCUIT BD ASSY:HEAD INTERCONNECT (SEE A20,A21,A22,A23) (ATTACHING PARTS)	80009	670-9366-01
-10	355-0259-00			4	.STD, LOCKING:0.850 X 0.188 HEX, SST	80009	355-0259-00
-11	211-0372-00			4	.SCREW, MACHINE:4-40 X 0.312, PNH, STL (END ATTACHING PARTS)	TK1543	880-00020-003
-12	386-5687-00			2	.SUPPORT, CKT BD:PLASTIC (ATTACHING PARTS)	80009	386-5687-00
-13	211-0408-00			2	.SCR, ASSEM WSHR:4-40 X 0.250, PNH, STL TORX (END ATTACHING PARTS)	93907	ORDER BY DESCR
-14	381-0452-00			2	.BAR, LOCKING MDL: (ATTACHING PARTS)	80009	381-0452-00
-15	211-0718-00			4	.SCREW, MACHINE:6-32 X 0.312, FLH, 100 DEG, STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-16	351-0784-00			3	.GUIDE, CKT BD:UPPER, PP, 7.0 L (ATTACHING PARTS)	80009	351-0784-00
-17	211-0392-00			6	.SCREW, MACHINE:4-40 X 0.25, FLH, 82 DEG, STL (END ATTACHING PARTS)	80009	211-0392-00
-18	670-9363-01			1	.CIRCUIT BD ASSY:ACQUISITION MPU (SEE A25, EXCHANGE ITEM)	80009	670-9363-01
-19	670-9364-03			1	.CIRCUIT BD ASSY:ACQUISITION ANALOG (SEE A24, EXCHANGE ITEM)	80009	670-9364-03
-20	670-9363-01			1	.CIRCUIT BD ASSY:ACQUISITION MPU (SEE A28, EXCHANGE ITEM)	80009	670-9363-01
-21	670-9364-03			1	.CIRCUIT BD ASSY:ACQUISITION ANALOG (SEE A27, EXCHANGE ITEM)	80009	670-9364-03
-22	670-9879-01			1	.CIRCUIT BD ASSY:STROBE TDR BUFFER (SEE A19, EXCHANGE ITEM) (ATTACHING PARTS)	80009	670-9879-01
-23	211-0408-00			2	.SCR, ASSEM WSHR:4-40 X 0.250, PNH, STL TORX (END ATTACHING PARTS)	93907	ORDER BY DESCR
-24	407-3562-00			1	.BRACKET, CKT BD:MODULE DISCONNECT, ALUMINUM (ATTACHING PARTS)	80009	407-3562-00
-25	211-0304-00			2	.SCR, ASSEM WSHR:4-40 X 0.312, PNH, STL, T9 TORX (END ATTACHING PARTS)	01536	ORDER BY DESCR
-26	670-9361-00			1	.CIRCUIT BD ASSY:M/F ACQUISITION INTCON (SEE A26, EXCHANGE ITEM) (ATTACHING PARTS)	80009	670-9361-00
-27	211-0304-00			4	.SCR, ASSEM WSHR:4-40 X 0.312, PNH, STL, T9 TORX (END ATTACHING PARTS)	01536	ORDER BY DESCR
-28	386-5535-00			1	.PLATE, REAR:ALUMINUM (ATTACHING PARTS)	80009	386-5535-00
-29	213-0904-00			8	.SCREW, TPG, TR:6-32 X 0.5, PNH, STL (END ATTACHING PARTS)	83385	ORDER BY DESCR
-30	131-1247-00			1	.TERM, QIK DISC.:0.187 X 0.02 BLADE, 45 DEG	00779	61664-1
-31	351-0761-00			2	.GUIDE, CKT BD:PLASTIC, 2.5 L	18677	11633-1
-32	426-2167-00			1	.FRAME SECT, CAB.:MODULE	80009	426-2167-00
-33	426-2165-00			1	.FRAME SECT, CAB.:MODULE	80009	426-2165-00
-34	426-2168-00			1	.FRAME SECT, CAB.:MODULE	80009	426-2168-00
-35	426-2166-00			1	.FRAME SECT, CAB.:MODULE	80009	426-2166-00

## WIRE ASSEMBLIES

# Replaceable Parts

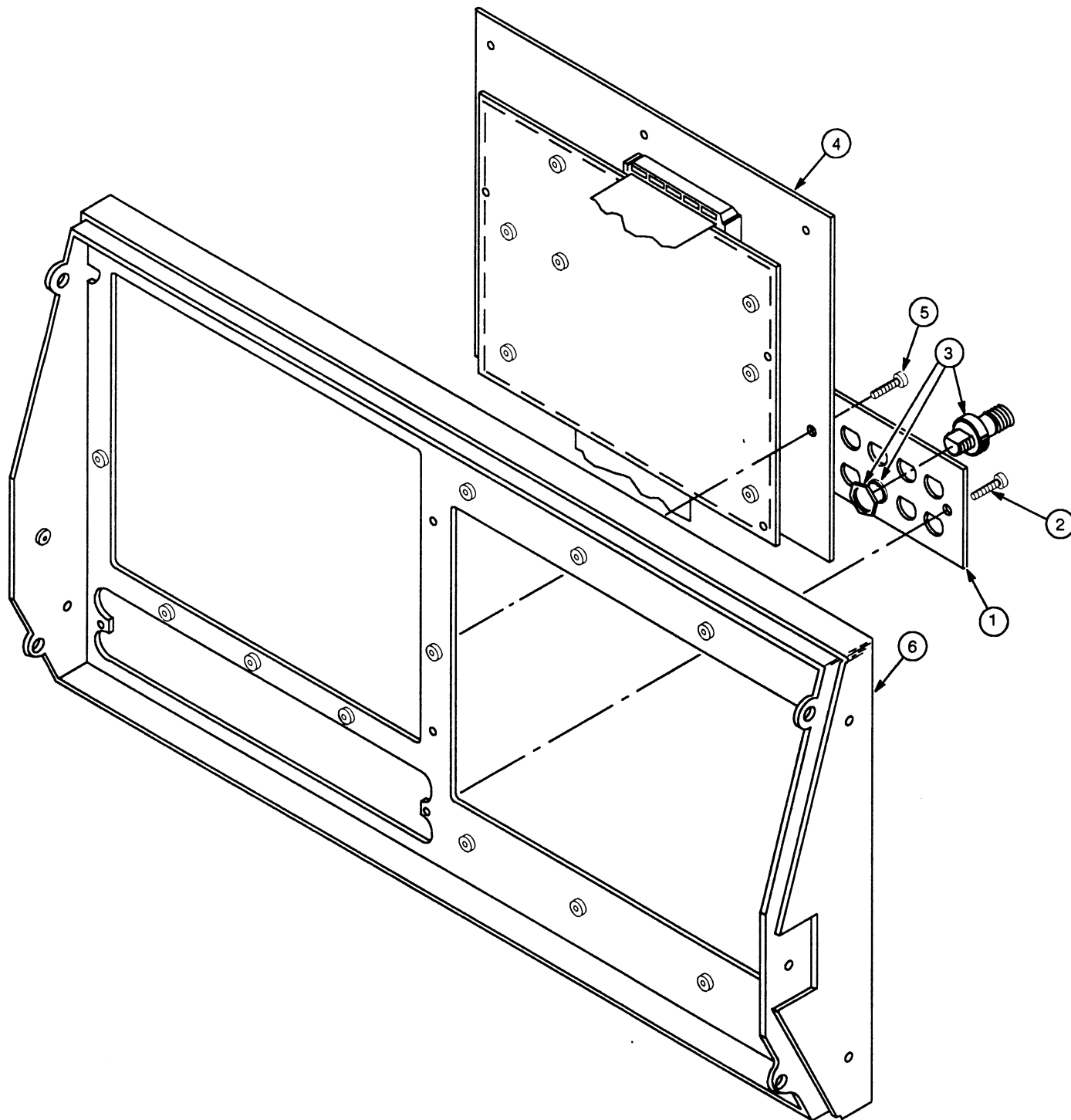
Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Discont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
5-					(SEE MAINT. SECTION FOR CABLING DIAGRAM)		
	174-0626-01			4	CABLE ASSY,RF:50 OHM COAX,16.5 L,9-6 (FROM A19J1C TO A20J1C) (FROM A19J2C TO A21J2C) (FROM A19J3C TO A22J3C) (FROM A19J4C TO A23J4C)	80009	174-0626-01
	174-0627-01			4	CABLE ASSY,RF:50 OHM COAX,15.0 L,9-5 (FROM A19J1C TO A20J1C) (FROM A19J2C TO A21J2C) (FROM A19J3C TO A22J3C) (FROM A19J4C TO A23J4C)	80009	174-0627-01
	174-0628-01			1	CABLE ASSY,RF:50 OHM COAX,13.0 L,9-1 (FROM A18J1B TO A20J1B)	80009	174-0628-01
	174-0629-01			1	CABLE ASSY,RF:50 OHM COAX,10.6 L,9-2 (FROM A18J1B TO A21J1B)	80009	174-0629-01
	174-0630-01			1	CABLE ASSY,RF:50 OHM COAX,8.2 L,9-3 (FROM A19J3B TO A22J3B)	80009	174-0630-01
	174-0631-01			1	CABLE ASSY,RF:50 OHM COAX,5.8 L,9-4 (FROM A19J4B TO A23J4B)	80009	174-0631-01
	343-0549-00			4	STRAP,TIEDOWN,E:0.091 W X 4.0 L,ZYTEL	06383	PLT1M

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective Discort	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
6-1	620-0022-04		1	POWER SUPPLY:ET,RTHLRES MAINFRAMES (SEE A2, EXCHANGE ITEM) (ATTACHING PARTS)	80009	620-0022-04
-2	211-0721-00		8	SCREW,MACHINE:6-32 X 0.375,PNH,STL (END ATTACHING PARTS) POWER SUPPLY ASSEMBLY INCLUDES:	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,FAST BLOW (F99, USED IN FUSE HOLDER)	71400	MTH-CW-6
	159-0021-00		1	.FUSE,CARTRIDGE:3AG,2A,250V,FAST BLOW (F410, PART OF LINE INVERTER BOARD)	71400	AGC-CW-2
	159-0248-00		1	.FUSE,WIRE LEAD:1.5 A,AXIAL LEAD (F650, PART OF LINE INVERTER BOARD)	75915	R25101.5 T1
	159-0220-00		1	.FUSE,WIRE LEAD:3A,125V,FAST (F740, PART OF CONTROL RECTIFIER BOARD)	71400	TRA3
-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



Replaceable Parts

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
7-				OPTION 1M		
-1	386-5472-00		1	PLATE,CONN MTG:ALUMINUM (ATTACHING PARTS)	80009	386-5472-00
-2	211-0721-00		3	SCREW,MACHINE:6-32 X 0.375,PNH,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-3	103-0269-00		20	ADAPTER,CONN:SMA TO PELTOLA	24931	39JR198-1
-4	614-0882-00		1	SUBPANEL ASSY:11801A (EXCHANGE ITEM) (ATTACHING PARTS)	80009	614-0882-00
-5	211-0721-00		7	SCREW,MACHINE:6-32 X 0.375,PNH,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-6	386-5471-00		1	SUBPANEL,REAR:	80009	386-5471-00
				WIRE ASSEMBLIES (SEE MAINT. SECTION FOR CABLING DIAGRAM)		
	174-0608-00		1	CABLE ASSY,RF:50 OHM COAX,167.0 L,9-2,167.0 L,9-2,179.0 L,9-3,179.0 L,9-3 (TO A19J29A,J30A,J33A,J33B) (TO A5J29B,J30B) (TO A1J33A,J33B)	80009	174-0608-00
	174-0613-00		12	CABLE ASSY,RF:50 OHM COAX,7.0 L,9-N (FROM A1+1,+2,+3,+4 TO REAR PANEL MCU TDR DRIVE +1,+2,+3,+4) (FROM A1-1,-2,-3,-4 TO REAR PANEL MCU TDR DRIVE -1,-2,-3,-4) (FROM A1 1,2,3,4 TO REAR PANEL MCU STROBE SENSE 1,2,3,4)	80009	174-0613-00
	174-0618-00		8	CABLE ASSY,RF:50 OHM COAX,15.0 L,9-N (FROM A5+1,+2,+3,+4 TO REAR PANEL MCU STROBE DRIVE +1,+2,+3,+4) (FROM A5-1,-2,-3,-4 TO REAR PANEL MCU STROBE DRIVE -1,-2,-3,-4)	80009	174-0618-00
	174-1093-00		1	CABLE ASSY,RF:50 OHM COAX,30.0 L,9-2 (FROM A1J15 TO A5J15)	80009	174-1093-00



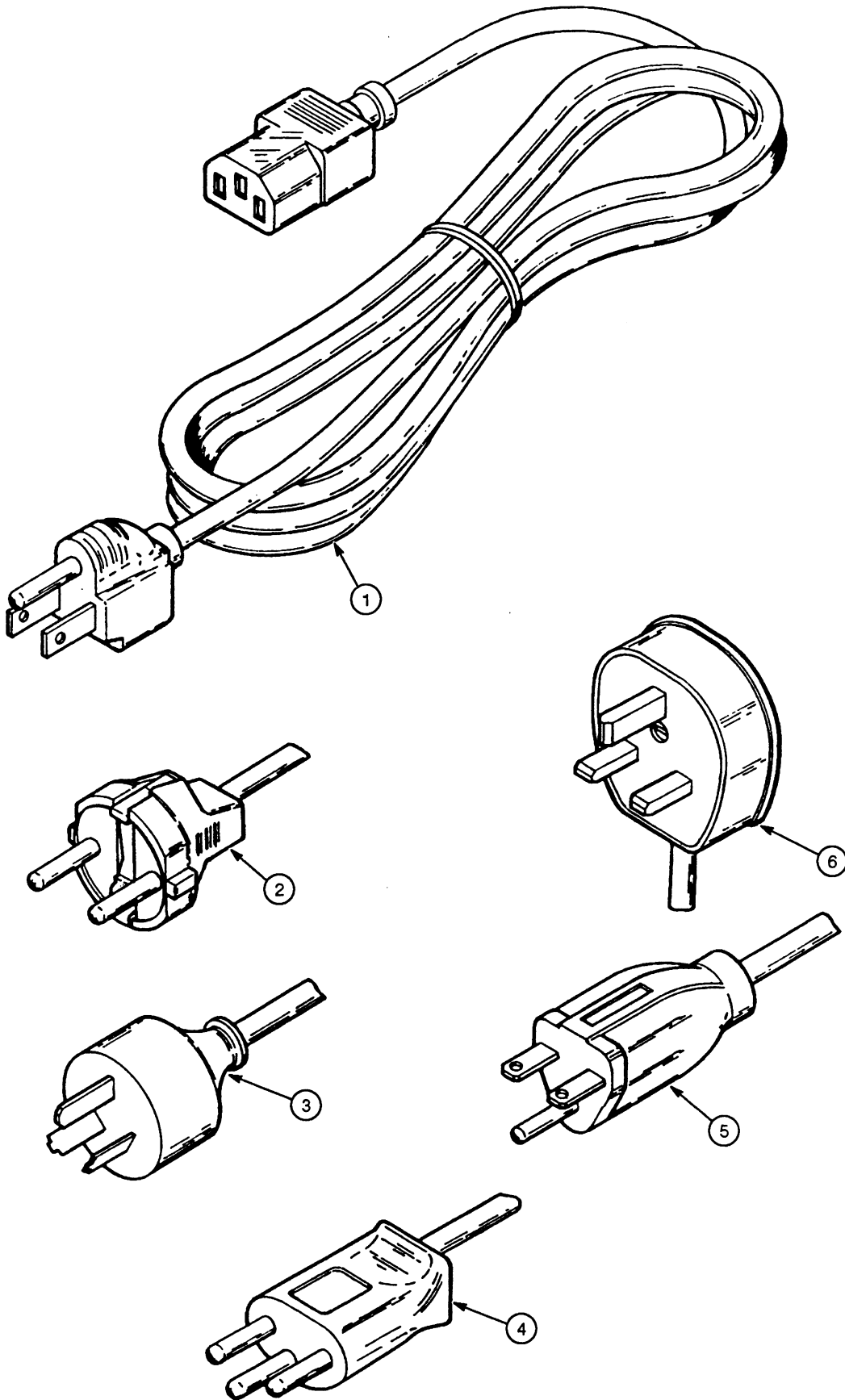


Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
8-				STANDARD ACCESSORIES		
-1	161-0066-00		1	CABLE ASSY,PWR,,:3,18AWG,115V,98.0 L	80009	161-0066-00
-2	161-0066-09		1	CABLE ASSY,PWR,,:3,0.75MM SQ,220V,99.0 L (OPTION A1 ONLY)	80009	161-0066-09
-3	161-0066-10		1	CABLE ASSY,PWR,,:THREE 0.75MM SQ,250V,2.5 METERS LONG,UNITED KINGDOM (OPTION A2 ONLY)	TK1373	24230
-4	161-0066-11		1	CABLE ASSY,PWR,,:3,0.75MM,240V,96.0 L (OPTION A3 ONLY)	80009	161-0066-11
-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)	80009	161-0154-00
	070-6274-00		1	MANUAL,TECH:INSTR,11000 SERIES (OPTION 1R ONLY)	80009	070-6274-00
	174-1120-00		2	CABLE ASSY,RF:50 OHM COAX,8.5 L	80009	174-1120-00
	174-1364-00		1	CABLE ASSY,RF:12.0 L,0-N	80009	174-1364-00
	006-3415-04		1	STRAP,WRIST:3M TYPE 2214,ADJ,5 FT COILED CD	80009	006-3415-04
	070-7720-01		1	MANUAL,TECH:COMMAND REFERENCE,CSA803/11801A	80009	070-7720-01
	070-7738-01		1	MANUAL,TECH:PRGM REFERENCE,CSA803/11801A	80009	070-7738-01
	070-8021-00		1	MANUAL,TECH:USERS REFERENCE,11801A	80009	070-8021-00
	070-8024-00		1	MANUAL,TECH:SERVICE,11801A	80009	070-8024-00
	070-8025-00		1	MANUAL,TECH:TUTORIAL,11801A	80009	070-8025-00
				OPTIONAL ACCESSORIES		
	012-0555-00		1	CABLE,INTCON:CENTRONIX,3 METERS LONG,36 POS RIBBON X 36 POS RIBBON,4695 TO TERMINAL	80009	012-0555-00
	012-0911-00		1	CABLE,INTCON:RS232C,DB25M-DB25F SERIAL,STRAIGHT THROUGH,10 FT L	TK6020	ESF-85249
	012-0991-00		1	CABLE,GPIB:LOW EMI,2 METER	00779	553577-3
	012-1220-00		1	CA ASSY,SP,ELEC:1 METER LONG,SAMPLING HEAD EXTENDER	80009	012-1220-00
	012-1221-00		1	CA ASSY,SP,ELEC:2 METER LONG,SAMPLING HEAD EXTENDER	80009	012-1221-00
	020-1805-00		1	COMPONENT KIT:QUICKSTART KIT(US),CSA/11800 SERIES	80009	020-1805-00
	020-1806-00		1	COMPONENT KIT:QUICKSTART KIT(EURO),CSA/11800 SERIES	80009	020-1806-00
	067-1267-00		1	FIXTURE,CAL:TROUBLE SHOOTING AID EXTENDER CARD W/CABLES	80009	067-1267-00
	067-1323-00		1	FIXTURE,CAL:11801,ACQ SYSTEM EXTENDER	80009	067-1323-00
	067-1324-00		1	FIXTURE,CAL:11801,ACQ EXTENDER	80009	067-1324-00
	200-3395-00		1	COV,SMPLG HEAD:SNAP-IN	80009	200-3395-00

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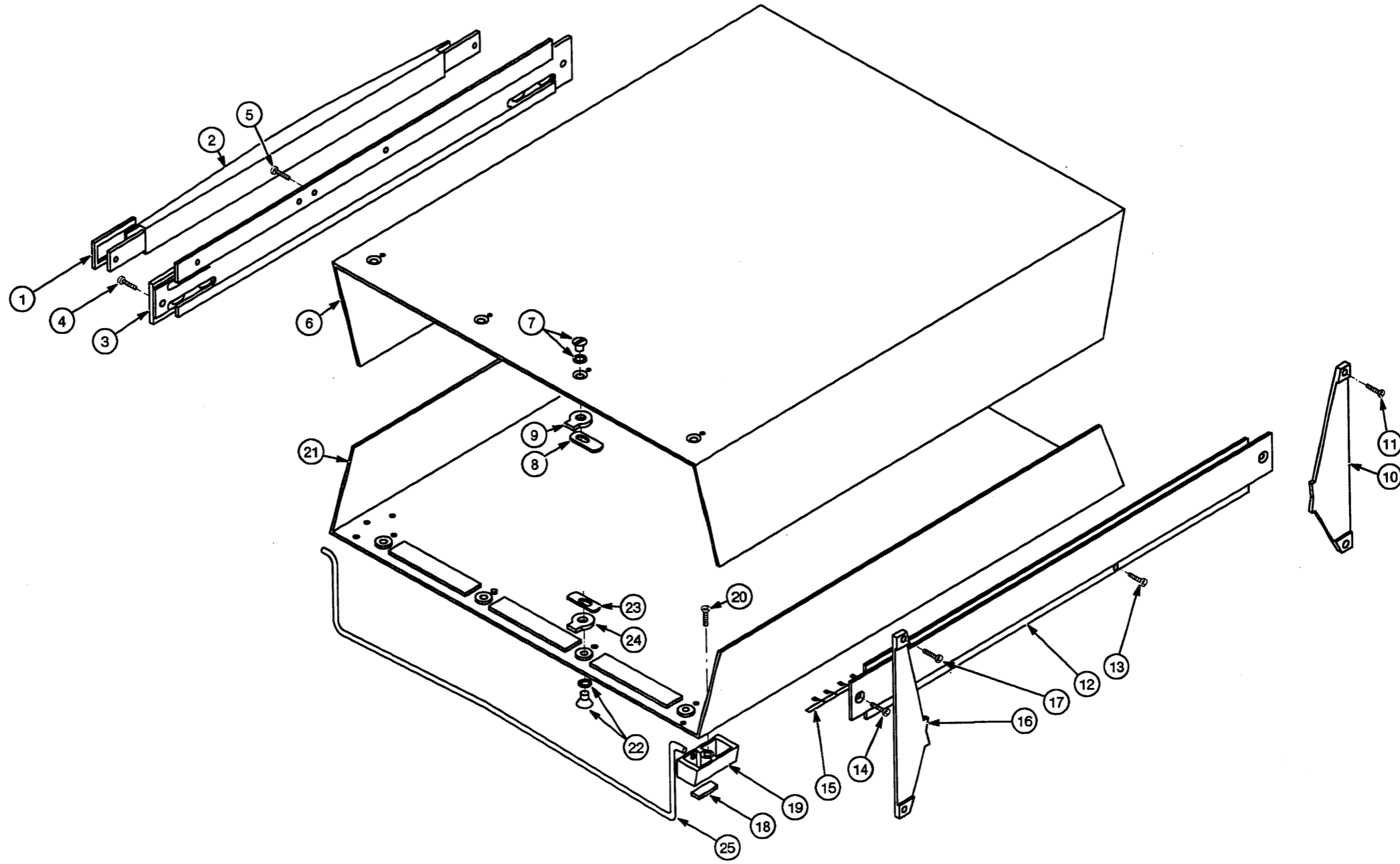
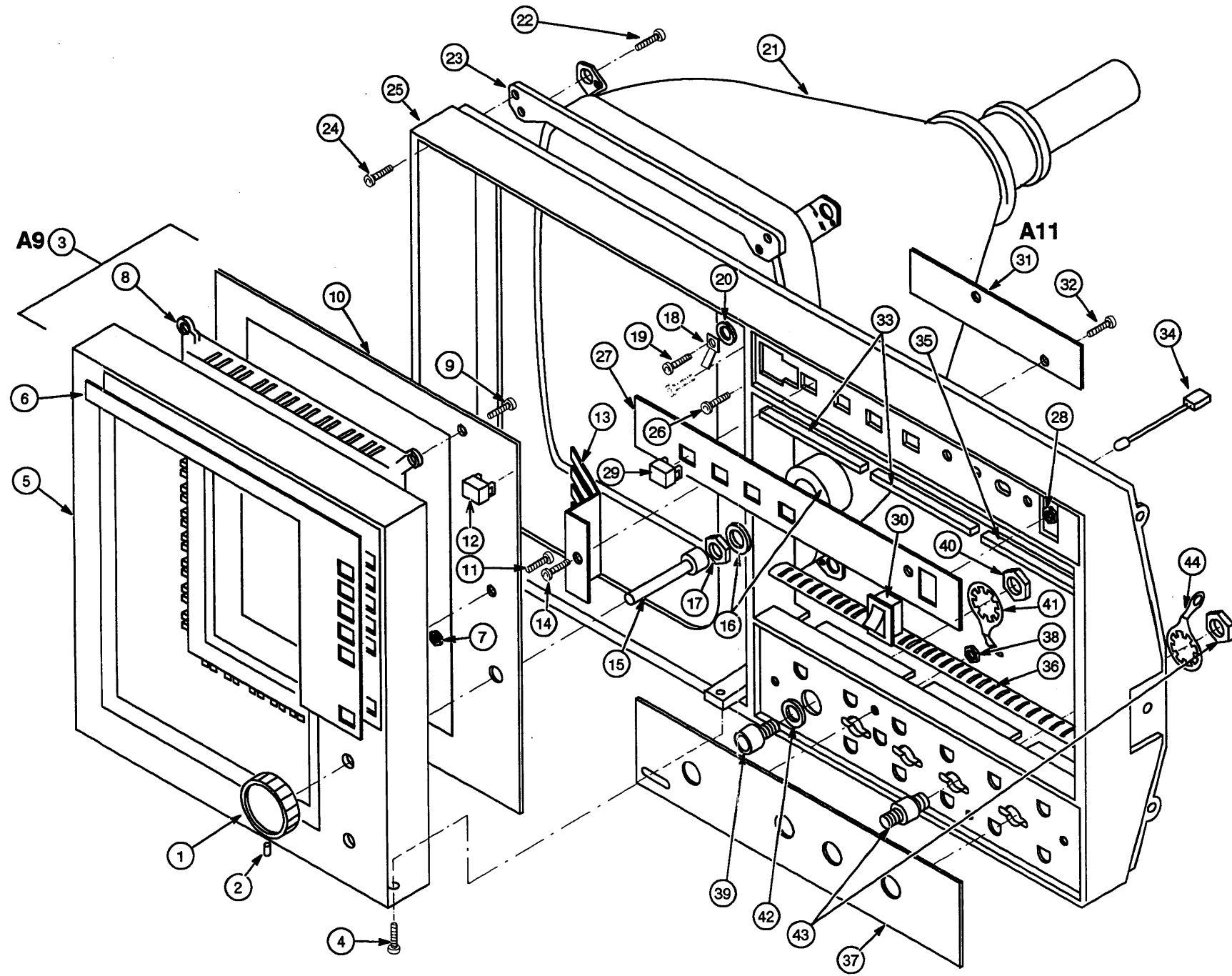


Fig. 2 Front Panel



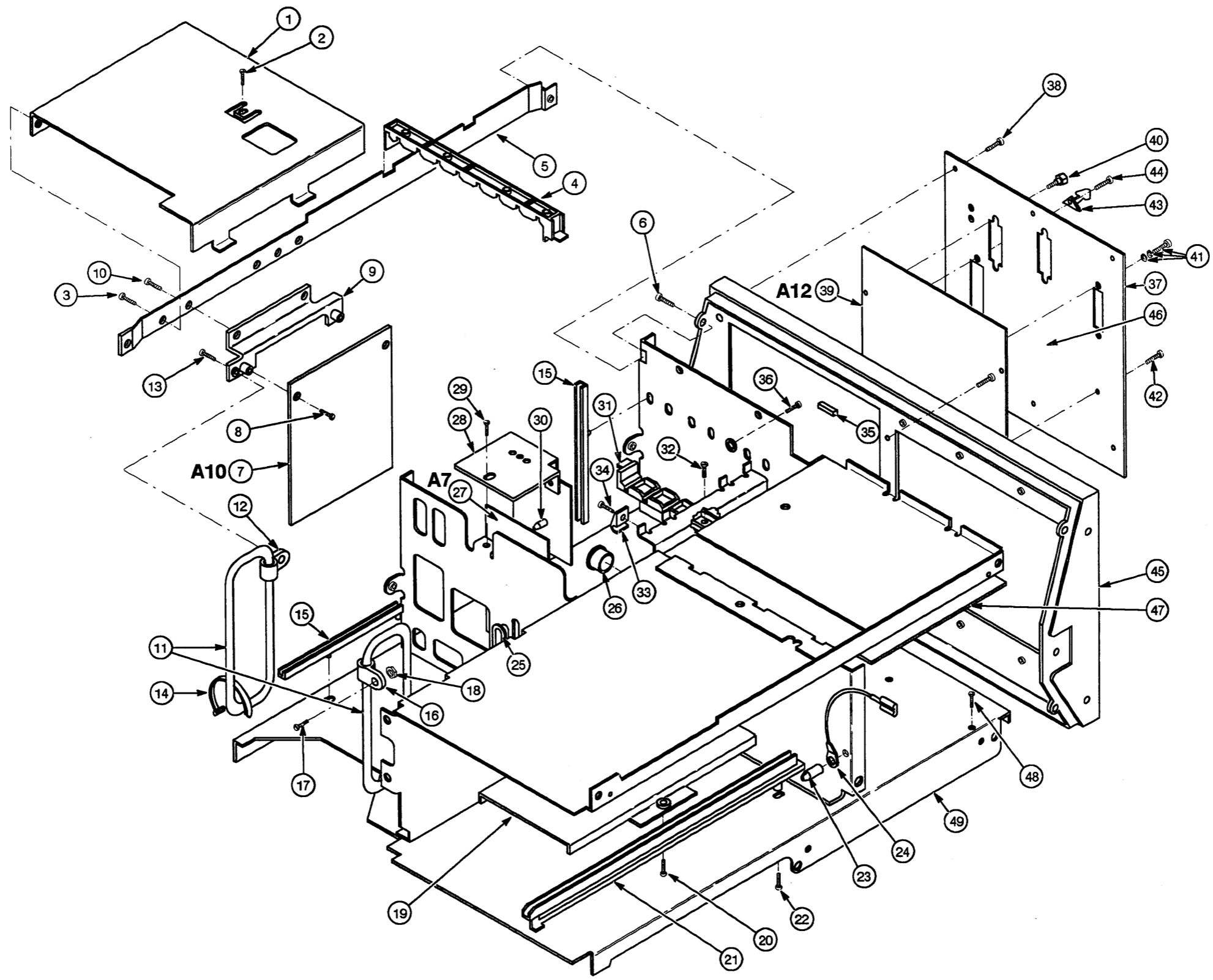
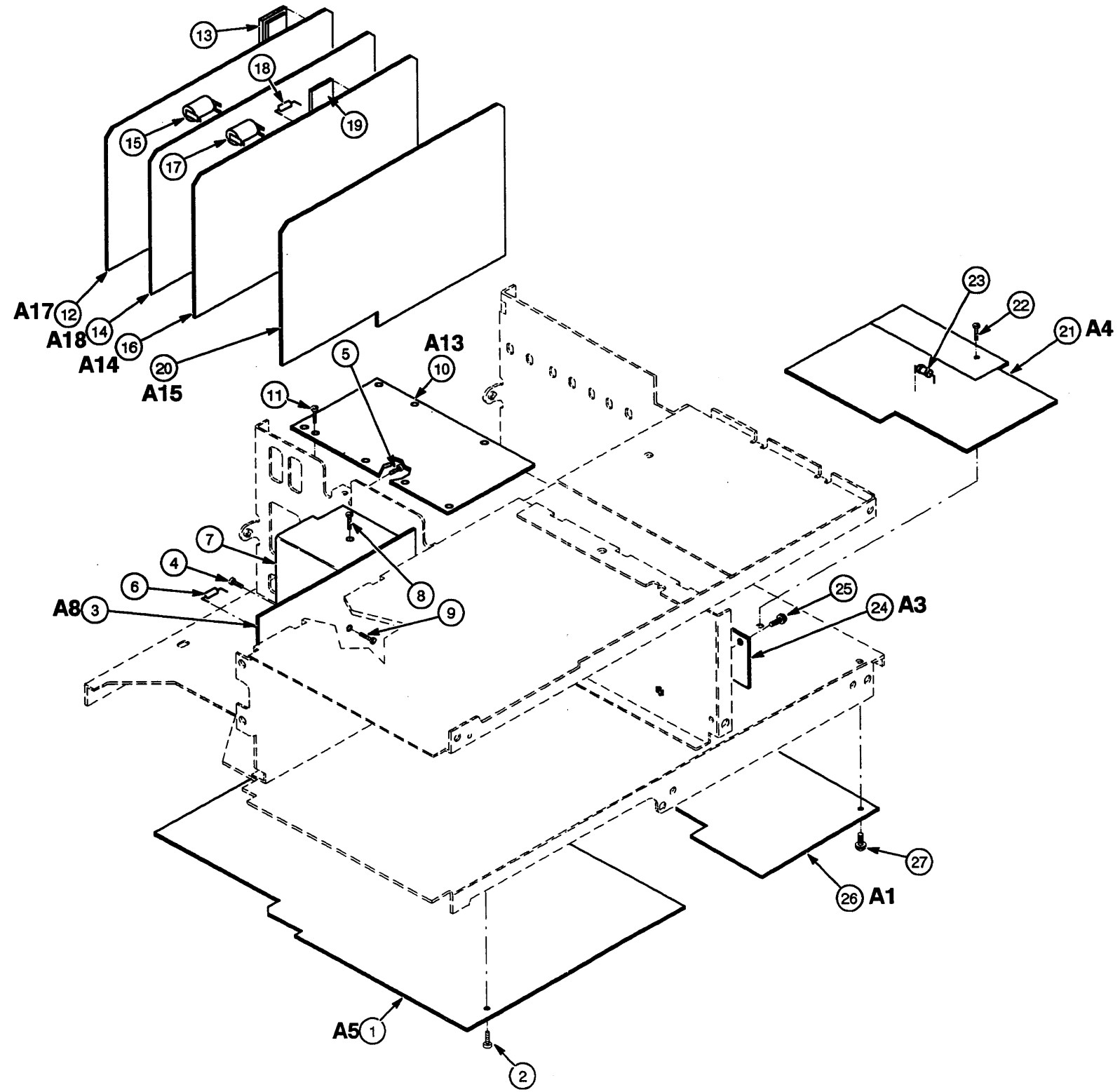




Fig. 4 Circuit Boards



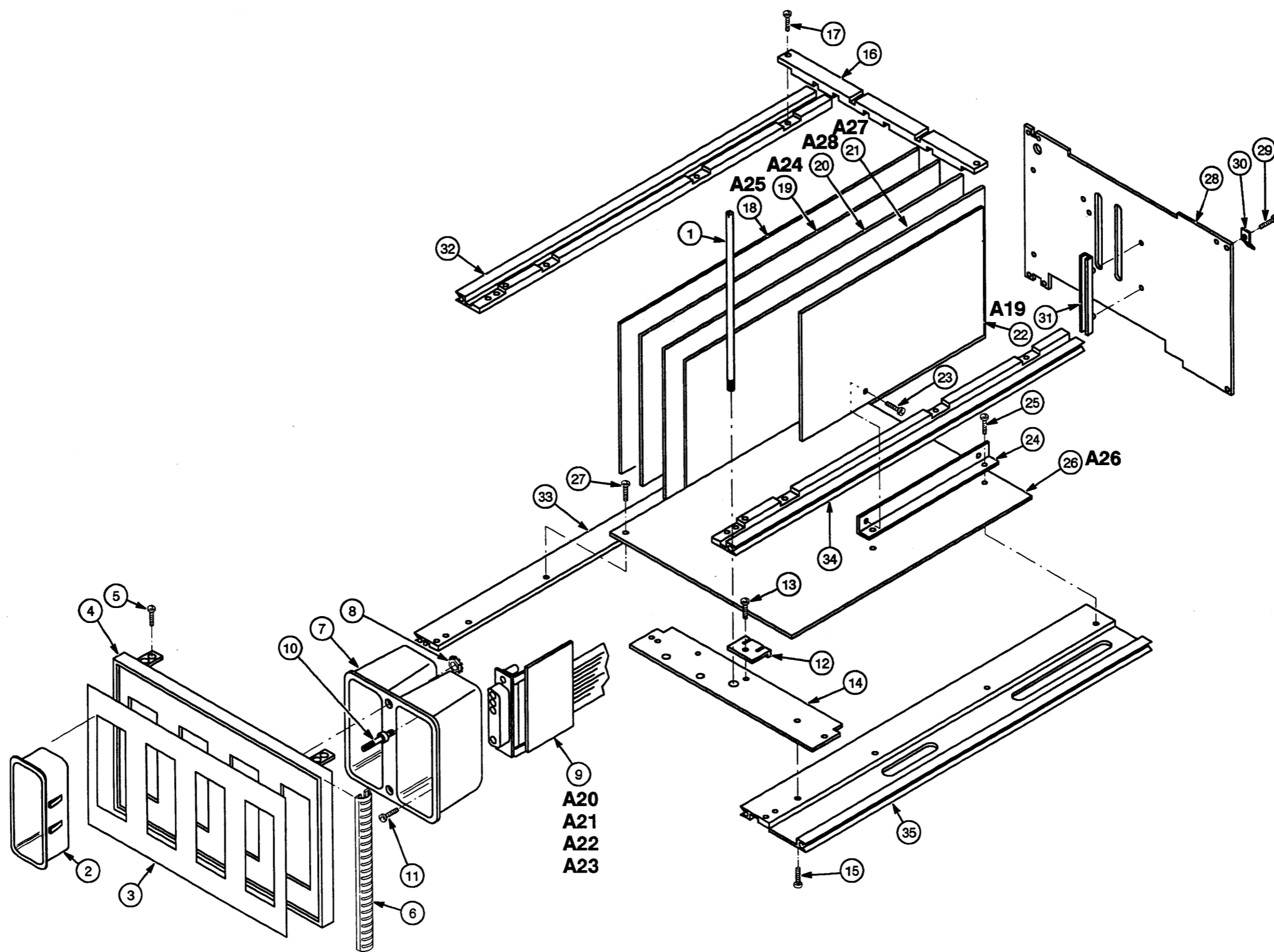


Fig. 6 Power Supply

