TEK **Service Reference Manual**

Part No. 070-7047-00
Product Group 47

THE 11802

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.

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Instrument Serial Numbers

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

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

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

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

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General Information

The *11802 Digital Sampling Oscilloscope Service Reference* manual is designed for use by qualified service personnel. It contains information necessary to check, troubleshoot, and maintain the 11802 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 oscilloscope.

First-time users are encouraged to read *Introducing the 11802 Digital Sampling Oscilloscope*. This is a tutorial manual that will help you to learn the basic functions of the oscilloscope.

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

Safety Summary

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

Terms in Manuals

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

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

Terms on Equipment

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

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

Symbols in Manuals

Static Sensitive Devices

Symbols on Equipment

DANGER High Voltage

Protective ground (earth) terminal

ATTENTION Refer to manual

Power Source

This product is intended to operate from a power source that will not apply more than 250 V rms between the supply conductors or between either supply conductor and ground. A protective ground connection, by way of the grounding conductor in the power cord, is essential for safe operation.

Grounding the Product

This product is grounded through the grounding conductor of the oscilloscope 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.

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 list for your product.

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 11802 Digital Sampling Oscilloscopes. The figure below shows the front panel of the 11802 Digital Sampling Oscilloscope and the locations of the sampling head compartments.

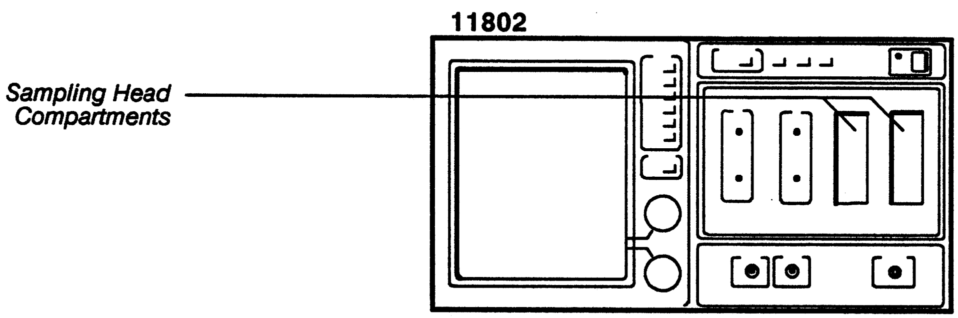


***Figure 1-1** — Sampling Head Compartments in the 11802 Digital Sampling Oscilloscope*

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.

CAUTION

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 oscilloscope operates from a single-phase power source. It has a three-wire power cord and two-pole, three-terminal grounding type plug. The voltage to ground (earth) from either pole of the power source must not exceed the maximum rated operating voltage, 250 V.*

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

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

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 oscilloscope's input or output terminals.

Power Cord Information

A power cord with appropriate plug configuration is supplied with each oscilloscope. Table 1-1, Power-Cord Conductor Identification, gives the color-coding of the conductors in the power cord. If you require a power cord other than the one supplied, refer to Table 1-2, Power-Cord and Plug Identification.

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

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

Memory Backup Power

There are four self-contained power sources within the oscilloscope 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 oscilloscope on-time and power-on sequences
- to retain stored settings and stored trace descriptions
- to retain **Time & Date** parameters
- to retain Time Base Cal Constants (these are regenerated automatically if lost)

The self-contained power sources 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 oscilloscope.

Operating Temperature

The oscilloscope can be operated where the ambient air temperature is between 0° and +50°C and can be stored in ambient temperatures from -40° to +75°C. After storage at temperatures outside the operating limits, allow the chassis to reach the safe operating temperature before applying power.

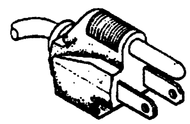
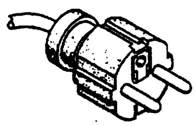
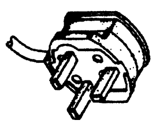
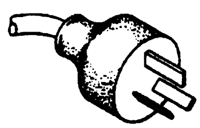
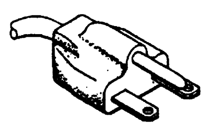
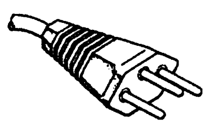
Ventilation Requirements

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

CAUTION

If air flow is restricted, then the oscilloscope'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	[1]ANSI C73.11 [2]NEMA 5-15-P [3]IEC 83 [10]UL [11]CSA	Standard
	European 220 V/6 A	[3]ICE 83 [4]CEE (7), II, IV, VII [8]VDE [9]SEMKO	A1
	United Kingdom 240 V/6 A	[3]IEC 83 [5]BSI 1363	A2
	Australian 240 V/6 A	[6]AS C112 [12]ETSAF	A3
	North American 250 V/10 A	[1]ANSI C73.20 [2]NEMA 6-15-P [3]IEC 83 [10]UL [11]CSA	A4
	Switzerland 240 V/6 A	[7]SEV	A5

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

Packaging for Shipment

If the oscilloscope 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 oscilloscope was shipped should be saved and used for this purpose.

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

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

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

- ☐ Step 1: Obtain a corrugated cardboard shipping carton with a 375-pound test strength and having inside dimensions at least six inches greater than the oscilloscope dimensions. This allows for cushioning.
- ☐ Step 2: Wrap the oscilloscope with polyethylene sheeting or equivalent material to protect the finish.
- ☐ Step 3: Cushion the oscilloscope on all sides by tightly packing dunnage or urethane foam between the carton and the oscilloscope, allowing three inches on each side.
- ☐ Step 4: Seal the carton with shipping tape or with an industrial stapler.
- ☐ Step 5: Mark the address of your local Tektronix service center and your return address on the carton in one or more prominent locations.

Instrument Options

Your oscilloscope may be equipped with one or more instrument options. A brief description of each available option is given in the following discussion. Option information is 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 oscilloscope 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.

Option 25—adds the PEP 301 Systems Controller and instrument drivers.

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 and examines 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 *11802 Digital Sampling Oscilloscope User Reference* manual for more information about specifications and oscilloscope operation. Then, the setup provides information concerning test equipment setup or interconnection. Refer to Table 2-2 for more information concerning test equipment used in the setups.

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

Part and Description	**Measurement Limits *(Example)***	**Specifications *(Check)***	**Adjustments *(Adjust)***	**Functional Test**
Part 1 Power-On Diagnostics	none	none	none	yes
Part 2 Extended Diagnostics	none	none	none	yes
Part 3 Power Supply				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	R730 +10 V Ref for +10.00 V	

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

Part and Description	**Measurement Limits (*Example*)**	**Specifications (*Check*)**	**Adjustments (*Adjust*)**	**Functional Test**
Part 4 Display				no
Vertical Size	±0.050 inch	none	■ R202 Main Brite until raster appears ■ R620 Horiz Hold and R530 Vert Hold for stable display ■ R530 Vert Hold so bottom line at bottom of raster ■ R520 Vert Pos and R120 Vert Size to align grid with index bumps ■ R541 Horiz Lin, R621 Horiz Size, and R540 Horiz Pos for optimum overall linearity and position ■ R202 Main Brite until retrace lines just extinguished ■ R100 Focus for optimum overall focus	
Horizontal Size	±0.050 inch	none		
Vertical Linearity	3.7 ±0.4 lines/ half inch	none		
Horizontal Linearity	5.6 ±0.6 lines/ half inch	none		
Part 5 Real Time Clock	1,000,000 µs ±5 µs		Real Time Clock for 1,000,000 µs	no
Part 6 Vertical Reference Voltage	none	5 ±200 µV and −5 ±200 µV	none	no
Part 7 Horizontal Reference Clock	none	2000,000 kHz ±5 kHz	none	no
Part 8 Vertical Input Offset	none	±2 mV	none	no
Part 9 Vertical Accuracy				
Vertical Gain	none	±1.2%	none	yes
Offset Accuracy	none	±2 mV	none	yes
Vertical Linearity	none	±1%	none	no

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

Part and Description	**Measurement Limits (*Example*)**	**Specifications (*Check*)**	**Adjustments (*Adjust*)**	**Functional Test**
Part 10 Vertical RMS Noise	■ ≤50 dB for 20–200 mV/div full scale ■ ≤40 dB for 20 mV/div full scale	none	none	no
Part 11 Time Base Accuracy				yes
1 ns/division	none	±0.2%	none	
5 μs/division	none	±0.1%	none	
100 ps/division	none	±2%	none	
10 ps/division	none	±10%	none	
1 ps/division	none	±25%	none	
Part 12 System Rise Time and Calibrator Output Accuracy				yes
System Rise Time	none	≤18 ps	none	
Calibrator and System Rise Time	none	≤35 ps	none	
Calibrator Amplitude	none	250 mV ±10%	none	
Part 13 Triggering				yes
1 GHz Sensitivity	none	250 mV display	none	
800 MHz Sensitivity	none	150 mV display	none	
100 MHz Sensitivity	none	50 mV display	none	
Trigger Pickoff				yes
1 GHz Sensitivity	none	1 V display	none	
800 MHz Sensitivity	none	600 mV display	none	
100 MHz Sensitivity	none	200 mV display	none	
Part 14 Internal Clock				yes
Rise Time	≤3 ns	none	none	
Frequency	100 kHz ±1%	none	none	
Duty Cycle	50% ±1%	none	none	
Part 15 Aberrations				no
100 ns and up	≤1%		none	
4 ns to 100 ns	≤2%		none	
1 ns to 4 ns	≤4%		none	
0 ns to 1 ns	≤10% and ≥7%		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 other equipment with similar specifications may be substituted. Test results, setup information, and related connectors and adapters may be altered by the use of different equipment.

***Table 2-2** — Test Equipment*

Description	Minimum Specification	Examples of Applicable Test Equipment
High Frequency Sine Wave Generator	250 MHz to 1000 MHz, Variable amplitude, 6 MHz reference	TEKTRONIX SG 504 Leveled Sine Wave Generator with a TM 500-Series Power Module
Medium Frequency Sine Wave Generator	250 kHz to 250 MHz, Variable amplitude, 50 kHz reference	TEKTRONIX SG 503 Leveled Sine Wave Generator with a TM 500-Series Power Module
Sampling Head	SD-Series	Any Tektronix SD-Series Sampling Head
Time Mark Generator	1 ns through 5 s markers in a 1-2-5 sequence, at least 5 parts in 10^7 accuracy	TEKTRONIX TG 501 Time Mark Generator with a TM 500-Series Power Module
Digital Voltmeter (w/test leads)	≤0.005% Accuracy	Fluke 8842A Digital Voltmeter
Calibration Generator	DC output, 0.25% accuracy 1 V output amplitude	TEKTRONIX PG 506 Calibration Generator with a TM 500-Series Power Module
Calibration Step Generator		TEKTRONIX 067-1338-0X Calibraton Step Generator (where X represents either 1, 2, 3, 5, or 6 depending on the power supply appropri-ate for your country)
Frequency Counter	1 Part in 1,000,000 Accuracy	TEKTRONIX DC 5010 Universal Counter/Timer with a TM 5000-Series Power Module

***Table 2-2** — Test Equipment (cont)*

Description	Minimum Specification	Examples of Applicable Test Equipment
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
Adapters	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
Power Divider, 50 Ω	6 dB load isolation, 50 Ω, SMA connectors	Tektronix Part 015-1014-00
Termination, 50 Ω	Impedance, 50 Ω; accuracy, within 2%; connectors, SMA	Tektronix Part 015-1022-00
Attenuator, 10X	20 dB attenuation, 50 Ω, one male and one female	Tektronix Part 011-0059-02
Power Supplies Troubleshooting Fixture		TEKTRONIX 067-1264-00 Extended Diagnostics 11000-Series Power Supplies troubleshooting fixture
Probe, 10X	Attenuation 10X	TEKTRONIX P6106A

Table 2-2 — *Test Equipment (cont)*

Description	Minimum Specification	Examples of Applicable Test Equipment
Alignment Tool	Plastic hex	Tektronix Part 003-0301-00
	Insulated slot	Tektronix Part 003-0675-01
	Square Tip (ceramic)	Tektronix Part 003-1400-00
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 screw-driver, large	
	Torx head 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	$^{1}/_{2}$ 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 the 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 this procedure. Comprehensive descriptions of menus and oscilloscope features are located in the *11802 Digital Sampling Oscilloscope User Reference Manual*.

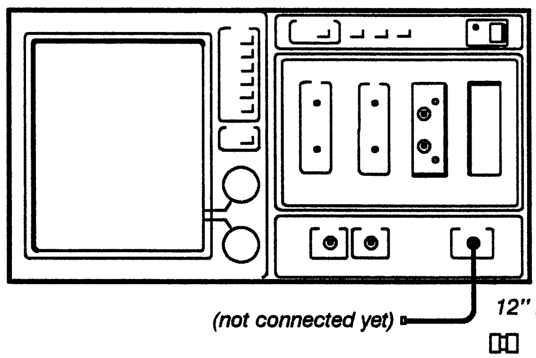
Tutorial Manual

The tutorial manual, *Introducing the 11802 Digital Sampling Oscilloscope*, is strongly recommended to familiarize the first-time user with oscilloscope controls and features.

Calibrating a Sampling Head

Prior to performing Parts 8, 9, 10, 12, and 15 the sampling head must be calibrated for loop gain and offset null.

Setup to Calibrate a Sampling Head



Setup to Calibrate a Sampling Head

Procedure to Calibrate a Sampling Head

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

11802 Oscilloscope
- ON/STANDBY switch .... ON
- UTILITY button .... press
  - **Initialize** .... touch

Sampling head .... no settings required

☐ Step 2: Press the ENHANCED ACCURACY button.

☐ Step 3: Touch **Loop Gain**.

☐ Step 4: Touch the channel number to be calibrated and then **Automatic Calibrate** in the **Loop Gain Calibration** pop-up menu.

☐ Step 5: Connect the CALIBRATOR output to the sampling head input channel to be calibrated.

☐ Step 6: Touch **Proceed** and then **Store Constants** in the **Loop Gain Calibration** pop-up menu.

☐ Step 7: Disconnect the CALIBRATOR from the sampling head input.

☐ Step 8: Touch **Offset Null** in the ENHANCED ACCURACY major menu and then **Automatic Calibrate** in the **Offset Nulling** pop-up menu.

☐ Step 9: Connect a 50 Ω termination to the sampling head input.

☐ Step 10: ouch **Proceed** and then **Store Constants** in the **Offset Nulling** pop-up menu.

☐ Step 11: Touch **Exit**.

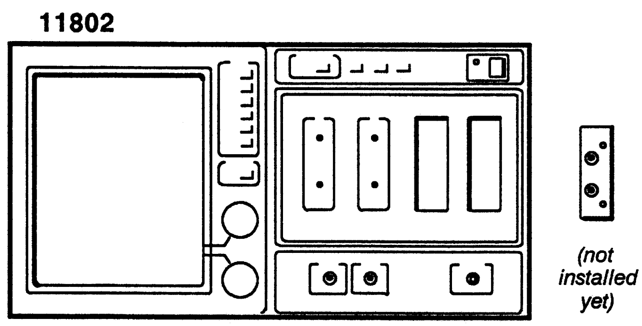
Repeat Steps 1 through 11 for all sampling head compartments and channels being tested.

Whenever the oscilloscope is powered-off, (that is, when in the ON/STANDBY switch is set to STANDBY or the PRINCIPAL POWER SWITCH is set to OFF) perform Steps 1 through 11 to calibrate the sampling head before performing Parts 8, 9, 10, 12, and 15.

Part 1 Power-On Diagnostics

This part must be performed within the ambient temperature range of +18° and +28°C to assure that the oscilloscope operates properly.

Setup to Power-On Diagnostics



Setup to Perform Power-On Diagnostics

Procedure to Power-on Diagnostics

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

11802 Oscilloscope
ON/STANDBY switch .... STANDBY
Sampling head .... Not installed yet

☐ 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 into the left compartment.

☐ 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 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 remain in the ON position. Then, use the front panel ON/STANDBY switch to perform all subsequent power switching.

☐ Step 6: Power-on the following test equipment, so that it is warmed up with the oscilloscope to be tested. A complete list of test equipment is listed in Table 2-2, Test Equipment.

- Digital voltmeter
- HF sine wave generator
- Time mark generator
- Medium frequency sine wave generator
- Calibration generator
- Calibration step generator

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 Power-on 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—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; and 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 in to remove this menu. However, if the diagnostics detect a fatal fault, it may not be possible to exit the menu.

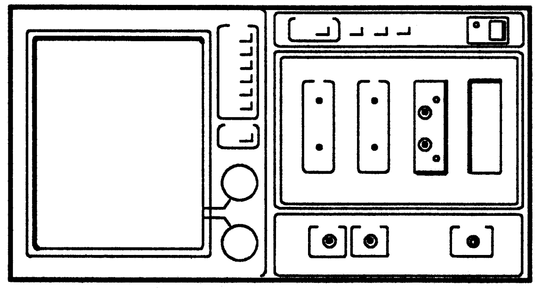
Completion of Power-on Diagnostics—is a message displayed when graticule is displayed, and the front panel settings that were in effect at the last power-off are restored, when the oscilloscope passes Power-on diagnostics (assuming that the **Extended Diagnostics** menu was not displayed).

Part 2 Extended Diagnostics

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

Setup to Invoke Extended Diagnostics

11802



Setup to Invoke Extended Diagnostics

The oscilloscope should have entered the normal operating mode without any diagnostic failures.

Perform the following steps to enter the Extended Diagnostics mode and run the indicated tests. No inputs or I/O cables should be attached to the oscilloscope for these tests.

Procedure to Invoke Extended Diagnostics

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

11802 Oscilloscope
- ON/STANDBY switch .... ON

Sampling head
- SELECT CHANNEL On/Off .... Off

CAUTION

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 NV RAM tests, may result in losing stored settings, save trace descriptions, or other data stored in NV RAM. However, this does not seriously affect oscilloscope operation.

☐ Step 2: Press the UTILITY button.

☐ Step 3: Touch **Diag/Self Test**.

☐ Step 4: Touch **Extended Diagnostics** in **Diag/Self Test** pop-up menu.

☐ Step 5: Touch **All** and then **Run** to start the tests.

☐ Step 6: *Check* that all tests have executed and have a Pass status.

☐ Step 7: Touch the following selectors in order:

- **Executive**
- **Block**
- **Input/Output**
- **Area**
- **GPIB**
- **Routine**

☐ Step 8: Touch **Run** to start the **Intrpt Reset** test.

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

☐ Step 10: Touch **Data Lines** and then **Run** to start the test.

☐ Step 11: Touch **Interrupt** and then **Run** to start the test.

All four tests should have executed and passed.

☐ Step 12: Touch **Exit** twice to exit Extended Diagnostics.

Part 3 Power Supply

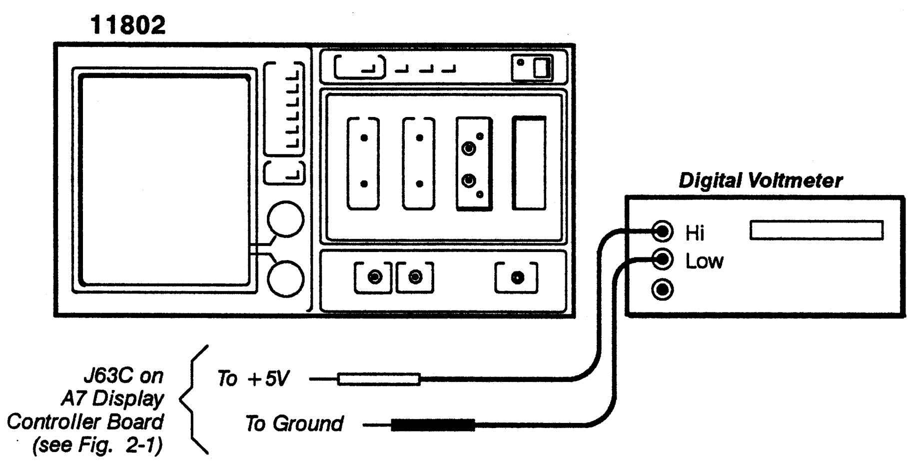
This part shows the setup and lists the procedure to check the measured voltage supply, the voltage reference, and the regulator reference (see Fig. 2-1, 2-2, and 2-3).

Measurement Limits

The measurement limits for this part are as follows:

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

Setup to Examine Voltage Supply



Setup to Examine Voltage Supply

Procedure to Examine Voltage Supply

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

Sampling head .... No settings required
11802 Oscilloscope .... No settings required
Digital voltmeter
    Mode .... DC Voltage

☐ Step 2: *Examine* the digital voltmeter for a reading within the limits of +4.85 V and +5.25 V.

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

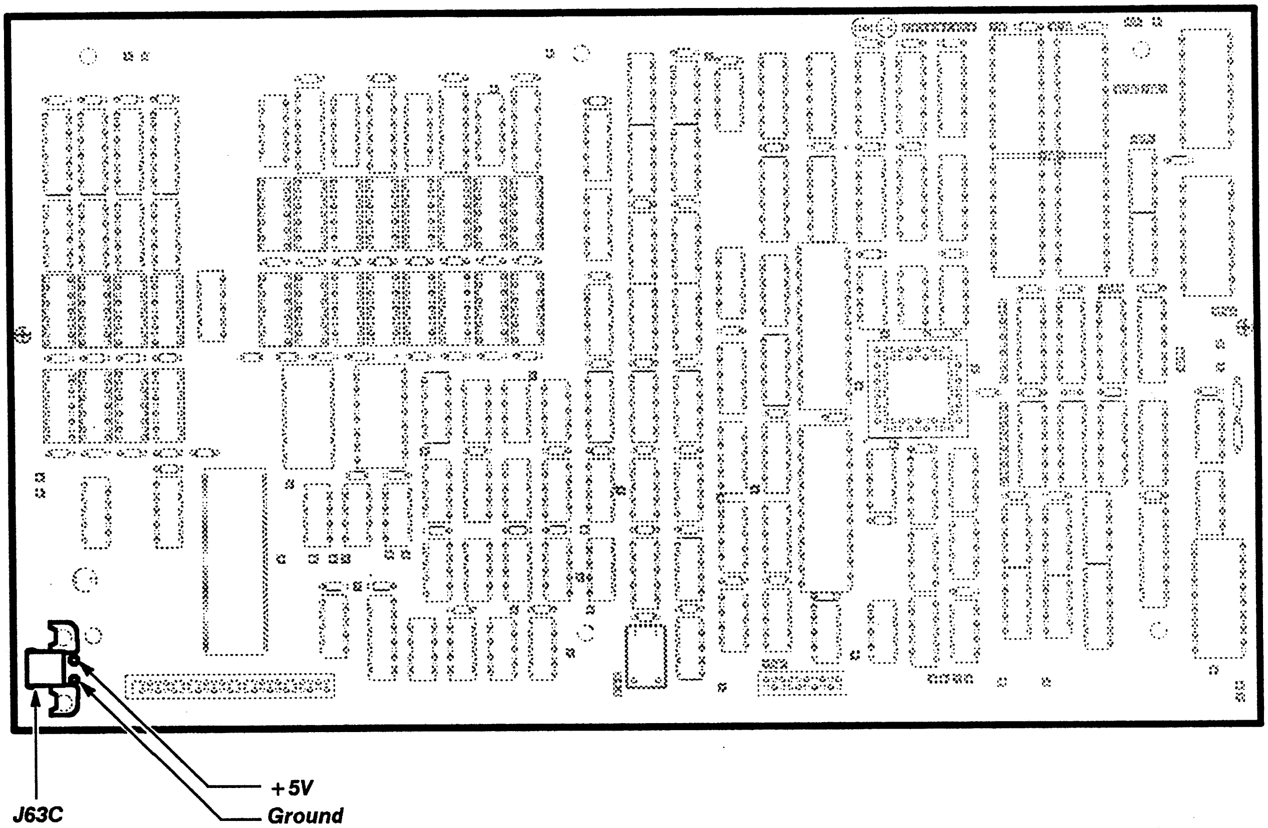
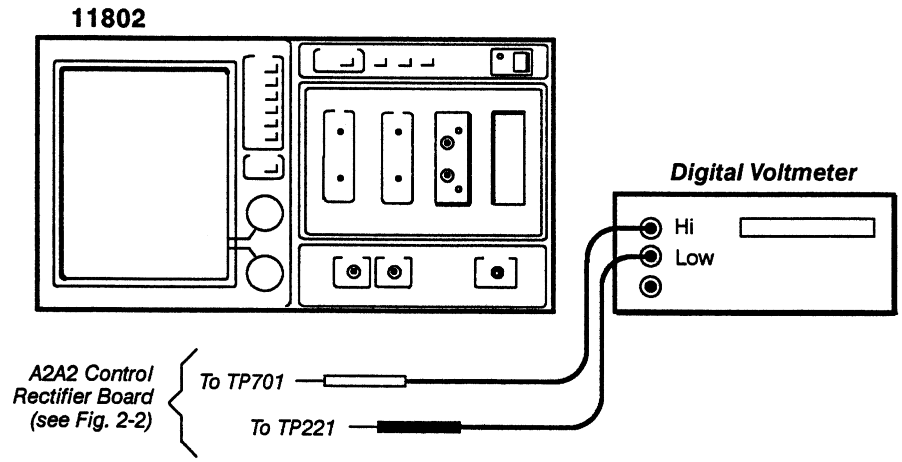


Figure 2-1 — A7 Display Controller Board Test Point Locations

Setup to Examine/Adjust Voltage Reference



Setup to Examine/Adjust Voltage Reference

Procedure to Examine/Adjust Voltage Reference

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

11802 Oscilloscope

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

b. Remove the Power Supply module, following the instructions given under Power Supply Module Removal in Section 3, Maintenance.

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

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

e. Set the rear panel PRINCIPAL POWER SWITCH to ON.

Digital voltmeter

Mode .... DC voltage

Sampling head .... Not used

WARNING

Extreme caution must be used when making the following adjustment.

☐ Step 2: *Examine* the digital voltmeter for a reading of +5.20 V, within the limits of +5.15 and +5.25 V.

STOP

DO NOT attempt to adjust the +5.2 V Ref adjustment, if the reading is within the stated limits. Proceed to Step 5.

☐ Step 3: *Adjust* +5.2 V Ref adjustment R800 on the A2A2 Control Rectifier board for +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 shorting strap.

☐ Step 8: Replace the Power Supply module following 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.

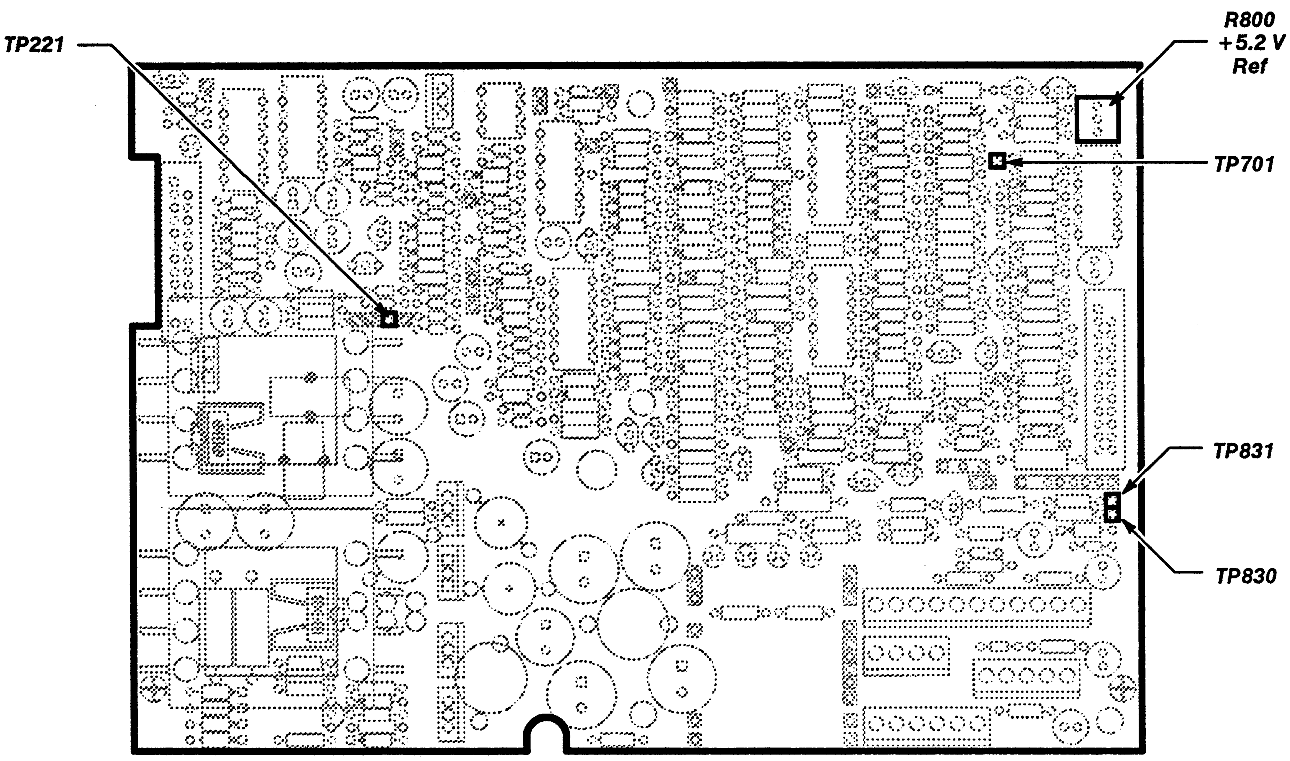
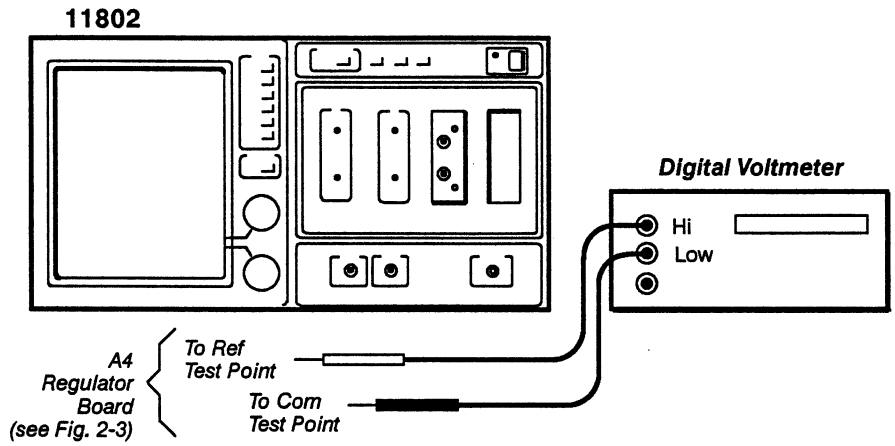


***Figure 2-2** — A2A2 Control Rectifier Board Test Point and Adjustment Locations*

Setup to Examine/Adjust Regulator Reference



Setup to Examine/Adjust Regulator Reference

Procedure to Examine/Adjust Regulator Reference

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

Sampling head .... Not used
11802 Oscilloscope .... No changes
Digital voltmeter
  Mode .... DC Voltage

WARNING

Extreme caution must be used when making the following adjustment.

☐ Step 2: *Examine* the digital voltmeter for a reading of +10.00 V, within the limits of +9.95 V and +10.05 V.

STOP

DO NOT attempt to adjust the +10 V Ref adjustment R730, if the reading is within the stated limits. Proceed to Step 4.

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

☐ Step 4: Remove the test leads.

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

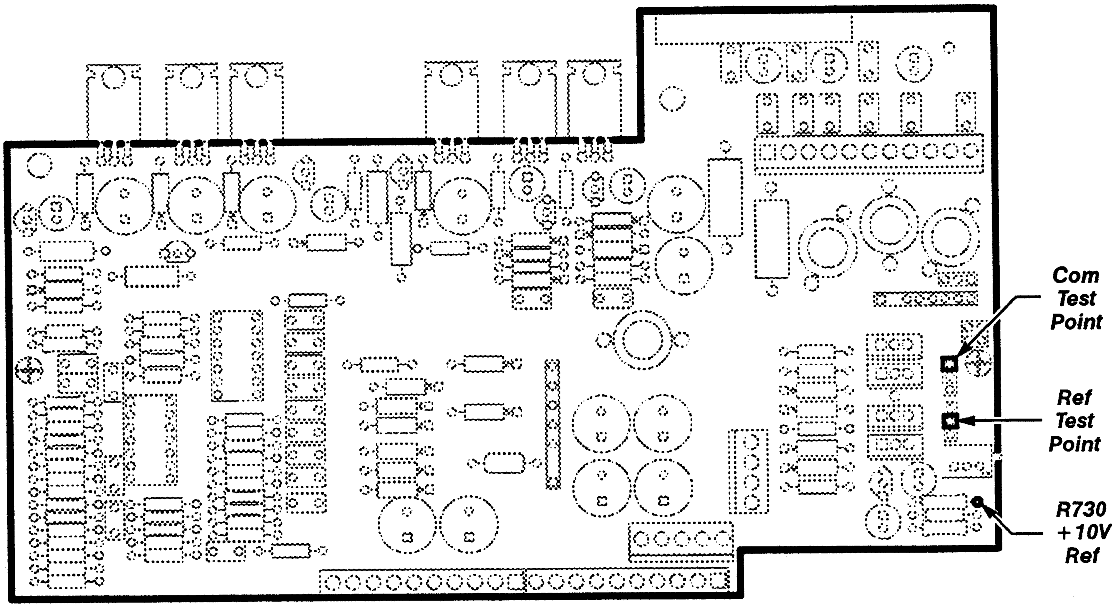


Figure 2-3 — *A4 Regulator Board Test Point and Adjustment Locations*

Part 4 Display

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

STOP

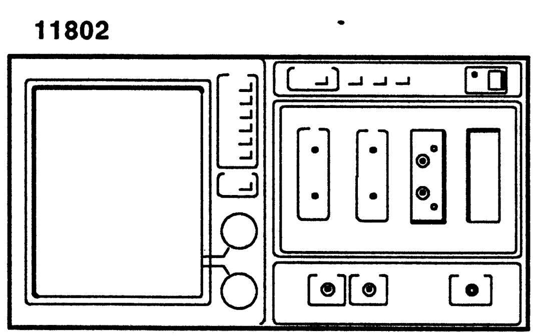
The adjustments in this part only affects the visual aspects of the CRT display and are to be made only when the CRT or A8 CRT Driver board components are replaced. These adjustments do not affect oscilloscope accuracy since all measurements are made on the acquired data, not the displayed data. Unless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

Measurement Limits

The measurement limits are set on the CRT as follows:

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

Setup to Examine/Adjust A8 CRT Driver Board



Setup to Examine/Adjust A8 CRT Driver board

WARNING

Extreme caution must be used when making the following adjustment.

Procedure to Examine/Adjust A8 CRT Driver Board

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

11801 Oscilloscope .... No settings required
Sampling head .... No settings required

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

☐ Step 3: *Adjust* Main Brite adjustment R202 on the A8 CRT Driver board clockwise until the raster appears.

☐ Step 4: *Adjust* Horiz Hold adjustment R620 and Vert Hold adjustment R530 A8 CRT Driver board so that a stable display appears on the screen.

☐ Step 5: Press the UTILITY button.

☐ Step 6: Touch **Extended Diagnostics** in the UTILITY major menu and then **Yes** in the **Extended Diag Verification** pop-up menu.

☐ Step 7: Touch **Area** and then **Verify**.

☐ Step 8: Touch **Routine** and then **Soft Keys**.

☐ Step 9: Touch **Run** (a grid pattern will fill the display area).

☐ Step 10: *Adjust* Vert Hold adjustment R530 so that the bottom line is at (or near) the bottom of the raster.

☐ Step 11: *Adjust* Vert Pos adjustment R520 and Vert Size adjustment L120 A8 CRT Driver board to align the grid with the index bumps along the inside vertical edge of the front panel bezel. There are three indexes along each side: one at each of the two corners and one in the center. To eliminate any parallax error, look directly into the CRT, align the top of the grid display with the top vertical index, the bottom of the grid with the bottom index, and the grid centerline with the center index. Optimize the settings of R520 and L120 for the optimum overall alignment.

☐ Step 12: Touch **Exit** once to remove the grid pattern.

☐ Step 13: Touch **Exit** twice.

☐ Step 14: Touch **Extended Diagnostics** in the UTILITY major menu and then **Yes** in the **Extended Diag Verification** pop-up menu.

☐ Step 15: Touch **Block** and then **Front Panel**.

☐ Step 16: Touch **Area** and then **Verify**.

☐ Step 17: Touch **Routine** and then **Soft Keys**.

☐ Step 18: Touch **Run** in the UTILITY major menu.

☐ Step 19: Use a small ruler (or piece of paper with a one-half inch increment marked on the edges) to measure the number of horizontal lines within 0.5 inches of the top, center, and bottom of the screen. (Count both the light and heavy lines.)

☐ Step 20: *Examine* the number of horizontal lines within a half-inch increment, of the top, center, and bottom of the screen (do not count the first line) to be from 3.3 to 4.1 lines.

☐ Step 21: *Adjust* Horiz Lin adjustment R541, Horiz Size adjustment R621, and Horiz Pos adjustment R540 A8 CRT Driver board for optimum overall linearity and position. Use the horizontal indexes along the top and bottom of the front panel bezel to align the grid by the same method used in Step 11.

☐ Step 22: *Examine* the number of vertical lines per half-inch at the top, center, and bottom of the screen to be 5.6 ±0.6 lines.

☐ Step 23: R621 Horiz Size, R541 Horiz Lin, and R540 Horiz Pos interact and therefore you may need to repeat Step 22 until R621, R541, and R540 are adjusted properly.

☐ Step 24: Touch **Exit**.

☐ Step 25: *Adjust* Main Brite adjustment R202 counter-clockwise until the retrace lines are just extinguished.

☐ Step 26: Touch **Exit** twice.

☐ Step 27: Touch **Instr Options** in the UTILITY major menu and then **Display Intensity** in the **Instrument Options** pop-up menu.

☐ Step 28: Use either control knob to set the display intensity to 100%.

☐ Step 29: *Adjust* Focus adjustment R100 A8 CRT Driver board for optimum overall focus.

☐ Step 30: Set the control knob for normal intensity (approximately 70%).

☐ Step 31: Replace the CRT protective shield.

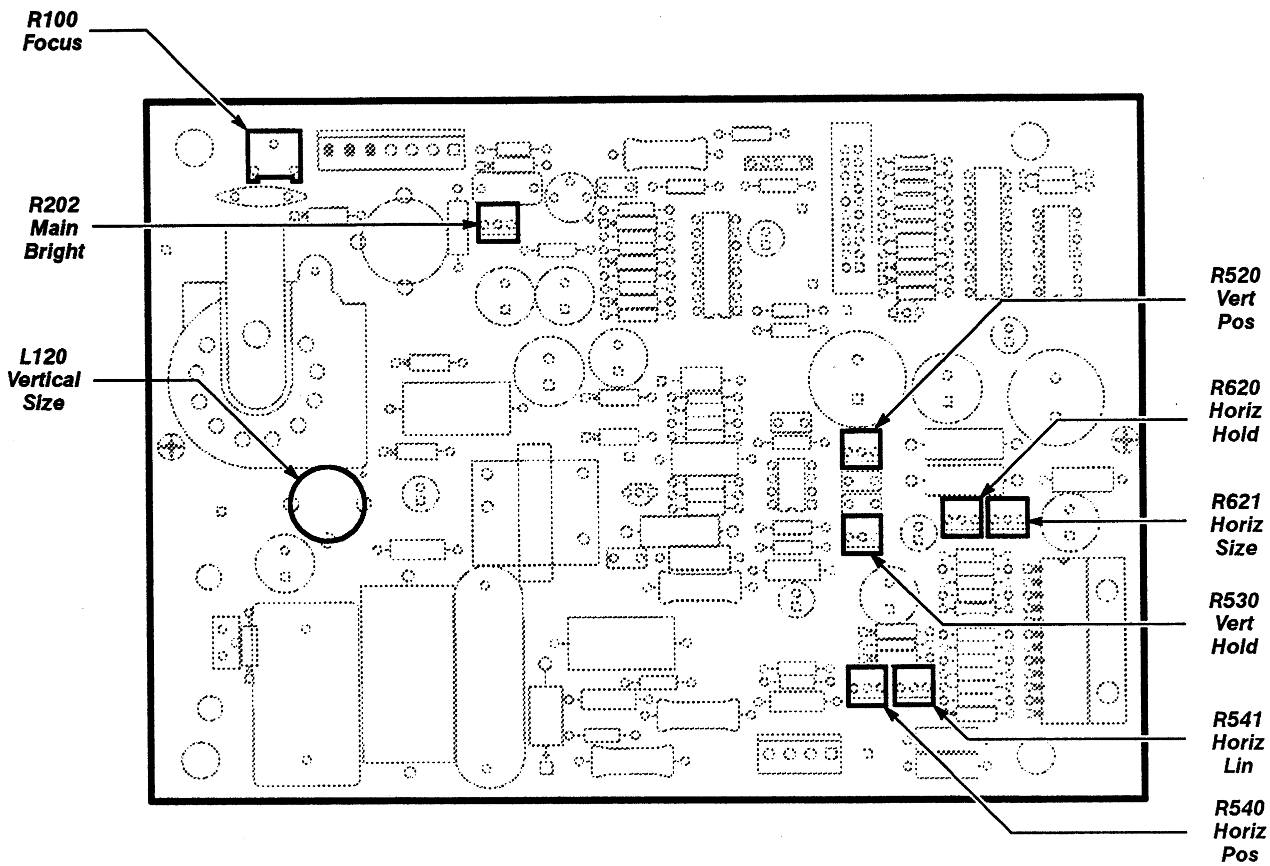


***Figure 2-4** — A8 CRT Driver Board Adjustment Locations*

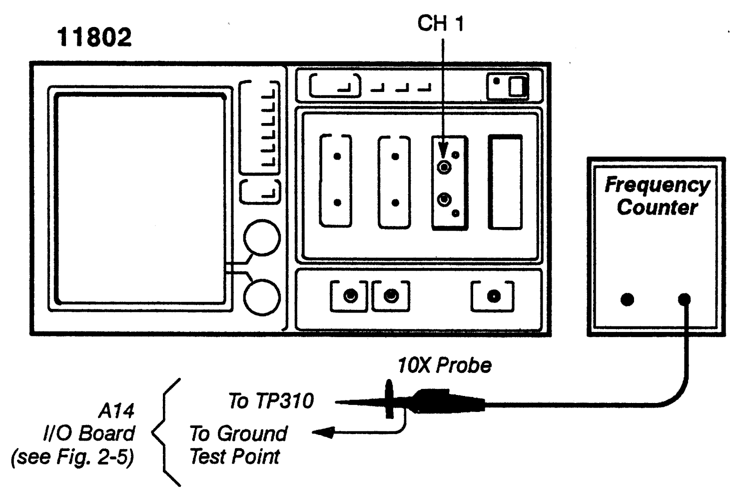
Part 5 Real Time Clock

This part verifies the correct operation and accuracy of the oscilloscope's input/output systems (see Fig. 2-5).

Measurement Limits

The measurement limit for the real time clock is 1,000,000 μs ±5 μs.

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, then perform the following settings in the order listed.

11802 Oscilloscope

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

b. Remove the L bracket on the front of the card cage.

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

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

e. Remove the A29 Memory Expansion board, and then place it in the third slot.

f. Remove the A14 Input/Output (I/O) board, and then place it in second slot.

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

h. Reconnect all the cables to A14 I/O board.

i. Set the oscilloscope front panel ON/STANDBY switch to ON.

Frequency counter

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

☐ Step 2: Press the UTILITY button.

☐ Step 3: Touch **Diag/Self Test**.

☐ Step 4: Touch **Extended Diagnostics** in **Diag/Self Test** pop-up menu.

☐ Step 5: Touch **Extended Diagnostics** and then **Yes** in the **Extended Diag Verification** pop-up menu.

☐ Step 6: Touch the following selectors in the order given:

- **Block**
- **Input/Output**
- **Area**
- **Real Time Clk**
- **Routine**
- **Calibrate**
- **Run**

☐ Step 7: *Examine* that the frequency counter reads within the limits of 999,995 μs and 1,000,050 μs.

DO NOT attempt to optimize the adjustment setting if the period is within the stated limits. Proceed to Step 7.

☐ Step 8: *Adjust* the Real Time Clock adjustment C510 for 1,000,000 μs.

☐ Step 9: Remove the frequency counter from the power module and replace it with the medium frequency sine wave generator.

☐ Step 10: Replace the circuit boards (rearranged in Step 1) to their original positions.

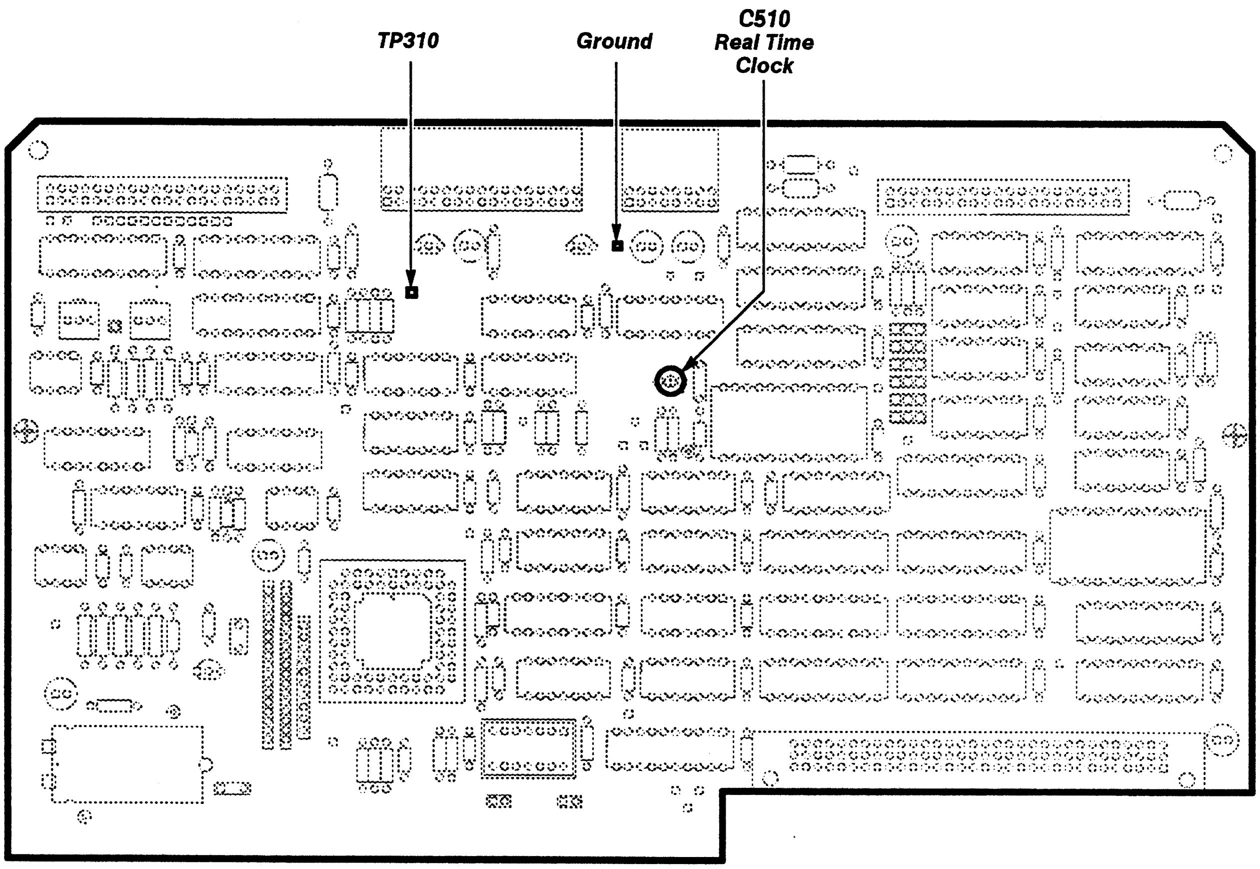


***Figure 2-5** — A14 I/O Board Test Point and Adjustment Locations*

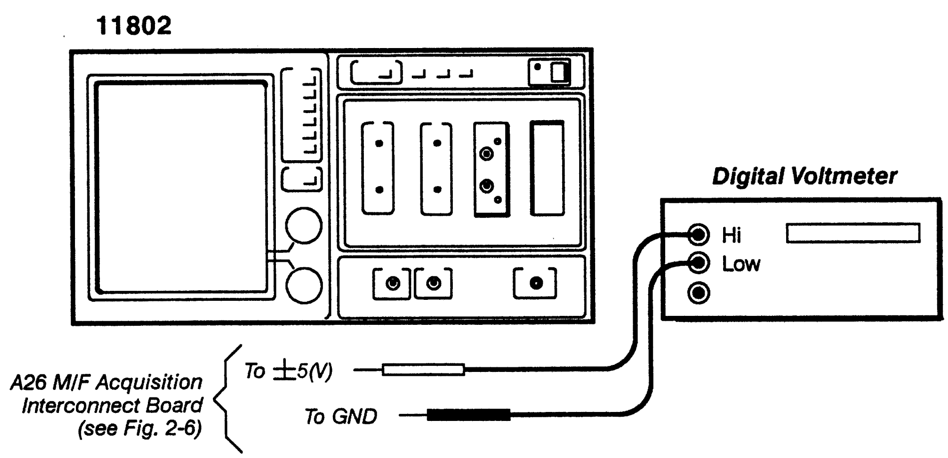
Part 6 Vertical Reference Voltage

This part checks that the vertical reference voltage is at ±5 V at J63C on the A26 M/F Acquisition Interconnect board (see Fig. 2-6).

Specifications

The measured voltage must be within the limits of 5 V ±200 µV and -5 V ±200 µV.

Setup to Check Vertical Reference Voltage



Setup to Check Vertical Reference Voltage

Procedure to Check Vertical Reference Voltage

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

Sampling head .... No settings required
11802 Oscilloscope .... No settings required
Digital voltmeter
Mode .... DC Voltage

☐ 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: *Check* the digital voltmeter for a reading of +5 V ± 200 µV.

☐ Step 4: Connect the digital voltmeter to the -5 (V reference) point and GND on the A26 M/F Acquisition Interconnect board.

☐ Step 5: *Check* the digital voltmeter for a reading of -5 V ± 200 µV.

STOP

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 7, Horizontal Reference Clock.

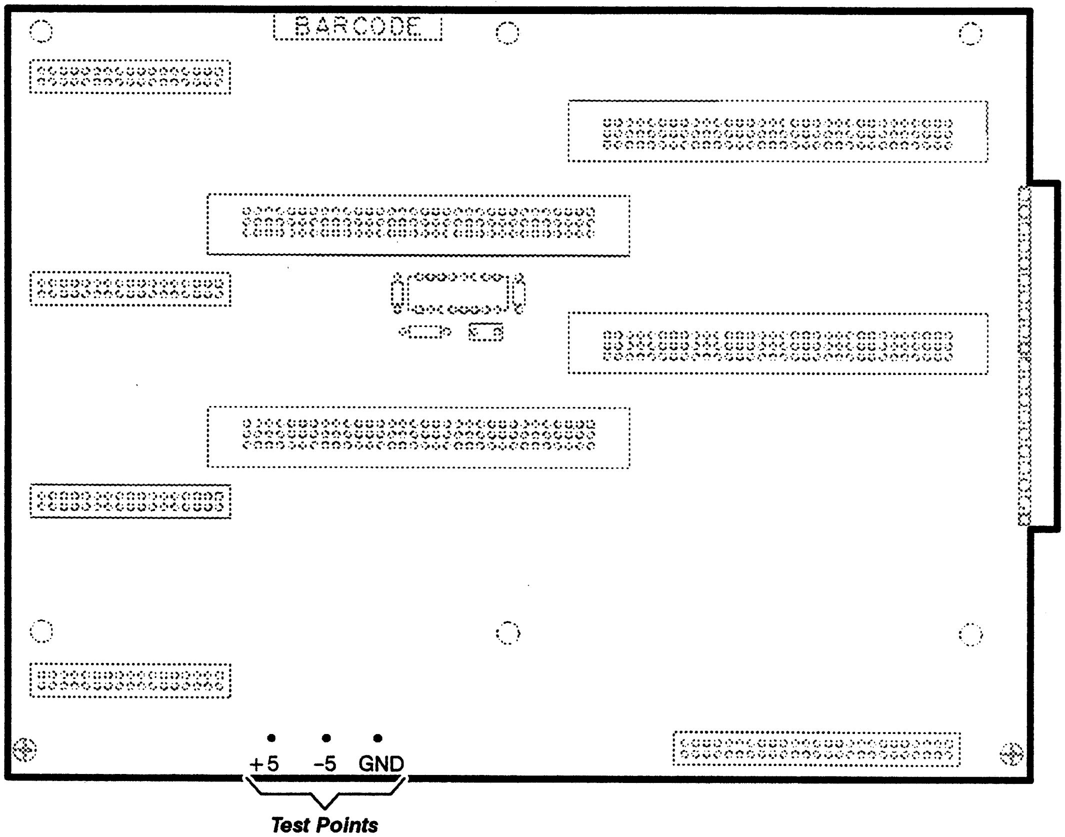


***Figure 2-6** — A26 M/F Acquisition Interconnect Board Test Point Locations*

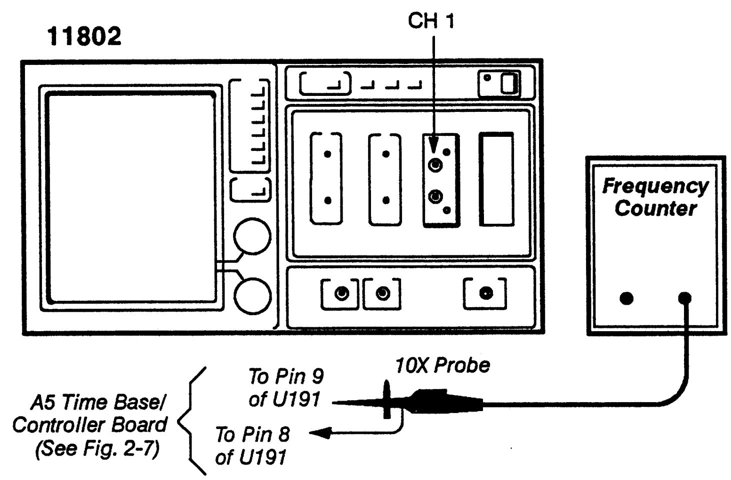
Part 7 Horizontal Reference Clock

This part verifies the correct operation and accuracy of the oscilloscope's horizontal reference clock (see Fig. 2-7).

Specifications

The specifications for the horizontal reference clock is 200,00 kHz ± 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, then perform the following settings in the order listed.

11802 Oscilloscope

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

b. Set the oscilloscope on its right side (as viewed from facing the front of the oscilloscope).

c. Set the oscilloscope front panel ON/STANDBY switch to ON.

Frequency counter

Mode .... Frequency A
Trigger .... AC
Slope .... + (positive)
Attenuation 1X
Termination .... 1 MΩ

Sampling head .... No settings required

☐ Step 2: Touch the 10X Probe to pin 9 and the ground probe to pin 1 of U191 on the A5 Time Base/Controller board.

☐ Step 3: *Check* that the frequency counter reads within the limits of 199,995 kHz and 200,005 kHz.

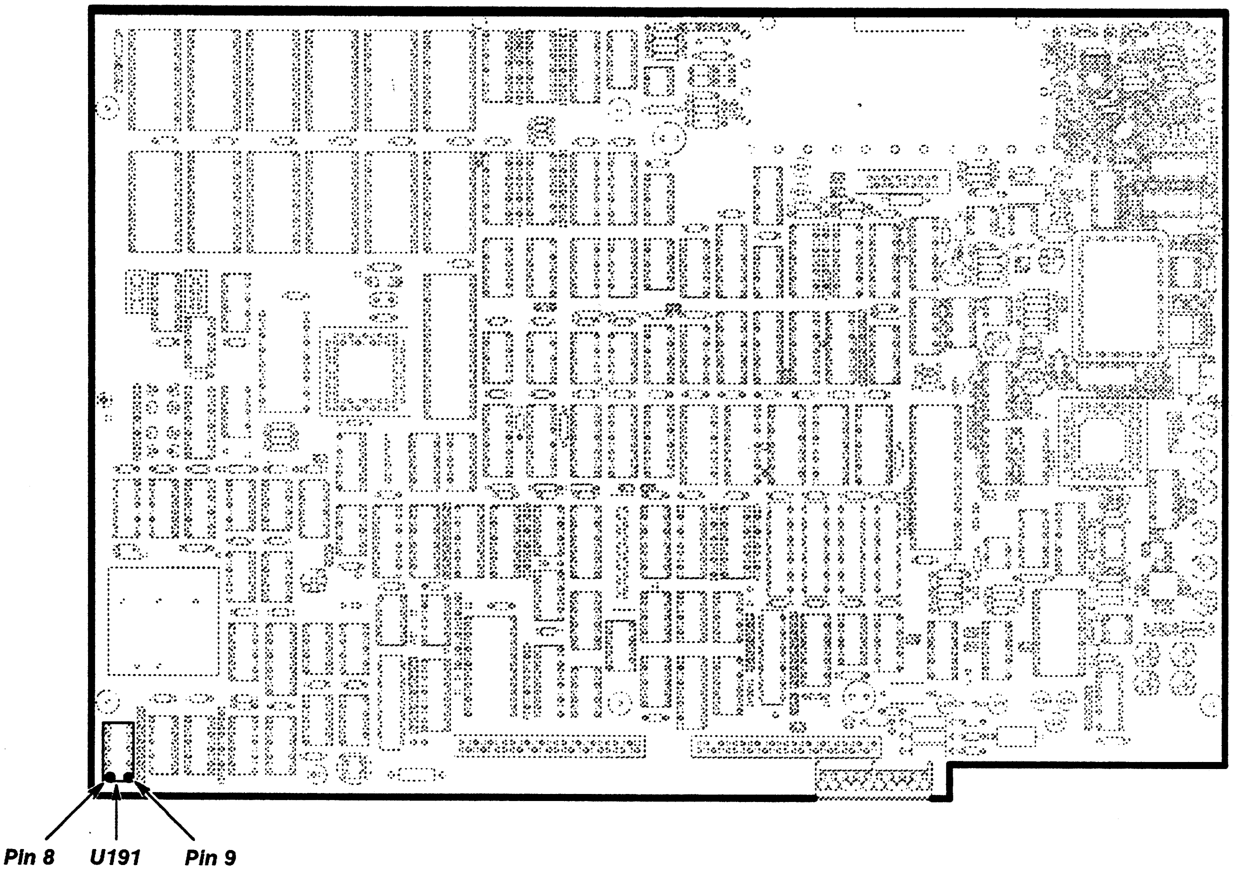


***Figure 2-7** — A5 Time Base/Controller Board Test Point Locations*

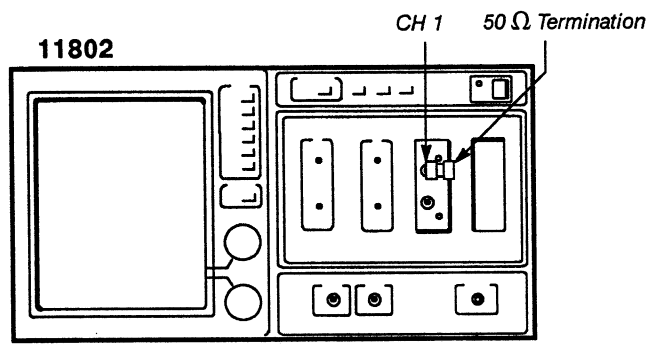
Part 8 Vertical Input Offset

This part checks the vertical input offset accuracy of the oscilloscope. The offset is checked/set in the Mean measurement mode. If the sampling head has not been calibrated for loop gain and offset null since the last power-off (that is when the ON/STANDBY switch is set to STANDBY or the PRINCIPAL POWER SWITCH is set to OFF), then perform the Procedure to Calibrate a Sampling Head under Using These Procedures earlier in this section.

Specification

The vertical input offset must be within ±2 mV.

Setup to Check Vertical Input Offset



Setup to Check Vertical Input Offset

Procedure to Check Vertical Input Offset

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

Sampling head
- SELECT CHANNEL On/Off .... On

11802 Oscilloscope
- TRIGGER button .... press
  - **Source** pop-up menu .... **Internal Clock**
- **Vert Offset: MX** .... 0 V
- **Vert Size: MX** .... 2 mV/div
- MEASURE button .... Press
  - **Measurements** pop-up menu .... **Mean**
- WAVEFORM button .... press
  - **Acquire Desc** pop-up menu .... **Average N** to **On**

☐ Step 2: *Check* that the trace is within one division of the horizontal center-line and that the magnitude of **Mean** is ≤2 mV.

☐ Step 3: Repeat steps 1 and 2 for all sampling head compartments in the oscilloscope.

STOP *Proceed to Part 9, Vertical Accuracy only if Step 2 is within the stated limits for all sampling head compartments.*

Part 9 Vertical Accuracy

This part shows the setups and lists the procedures to check the vertical accuracy of the oscilloscope. If the sampling head has not been calibrated for loop gain and offset null since the last power-off (that is when the ON/STANDBY switch is set to STANDBY or the PRINCIPAL POWER SWITCH is set to OFF), then perform the Procedure to Calibrate a Sampling Head under Using These Procedures earlier in this section.

Specifications

The specifications for this part are as follows:

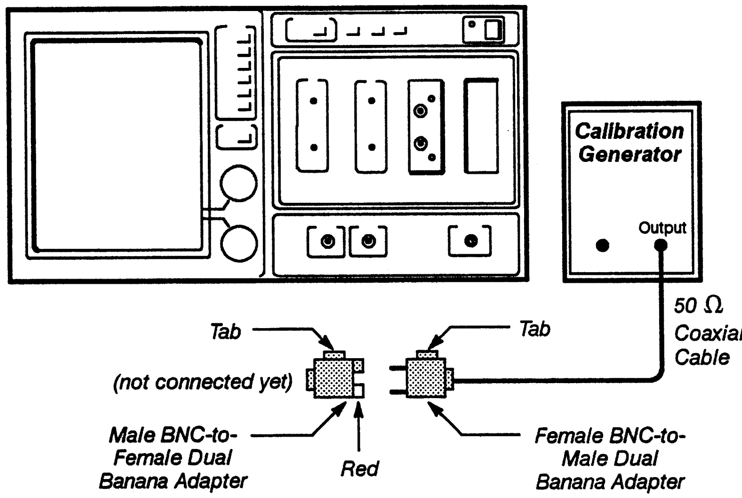
- the vertical gain must be within 1.2%
- the offset accuracy must be within ±2 mV
- the vertical linearity must be within 1%

***Table 2-3** — Vertical Accuracy Systems Settings*

Vert Size: M1	Calibration Generator's Actual Amplitude	PG 506 Calibration Generator Amplitude Setting	Divisions of Vertical Deflection
200 mV/division	0.5 V	1.0 V	±2.5 divisions
100 mV/division	0.25 V	0.5 V	±2.5 divisions
50 mV/division	0.1 V	0.2 V	±2.0 divisions
20 mV/division	.05 V	0.1 V	±2.5 divisions
10 mV/division	.025 V	.05 V	±2.5 divisions
5 mV/division	.01 V	.02 V	±2.0 divisions
2 mV/division	.005 V	.01 V	±2.5 divisions

Note: *The values in this table were chosen for use with the PG 506 Calibration Generator. The Calibration Generator's Actual Amplitude values are one-half of the Amplitude dial setting. For example to get the desired 0.5 V DC signal for the first test the Amplitude dial setting must be 1 V.*

Setup to Check Vertical Gain



Setup to Check Vertical Gain

Procedure to Check Vertical Gain

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

Sampling head
- SELECT CHANNEL On/Off .... On

11802 Oscilloscope
- TRIGGER Button .... press
  - **Mode** .... **Auto**
- WAVEFORM button .... press
  - **Acquire Description** pop-up menu .... **Average N** to **On**
- MEASURE button .... press
  - **Measurements** pop-up menu .... **Mean**

Calibration generator .... Not connected yet

☐ Step 2: With no signal applied, touch the vertical icon, and then set **Vert Size: M1** from 200 to 2 mV/division. If the trace does not remain on the horizontal centerline, then perform the following:

- Press the ENHANCED ACCURACY button.
- Touch the **Offset Null** and then **Manual Calibrate** in the **Offset Nulling** pop-up menu.
- Touch **Offset Null:M1** and then **Fine** in the **Knob Resolution** pop-up menu.
- Position the trace on the horizontal centerline with the offset knob.

☐ Step 3: Set the internal switch in the calibration generator to produce a DC signal and then the Mode to Std Ampl.

☐ Step 4: Set the **Vert Size: M1** to 200 mV/div (refer to Table 2-3, Vertical Accuracy System Settings for **Vert Size: M1** settings on successive tests).

☐ Step 5: Connect the DC signal from the calibration generator (refer to Table 2-3, Vertical Accuracy System Settings for the correct PG 506 Calibration Generator Amplitude Setting for each test) through an adapter with a male BNC-to-female dual banana and an adapter with a male dual banana-to-female BNC to the channel input connector. The ground tabs on the banana adapters must be matched together for a positive deflection.

Note: *The process of averaging a DC signal to its peak amplitude can be a tedious process. To accelerate this process, you can touch the horizontal icon, and then turn the* ***Main Pos*** *knob one click. The trace will appear at its final amplitude in a few seconds.*

☐ Step 6: Press the MEASURE button.

☐ Step 7: Touch **Mean** and then set **Data Interval** to **whole zone** in the **Mean** pop-up menu.

☐ Step 8: Press the MEASURE button to observe the trace and verify that the trace is +2.0 or +2.5 divisions from the centerline. (Refer to Table 2-3, Vertical Accuracy System Settings for the correct amount of deflection for each vertical size and amplitude setting.)

☐ Step 9: Touch **Compare and References**, and then set **Compare** to **on** in the **Compare and Reference Values** pop-up menu.

☐ Step 10: Touch the **Save Current Values as References** selector.

☐ Step 11: Reverse the connection between the two adapters shown in the preceeding setup.

☐ Step 12: Verify that the trace is −2.0 or −2.5 divisions from the horizontal centerline.

☐ Step 13: *Check* that Δ**mean** in the MEASURE major menu is twice the Calibration Generator's Actual Amplitude Setting listed in Table 2-3, Vertical Accuracy System Settings, ±1.2%.

☐ Step 14: Repeat Steps 4 through 13 for 100 through 2 mV/div; setting the calibration generator to obtain 4-5 divisions total defection. (Refer to Table 2-3, Vertical Accuracy System Settings for the correct Calibration Generator's Amplitude Setting and the vertical defection specification for each **VERT SIZE: M1** test.)

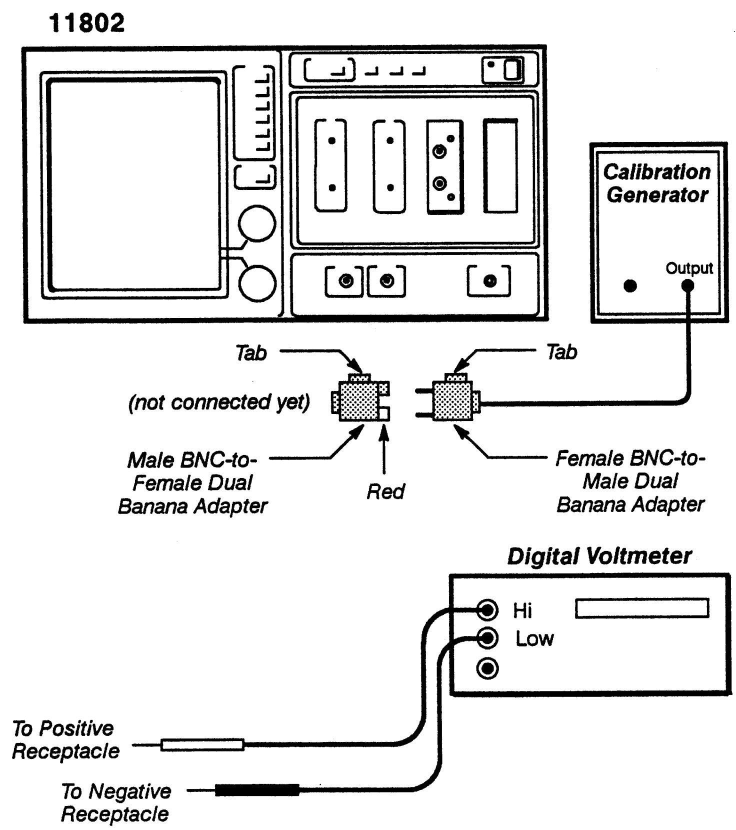
☐ Step 15: Disconnect the banana adapters from the oscilloscope and the coaxial cable.

☐ Step 16: Connect the coaxial cable to the DELAY LINE 1 INPUT through a BNC-to-SMA adapter.

☐ Step 17: Connect the DELAY LINE 1 OUTPUT to the sampling head input that was previously used through the 8.5 inch RF cable.

☐ Step 18: *Check* that Δ**mean** is one-half the Calibration Generator's Actual Amplitude value listed in Table 2-3, Vertical Accuracy System Settings, ±1.2%.

Setup to Check Offset Accuracy



Setup to Check Offset Accuracy

Procedure to Check Offset Accuracy

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

Sampling head
SELECT CHANNEL On/Off .... On
11802 Oscilloscope
TRIGGER button .... press
Mode .... **Auto**
Source .... **Internal Clock**
WAVEFORM button .... press
Acquire Description pop-up menu .... **Average N** to **On**
MEASURE button .... press
Measurements pop-up menu .... **Mean**

Calibration generator .... Not connected yet
Digital voltmeter
Mode .... DC Voltage

☐ Step 2: Set **Vert Size: M1** to 10 mV/div.

☐ Step 3: Set **Vert Offset: M1** to 0 V. The trace should be at the center of the screen. If the trace does not remain on the horizontal centerline, then perform the following:

- Press the ENHANCED ACCURACY button.
- Touch the **Offset Null** and then **Manual Calibrate** in the **Offset Nulling** pop-up menu.
- Touch **Offset Null:M1** and then **Fine** in the **Knob Resolution** pop-up menu.
- Position the trace on the horizontal centerline with the offset knob.

☐ Step 4: Connect the 1 V DC signal (the PG 506 Calibration Generator's amplitude dial setting should be 2 V) from the calibration generator through an adapter with a male BNC-to-female dual banana and an adapter with a male dual banana-to-female BNC to the channel input connector and then set the Mode of the calibration generator to Std Ampl.

☐ Step 5: Unscrew the male BNC-to-female dual banana adapter receptacles so that the small holes in the conductors are showing. Insert the positive reference lead of the digital voltmeter into the positive receptacle (the one opposite of the black ground tab) of the male BNC-to-female dual banana adapter, and then screw the receptacle back into place until the digital voltmeter's lead is secure. Insert the ground lead of the digital voltmeter into the negative receptacle of the male BNC-to-female dual banana adapter, and then screw the receptacle back into place until the voltmeter's lead is secure.

☐ Step 6: Touch **Vert Offset: M1**.

☐ Step 7: Touch **1** and then **CHS** in the **Numeric Entry** pop-up menu.

☐ Step 8: Touch **Enter**.

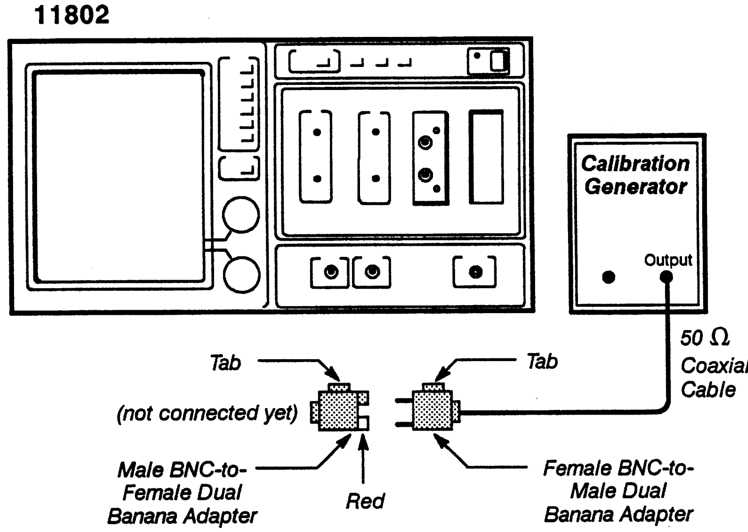
☐ Step 9: Touch **Vert Offset: M1**.

☐ Step 10: Touch **Fine** in the **Knob Resolution** pop-up menu.

☐ Step 11: Use the Offset knob to move the waveform to the center of the screen.

☐ Step 12: *Check* that **Vert Offset: M1** reading is within ±2 mV of the digital voltmeter's reading.

Setup to Check Vertical Linearity



Setup to Check Vertical Linearity

Procedure to Check Vertical Linearity

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

Sampling head
- SELECT CHANNEL On/Off .... On

11802 Oscilloscope
- TRIGGER button .... press
  - **Mode** .... **Auto**
  - **Source** .... **Internal Clock**
- WAVEFORM button .... press
  - **Acquire Description** pop-up menu .... **Average N** to **On**
- MEASURE button .... press
  - **Measurements** pop-up menu .... **Mean**
- **Vert Size: M1** .... 100 mV/div

Calibration generator .... Not connected yet

☐ Step 2: Apply a 100 mV DC signal from the calibration generator.

Note: *The process of averaging a DC signal to its peak amplitude can be a tedious process. To accelerate this process, you can touch the horizontal icon, and then turn the* **Main Pos** *knob one click. The trace will appear at its final amplitude in a few seconds.*

☐ Step 3: Press the MEASURE button

☐ Step 4: Touch the **Mean** selector in the **Measurements** pop-up menu, and then set **Data Interval** to **whole zone.**

☐ Step 5: Press the MEASURE button.

☐ Step 6: Touch **Compare and References**, and then set **Compare** to **on.**

☐ Step 7: When the trace has reached its peak amplitude, then touch **Save Current Values as References.**

☐ Step 8: Reverse the connection between the two adapters shown in the preceeding setup, and then record that Δ **mean** for later use.

Note: *The process of averaging a DC signal to its peak amplitude can be a tedious process. To accelerate this process, you can touch the horizontal icon, and then turn the* ***Main Pos*** *knob one click. The trace will appear in a few seconds at its final amplitude.*

☐ Step 9: Reconnect the adapters as configured in the preceeding setup, and then apply a 250 mV DC signal from the calibration generator.

☐ Step 10: When the trace has reached its peak amplitude, then touch **Save Current Values as References.**

☐ Step 11: Reverse the connection between the banana adapters, and then record Δ **mean** for later use.

☐ Step 12: Reconnect the adapters as configured in the preceeding setup, and then apply a 500 mV DC signal from the calibration generator.

☐ Step 13: Touch **Save Current Values as References.**

☐ Step 14: Reverse the connection between the two adapters, and then record the Δ **mean** for later use.

☐ Step 15: *Check* that for each Δ **mean** recorded, the

$$abs\left[1 - \left(\frac{2 \times Nominal\ \ DC\ \ voltage\ \ applied}{\Delta\ \mathbf{mean}}\right)\right] \times 100\%$$

is $\leq$1%.

☐ Step 16: Repeat all of Part 9 for all sampling head compartments in the oscilloscope.

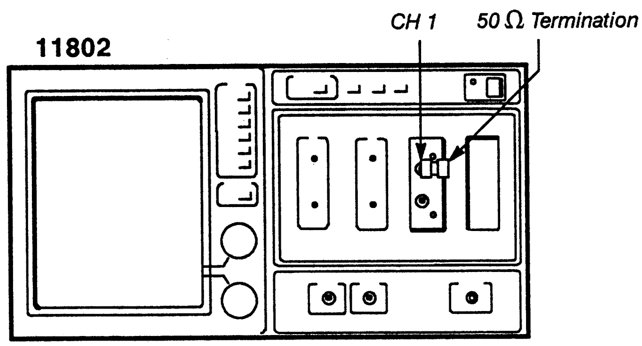
Part 10 System Vertical RMS Noise

This part uses the RMS measurement function to measure the noise on the trace from a sampling head compartment. If the sampling head has not been calibrated for loop gain and offset null since the last power-off (that is when the ON/STANDBY switch is set to STANDBY or the PRINCIPAL POWER SWITCH is set to OFF), then perform the Procedure to Calibrate a Sampling Head under Using These Procedures earlier in this section.

Measurement Limits

The measurement limits for vertical linearity noise (relative to full scale) is ≤50 dB at 20 mV/division to 200 mV/div full scale and ≤40 dB at 2 mV/division full scale.

Setup to Examine Vertical RMS Noise



Setup to Examine Vertical RMS Noise

Procedure to Examine Vertical RMS Noise

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

Sampling head
- SELECT CHANNEL On/Off .... On

11802 Oscilloscope
- **Def Tra** .... press
  - **M1** .... press
  - **-** .... press
  - **Avg(** .... press
  - **M1** .... press
  - **)** .... press
  - **Enter Desc** .... press
- TRIGGER button .... press
  - **Mode** .... **Auto**
- MEASURE button .... press
  - **Measurements** pop-up menu .... **RMS**
  - **RMS** selector .... touch
  - **Data Interval** .... **whole zone**

☐ Step 2: *Examine* that the **RMS** readout on the screen is ≤2 mV (≃50 dB at 200 mV full scale).

☐ Step 3: Repeat Steps 1 and 2 for each sampling head compartment.

Part 11
Time Base Accuracy

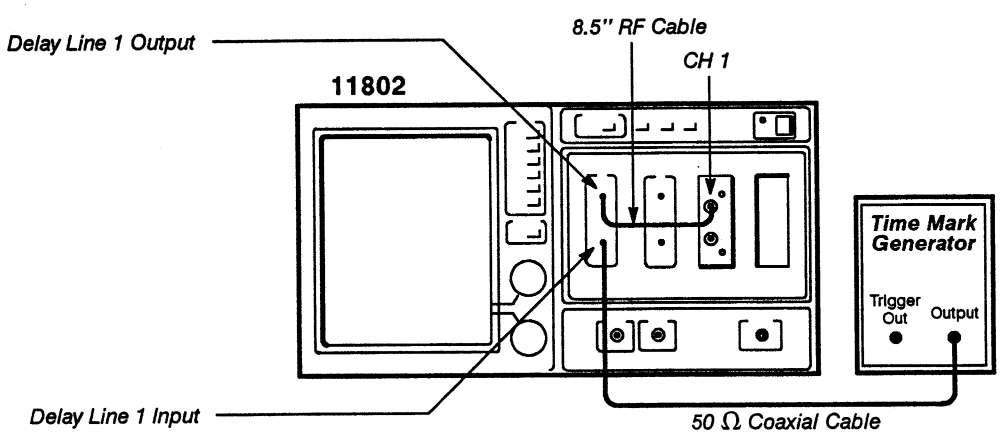
This part shows the setup and lists the procedure to check the time base accuracy.

Specifications

The specifications for the time base accuracy is as follows:

- ±0.2% at 1 ns/division
- ±0.1% at 5 μs/division
- ±2% at 100 ps/division
- ±10% at 10 ps/division
- ±25% at 1 ps/division

Setup to Check Time Base Accuracy at 1 ns/div and 5 μs/div



Setup to Check Time Base Accuracy at 1 ns/div and 5 μs/div

Procedure to Check Time Base Accuracy at 1 ns/div and 5 μs/div

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

Sampling head

SELECT CHANNEL On/Off . . . . Off

(Do not press the SELECT CHANNEL button when using the delay line in the 11802 Oscilloscope.)

11802 Oscilloscope
- **Def Tra** .... press
- **Vertical Description** pop-up menu
  - **Delay Line 1(** .... select
  - **1** .... select
  - **)** .... select
  - **Enter Desc** .... select
- Vertical icon .... press
  - **Vert Size: M1** .... 100 mV/division
- TRIGGER button .... press
  - **Source** pop-up menu .... **Delay Line 1**
  - **Mode** .... **Auto**

Time mark generator
- Marker(Sec) .... 1 ns

To Check Time Base Accuracy at 1 ns/division—perform Steps 2 through 4.

☐ Step 2: Touch the horizontal icon, and then set the **Main Size** to 1 ns/division. The waveform will be triggered.

☐ Step 3: Set the **Main Pos** so that the average of the first pulse (rising-edge) crosses the horizontal centerline at the left-most edge of the screen.

☐ Step 4: *Check* that the average of the tenth pulse (rising edge) crosses the horizontal centerline at the ninth time division within ±0.016 divisions (this is 2% of eight divisions, assuming that the left-most edge is the first time division).

To Check Time Base Accuracy at 5 μs/division—perform Steps 5 through 8.

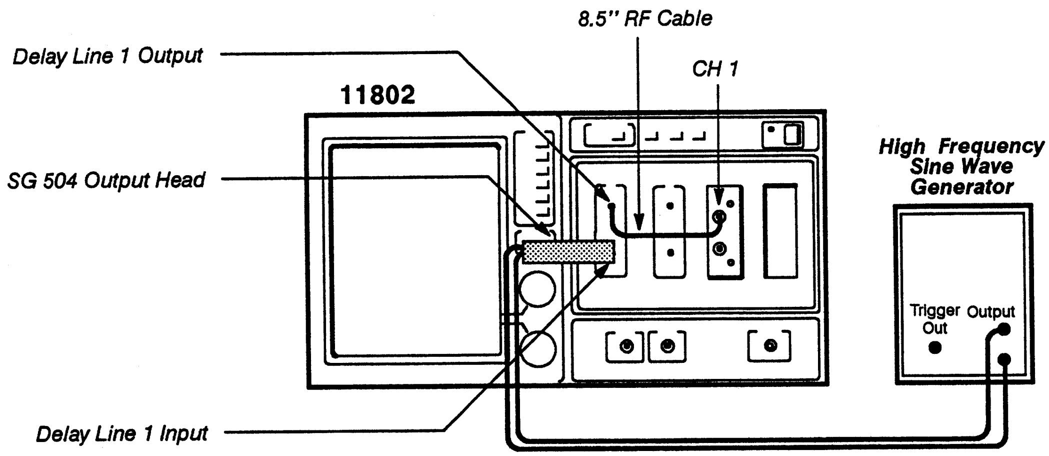
☐ Step 5: Set the **Main Size** to 5 μs/div.

☐ Step 6: Set the Time Mark Generator for 5 μs.

☐ Step 7: Set the **Main Pos** so that the second pulse is directly on the second time division (the first graticule to the right of the left edge of the screen).

☐ Step 8: *Check* that the ninth pulse is directly on the ninth time division within ±0.008 divisions (0.1% of eight divisions).

Setup to Check Time Base Accuracy at 100, 10, and 1 ps/div



Setup to Check Time Base Accuracy at 100, 10, and 1 ps/div

Procedure to Check Time Base Accuracy at 100, 10, and 1 ps/div

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

Sampling head
- SELECT CHANNEL On/Off .... Off
- (Do not press the SELECT CHANNEL button when using the delay line in the 11802 Oscilloscope.)

11802 Oscilloscope
- **Def Tra** .... press
- **Vertical Description** pop-up menu
  - **Delay Line 1(** .... select
  - **1** .... select
  - **)** .... select
  - **Enter Desc** .... select
- Vertical icon .... press
  - **Vert Size: M1** .... 100 mV/division
- **TRIGGER** button .... press
  - **Source** pop-up menu .... **Delay Line 1**
  - **External Coupling** .... **AC**
  - **Mode** .... **Auto**
  - **Level** .... **0 V**
- Horizontal icon .... press
  - **Main Size** .... 1 ns/division

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

To Check Time Base Accuracy at 100 ps/division—perform Steps 2 through 5.

☐ Step 2: Set the high frequency sine wave generator's frequency for exactly 10 cycles in 10 divisions.

☐ Step 3: Set the high frequency sine wave generator's amplitude for exactly 10 divisions of vertical deflection.

☐ Step 4: Set the **Main Size** to 100 ps/div.

☐ Step 5: *Check* that there is one cycle ±0.2 divisions between the zero and tenth time division.

To Check Time Base Accuracy at 10 ps/division—perform Steps 6 through 10.

☐ Step 6: Set the **Main Size** to 10 ps/div.

☐ Step 7: Set the **Main Pos** so that the zero crossing is centered on the horizontal centerline.

☐ Step 8: Press the WAVEFORM button.

☐ Step 9: Touch **Horiz Desc** and then **Center** in the **Horizontal Description** pop-up menu.

☐ Step 10: *Check* that the peak-to-peak vertical deviation is 3.08 divisions ±0.7 divisions.

To Check Time Base Accuracy at 1 ps/division—perform Steps 11 through 15.

☐ Step 11: Touch the vertical icon, and then set **Vert Size: M1** to 10 mV/div.

☐ Step 12: Touch **Acquire Desc** in the WAVEFORM major menu, and then set **Average N** to **On** in the **Acquire Description** pop-up menu.

☐ Step 13: Touch the horizontal icon, and then set the **Main size** to 1 ps/div.

☐ Step 14: Adjust the **Main Pos** so that the zero crossing is centered on the horizontal centerline.

☐ Step 15: *Check* that the peak-to-peak vertical deviation is 3.14 divisions ±1.4 divisions.

Part 12 System Rise Time and Calibrator Output Accuracy

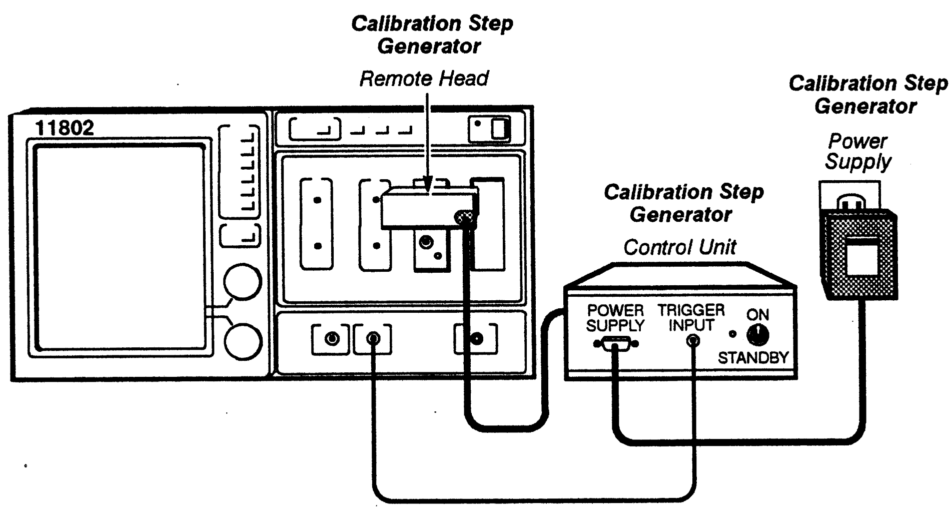
In this part a reference pulse is applied and then mathematically removed to obtain the system rise time. After the system rise time is verified, the CALIBRATOR output is checked. If the sampling head has not been calibrated for loop gain and offset null since the last power-off (that is when the ON/STANDBY switch is set to STANDBY or the PRINCIPAL POWER SWITCH is set to OFF), then perform the Procedure to Calibrate a Sampling Head under Using These Procedures earlier in this section.

Specifications

The specifications for this part are as follows:

- system rise time must be ≤18 ps
- calibrator and system rise time together must be ≤35 ps
- amplitude of the calibrator pulse must be within 250 mV (nominal value) ±10%

Setup to Check System Rise Time and Calibrator Output Accuracy



Setup to Check System Rise Time and Calibrator Output Accuracy

Procedure to Check System Rise Time and Calibrator Output Accuracy

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

Sampling head

Channel 1 select On/Off .... On

11802 Oscilloscope
TRIGGER button .... press
Source pop-up menu .... **Internal Clock**
AUTOSET button .... press
MEASURE button .... press
Measurements pop-up menu .... **Rise, Peak-Peak**
Calibration step generator
ON/STANDBY .... ON

☐ Step 2: Record the **Rise** observed in the MEASURE major menu for later use.

Note: *The Calibration Step Generator Rise is read from the calibration step generator.*

☐ Step 3: *Check* that system rise is ≤18 ps.

$$System\ \ Rise = \sqrt{(Observed\ \ \mathbf{Rise})^2 - (067-1388-00\ \ Rise)^2}$$

☐ Step 4: Disconnect the calibration step generator from the oscilloscope, and then connect the CALIBRATOR to the sampling head input through the 12-inch RF cable.

☐ Step 5: *Check* that **Rise** observed in the MEASURE major menu is ≤35 ps.

☐ Step 6: *Check* that **Peak-Peak** observed in the MEASURE major menu is 250 mV ±10%.

Part 13 Triggering

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

Specifications

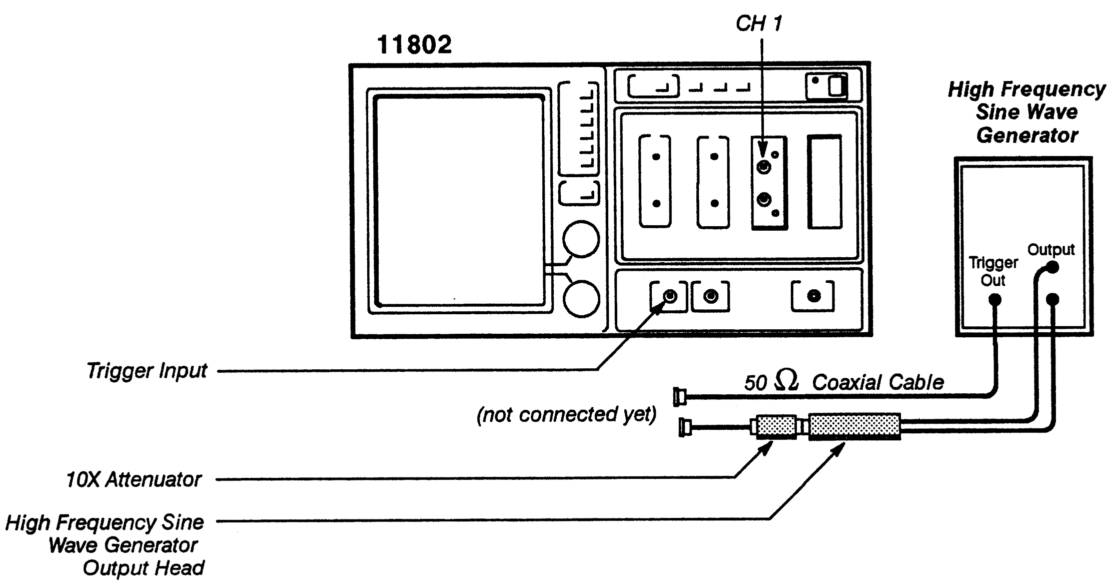
The specifications for triggering using the external trigger are as follows:

- 250 mV at 1 GHz
- 150 mV at 800 MHz
- 50 mV at 100 MHz

The specifications for triggering using the delay line trigger pickoff is as follows:

- 1 V at 1 GHz
- 600 mV at 800 MHz
- 200 mV at 100 MHz

Setup to Check 1 GHz and 800 MHz Sensitivity



Setup to Check 1 GHz and 800 MHz Sensitivity

Procedure to Check 1 GHz and 800 MHz Sensitivity

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

Sampling head
SELECT CHANNEL On/Off .... On

11802 Oscilloscope

Vertical icon	press
Vert Size: M1	50 mV/div
TRIGGER button	press
Mode	**Auto**
MEASURE button	press
Measurements pop-up menu	**Peak-Peak**
High frequency sine wave generator	Not connected yet

To check 1 GHz sensitivity—perform Steps 2 through 12.

☐ Step 2: Set **Main Size** to 1 ns/div.

☐ Step 3: Connect the high frequency sine wave generator Output through a 10X attenuator to the CH 1 input.

☐ Step 4: Connect the high frequency sine wave generator's Trigger Out to the TRIGGER INPUT on the oscilloscope.

☐ Step 5: Set the high frequency sine wave generator output frequency to 1 GHz.

☐ Step 6: Set the generator output to achieve a **Peak-Peak** measurement (in the MEASURE major menu) of 250 mV.

☐ Step 7: Disconnect the high frequency sine wave generator from the oscilloscope.

☐ Step 8: Connect the high frequency sine wave generator's Output to the TRIGGER INPUT and connect the sine wave generator's Trigger Out to CH 1.

☐ Step 9: Press the TRIGGER button, and then touch the **Level** selector.

☐ Step 10: Set the **Knob Resolution** in the **Trig Level** pop-up menu to **Fine** (select the knob label).

☐ Step 11: *Check* that you are able to set the **Trig Level** for a stable display.

☐ Step 12: Disconnect the high frequency sine wave generator.

To Check 800 MHz sensitivity—perform Steps 13 through 20.

☐ Step 13: Connect the high frequency sine wave generator's Output through a 10X attenuator to the CH 1 input and the high frequency sine wave generator's Trigger Out to the oscilloscope's TRIGGER INPUT.

☐ Step 14: Set the high frequency sine wave generator output frequency to 800 MHz.

☐ Step 15: Set the high frequency sine wave generator's Output to achieve a **Peak-Peak** (in the MEASURE major menu) measurement of 150 mV.

☐ Step 16: Disconnect the high frequency sine wave generator from the oscilloscope.

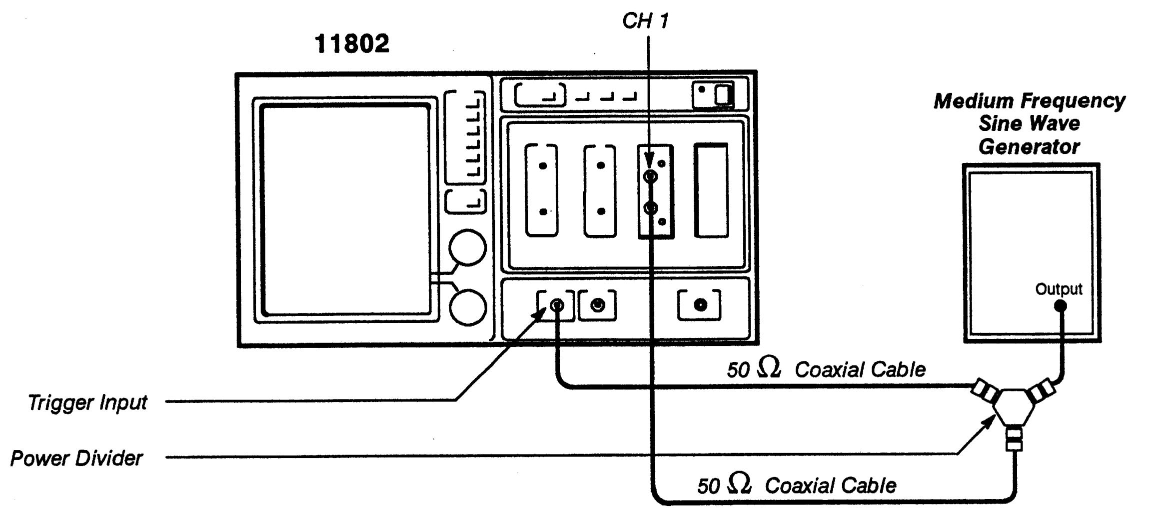
☐ Step 17: Connect the high frequency sine wave generator's Output to the TRIGGER INPUT and connect the high frequency sine wave generator's Trigger Out to CH 1.

☐ Step 18: Press the TRIGGER button.

☐ Step 19: *Check* that you are able to set the **Trig Level** for a stable display.

☐ Step 20: Disconnect the high frequency sine wave generator.

Setup to Check 100 MHz Sensitivity



Setup to Check 100 MHz Sensitivity

Procedure to Check 100 MHz Sensitivity

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

Sampling head
- SELECT CHANNEL On/Off .... On

11802 Oscilloscope
- Vertical icon .... press
  - **Vert Size: M1** .... 10 mV/div
- TRIGGER button .... press
  - **Mode** .... **Auto**
- MEASURE button .... press
  - **Measurements** pop-up menu .... **Peak-Peak**

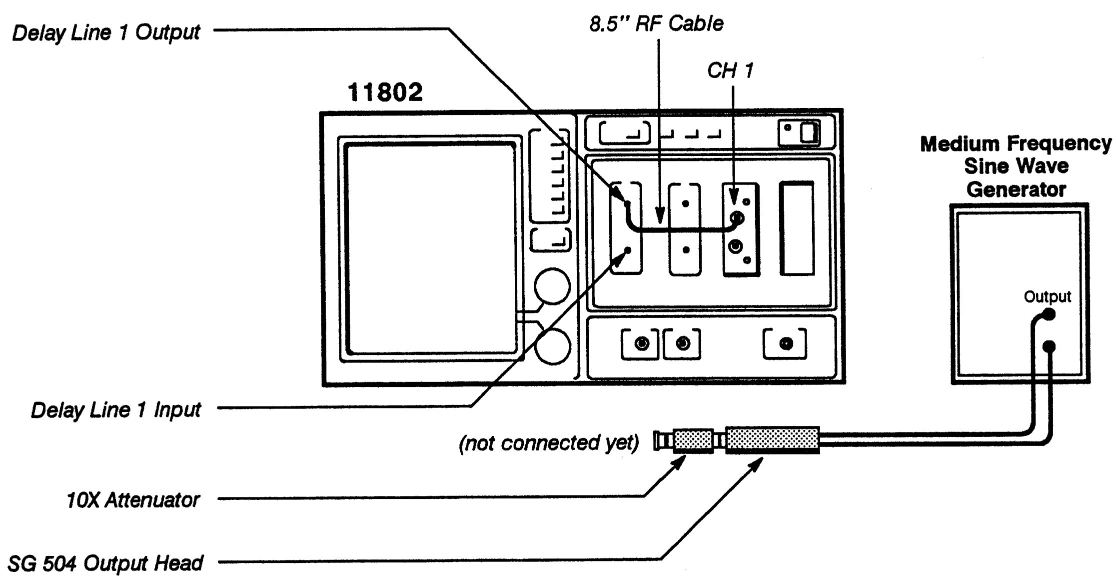
Medium frequency sine wave generator .... Not connected yet

☐ Step 2: Connect the medium frequency sine wave generator through a power divider to the CH 1 input.

☐ Step 3: Connect the other output of the power divider to the TRIGGER INPUT on the oscilloscope.

- ☐ Step 4: Set the medium frequency sine wave generator's frequency to 100 MHz.
- ☐ Step 5: Touch the horizontal icon, and then set the **Main Size** to 10 ns/div.
- ☐ Step 6: Set the medium frequency sine wave generator's output for a peak-to-peak measurement of 50 mV.
- ☐ Step 7: Disconnect the power divider from the oscilloscope and the sampling head.
- ☐ Step 8: Connect the power divider's output that was previously connected to CH 1 to the oscilloscope's TRIGGER INPUT and connect the power divider's other output to the CH 1 input.
- ☐ Step 9: Touch **Level** in the TRIGGER major menu.
- ☐ Step 10: *Check* that you are able to set the **Trig Level** for a stable display.

Setup to Check Trigger Sensitivity Using Delay Line Trigger Pickoff



Setup to Check Trigger Sensitivity Using Delay Line Trigger Pickoff

Procedure to Check Trigger Sensitivity Using Delay Line Trigger Pickoff

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

Sampling head
- SELECT CHANNEL On/Off .... Off
- (Do not press the SELECT CHANNEL button when using the delay line in the 11802 Oscilloscope.)

11802 Oscilloscope
- **Def Tra** .... press
- **Vertical Description** pop-up menu
  - **Delay Line 1(** .... select
  - **1** .... select
  - **)** .... select
  - **Enter Desc** .... select
- Vertical icon .... press
  - **Vert Size: M1** .... 100 mV/div
- TRIGGER button .... press
  - **Source** .... **Delay Line 1**
  - **Mode** .... **Auto**
- MEASURE button .... press
  - **Measurements** pop-up menu .... **Peak-Peak**

High frequency sine wave generator .... Not connected yet

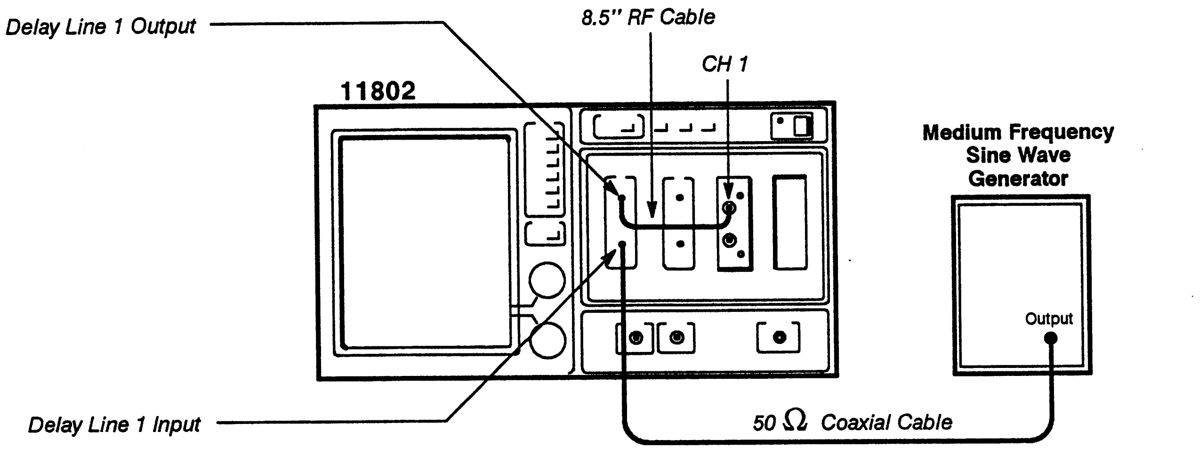
To Check 1 GHz Sensitivity—perform Steps 2 through 9.

- [ ] Step 2: Touch the horizontal icon, and then set the **Main Size** to 1 ns/div.
- [ ] Step 3: Connect the high frequency sine wave generator's Output through a 10X attenuator to the DELAY LINE 1 INPUT (the DELAY LINE 1 OUTPUT should already be connected to the channel input).
- [ ] Step 4: Set the high frequency sine wave generator's Output frequency to 1 GHz.
- [ ] Step 5: Set the high frequency sine wave generator's Output to achieve a peak-to-peak measurement of 1 V.
- [ ] Step 6: Press the **TRIGGER** button, and then touch **Level**.
- [ ] Step 7: Touch **Fine** in the **Knob Resolution** pop-up menu.
- [ ] Step 8: *Check* that you can adjust the **Trig Level** to achieve a stable display.
- [ ] Step 9: Disconnect the high frequency sine wave generator.

To Check 800 MHz sensitivity—perform Steps 10 through 16.

- [ ] Step 10: Connect the high frequency sine wave generator's output through a 10X attenuator to the DELAY LINE 1 INPUT (the DELAY LINE 1 OUTPUT should already be connected to the channel input).
- [ ] Step 11: Set the high frequency sine wave generator output frequency to 800 MHz.
- [ ] Step 12: Set the high frequency sine wave generator's Output to achieve a **Peak-Peak** measurement of 600 mV.
- [ ] Step 13: Press the TRIGGER button.
- [ ] Step 14: *Check* that you are able adjust the **Trig Level** for a stable display.
- [ ] Step 15: Disconnect the high frequency sine wave generator.

Setup to Check 100 MHz Sensitivity



Procedure to Check 100 MHz Sensitivity

Procedure to Check 100 MHz Sensitivity

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

Sampling head
- SELECT CHANNEL On/Off .... Off
- (Do not press the SELECT CHANNEL button when using the delay line in the 11802 Oscilloscope.)

11802 Oscilloscope
- **Def Tra** .... press
- **Vertical Description** pop-up menu
  - **Delay Line 1(** .... select
  - **1** .... select
  - **)** .... select
  - **Enter Desc** .... select
- Vertical icon .... press
  - **Vert Size: M1** .... 40 mV/div
- TRIGGER button .... press
  - **Source** .... **Delay Line 1**
  - **Mode** .... **Auto**
- MEASURE button .... press
  - **Measurements** pop-up menu .... **Peak-Peak**

☐ Step 2: Set the sine wave generator's frequency to 100 MHz.

☐ Step 3: Touch the horizontal icon, and then set the **Main Size** to 10 ns/div.

- [ ] Step 4: Set the sine wave generator's Output for a peak-to-peak measurement of 200 mV.
- [ ] Step 5: Press the TRIGGER button.
- [ ] Step 6: Touch **Level** in the TRIGGER major menu.
- [ ] Step 7: *Check* that you are able to set the **Trig Level** for a stable display.

Part 14 Internal Clock

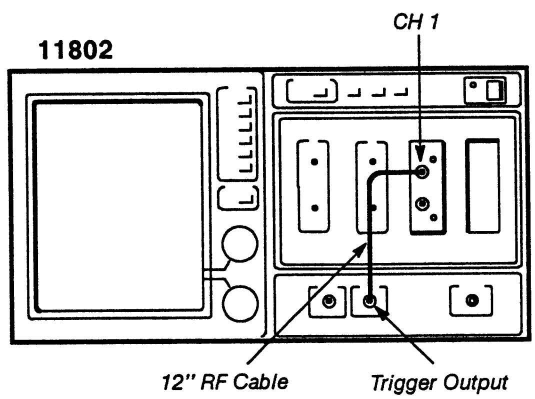
This part verifies the correct operation and accuracy of the oscilloscope's input/output systems.

Measurement Limits

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

- rise time ≤3 ns
- frequency of 100 kHz ±1% accuracy
- duty cycle 50% ±1%

Setup to Examine Internal Clock



Setup to Examine Internal Clock

Procedure to Examine Internal Clock

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

Sampling head
SELECT CHANNEL On/Off . . . . On
11802 Oscilloscope
TRIGGER Button . . . . press
Source pop-up menu . . . . **Internal Clock**

☐ Step 2: Press the AUTOSET button.

☐ Step 3: Press the MEASURE button.

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

☐ Step 5: *Examine* that Δ**Rise** is ≤3 ns.

☐ Step 6: Touch the horizontal icon, and then set the **Main Size** to 5 µs/div.

- ☐ Step 7: Touch **Measurements** in the MEASURE major menu and then **Frequency** in the **Measurements** pop-up menu.
- ☐ Step 8: *Examine* that the **Frequency** is 100 kHz ±1%.
- ☐ Step 9: Touch **Width** in the **Measurements** pop-up menu, and then record the **Width** value displayed for later use.
- ☐ Step 10: Touch **Period** in the **Measurements** pop-up menu, and then record the **Period** value displayed for later use.
- ☐ Step 11: *Examine* that the duty cycle [(**Width/Period**) × 100%] = 50% ±1%.

Part 15 Aberrations

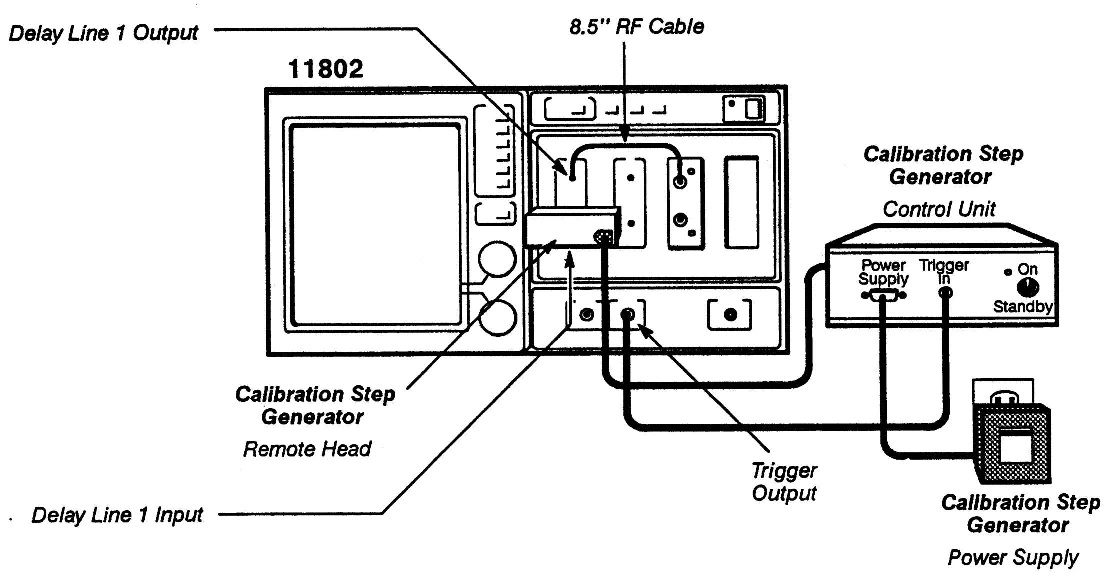
This part shows the setup and lists the procedure to check aberrations. If the sampling head has not been calibrated for loop gain and offset null since the last power-off (that is when the ON/STANDBY switch is set to STANDBY or the PRINCIPAL POWER SWITCH is set to OFF), then perform the Procedure to Calibrate a Sampling Head under Using These Procedures earlier in this section.

Measurement Limits

The measurement limits for aberrations are as follows;

- 100 ns +, aberrations must be ≤2%
- from 4 ns to 100 ns, aberrations must be ≤2%
- from 1 ns to 4 ns, aberrations must be ≤4% and
- from 0 ns to 1 ns, aberrations must be ≤10% and ≥ -7%

Setup to Examine Aberrations



Setup to Examine Aberrations

Procedure to Examine Aberrations

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

Sampling Head
SELECT CHANNEL On/Off .... Off
11802 Oscilloscope
Def Tra .... press
Delay Line 1(.... press
1 .... press
) .... press
Enter Desc .... press

TRIGGER button .... press
Source pop-up menu .... **Delay Line1**
AUTOSET button .... press
Main Size .... 50 ns/div
Main Pos .... **Set to Min**
Vert Size: M1 .... 100 mV/div
Calibration step generator
ON/STANDBY .... ON

- [ ] Step 2: Press the WAVEFORM button, and then touch **Acquire Desc.**
- [ ] Step 3: Set **Average N** to **On**, and then touch **Set AvgN**.
- [ ] Step 4: Set the **Average N** to 64 with the top knob.
- [ ] Step 5: Touch the vertical icon, and then set the **Vert Offset: M1** so that the average of the top of the pulse is on the horizontal centerline.
- [ ] Step 6: Verify that the step is 2.5 divisions in height.
- [ ] Step 7: Touch **Acquire Desc**, and then set **Average N** to **On**.
- [ ] Step 8: Set the **Vert Size: M1** to 5 mV/div.
- [ ] Step 9: Touch the horizontal icon and adjust the **Main Pos** so the rising edge of the step is on the left-most edge of the screen.
- [ ] Step 10: *Examine* that from 2 time divisions (not including the left-most edge of the screen) to the right-most edge of the screen that all deviations from the horizontal centerline are ≤0.5 vertical divisions (that is 5 minor divisions or 1% of the step amplitude).
- [ ] Step 11: Set the **Main Size** to 10 ns/div.
- [ ] Step 12: Set the **Main Pos** so the rising edge of the step is on the left-most edge of the screen.
- [ ] Step 13: *Examine* that from 0.5 time divisions (from the left-most edge of the screen) to the tenth time division that all deviations from the horizontal centerline are ≤1.0 vertical divisions (that is 10 minor divisions or 2% of the step amplitude).
- [ ] Step 14: Set the **Main Size** to 1 ns/div and then the **Main Pos** so that the rising edge of the step is at the left-most edge of the screen.
- [ ] Step 15: *Examine* that from the first time division to the fifth time division that all deviations from the horizontal centerline are ≤2.0 vertical divisions (that is 4% of the step amplitude).
- [ ] Step 16: Set the **Main Size** to 100 ps/div, and then adjust the **Main Pos** so that the rising edge of the step is at the left-most edge of the screen.
- [ ] Step 17: *Examine* that all deviations above the horizontal centerline are ≤5 divisions (that is 10% of the step amplitude), and that all deviations below the centerline are ≤3.5 vertical divisions (that is 7% of the step amplitude).

Maintenance

This section contains information for performing preventive maintenance, corrective maintenance, and diagnostic troubleshooting on the 11802 Digital Sampling Oscilloscope.

Preventive Maintenance

Regular maintenance can prevent oscilloscope breakdown and may improve the reliability of the oscilloscope. The environment in which the oscilloscope 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 oscilloscope. When the oscilloscope 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 oscilloscope or replacing any parts.

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

Cleaning the Oscilloscope

The oscilloscope should be cleaned as often as operating conditions require. Dirt in the oscilloscope 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 oscilloscope to fail. The side panels reduce the amount of dust that reaches the interior of the oscilloscope. 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 oscilloscope. Use a nonresidue type of cleaner, preferably isopropyl alcohol or totally denatured ethyl alcohol. Before using any other type of cleaner, consult your local Tektronix service center or representative.

Exterior – dust on the oscilloscope can be removed with a soft cloth or small brush. The brush is also useful for dislodging dirt on and around the front panel controls. 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^2). Remove any dirt which remains with a soft brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces, or for cleaning more delicate circuit components. After cleaning, use a washcloth dampened with water to remove any residue.

CAUTION

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 oscilloscope operation.

Visual Inspection

The oscilloscope should be inspected occasionally for defects such as broken connections, improperly seated semiconductors, damaged or improperly installed circuit boards and heat-damaged parts. The corrective procedure for most visible defects is obvious; however, particular care must be taken if heat-damaged parts are found. Since overheating usually indicates other trouble in the oscilloscope; 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 oscilloscope after each 2,000 hours of operation, or every 24 months if used infrequently.

Corrective Maintenance

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

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 oscilloscope is not grounded. Do not remove the ground wire (green-yellow) that connects the Power Supply module chassis to the oscilloscope.

Ordering Parts

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

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

Static-Sensitive Device Classification

CAUTION

Static discharge can damage any semiconductor component in this oscilloscope.

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

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

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

Observe the following precautions to avoid damage:

- 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*

FRU to be Removed/Replaced	Figures to Reference During Removal	Page
Power Supply Module	Figure 3-2 – Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector Plate	3-12
	Figure 3-3 – A2A2 Control Rectifier Board Connectors Locations	3-13
Fan Motor	Figure 3-2 – Removing the Power Supply Module, Fan Housing, and Rear Panel Connector Plate	3-12
Cathode Ray Tube (CRT)	Figure 3-4 – Removing and Replacing the Cathode Ray Tube	3-16
	Figure 3-11 – Removing and Replacing the A8 CRT Driver Board	3-29
	Figure 3-13 – Removing and Replacing the A10 Front Panel Button Board	3-32
	Figure 3-34 – Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
Acquisition Unit	Figure 3-12 – Removing the Left-Side Decorative Trim Covers	3-30
	Figure 3-22 – Removing and Replacing the A19 Strobe/TDR Buffer Board	3-46
	Figure 3-25 – Removing and Replacing the A26 M/F Acquisition Interconnect Board	3-49
	Figure 3-32 – Removing and Replacing the A32 Trigger Select Board	3-57
	Figure 3-34 – Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
Batteries	Figure 3-8 – Removing and Replacing the A5 Time Base/Controller Board	3-26
	Figure 3-17 – Removing and Replacing the A14 I/O Board	3-37
	Figure 3-20 – Removing and Replacing the A17 Main Processor Board	3-44
	Figure 3-29 – A29 Memory Expansion Board Lithium Battery Locations	3-54
A1 Mainframe (M/F) Strobe Drive Board	Figure 3-6 – Removing and Replacing the A1 M/F Strobe Drive Board	3-23
	Figure 3-34 – Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A3 Mainframe (M/F) Power Connect Board	Figure 3-2 – Removing the Power Supply Module, Fan Housing, and Rear Panel Connector Plate	3-12
	Figure 3-3 – A2A2 Control Rectifier Board Connectors Locations	3-13
	Figure 3-7 – Removing and Replacing the A4 Regulator Board	3-24
	Figure 3-17 – Removing and Replacing the A14 I/O Board	3-37
A4 Regulator Board	Figure 3-2 – Removing the Power Supply Module, Fan Housing, and Rear Panel Connector Plate	3-12
	Figure 3-3 – A2A2 Control Rectifier Board Connectors Locations	3-13
	Figure 3-7 – Removing and Replacing the A4 Regulator Board	3-24
	Figure 3-34 – Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A5 Time Base/Controller Board	Figure 3-8 – Removing and Replacing the A5 Time Base/Controller Board	3-26
	Figure 3-32 – Removing and Replacing the A32 Trigger Select Board	3-57
	Figure 3-34 – Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60

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

FRU to be Removed/Replaced	Figures to Reference During Removal	Page
A6 Calibrator Assembly	Figure 3-9 — Removing and Replacing the A6 Calibrator Assembly	3-27
A7 Display Controller Board	Figure 3-10 — Removing and Replacing the A7 Display Controller Board	3-28
	Figure 3-34 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A8 CRT Driver Board	Figure 3-4 — Removing and Replacing the Cathode Ray Tube	3-16
	Figure 3-11 — Removing and Replacing the A8 CRT Driver Board	3-29
	Figure 3-12 — Removing the Left-Side Decorative Trim Covers	3-30
	Figure 3-13 — Removing and Replacing the A10 Front Panel Button Board	3-32
	Figure 3-34 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A9 Touch Panel Assembly	Figure 3-4 — Removing and Replacing the Cathode Ray Tube	3-16
	Figure 3-13 — Removing and Replacing the A10 Front Panel Button Board	3-32
	Figure 3-34 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A10 Front Panel Control Board	Figure 3-4 — Removing and Replacing the Cathode Ray Tube	3-16
	Figure 3-10 — Removing and Replacing the A7 Display Controller Board	3-28
	Figure 3-13 — Removing and Replacing the A10 Front Panel Button Board	3-32
	Figure 3-34 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A11 Front Panel Button Board	Figure 3-4 — Removing and Replacing the Cathode Ray Tube	3-16
	Figure 3-10 — Removing and Replacing the A7 Display Controller Board	3-28
	Figure 3-13 — Removing and Replacing the A10 Front Panel Button Board	3-32
	Figure 3-14 — Removing and Replacing the A11 Front Panel Button Board	3-33
	Figure 3-34 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A12 Rear Panel Assembly	Figure 3-2 — Removing the Power Supply Module, Fan Housing, and Rear Panel Connector Plate	3-12
	Figure 3-15 — Removing and Replacing the A12 Rear Panel Assembly	3-35
	Figure 3-34 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A13 Mother Board	Figure 3-5 —Top View of the Card Cage	3-22
	Figure 3-16 — Removing and Replacing the A13 Mother Board	3-36
	Figure 3-17 — Removing and Replacing the A14 I/O Board	3-37
	Figure 3-34 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A14 Input/Output (I/O) Board	Figure 3-5 —Top View of the Card Cage	3-22
	Figure 3-17 — Removing and Replacing the A14 I/O Board	3-37
	Figure 3-34 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A15 Memory Manager Unit (MMU) Board	Figure 3-5 —Top View of the Card Cage	3-22
	Figure 3-17 — Removing and Replacing the A14 I/O Board	3-37
	Figure 3-18 — Removing and Replacing the A15 MMU Board	3-40
	Figure 3-34 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A16 Compressor Board	Figure 3-5 —Top View of the Card Cage	3-22
	Figure 3-17 — Removing and Replacing the A14 I/O Board	3-37
	Figure 3-19 — Removing and Replacing the A16 Compressor Board	3-42
	Figure 3-34 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60

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

FRU to be Removed/Replaced	Figures to Reference During Removal	Page
A17 Main Processor Board	Figure 3-5 — Top View of the Card Cage	3-22
	Figure 3-20 — Removing and Replacing the A17 Main Processor Board	3-44
	Figure 3-34 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A18 Memory Board	Figure 3-5—Top View of the Card Cage	3-22
	Figure 3-21 — Removing and Replacing the A18 Memory Board	3-45
A19 Strobe/TDR Buffer Board	Figure 3-12 — Removing the Left Side Decorative Trim Covers	3-30
	Figure 3-22 — Removing and Replacing the A19 Strobe/TDR Buffer Board	3-46
	Figure 3-25 — Removing and Replacing the M/F Acquisition Interconnect Board	3-49
	Figure 3-32 — Removing and Replacing the A32 Trigger Select Board	3-57
	Figure 3-34 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A22/A23 Head Interconnect Boards	Figure 3-12 — Removing the Left-Side Decorative Trim Covers	3-30
	Figure 3-22 — Removing and Replacing the A19 Strobe/TDR Buffer Board	3-46
	Figure 3-23 — Removing and Replacing the A22/A23 Head Interconnect Boards	3-47
	Figure 3-24 — Removing and Replacing the Front Subpanel Assembly	3-48
	Figure 3-25 — Removing and Replacing the A26 M/F Acquisition Interconnect Board	3-49
	Figure 3-27 — Removing and Replacing the A24 Acquisition Analog Board	3-51
	Figure 3-28 — Removing and Replacing the A28 Acquisition MPU Board	3-52
	Figure 3-32 — Removing and Replacing the A32 Trigger Select Board	3-57
	Figure 3-34 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A26 Mainframe (M/F) Acquisition Interconnect Board	Figure 3-12 — Removing the Left-Side Decorative Trim Covers	3-30
	Figure 3-22 — Removing and Replacing the A19 Strobe/TDR Buffer Board	3-46
	Figure 3-24 — Removing and Replacing the Front Subpanel Assembly	3-48
	Figure 3-25 — Removing and Replacing the A26 M/F Acquisition Interconnect Board	3-49
	Figure 3-26 — Top View of the A26 MF Acquisition Interconnect Board	3-50
	Figure 3-27 — Removing and Replacing the A24 Acquisition Analog Board	3-51
	Figure 3-28 — Removing and Replacing the A28 Acquisition MPU Board	3-52
	Figure 3-32 — Removing and Replacing the A32 Trigger Select Board	3-57
	Figure 3-34 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A27 Acquisition Analog Board	Figure 3-12 — Removing the Left-Side Decorative Trim Covers	3-30
	Figure 3-22 — Removing and Replacing the A19 Strobe/TDR Buffer Board	3-46
	Figure 3-25 — Removing and Replacing the A26 M/F Acquisition Interconnect Board	3-49
	Figure 3-27 — Removing and Replacing the A47 Acquisition Analog Board	3-51
	Figure 3-32 — Removing and Replacing the A32 Trigger Select Board	3-57
	Figure 3-34 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A28 Acquisition MPU Board	Figure 3-12 — Removing the Left-Side Decorative Trim Covers	3-30
	Figure 3-22 — Removing and Replacing the A19 Strobe/TDR Buffer Board	3-46
	Figure 3-25 — Removing and Replacing the A26 M/F Acquisition Interconnect Board	3-49
	Figure 3-28 — Removing and Replacing the A28 Acquisition MPU Board	3-52
	Figure 3-32 — Removing and Replacing the A32 Trigger Select Board	3-57
	Figure 3-34 — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60

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

FRU to be Removed/Replaced	Figures to Reference During Removal	Page
A29 Memory Expansion Board	Figure 3-5—Top View of the Card Cage	3-22
	Figure 3-29 – Removing and Replacing the A29 Memory Expansion Board	3-54
A30/A31 Trigger Pickoff and Delay Line Compensator Assembly	Figure 3-12 – Removing the Left-Side Decorative Trim Covers	3-30
	Figure 3-22 – Removing and Replacing the A19 Strobe/TDR Buffer Board	3-46
	Figure 3-24 – Removing and Replacing the Front Subpanel Assembly	3-48
	Figure 3-25 – Removing and Replacing the A26 M/F Acquisition Interconnect Board	3-49
	Figure 3-30 – Rear Panel of the Acquisition Unit	3-56
	Figure 3-31 – Delay Line Chassis	3-56
	Figure 3-32 – Removing and Replacing the A32 Trigger Select Board	3-57
	Figure 3-34 – Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
A32 Trigger Select Board	Figure 3-32 – Removing and Replacing the A32 Trigger Select Board	3-57
	Figure 3-34 – Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
Firmware ICs	Figure 3-34 – Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
Serial Data Interface (SDI) IC	Figure 3-17 – Removing and Replacing the A14 I/O Board	3-37
	Figure 3-34 – Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	3-60
	Figure 3-35 – IC Insertion-Extraction Tool	3-62
Fuses	Figure 3-40 – Fuse Locations	3-93

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 3-33 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 oscilloscope. If another reference is intended, it will be indicated (for example, viewing from the left side or viewing from the rear of the oscilloscope).

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

WARNING

To avoid electric-shock hazard and oscilloscope 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 oscilloscope 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 oscilloscope in the upright position.
- [ ] Step 9: Reconnect the AC power cable and switch the PRINCIPAL POWER SWITCH to ON.

  The power will now remain on regardless of the setting of the ON/STANDBY power switch.

CAUTION

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

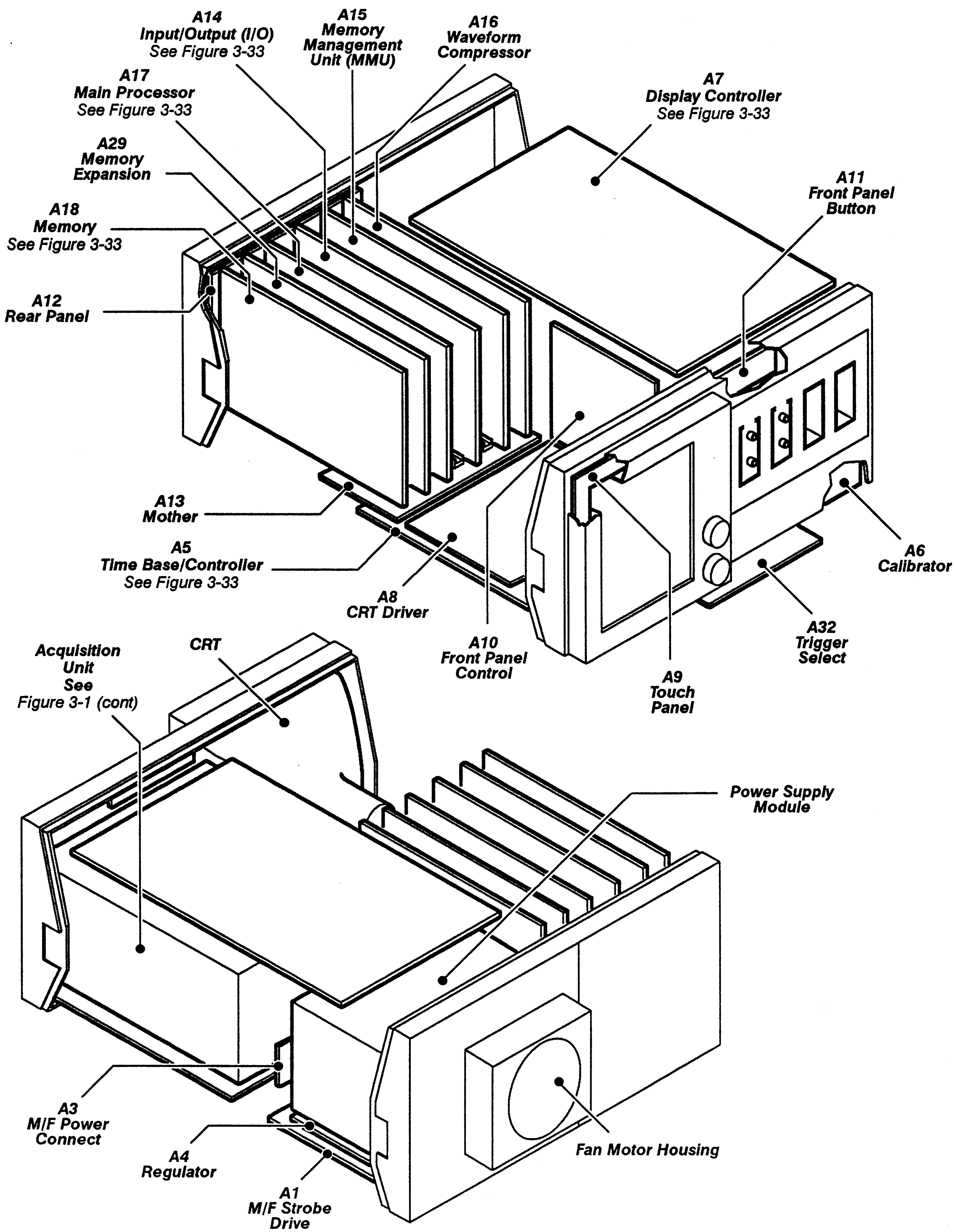


Figure 3-1 — *Field Replaceable Units (FRU) Locator*

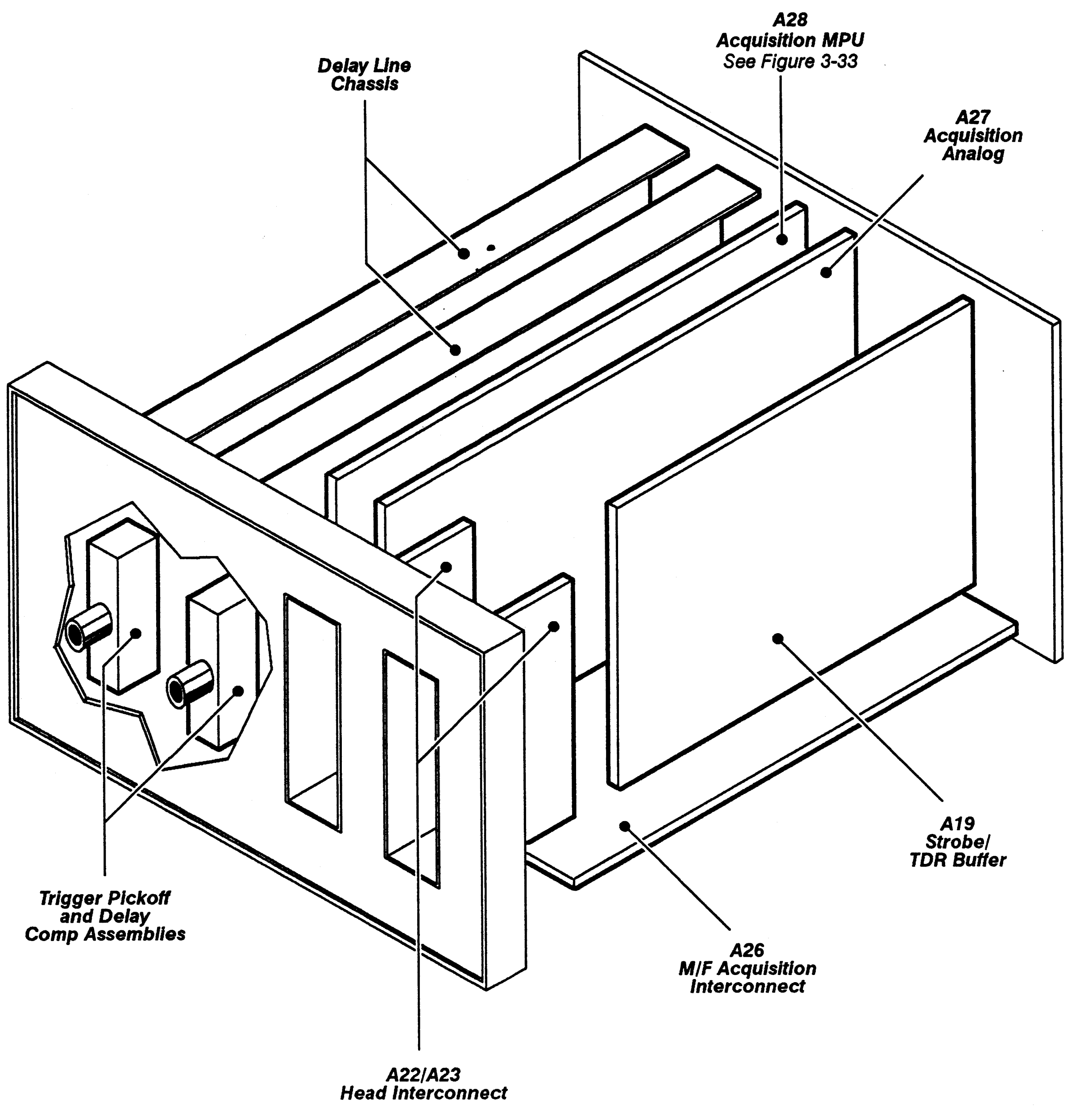


Figure 3-1 (cont) — *Field Replaceable Unit (FRU) Locator*

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.

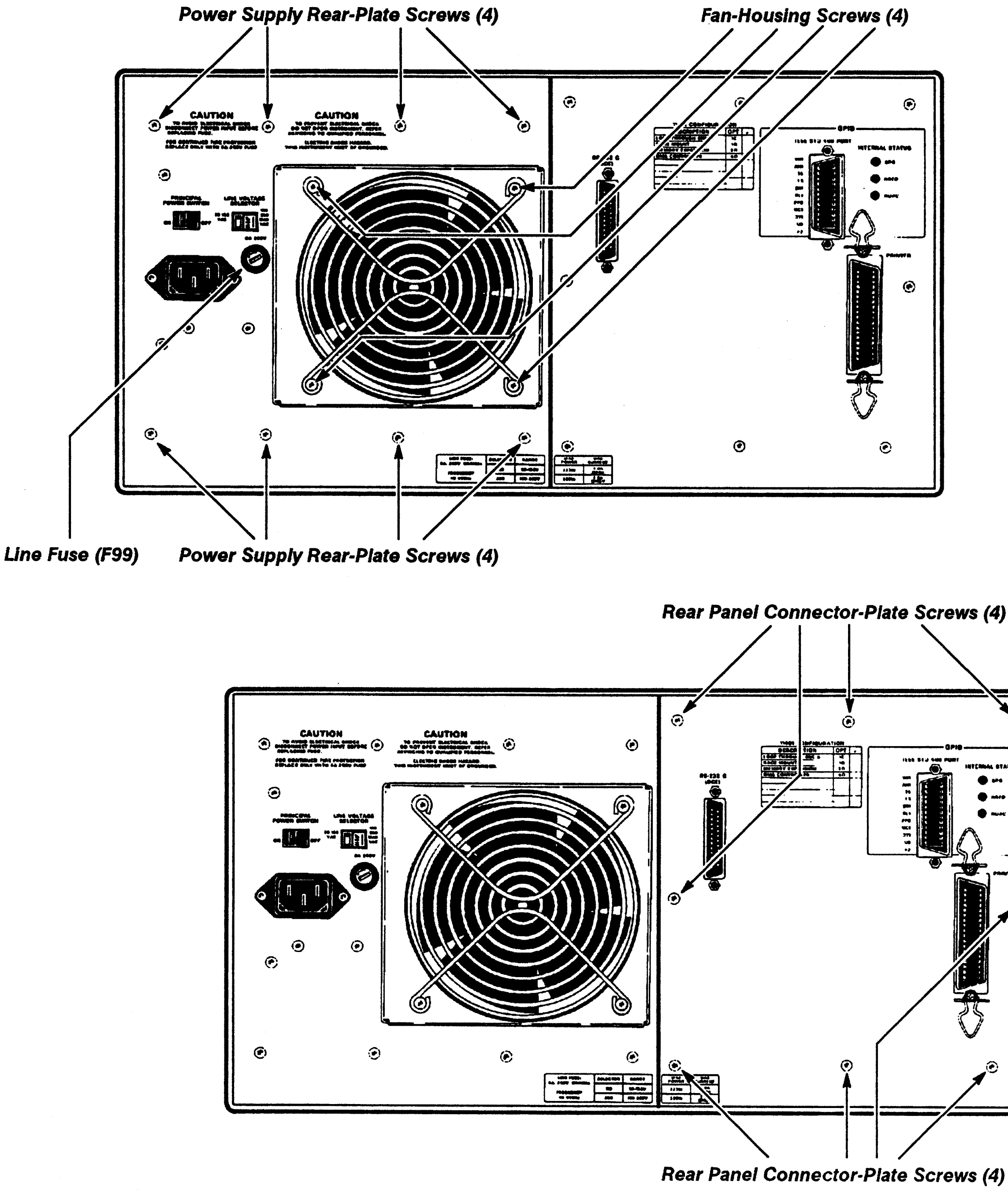


Figure 3-2 — Removing the Power Supply Module, Fan Housing, and Rear Panel Connector Plate

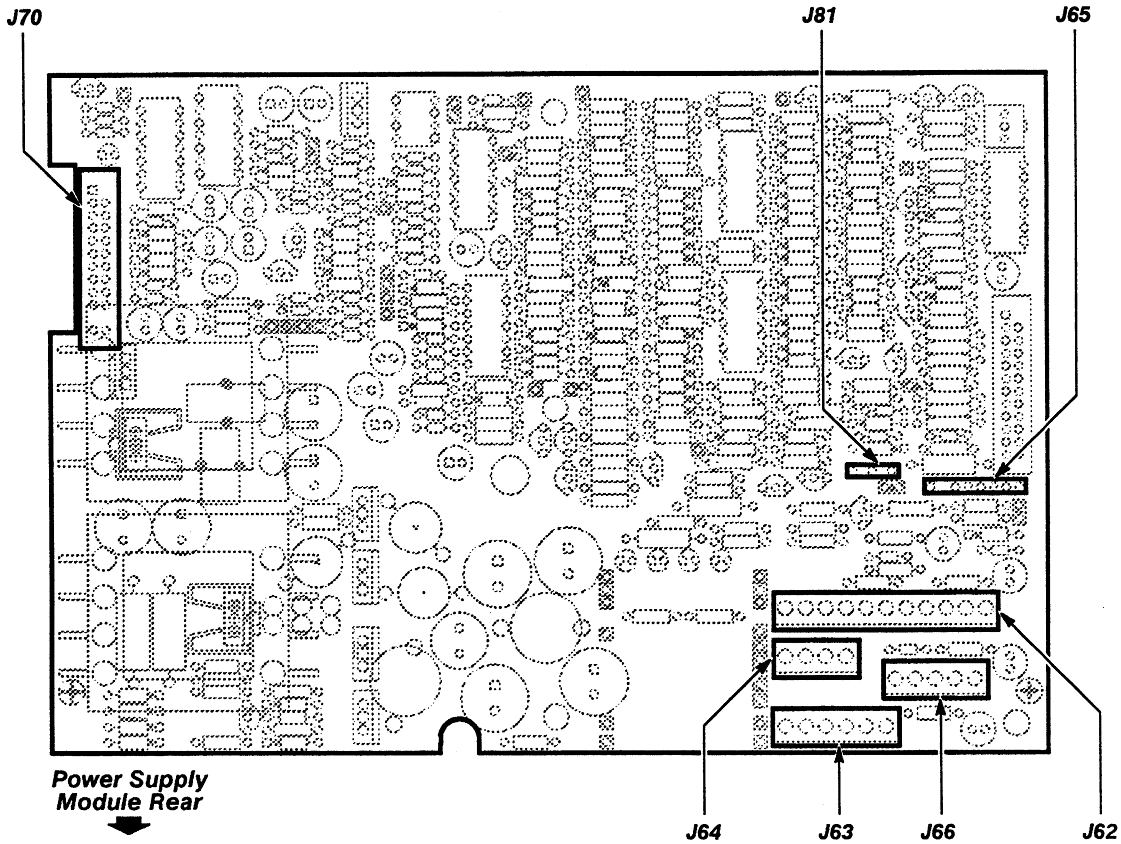


***Figure 3-3** — A2A2 Control Rectifier Board Connector Locations*

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

☐ Step 11: Turn the oscilloscope on its left side (as viewed facing the rear panel). The Power Supply module will now be at the bottom of the oscilloscope.

☐ Step 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 oscilloscope. Stop short of stretching taut or binding the wires connecting to the A2A2 Control Rectifier board connectors.

CAUTION

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

☐ Step 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 oscilloscope.

☐ 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 oscilloscope.*

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 oscilloscope mainframe. Hold the housing as you remove the last screws.

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

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

CAUTION

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 (12 kV) charge. Before removing the CRT, the anode must be fully discharged. Short the anode lead from the CRT to the chassis. Wait approximately ten minutes and again firmly short this lead to the chassis. Then, remove the anode 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. Otherwise, set the CRT face down in a protected location. That has a smooth surface with a soft mat under the CRT faceplate.

See Figures 3-4, 3-11, 3-13 and 3-34 for connector, screw, and index locations.

Remove the CRT as follows:

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

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

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

WARNING

The CRT anode voltage is 12 kV. Ground the anode lead from the CRT to the chassis to short any stored charge remaining in the CRT.

Wait approximately ten minutes, and then ground the anode lead from the CRT again.

☐ Step 3: Use a non-conducting tool to pry up the of the anode lead cap. (This rubber cap is located on the upper part of the CRT, behind the front casting. Release the spring clip inside the cap and in the CRT opening to remove the anode. Ground the anode to the chassis by inserting a screwdriver blade tip against the anode and touching the blade to the top of the front casting.)

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

☐ Step 5: Disconnect connector J54 from the A8 CRT Driver board.

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

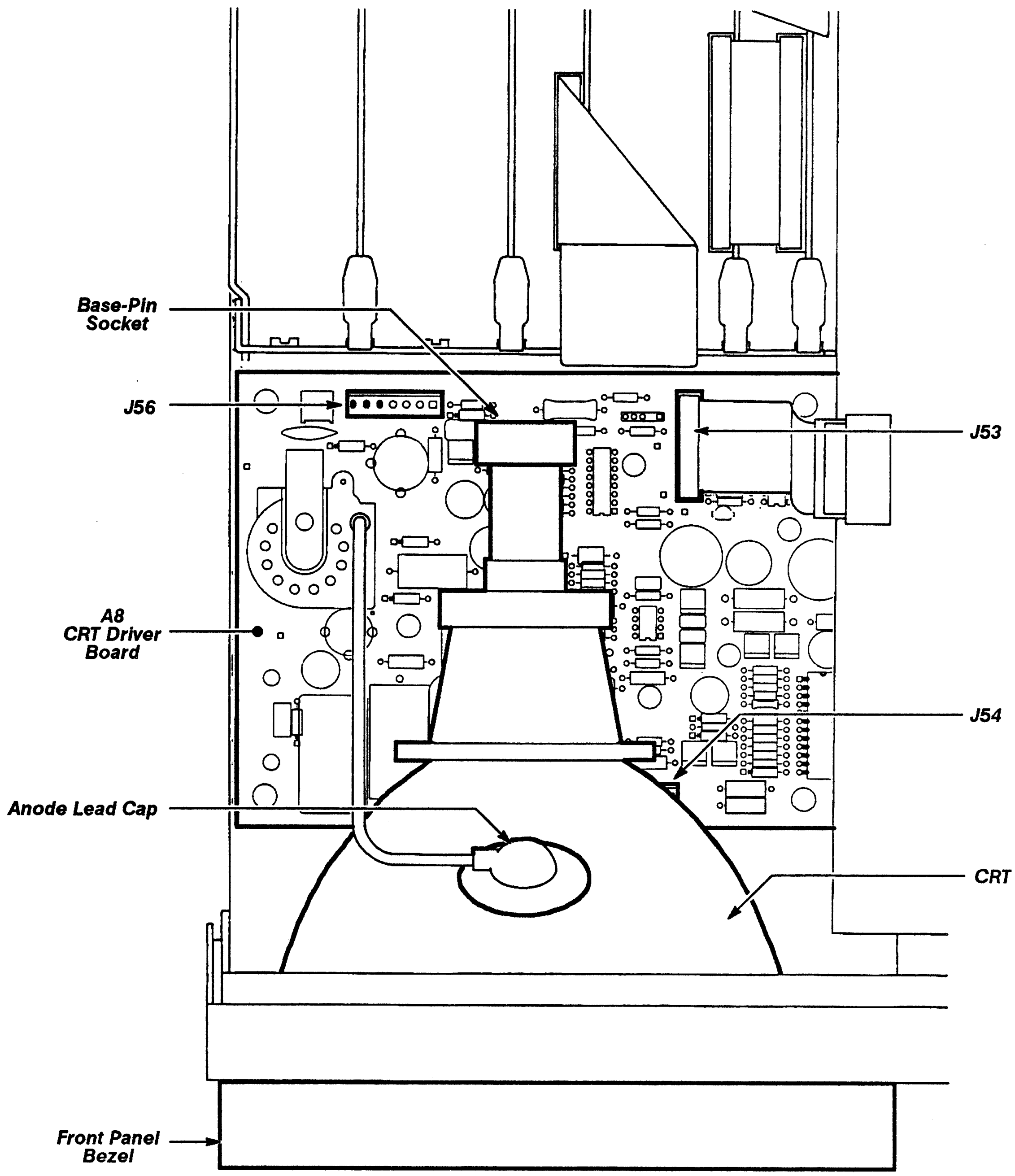


Figure 3-4 *— Removing and Replacing the Cathode Ray Tube*

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

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

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

☐ Step 10: Lift up on the bottom of the bezel and swing it outward.

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

☐ Step 11: The wire cable from J73 on the A10 Front Panel Control board may be removed. Disconnect connector J73 from the A10 Front Panel Control board. Note the position of the multi-pin connector's index triangles to ensure that the connector can be correctly replaced. Carefully remove the wire cable through the slot provided in the front casting.

☐ Step 12: Remove the front panel bezel.

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

CAUTION

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

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

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

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

Replace the CRT as follows:

☐ Step 1: Replace connector J54 on the A8 CRT Driver board. Replace the wire connector to the quick-disconnect contact on the front casting.

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

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

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

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

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

☐ Step 5: Replace the two control knobs on their shafts. Tighten their setscrews securely.

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

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

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

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

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

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

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

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

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

Acquisition Unit Removal/Replacement

See Figures 3-12, 3-22, 3-25, 3-32, and 3-34 for connector, screw, and index locations.

Remove and replace the Acquisition unit as follows:

☐ Step 1: Place the oscilloscope in the inverted position.

☐ Step 2: Remove connectors J86, J89, and Peltola connector J88 on the A32 Trigger Select board.

☐ Step 3: Remove the three Torx head screws from the A32 Trigger Select board and lift the trigger select board far enough so that the J86 and J89 connectors can be slipped through the holes below the A32 Trigger Select board.

☐ Step 4: Turn the oscilloscope on its side and remove the long holding rod located in front of the A7 Display Controller board.

☐ Step 5: Turn the oscilloscope in the inverted position again.

CAUTION

Do not lift the trim covers to remove them; doing so will break the trim covers. There is a clip on the inside of the trim cover which slides over the end of the side frame section. To remove the trim covers, move each cover towards the end of the oscilloscope 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 oscilloscope.

☐ Step 6: Remove the trim covers from the right side (as viewed from the front of the oscilloscope).

☐ Step 7: Remove the two Torx head screws holding the frame section and remove the frame section.

☐ Step 8: 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 9: Remove connectors J29A, J30A, J32, J33A, and J33B on the A19 Strobe/TDR Buffer board.

☐ Step 10: Grab between the two sampling head slots and gently pull out the Acquisition unit a few inches.

☐ Step 11: Disconnect the gray ground wire from the rear of the Acquisition unit.

☐ Step 12: Remove the Acquisition unit.

CAUTION

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 oscilloscope 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 (BT160) on the A17 Main Processor board
- two batteries (BT160 and BT260) on the A29 Memory Expansion board

See Figures 3-8, 3-17, 3-20, and 3-29 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 monoflouride, BR 2/3 A
- **Solvent** (electrolyte): Gama Butyrlactone 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 Assembly Removal

Pin connectors are used for electrical interconnection with chassis mounted components and other circuit boards. All boards/assemblies in the oscilloscope are mounted on the chassis. Six boards which plug onto the top of the A13 Mother board (see Fig. 3-5 for the location of these boards in the card cage):

- A14 Input/Output (I/O)
- A15 Memory Management Unit
- A16 Waveform Compressor
- A17 Main Processor
- A18 Memory
- A29 Memory Expansion

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):

- A27 Acquisition Analog
- 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 circuit board from the oscilloscope, place it on a grounded antistatic surface. This will minimize the chance of static charge damage to the integrated circuits and/or related circuitry.

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

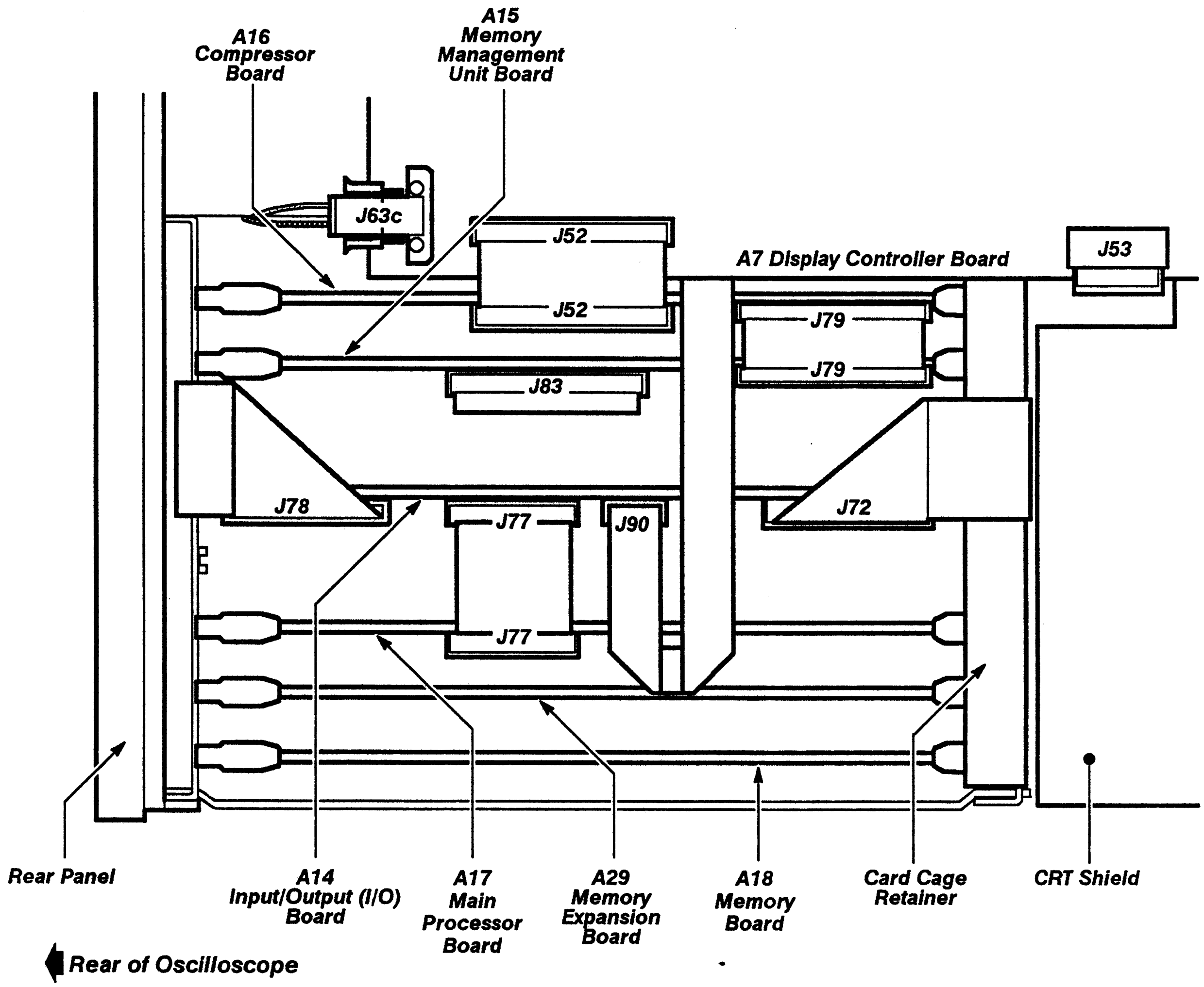


Figure 3-5 —*Top View of the Card Cage*

A1 M/F Strobe Drive Board—removal and replacement steps are listed below. See Figures 3-6 and 3-34 for connector, screw, and index locations.

☐ Step 1: Place the oscilloscope in the inverted position and remove the bottom panel.

☐ Step 2: Remove connectors; J16, J17 J28, J33A, J33B, and J35 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.

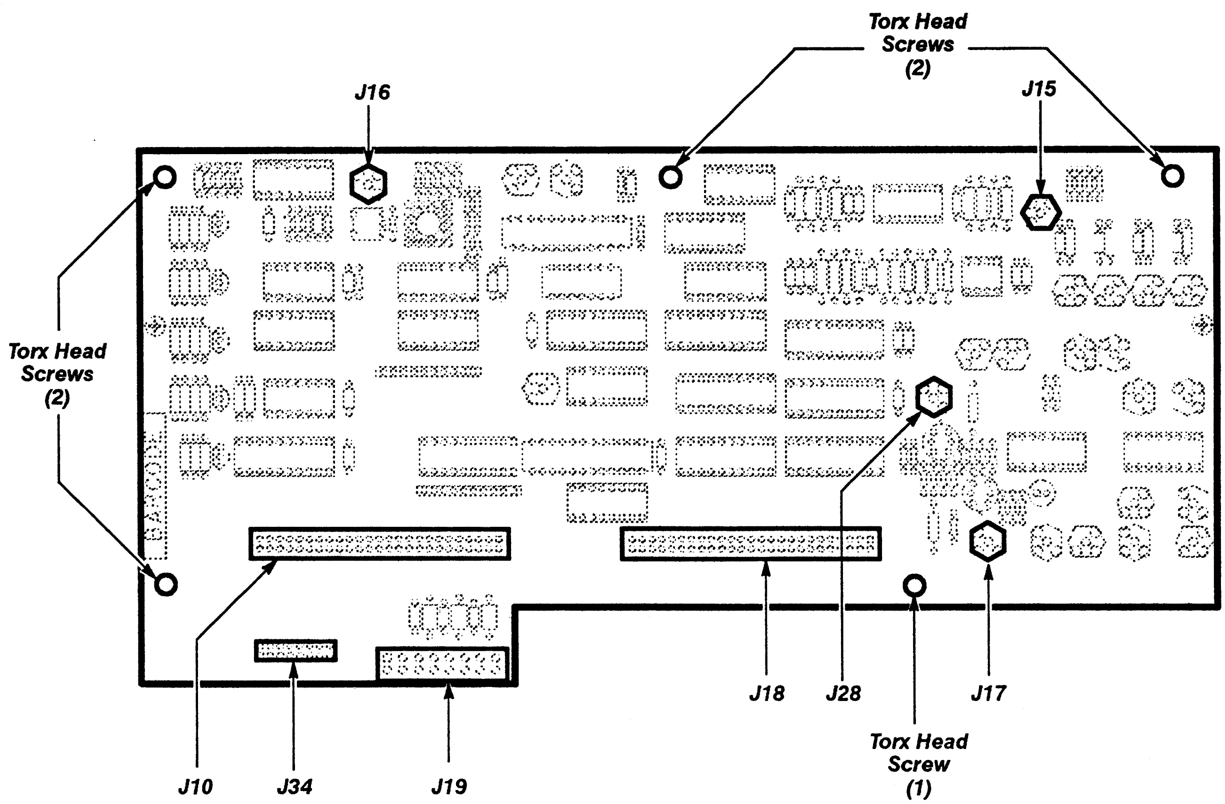


***Figure 3-6** — Removing and Replacing the A1 M/F Strobe Drive Board*

A3 M/F Power Connect board – removal and replacement steps are listed below. See Figures 3-2, 3-3, 3-7 and 3-17 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 A4 Regulator board.

☐ Step 3: Disconnect J90 from the A14 Input/Output board.

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

CAUTION

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

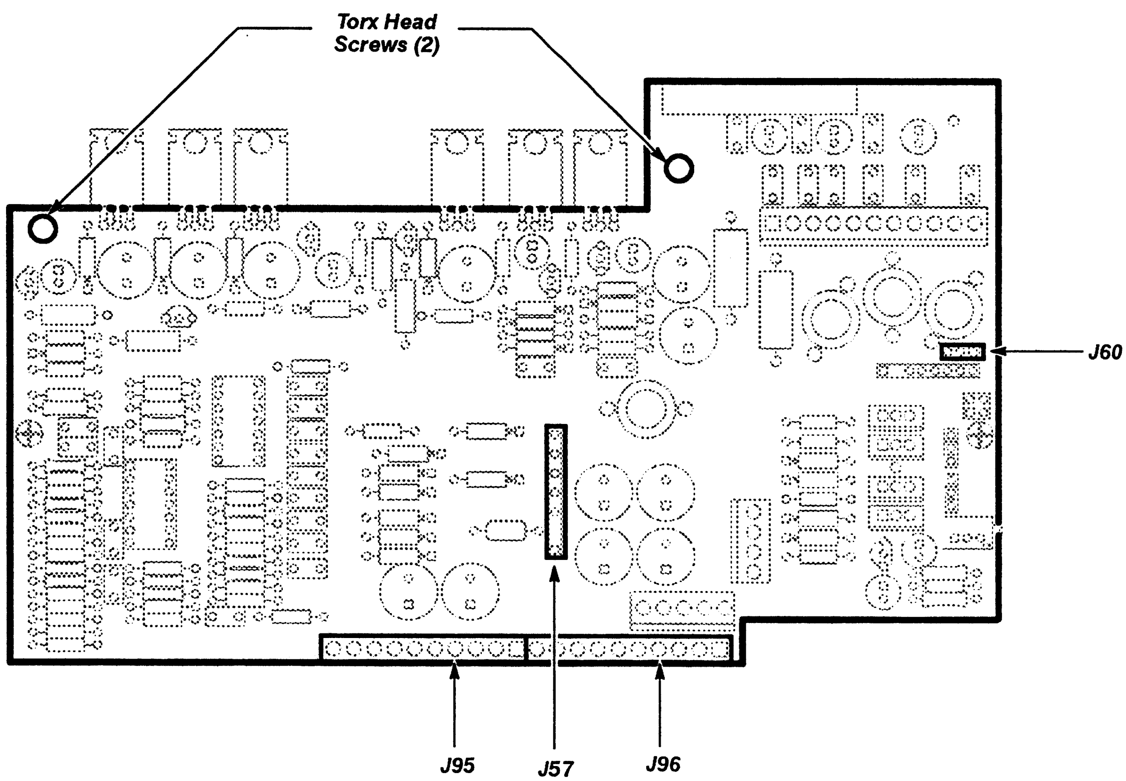


***Figure 3-7** – Removing and Replacing the A4 Regulator Board*

A4 Regulator board – removal and replacement steps are listed below. See Figures 3-2, 3-3, 3-7, and 3-34 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 oscilloscope 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 3-8, 3-32, and 3-34 for connector, screw, and index locations.

☐ Step 1: Place the oscilloscope in the inverted position.

☐ Step 2: Remove the A32 Trigger Select board.

☐ Step 3: Remove connectors J15, J29B, J30B, J32, J35, and J91 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 4: Remove the six Torx head screws holding the board in place.

☐ Step 5: Remove the A5 Time Base/Controller board.

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

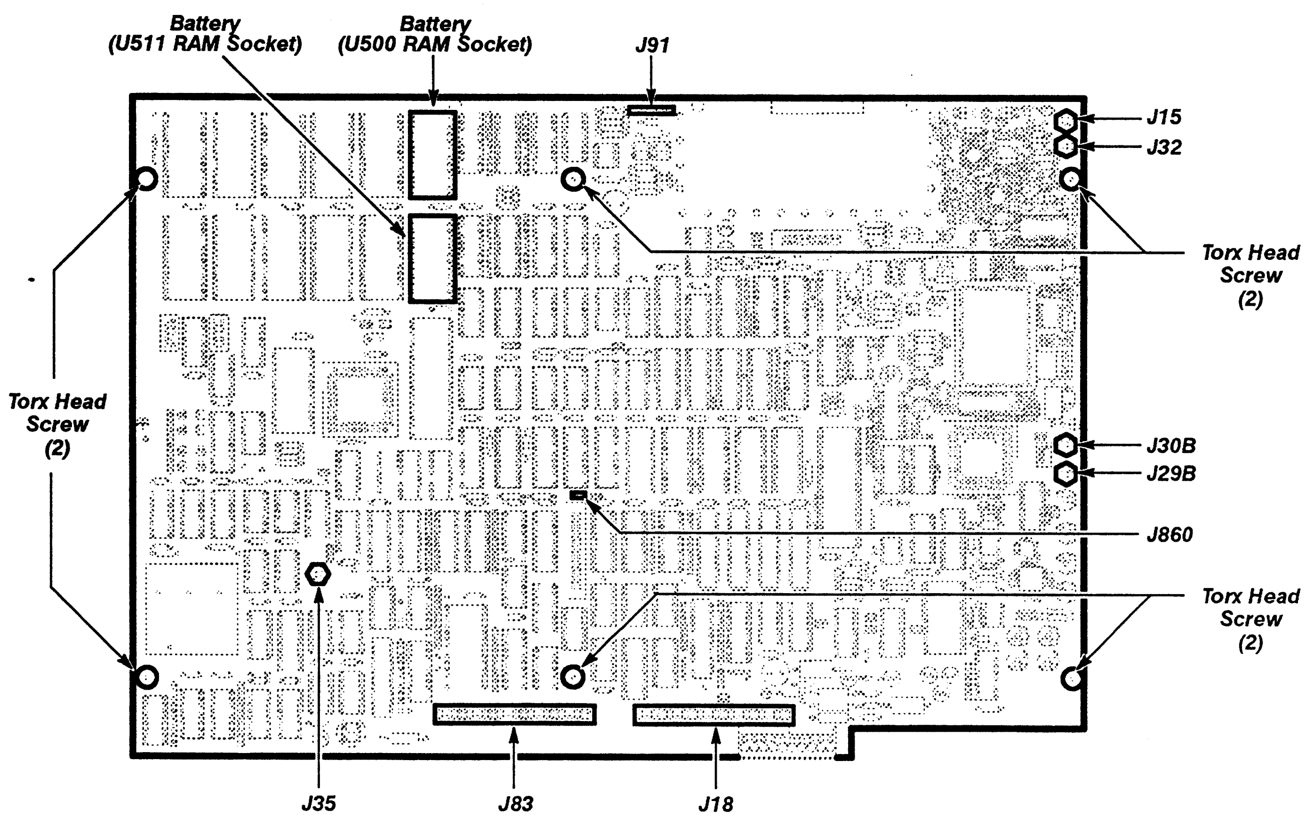


***Figure 3-8** – Removing and Replacing the A5 Time Base/Controller Board*

A6 Calibrator Assembly—removal and replacement steps are listed below. See Figure 3-9 for the connector location.

- [ ] Step 1: Place the oscilloscope in the inverted position.
- [ ] Step 2: Remove the nut directly above the A6 Calibrator assembly with a wrench or a needle-nose plier.
- [ ] Step 3: Remove the J91 connector and the J17 cable attached into the A6 Calibrator assembly.
- [ ] Step 4: Remove the A6 Calibrator assembly.

To replace the A6 Calibrator assembly, then perform the previous steps in reverse order.

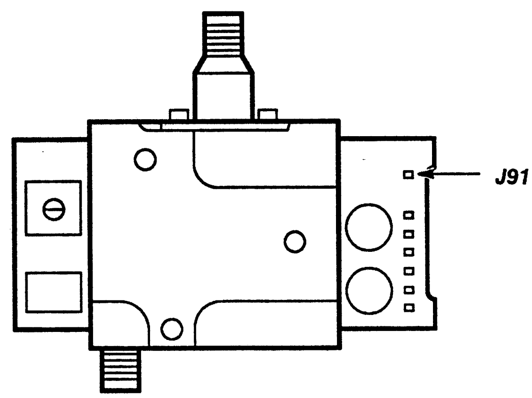


***Figure 3-9** — Removing and Replacing the A6 Calibrator Assembly*

A7 Display Controller board – removal and replacement steps are listed below. See Figures 3-10 and 3-34 for connector, screw, and index locations.

☐ Step 1: Remove connectors J57, J53, J52, and J63C from the A7 Display Controller board. Note the position of the multi-pin connector's index triangles on each connector to ensure that the connectors can be correctly replaced.

☐ Step 2: Remove the six Torx head screws.

☐ Step 3: Remove the A7 Display Controller board. Lift and extract the board toward the right side of the oscilloscope (as viewed from the front of the oscilloscope).

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

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

CAUTION

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

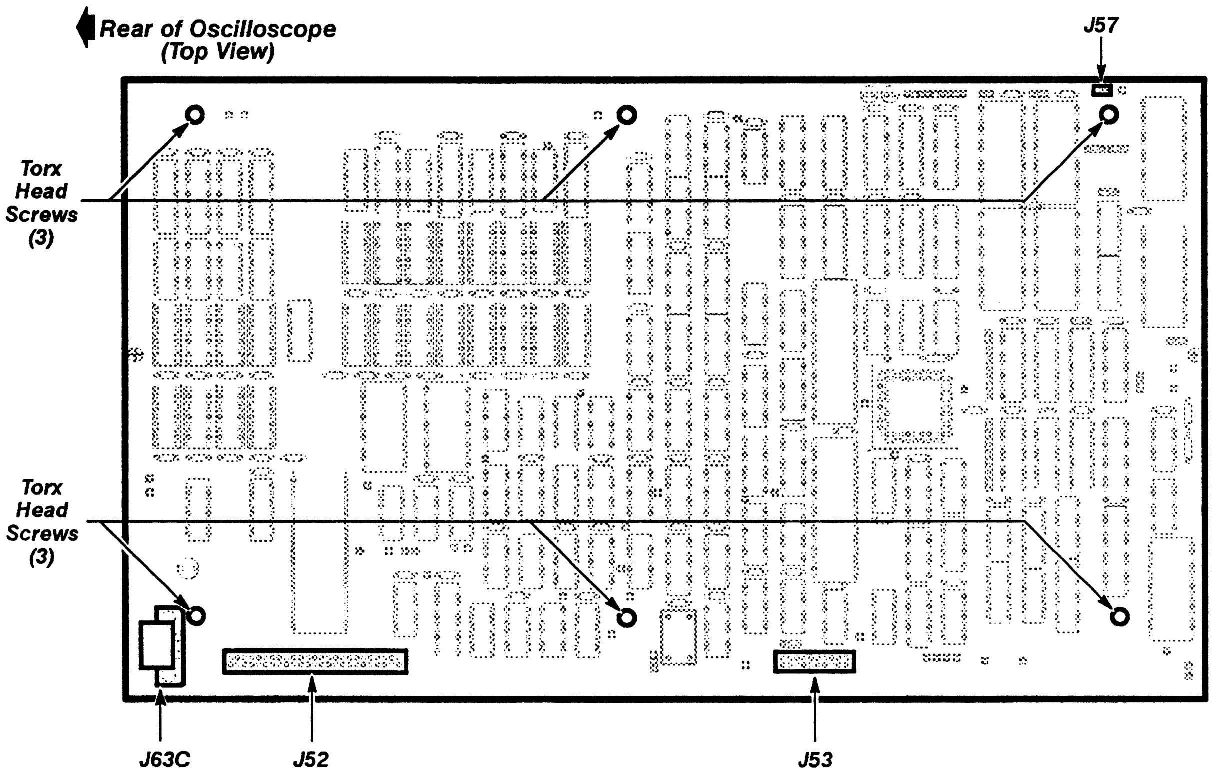


***Figure 3-10** — Removing and Replacing the A7 Display Controller Board*

Note: *Insert the inner edge of this board back into each of the slots of the board guides. (Be certain the guides are seated correctly on top of the circuit boards in the card cage).*

A8 CRT Driver Board—removal and replacement steps are listed below. See Figures 3-4, 3-11, 3-12, 3-13 and 3-34 for connector, screw, and index locations.

☐ Step 1: Remove the CRT shield.

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

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

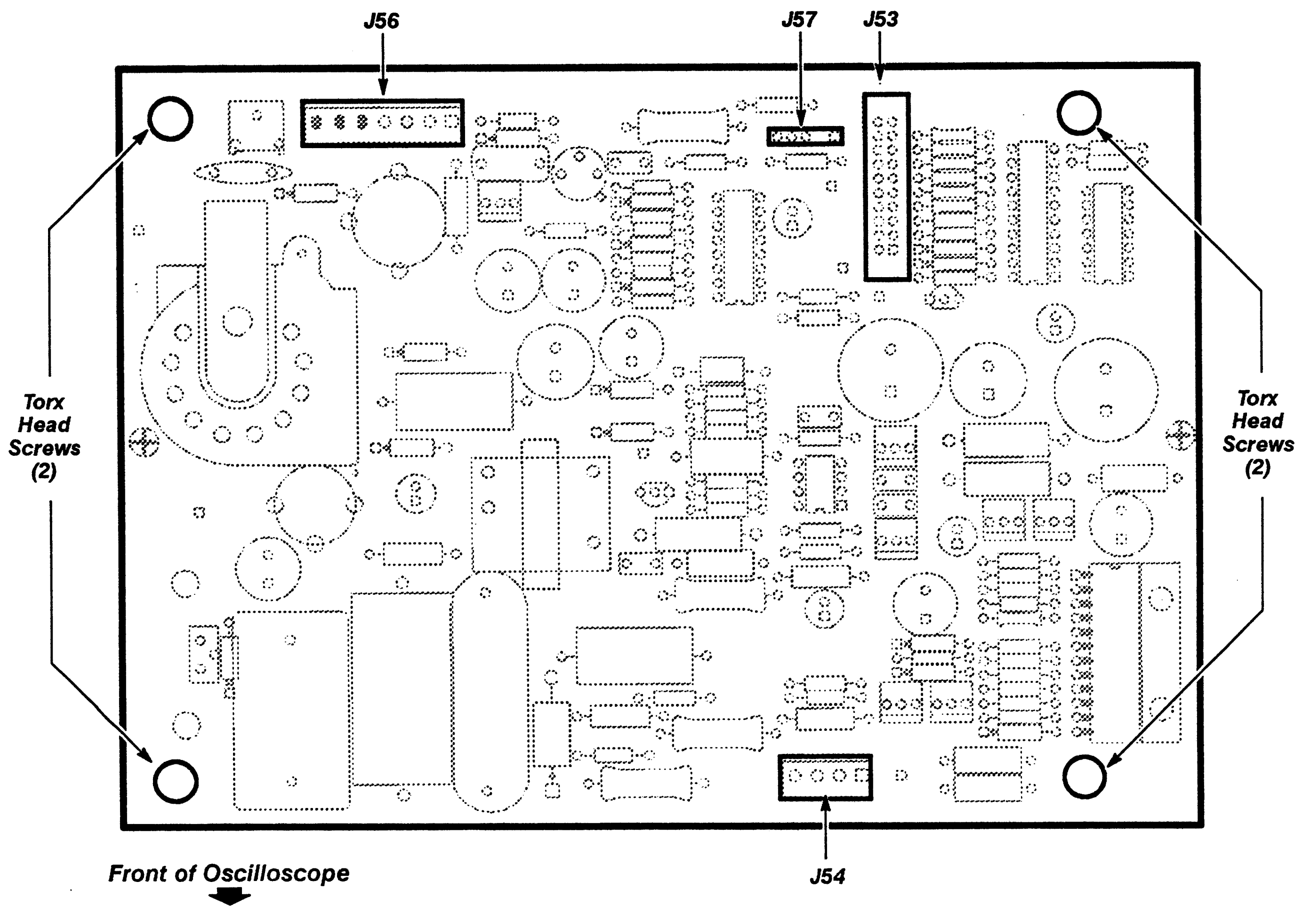


***Figure 3-11** — Removing and Replacing the A8 CRT Driver Board*

CAUTION

Do not lift the trim covers to remove them; doing so will break the trim covers. There is a clip on the inside of the trim cover which slides over the end of the side frame section. To remove the trim covers properly and prevent breakage of these covers, move each cover towards the end of the oscilloscope 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 oscilloscope.

- ☐ Step 4: Remove the trim covers.
- ☐ Step 5: Remove the single Torx head screw from the center of the (left side) frame section.
- ☐ Step 6: Remove the screws from the ends of the frame section.
- ☐ Step 7: Remove the frame section.
- ☐ Step 8: Remove the Torx head screws from each corner of the A8 CRT Driver board.
- ☐ Step 9: Remove the A8 CRT Driver board by sliding it under the neck of the CRT and then out of the left side of the oscilloscope.

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

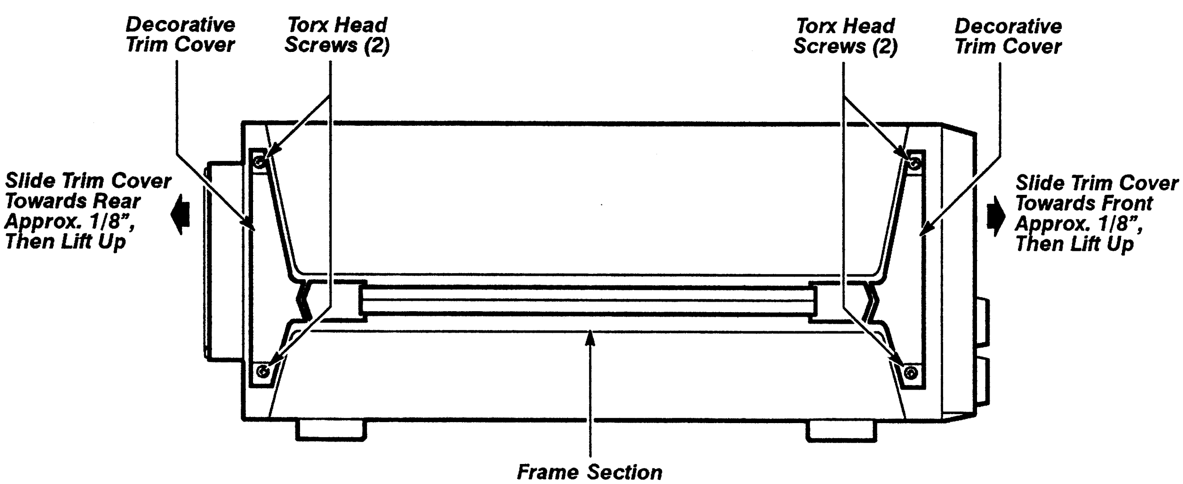


Figure 3-12 — *Removing the Left-Side Decorative Trim Covers*

A9 Touch Panel Assembly—removal and replacement steps are listed below. See Figures 3-4, 3-13 and 3-34 for connector, screw, and index locations.

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

Note: *The wire cable from J73 on the A10 Front Panel Control board is removed with the A9 Touch Panel Assembly.*

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

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

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

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

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.*

A10 Front Panel Control board – removal and replacement steps are listed below. See Figures 3-4, 3-10, 3-13 and 3-34 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 connector J53 from the A7 Display Controller board.
- ☐ Step 3: Remove connectors J72, J73, J74 and J75 from the A10 Front Panel Button board. Note the position of the multi-pin connector's index triangles to ensure that the connectors can be correctly replaced.
- ☐ Step 4: Remove the two Torx head screws at the upper edge of the board.
- ☐ Step 5: Lift the board away from the guides at its bottom and remove it.

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

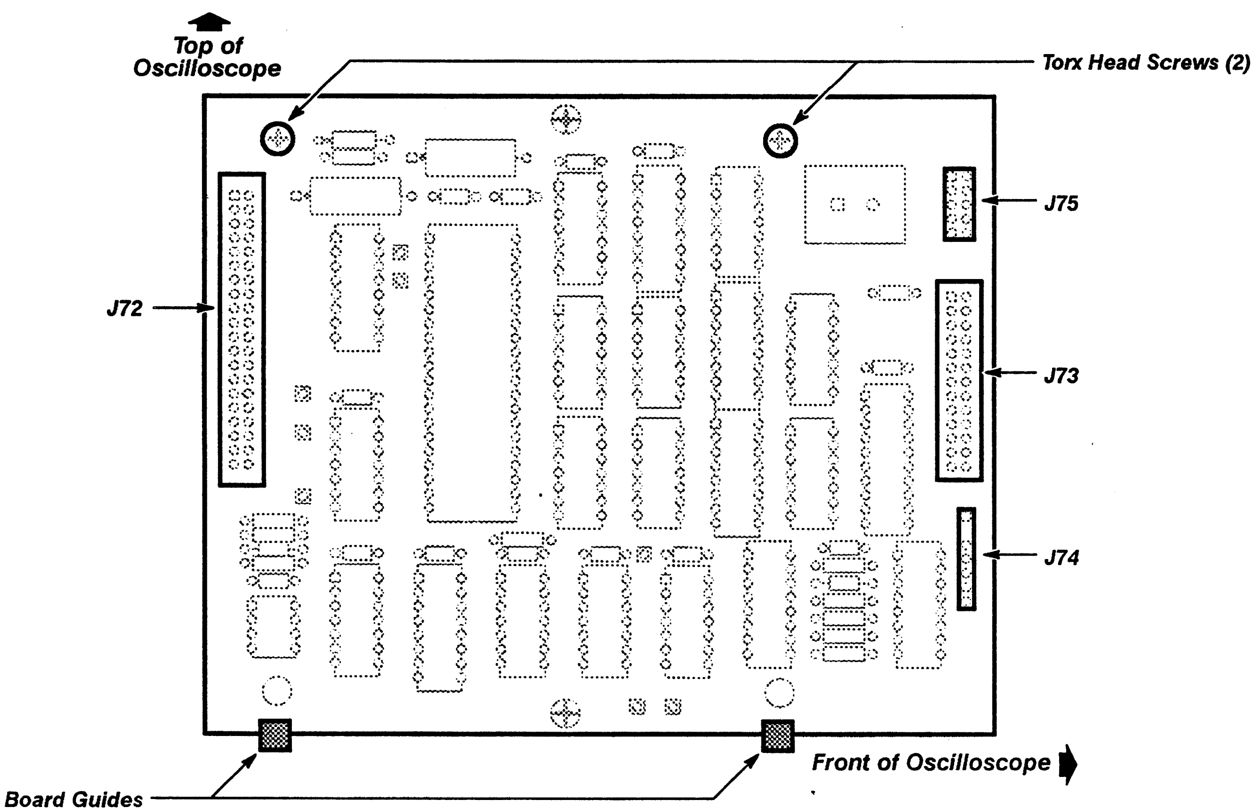


Figure 3-13 – Removing and Replacing the A10 Front Panel Button Board

A11 Front Panel Button board—removal and replacement steps are listed below. See Figures 3-4, 3-10, 3-13, 3-14 and 3-34 for connector, screw, and index locations.

☐ Step 1: Remove the A7 Display Controller board.

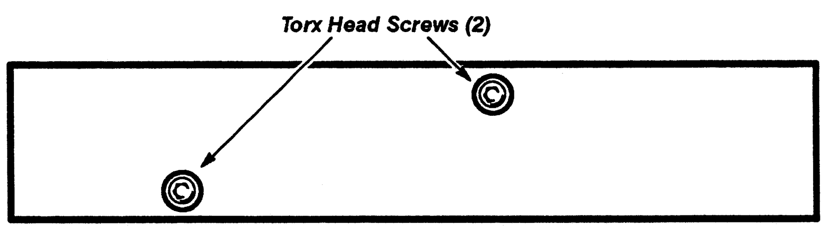
☐ Step 2: Remove the CRT shield. (Refer to the removal instructions under Cathode Ray Tube Removal/Replacement earlier in this section; following Steps 1 and 2.)

☐ Step 3: Remove connector J75 from the A10 Front Panel Control board. Note the position of connector index triangles for correct replacement.

☐ Step 4: 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 5: 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 3-14** — Removing and Replacing the A11 Front Panel Button Board*

A12 Rear Panel Assembly—removal and replacement steps are listed below. See Figures 3-2, 3-15 and 3-34 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 oscilloscope. Remove connector J78 from the top of the A12 Rear Panel assembly. Note the position of the connector's index triangles to ensure that the connectors can be correctly replaced.

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

☐ Step 5: Remove the following items from the rear panel 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.

CAUTION

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.*

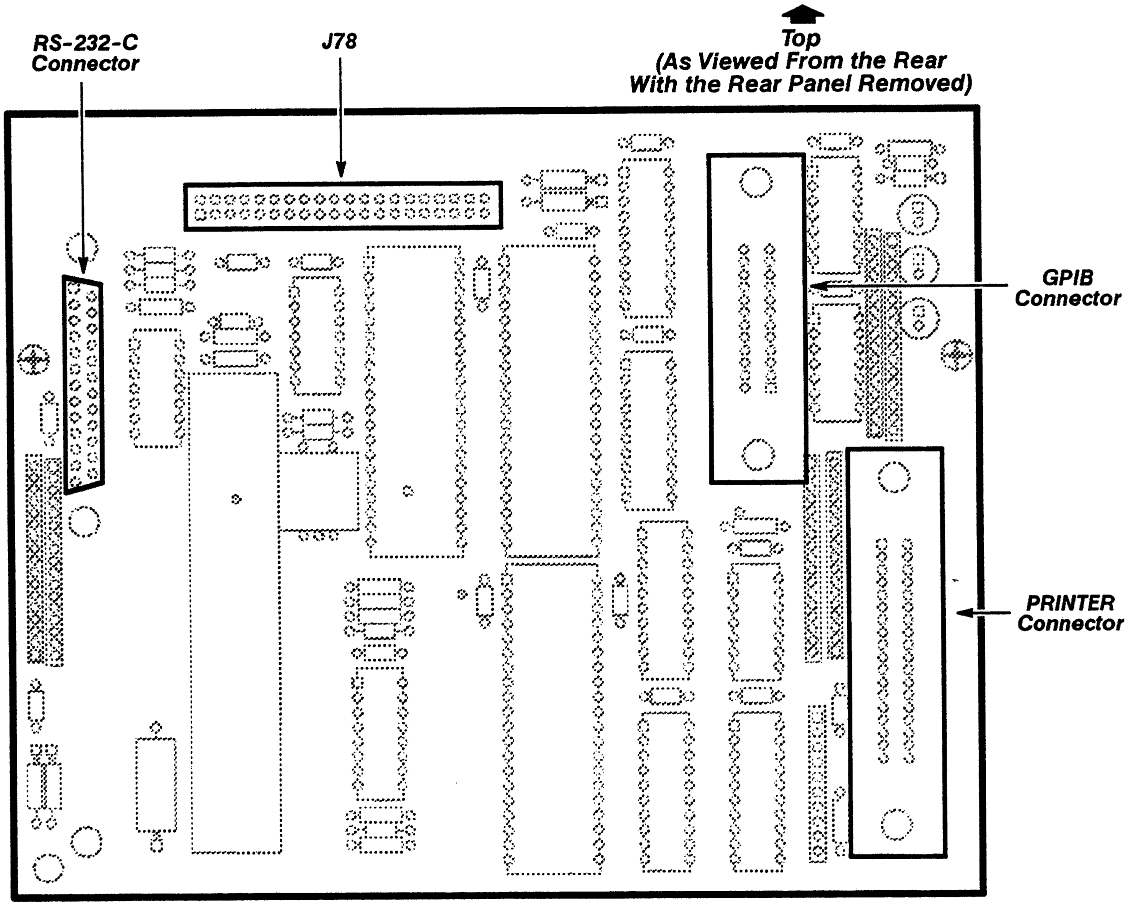


Figure 3-15 *— Removing and Replacing the A12 Rear Panel Assembly*

A13 Mother board – removal and replacement Steps are listed below. See Figures 3-5, 3-16 and 3-34 for connector, screw, and index locations.

- [ ] Step 1: 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 guides are retained by two small catches, located in two holes in the left side bracket of the card cage. The other ends of the guides contain slots which attach to the edge of the A7 Display Controller board. Both ends of the guides can be pried loose for removal.
- [ ] Step 2: Remove the A14 I/O, A15 MMU, A16 Compressor, A17 Main Processor, A18 Memory and A29 Memory Expansion 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, follow the previous steps in reverse order.

CAUTION

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

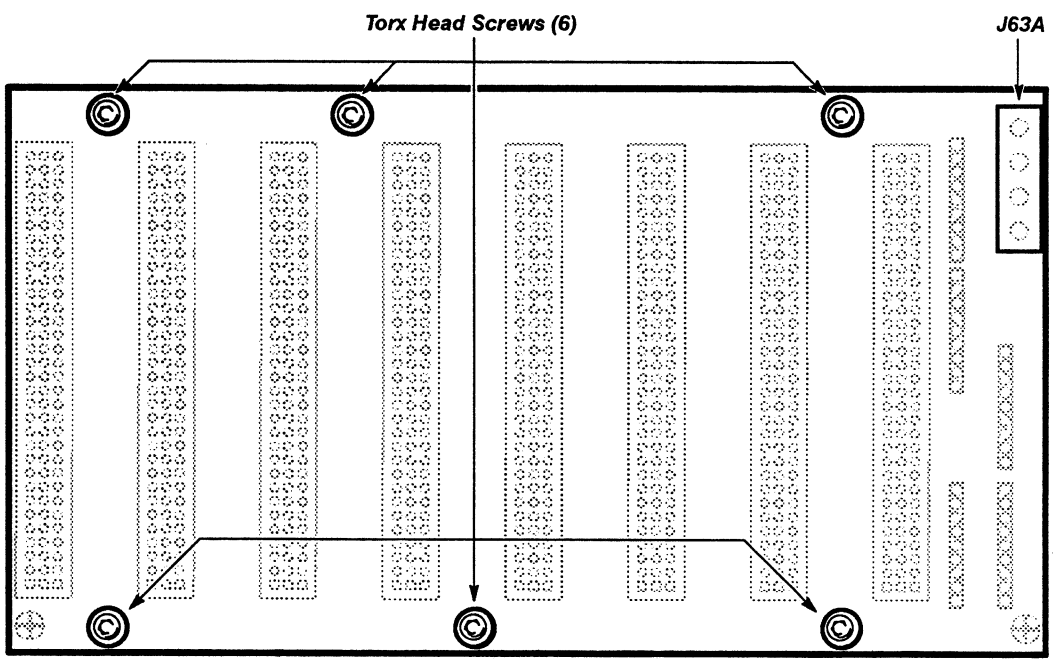


***Figure 3-16** – Removing and Replacing the A13 Mother Board*

A14 Input/Output (I/O) Board—removal and replacement steps are listed below. See Figures 3-5, 3-17 and 3-34 for board guides, connector, and index locations.

☐ Step 1: 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 the card cage. These guides are retained by two small catches located in two holes in the left bracket of the card cage. The other ends of the guides contain slots which attach to the edge of the A7 Display Controller board. Both ends of the guides can be pried loose for removal.

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

☐ Step 3: Lift the white, hinged tab at the upper, front edge of the board. Pull the tab upward until the A14 I/O board separates from the A13 Mother board.

☐ Step 4: Remove the A14 I/O board.

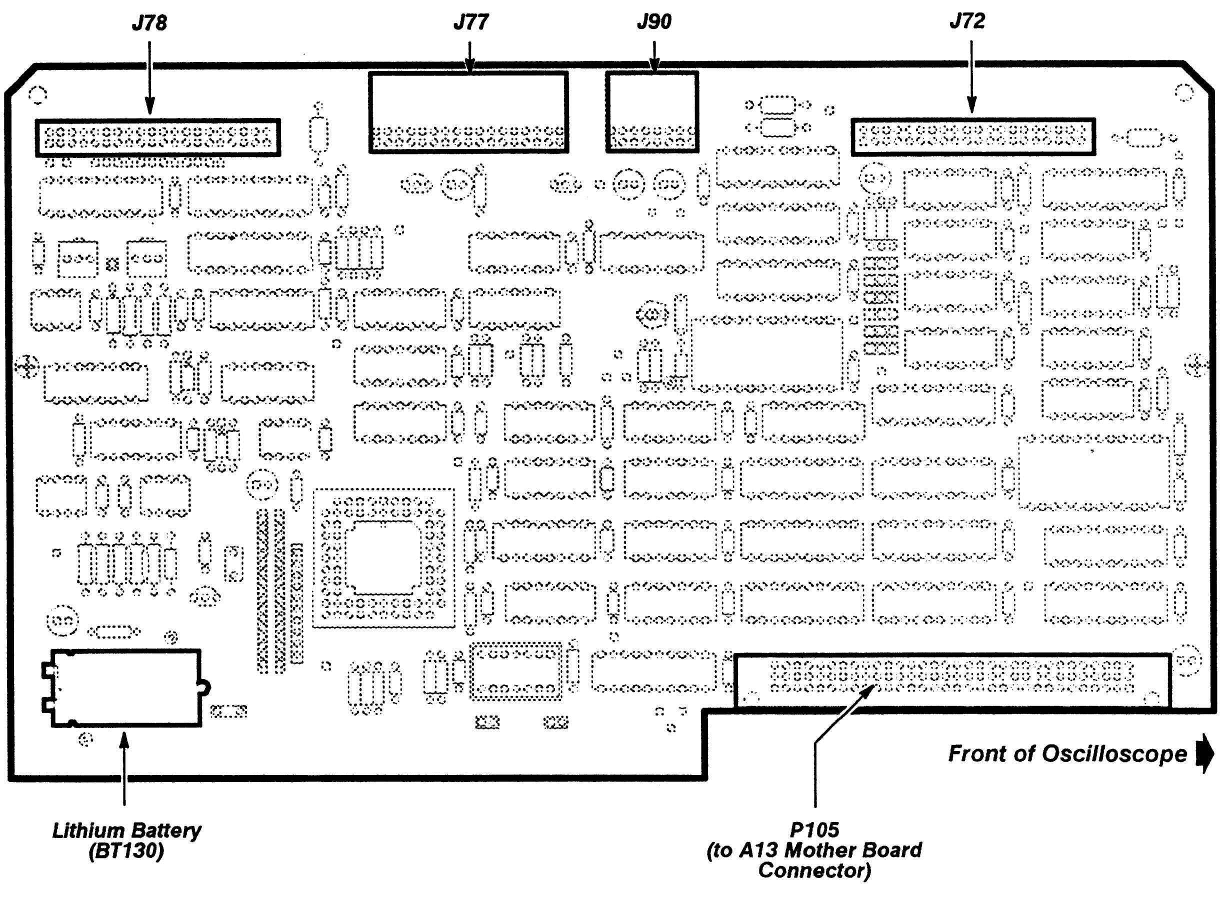


***Figure 3-17** — Removing and Replacing the A14 I/O Board*

WARNING

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

To replace the A14 I/O board, perform the previous steps in the reverse order.

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

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

A15 Memory Manager Unit (MMU) board—removal and replacement steps are listed below. See Figures 3-5, 3-17, 3-18 and 3-34 for board guides, connector, and index locations.

- [ ] Step 1: Remove the card cage retainer from the top front of the card cage by removing the card cages two screws. Remove both circuit board guides from the top of the card cage. The guides are retained by two small catches located in two holes in the left bracket of the card cage. The other ends of the guides contain slots which attach to the edge of the A7 Display Controller board. Both ends of the guides can be pried loose for removal.
- [ ] Step 2: Remove connectors J79 and J83 from the A15 MMU board. Note the position of the multi-pin connector's index triangles to ensure that the connectors can be correct replaced.
- [ ] Step 3: Remove J90 from the A14 I/O board.
- [ ] Step 4: Lift the white, hinged tabs at the front and rear edges of the A15 MMU board. Pull the tabs upward until the A15 MMU board separates from the A13 Mother board.
- [ ] Step 5: Remove the A15 MMU board.

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

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

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

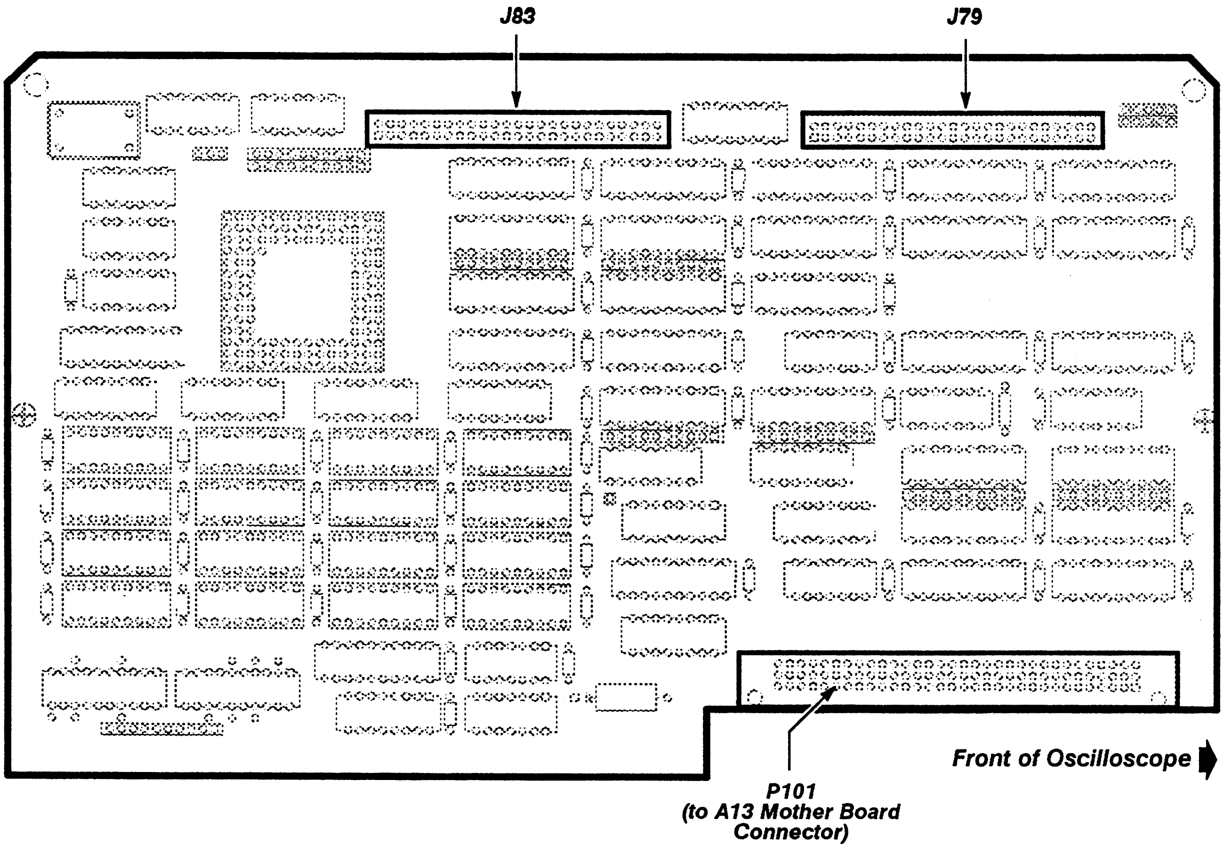


Figure 3-18 — Removing and Replacing the A15 MMU Board

A16 Compressor board—removal and replacement steps are listed below. See Figures 3-5, 3-17, 3-19 and 3-34 for board guides, connector, and index locations.

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

To replace the A16 Compressor board perform the previous steps in reverse order.

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

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

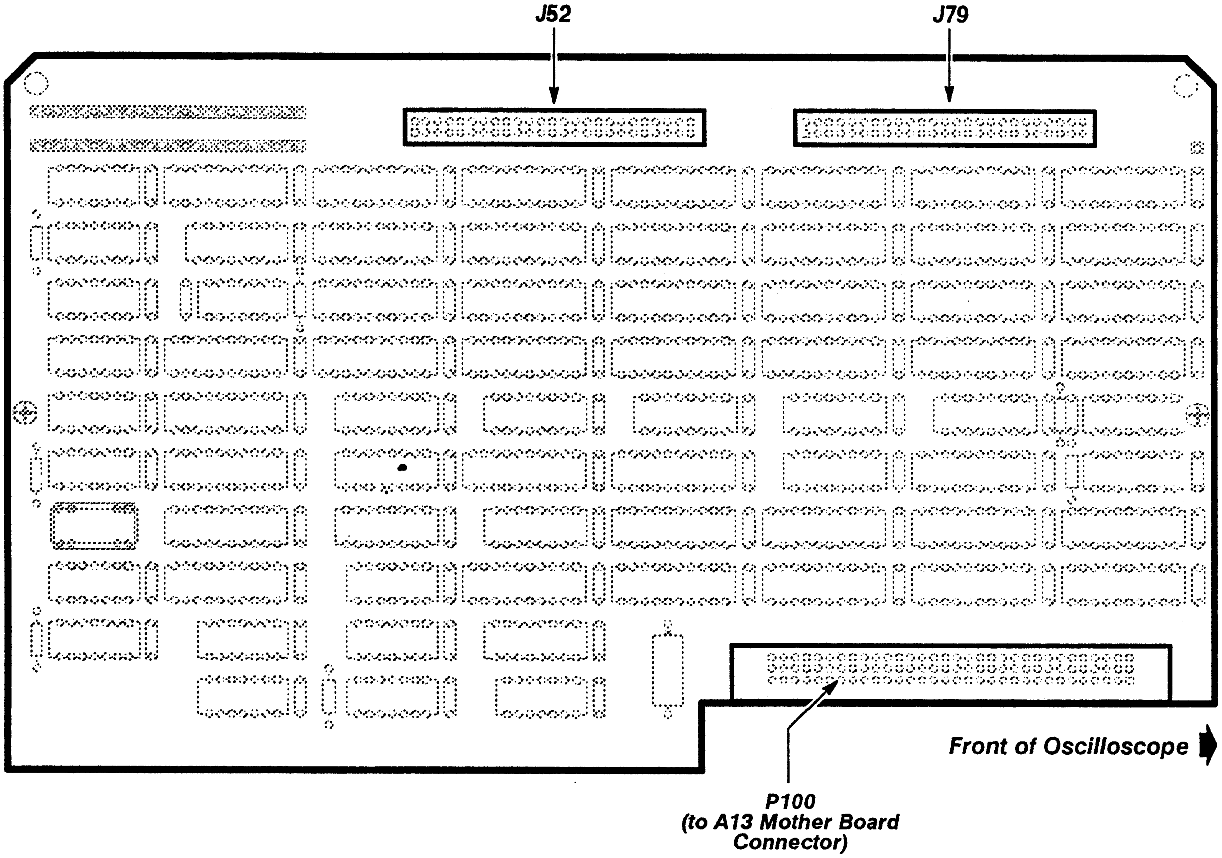


Figure 3-19 — Removing and Replacing the A16 Compressor Board

A17 Main Processor board–removal and replacement steps are listed below. See Figures 3-5, 3-20 and 3-34 for board guide, connector, and index locations.

☐ Step 1: 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 guides are retained by two small catches located in two holes in the left bracket of the card cage. The other ends of the guides contain slots which attach to the edge of the A7 Display Controller board. Both ends of the guides can be pried loose for removal.

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

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

☐ Step 4: Remove the A17 Main Processor board.

WARNING

A lithium battery (BT160) is mounted on the A17 Main Processor board. ***The battery requires special handling for disposal.*** *Read the instructions on the Lithium Battery Disposal and First Aid in this section. Care is required when placing the A17 Main Processor board on metal surfaces. If some IC or battery leads are shorted, the battery may discharge or overheat and vent. (Plastic standoffs are to prevent shorts.)*

To replace the A17 Main Processor board, perform the previous steps in reverse order.

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

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

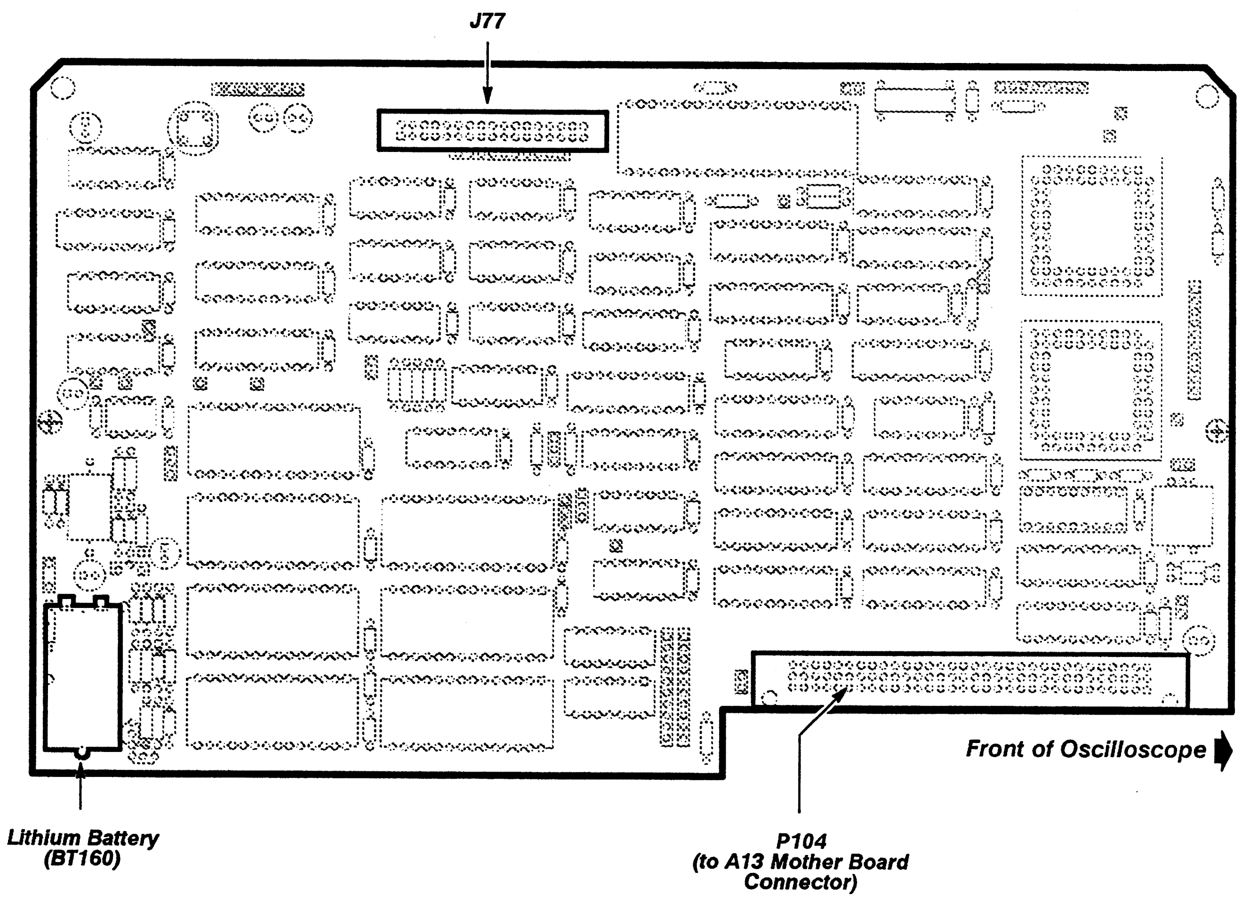


Figure 3-20 — *Removing and Replacing the A17 Main Processor Board*

A18 Memory board – removal and replacement steps are listed below. See Figure 3-5 and 3-21 for circuit board guide locations.

☐ Step 1: 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 guides are retained by two small catches located in two holes in the left bracket of the card cage. The other ends of the guides contain slots which attach to the edge of the A7 Display Controller board. Both ends of the guides can be pried loose for removal.

☐ Step 2: Lift the white, hinged tabs at the front and rear edges of the board. Pull the tabs upward until the A18 Memory board separates from the A13 Mother board.

☐ Step 3: Remove the A18 Memory board.

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

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

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

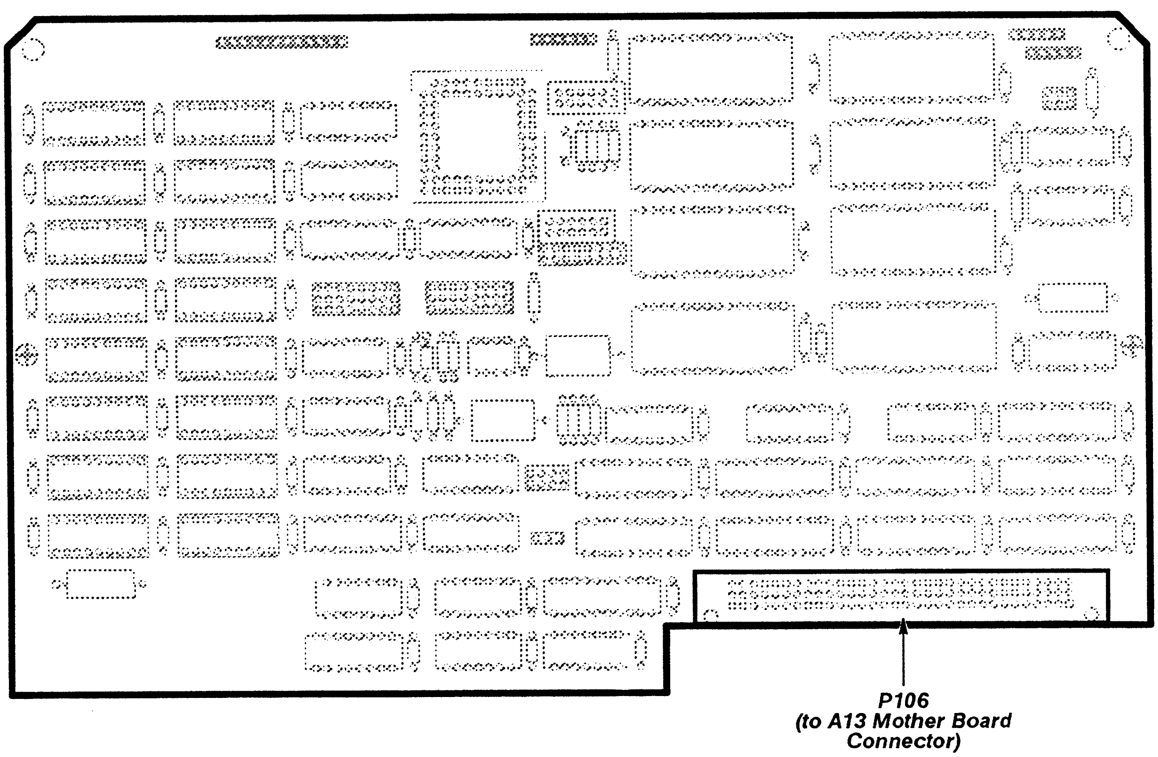


Figure 3-21 – *Removing and Replacing the A18 Memory Boards*

A19 Strobe/TDR Buffer board – removal and replacement steps are listed below. See Figures 3-12, 3-22, 3-25, 3-32 and 3-34 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 and J4C 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 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.

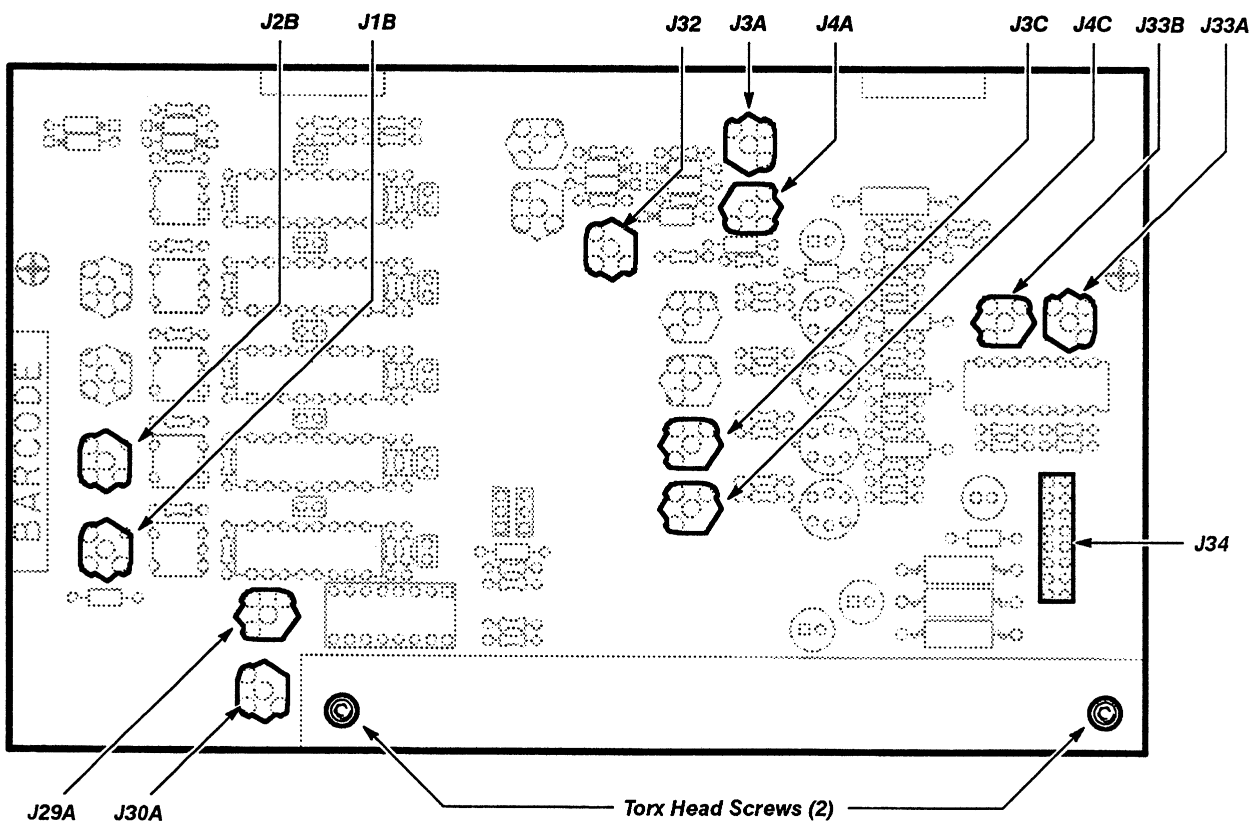


Figure 3-22 – *Removing and Replacing the A19 Strobe/TDR Buffer Board*

A22/A23 Head Interconnect board—removal and replacement steps are listed below. See Figures 3-12, 3-22, 3-23, 3-24, 3-25, 3-27, 3-28, 3-32 and 3-34 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 A27 Acquisition Analog board, the A28 Acquisition MPU board 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 connectors from 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.

☐ Step 8: Remove the Front Subpanel assembly with the 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 removing.

☐ Step 10: Turn the Front Subpanel assembly around so that the open compartments face away from you.

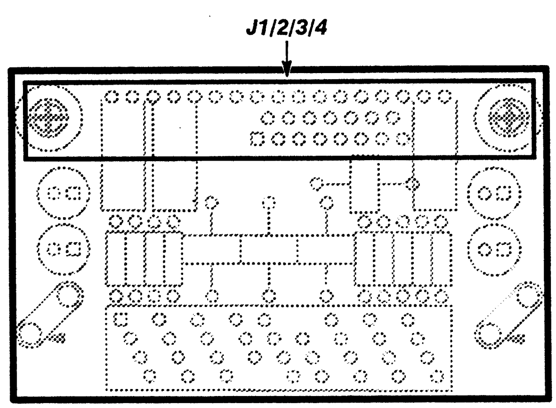


***Figure 3-23** — Removing and Replacing the A22/A23 Head Interconnect Boards*

☐ Step 11: Remove the top nut that retains the sampling head compartment to the head interconnect board you are removing.

☐ Step 12: Remove the head interconnect board by slightly prying up on the tabs that are keeping it in place, and then slowly remove the board from the J1/2/3/4 connector.

To replace the A22/A23 Head Interconnect boards, perform the previous steps in reverse order.

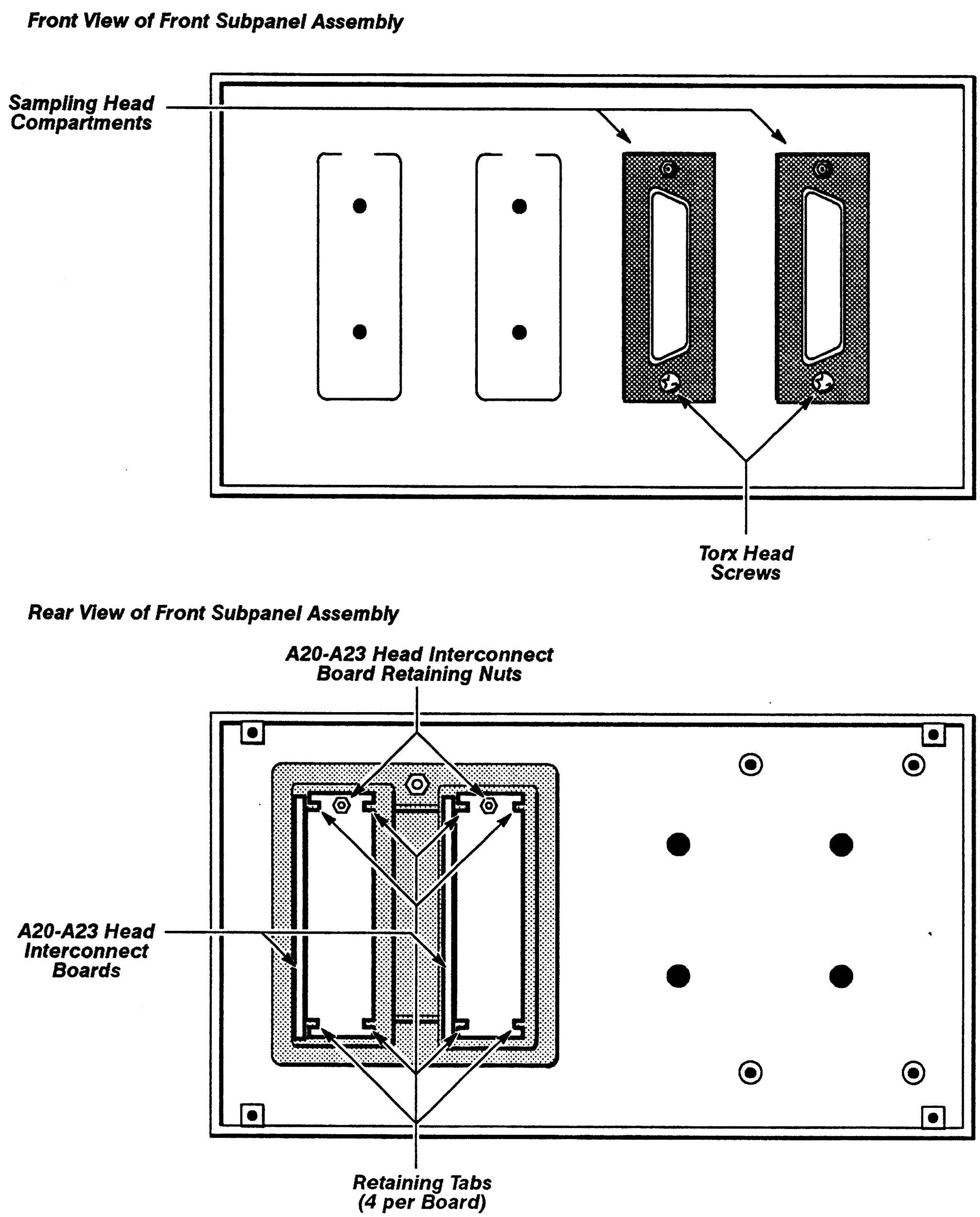


Figure 3-24 – *Removing and Replacing the Front Subpanel Assembly*

A26 M/F Acquisition Interconnect board—removal and replacement Steps are listed below. See Figures 3-12, 3-22, 3-24, 3-25, 3-26, 3-27, 3-28, 3-32 and 3-34 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 A27 Acquisition Analog board, the 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.

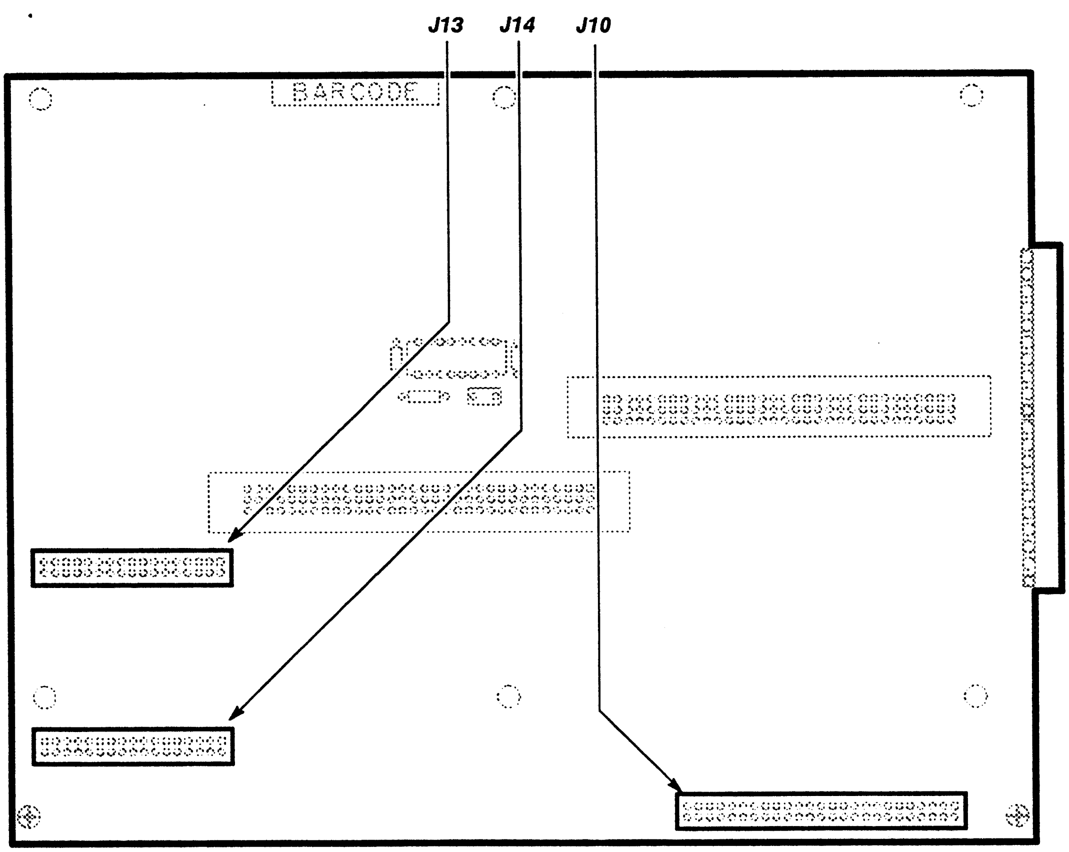


Figure 3-25 — Removing and Replacing the A26 M/F Acquisition Interconnect Board

☐ 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.

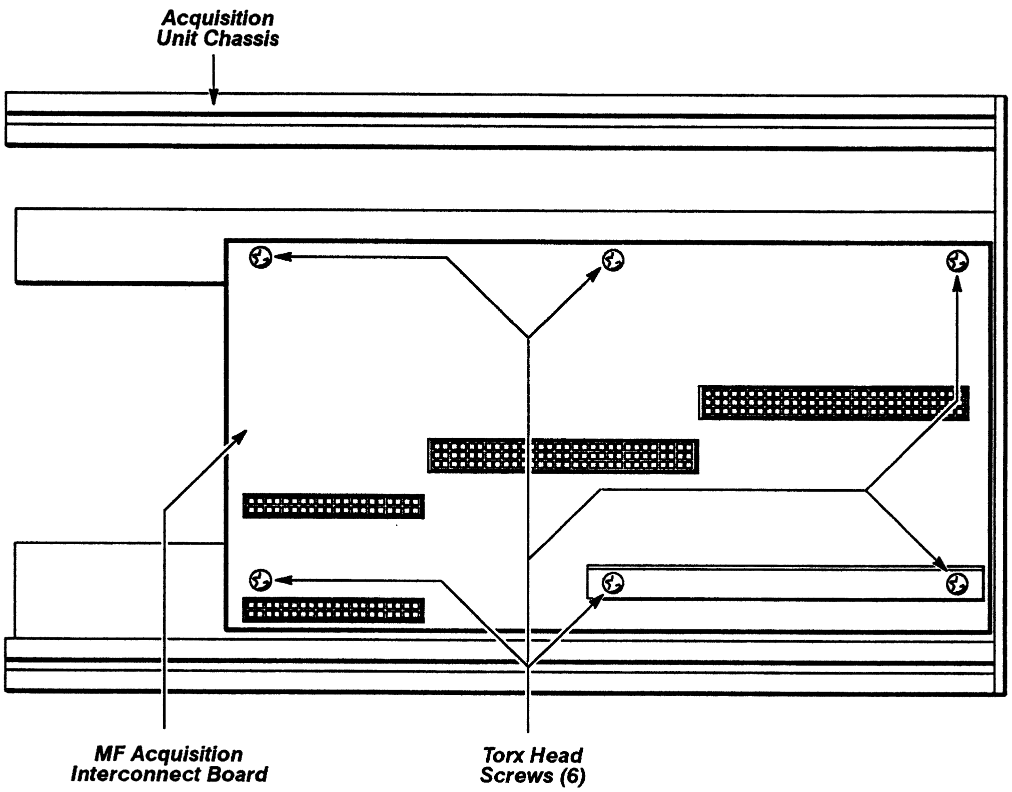


***Figure 3-26** — Top View of the A26 Mainframe Acquisition Interconnect Board*

A27 Acquisition Analog board—removal and replacement steps are listed below. See Figures 3-12, 3-22, 3-25, 3-27, 3-32 and 3-34 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 A27 Acquisition Analog board.
- [ ] Step 4: Pull up on the hinged white tabs until the board separates from connector P6.

To replace the 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 A27 Acquisition Analog board to connect this connector to the A26 M/F Acquisition Interconnect board.

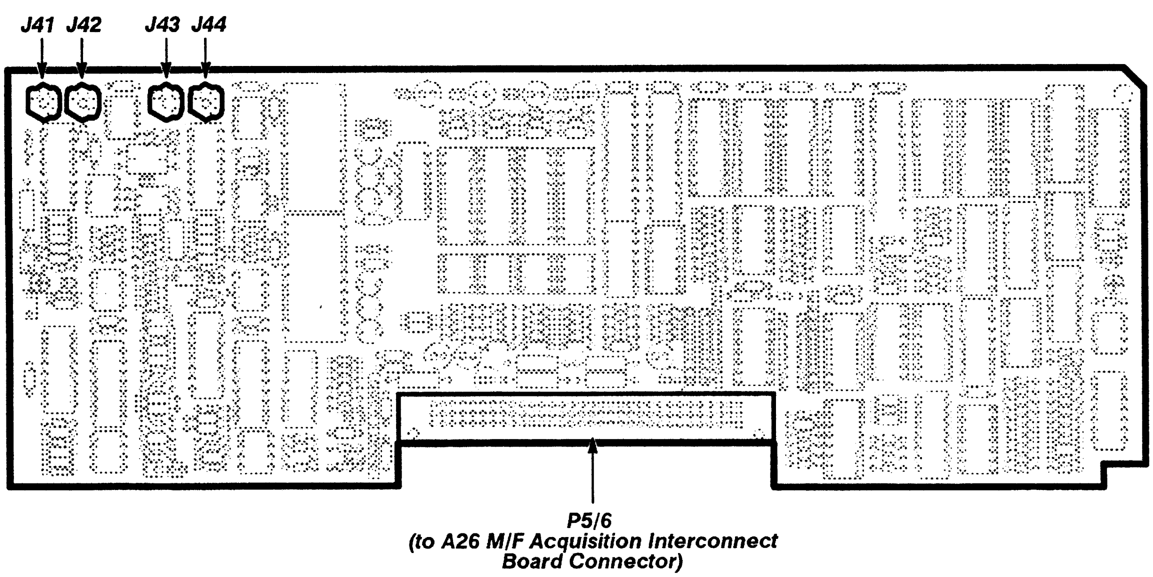


Figure 3-27 — *Removing and Replacing the A27 Acquisition Analog Board*

A28 Acquisition MPU board – removal and replacement steps are listed below. See Figures 3-12, 3-22, 3-25, 3-28, 3-32 and 3-34 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 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 A28 Acquisition MPU board to connect this connector to the A26 M/F Acquisition Interconnect board.

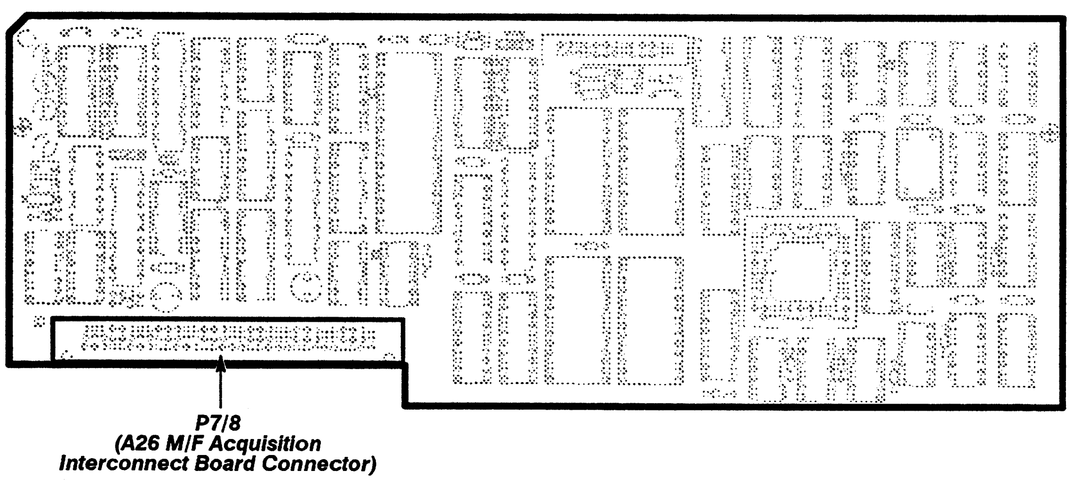


Figure 3-28 *— Removing and Replacing the A28 Acquisition MPU Board*

A29 Memory Expansion board – removal and replacement steps are listed below. See Figures 3-5 and 3-29 for circuit board guide and connector locations.

☐ Step 1: 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 guides are retained by two small catches located in two holes in the left bracket of the card cage. The other ends of the guides contain slots which attach to the edge of the A7 Display Controller board. Both ends of the guides can be pried loose for removal.

☐ Step 2: Lift the white, hinged tabs at the front and rear edges of the board. Pull the tabs upward until the A29 Memory Expansion board separates from the A13 Mother board.

☐ Step 3: Remove the A29 Memory Expansion board.

WARNING

Lithium batteries (BT160 and BT260) is mounted on the A14 I/O board. ***These batteries require special handling for disposal.*** *Read the instructions on Lithium Battery Disposal and First Aid in this section. Care is required when placing the A29 Memory Expansion board on metal surfaces. If some IC or battery leads are shorted the batteries may discharge or overheat and vent. (Plastic standoffs are to prevent shorts.)*

To replace the A29 Memory Expansion board, perform the previous steps in reverse order.

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

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

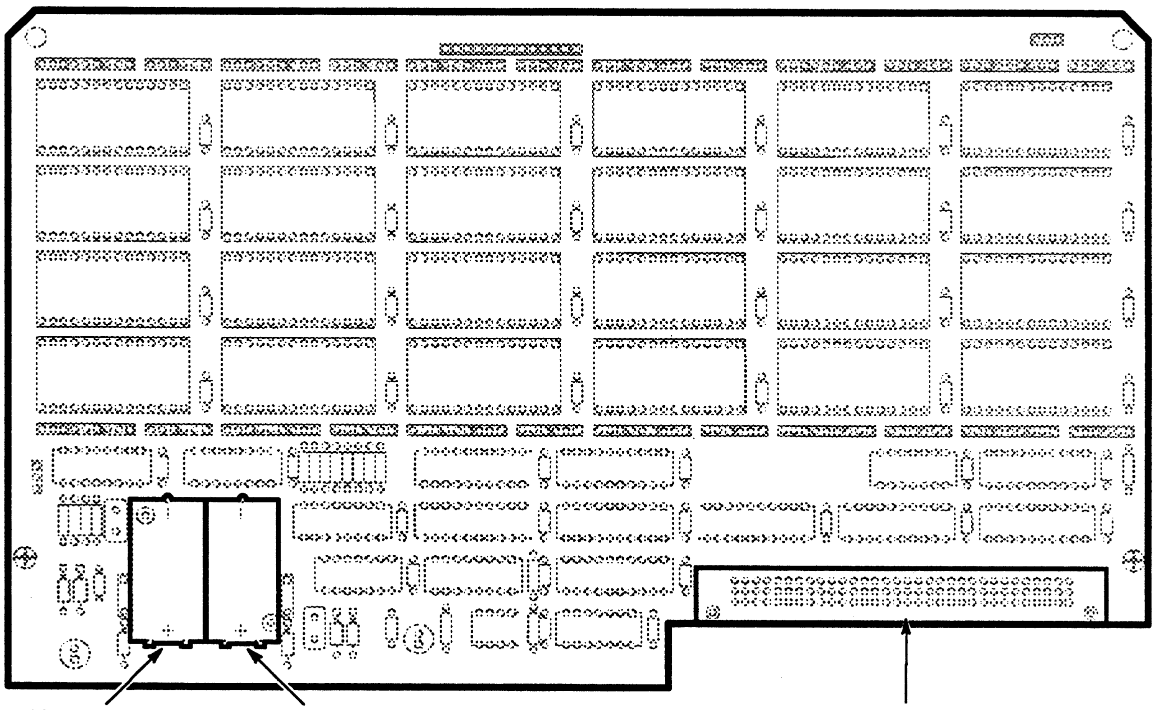


Figure 3-29 — *Removing and Replacing the A29 Memory Expansion Board*

A30/31 Trigger Pickoff and Delay Line Compensator Assembly—removal and replacement steps are listed below. See Figures 3-12, 3-22, 3-24, 3-25, 3-30, 3-31, 3-32, and 3-34 for circuit board guide and screw locations.

- [ ] Step 1: Remove the Acquisition unit, and position the unit in the upright position.
- [ ] Step 2: Remove the four screws holding the top of the Front Subpanel Assembly of the Acquisition unit.
- [ ] Step 3: Remove the four screws on the gold colored retaining brace located on the top front of the Acquisition unit.
- [ ] Step 4: Turn the oscilloscope in the inverted position and repeat.
- [ ] Step 5: Remove connectors J13 and J14 on the A26 M/F Acquisition Interconnect board. Note the connector index triangle locations for correct orientation.
- [ ] Step 6: Remove front panel assembly with the head interconnect boards intact.
- [ ] Step 7: Remove the two delay line screws on the rear panel of the Acquisition unit holding the desired delay line chassis. Remove the delay line chassis.
- [ ] Step 8: Use an 11/32-inch nutdriver and remove the two washer nuts, flat washers and retaining clamps holding the delay line coil to the chassis.
- [ ] Step 9: Use a 5/16-inch open-end wrench to loosen the delay line nuts at the SMA connectors, then alternate loosening the nuts with your fingers and pulling the delay line coil away from the connectors, so that the delay line comes off straight (refer to Fig. 3-2).
- [ ] Step 10: Use a 5/16-inch or 8 mm open-end wrench to remove the trigger pickoff cable from the A30/A31 Trigger Pickoff and Delay Line Compensator assembly.
- [ ] Step 11: Remove the two flathead torx screws and withdraw the A30/A31 Trigger Pickoff and Delay Line Compensator assembly from the chassis.
- [ ] Step 12: Replace the assembly by following the preceding steps in reverse order. Use an open-end torque wrench to tighten the SMA connector nuts to 10 in-lbs.

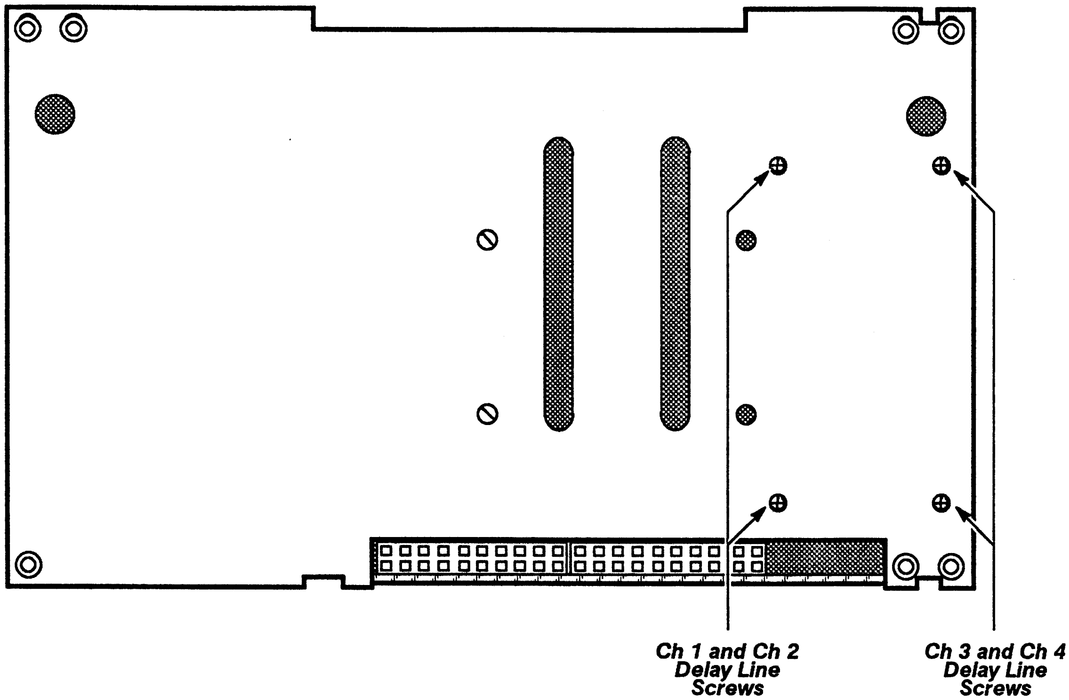


Figure 3-30 — Rear Panel of the Acquisition Unit

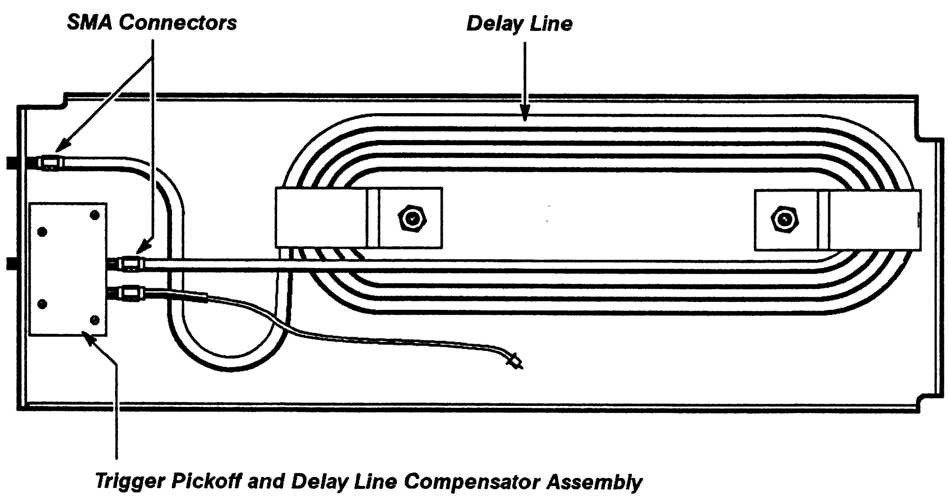


Figure 3-31 — Delay Line Chassis

A32 Trigger Select board—removal and replacement steps are listed below. See Figure 3-32 for connector and screw locations.

- ☐ Step 1: Place the oscilloscope in the inverted position.
- ☐ Step 2: Remove connectors J16, J86, J89 and Peltola connectors J88 and J87.

Note: *Record the positions of the connectors and the receptacles to aid in their correct reinstallation.*

- ☐ Step 3: Remove the connector J84 and note the position of the connector index triangle locations for correct orientation.
- ☐ Step 4: Remove the three Torx head screws and pull up on the board to remove it.
- ☐ Step 5: To replace the board, follow the removal procedures in reverse order.

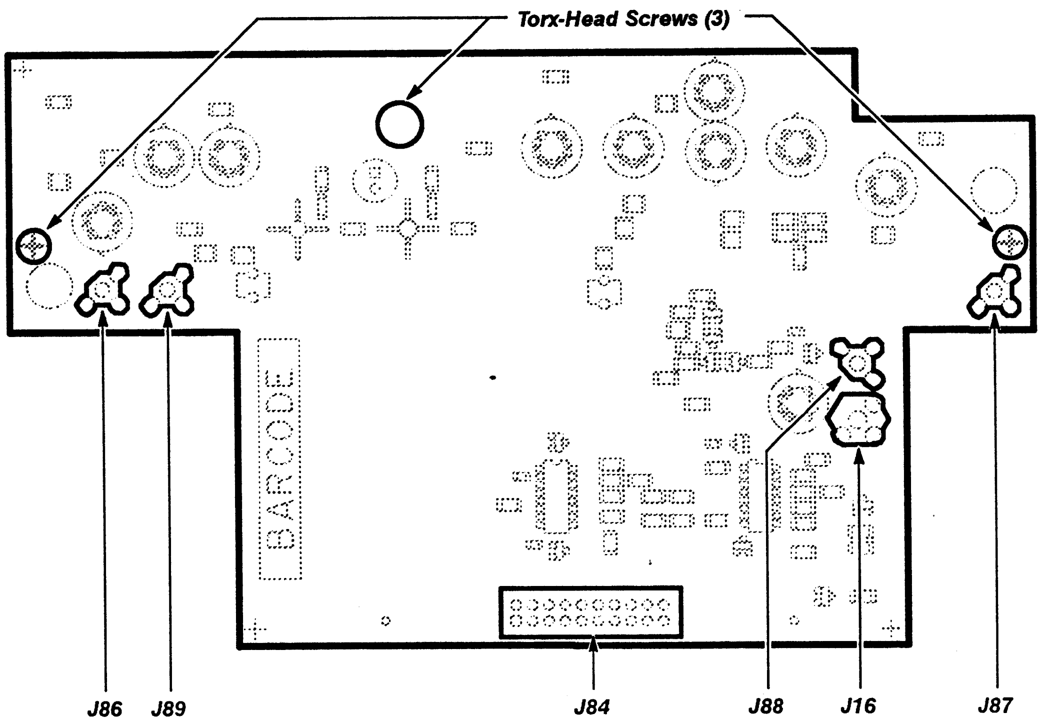


***Figure 3-32** — Removing and Replacing the A32 Trigger Select Board*

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 3-33 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 3-34.

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.

CAUTION

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.

CAUTION

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).

CAUTION

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

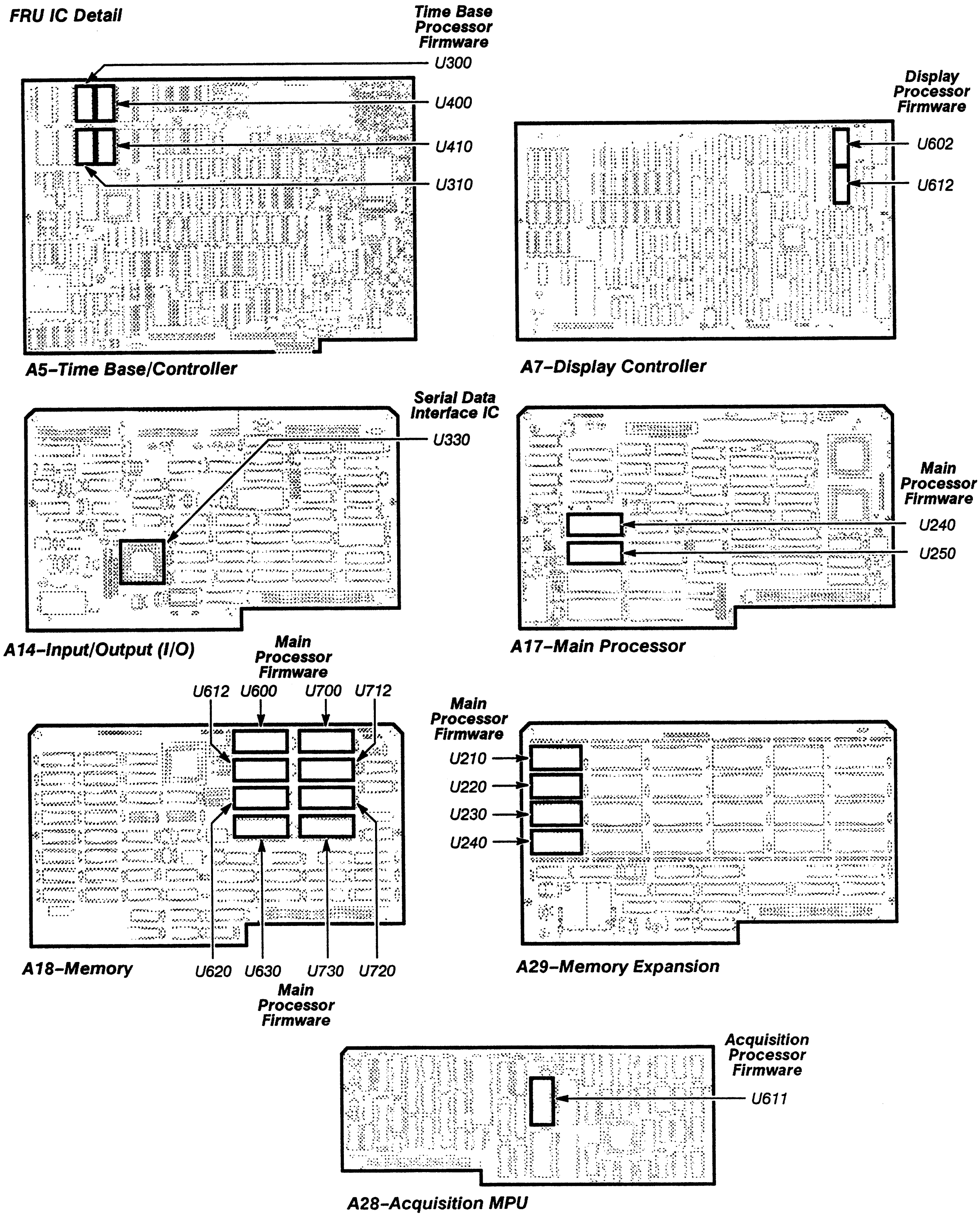


Figure 3-33 — *FRU IC Detail*

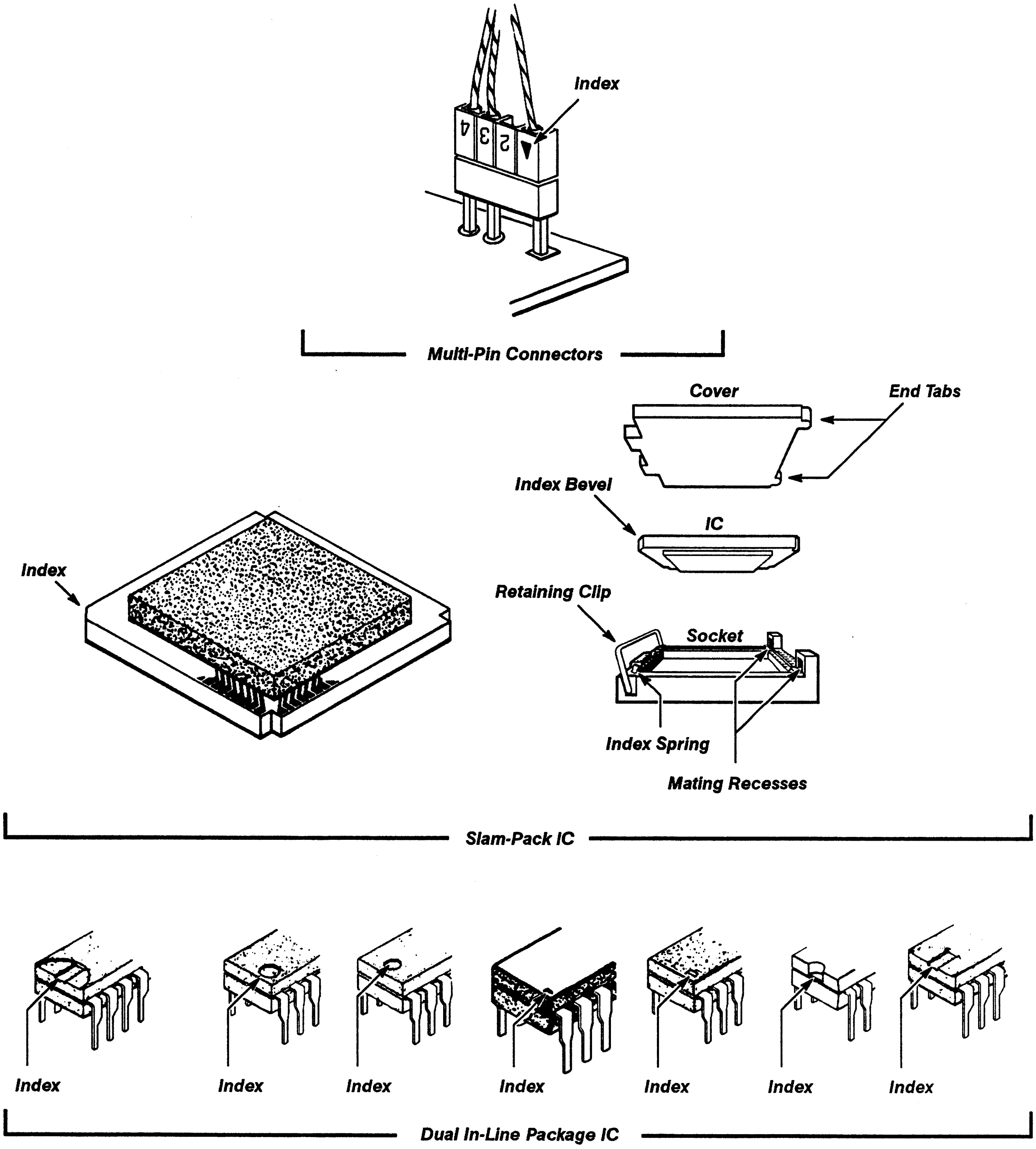


***Figure 3-34** — Multi-Pin Connector Orientation and Semiconductor Indexing Diagram*

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. 3-33 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)
- **A7 Display Controller board**—Display Processor FW (U602 and U612)
- **A17 Main Processor board**—Main Processor FW (U240 and U250)
- **A18 Memory board**—Main Processor FW (U600, U612, U620, U630, U700, U712, U720 and U730)
- **A28 Acquisition MPU board**—Acquisition Processor FW (U611)
- **A29 Memory Expansion board**—Main Processor FW (U210 and U220)

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 11802 Oscilloscope, the firmware kit number is 020-1717-00.

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

WARNING

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

CAUTION

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

- **Preparing the oscilloscope**—for the firmware upgrade procedure requires the following steps:
  - ☐ Step 1: Set the PRINCIPAL POWER SWITCH to OFF and remove the power cord.
  - ☐ Step 2: Leave the oscilloscope on its right side to provide access to circuit boards involved in the firmware upgrade procedure.

- **Upgrade the A7 Display Controller board firmware**—requires the following steps:
  - ☐ Step 1: Ensure that the PRINCIPAL POWER SWITCH is set to OFF and the power cord is disconnected.
  - ☐ Step 2: Remove the oscilloscope's top panel cover.
  - ☐ Step 3: Locate the A7 Display Controller board (see Fig. 3-1 in this section).

☐ Step 4: Locate the two EPROMs, located near the near right corner of the board. The circuit numbers for these components are U602 and U612.

CAUTION

Ensure pin 1 is positioned correctly when replacing components.

Note: *Use the IC Insertion-Extraction Pliers shown in Figure 3-35 for removing and replacing the ICs. (Refer to Table NO TAG, 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. 3-34 for the correct location of the index on the IC.)

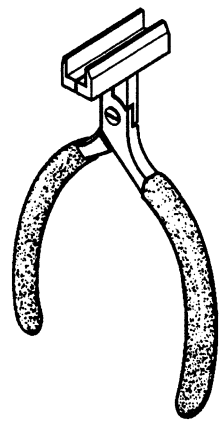


***Figure 3-35** — IC Insertion-Extraction Tool*

☐ Step 5: Remove EPROM U602 and replace it with the upgraded IC. The last two-digit portion of the part number on the replacement IC should be the same as, or higher than, that on the removed IC.

☐ Step 6: Similarly replace EPROM U612 with an upgraded IC.

- **Accessing Boards within the card cage**—requires the following steps:

☐ Step 1: Remove the two nylon circuit board guides from the top of the card cage (at the left rear of the oscilloscope).

☐ Step 2: Remove the screws that secure the card cage retainer (an angle bar that prevents removal of the boards in the card cage). See Figure 3-5 for a top view of the card cage.

- **Upgrading the A18 Memory board firmware**—requires the following steps:

☐ Step 1: Remove the A18 Memory board from the card cage. The A18 Memory board is located nearest the outside of the oscilloscope.

☐ Step 2: On the A18 Memory board, replace the following ICs. See Figure 3-33.

U600	U700
U612	U712
U620	U720
U630	U730

In each case, 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 3: Return the A18 Memory board to its former location in the card cage.

- **Upgrading the A29 Memory Expansion board firmware** – requires the following steps:

☐ Step 1: Remove the A29 Memory Expansion board from the card cage. The A29 Memory Expansion board is typically located next to the A18 Memory board in the card cage.

☐ Step 2: On the A29 Memory Expansion board, replace ICs U210, U220, U230 and U240 (see Fig. 3-33 in this section).

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

☐ Step 3: Return the A18 Memory board to its former location in the card cage.

- **Upgrading the A17 Main Processor board firmware** – requires the following steps:

☐ Step 1: Remove the A17 Main Processor board, which is typically located in the slot beside the A18 Memory board. A cable connector must be removed from the top of the board before it can be removed from the oscilloscope.

☐ Step 2: On the A17 Main Processor board, replace U240 and U250 (see Fig. 3-33.) 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 when inserting the new parts.

- **Replacing the Card Cage and Circuit Board Retainers** – requires the following steps:

☐ Step 1: Replace the card cage retainer using the two screws removed earlier and replace the two nylon circuit board guides.

☐ Step 2: Reconnect the cable at the top of the A17 Main Processor board.

☐ Step 3: Replace the top cover of the oscilloscope.

- **Upgrading the A5 Time Base/Controller board firmware** – requires the following steps:

  ☐ Step 1: Locate U300, U310, U400 and U410 on the A5 Time Base/Controller board (see Fig. 3-33). These components are found near the bottom front of the oscilloscope with the oscilloscope positioned on its right side.

  ☐ Step 2: 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.

- **Upgrading the A28 Acquisition MPU board firmware** – requires the following steps:

  ☐ Step 1: Remove the Acquisition unit from the oscilloscope.

  ☐ Step 2: Remove the A28 Acquisition MPU board from the Acquisition unit (see Fig. 3-1 for the exact location of these boards in the Acquisition unit).

  ☐ Step 3: Locate U611 on the A28 Acquisition MPU board (see Fig. 3-27 in this section). This board is located in the card cage.

  ☐ Step 4: Replace U611 on the 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.

- **Setting and verifying the oscilloscope unit identification number** – can be performed using the procedure described next.

  The oscilloscope unit identification number can be set to match the oscilloscopes serial number or to any number you choose. To change the current identification number, perform the following steps.

  ☐ Step 1: Locate the jumper, J860, on the A5 Time Base/Controller board (see Fig. 3-8 for the jumper location). Install one of the black, plastic, short circuit jumpers on the jumper pins.

  ☐ Step 2: Connect the oscilloscope to a suitable power source.

  ☐ Step 3: Connect a terminal or controller to the oscilloscope's RS-232-C port at the rear of the oscilloscope. Refer to the *11802 Digital Sampling Oscilloscope Programmer Reference Manual*.

  ☐ Step 4: Set the PRINCIPAL POWER SWITCH to ON and the ON/STANDBY SWITCH to ON.

- [ ] Step 5: Set the necessary communication parameters between the terminal or controller and the oscilloscope (for example baud rate). The oscilloscope's parameters can be set in the **RS-232 Parameters** pop-up menu through the UTILITY button.

- [ ] Step 6: Enter the following commands establish communication from the terminal or controller (<CR> is the return or enter key):

  e <CR>
  v<CR>

- [ ] Step 7: Next, enter the command:

  Uid main: "BXXXXXX" <CR>

  where XXXXXX is the new oscilloscope identification number.

- [ ] Step 8: Verify that the proper identification number is now displayed in the **Identify** pop-up menu, after the string **11802 Mainframe ID#**.

- **Removing the Procedure Setup** — requires the following steps:
  - [ ] Step 1: Set the PRINCIPAL POWER SWITCH to OFF.
  - [ ] Step 2: Remove the short circuit jumper from J860 on the A5 Time Base/Controller board.
  - [ ] Step 3: Replace the bottom oscilloscope cover and set the oscilloscope upright.

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. 3-33.)

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*

FRU Replaced	Checks Required
A1 Strobe Drive Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics Part 14 — Internal Clock
A3 M/F Power Connect Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics
A4 Regulator Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics Part 3 — Power Supply Part 6 — Vertical Reference Voltage Part 8 — Vertical Input Offset Part 9 — Vertical Accuracy Part 10 — System Vertical RMS Noise Part 11 — Time Base Accuracy Part 13 — Triggering
A5 Time Base Controller Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics Part 9 — Vertical Accuracy Part 10 — System Vertical RMS Noise
A6 Calibrator Assembly	Part 12 — System Rise Time and Calibrator Output Accuracy
A7 Display Controller Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics
A8 CRT Driver Board	Part 4 — Display
A9 Touch Panel Assembly	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics
A10 Front Panel Control Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics
A11 Front Panel Button Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics

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

FRU Replaced	Checks Required
A12 Rear Panel Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics
A13 Mother Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics
A14 Input/Output Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics Part 5 — Real Time Clock
A15 MMU Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics
A16 Compressor Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics
A17 Main Processor Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics
A18 Memory Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics
A29 Memory Expansion Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics
A19 Strobe/TDR Buffer Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics Part 11 — Time Base Accuracy Part 14 — Internal Clock
A22/A23 Head Interconnect Boards	Part 1 — Power-On Diagnostics Part 8 — Vertical Input Offset Part 9 — Vertical Accuracy Part 10 — System Vertical RMS Noise
A26 M/F Acquisition Interconnect Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics Part 6 — Vertical Reference Voltage
A27 Acquisition Analog Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics Part 8 — Vertical Input Offset Part 9 — Vertical Accuracy Part 10 — System Vertical RMS Noise
A28 Acquisition MPU Board	Part 1 — Power-On Diagnostics Part 2 — Extended Diagnostics

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

FRU Replaced	Checks Required
A30/A31 Trigger Pickoff and Delay Line Compensator Assembly	Part 12—System Rise Time and Calibrator Output Accuracy Part 15—Aberrations
A32 Trigger Select Board	Part 1—Power-On Diagnostics Part 2—Extended Diagnostics Part 13—Triggering
Firmware ICs	Part 1—Power-On Diagnostics Part 2—Extended Diagnostics
Cathode Ray Tube (CRT)	Part 4—Display
Power Supply Module	Part 1—Power-On Diagnostics Part 2—Extended Diagnostics Part 3—Power Supply Part 6—Vertical Reference Voltage Part 8—Vertical Input Offset Part 9—Vertical Accuracy Part 10—System Vertical RMS Noise Part 11—Time Base Accuracy Part 12—System Rise Time and Calibrator Output Accuracy

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, and Time Base, Mainframe Acquisitions) executes a set of Kernel diagnostics prior to the Self-Tests diagnostics. After all Acquisition processors verify their support circuitry, they try 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 all possible Acquisition processors, 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 oscilloscope's processor subsystems: Display, Executive, Time Base, and Mainframe and Acquisition processors. Following successful execution of their Kernel diagnostics, Acquisition processors attempt 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, then the message indicating that Self-Tests diagnostics are beginning will not appear on the screen. Kernel diagnostics failure 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 processor, Time Base processor, or both Mainframe 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, DMA's, timers, and interrupt control circuitry. For the Executive/Main 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 an Acquisition processor.

Since the condition of the oscilloscope 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 hexidecimal (hex) numbers that are read as a series of binary bits, such as XXX1 0101 (hex error code 15_{hex}) for the Executive processor or 0100 (hex error code 4_{hex}) for the Time Base processor or 10 (hex error code 2_{hex}) for an Acquisition processor, from either internal test points or LEDs. Refer to Tables 3-10, 3-13 and 3-14 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 Timer 2 test failed:

Dsy Kernel Failure
Timer 2

If the display is disabled, the error index code is read from status LEDs on the A7 Display Controller board (see Fig. 3-34).

Self-Tests/Extended Diagnostics

Refer to Part 1 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, E3321 is decoded as follows:

E Subsystem – Executive

3 Block name – Front Panel

3 Area name – Soft Keys

2 Routine name – Column Open

1 Failure Identity – specific failure mode

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

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

Code	Meaning
E	Executive
D	Display
T	Time Base Processor
m	Mainframe Acquisition Processors

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 both Mainframe 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 to scan forward to the next routine or to the next failure to touch the appropriate selectors in the lower portion of the screen (which functions like a simple keypad). Scanning continues in a circular fashion through all available subsystems.

  Upon exiting this menu, the oscilloscope 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 oscilloscope 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 or Areas and may contain a maximum of ten ASCII characters (up to twelve are allowed for Block and Area titles).
- **Error Index Code field**—contains an index code. 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.
"xxxx"	An automatic test has not yet been executed. When the test does execute, the test will provide **pass** or **Yxxxx** failure status.
"- - - -"	The test requires you to perform some type of test set-up using the RS-232-C loopback connector. When executed, this status provides **pass** or **Yxxxx** failure status. To execute this test, you must select it.
" " (blank)	This status indicates that the test requires action from 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 oscilloscope configuration or that a subsystem was found that did not have a working communication path.

- **Failure Count field** – indicates the total number of routine failures (one per routine) currently encountered in the 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 may be unavailable for some tests requiring human interaction, such as touch panel interactive tests, various display tests, and CRT/touch panel calibration patterns.

The knobs control the screen intensity during the four main 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 oscilloscope must be in the Extended Diagnostic mode.

To exit the terminal mode, recycle the power, and then either enter the (Exit) keystroke twice to begin normal operation, or enter the appropriate L keystroke.

System Mode (GPIB & RS-232-C)

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

***Table 3-6** — System Mode Commands*

Header	Argument	Notes
TEST		Set-only
TEST	**[XTND]**	Set-only
TEST	**[MAN]**	Set-only
DIAG?		Query-only

The **TEST** command invokes Self-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 *11802 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*

Event Code	Explanation
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 oscilloscope becomes non-responsive to further GPIB commands until normal operation is resumed.*

The **DIAG?** query returns pass/fail information from the most recent invocation of Self-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 six lithium batteries to provide power when the oscilloscope is turned off. The following discussions provide criteria for determining if a battery has exceeded its lifetime, and is thus producing incorrect oscilloscope 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 oscilloscope power off.)

Battery BT130 provides power for the real time clock on the A14 I/O board. If the clock begins to lose time rapidly when the oscilloscope is turned off, the diagnostics report that the **Real Time Clk (E42XX)** has failed, or then the battery 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 BT160 provides power for the non-volatile RAM (NV RAM) on the A17 Main Processor board. If the diagnostics consistently reports an **NVRAM No Bank Battery (E171X)** failure over multiple power-ons, then the battery should be tested. If the battery voltage measures less than 2.45 V, then follow the instructions for battery disposal earlier in this section.

Batteries BT160 and BT260 provide power for the NV RAM on the A29 Memory Expansion board. If the diagnostics consistently report an **NVRAM Banks Battery (E181X)** failure over multiple power-ons, then the batteries should be tested. If either one of the battery voltages measures less than 2.8 V, follow the instructions for battery disposal earlier in this section. (It is recommended that both batteries be replaced at the same time.)

Sockets for devices U500 and U511 provide power for the NV RAM 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 oscilloscope off while Extended Diagnostics is executing one of the NVRAM memory tests may cause failure of the NV RAM battery test. If the diagnostics report an NV RAM battery failure, then exit the diagnostics. This will rewrite the confidence words into the NV RAM. Turn off the oscilloscope for at least one hour. Then, turn the oscilloscope back on. If the diagnostics still indicate an NV RAM 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 and saved trace descriptions (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 five processor subsystems: Executive, Display, Time Base, and Acquisition processors. Each subsystem group has a table of kernel diagnostic error index codes. In addition, the Executive and Display have a table of manual test error index codes, which help extend the confidence level of oscilloscope 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)
MFPOWERR	M/F Power Connect board	(A3)
REG	Regulator board	(A4)
TBC	Time Base/Controller board	(A5)
CAL	Calibrator assembly	(A6)
DSY	Display Controller 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)
CMPR	Compressor board	(A16)
MPU	Main Processor board	(A17)
MEM	Memory board	(A18)
STROBEBUF	Strobe/TDR Buffer board	(A19)
HEAD	Head Interconnect board	(A22-A23)
ACQANALOG	Acquisition Analog board	(A27)
ACQMPU	Acquisition MPU board	(A28)
MFACQCON	M/F Acquisition Interconnect board	(A26)
MEMXPN	Memory Expansion board	(A29)
DLYCOMP	Trigger Pickoff and Delay Line Comp Ass	(A30/A31)
TRIGSEL	Trigger Select board	(A32)

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	Main, Display, Time Base, or Acquisition Firmware
SDI	Serial Data Interface IC
BATTERY	Lithium Battery
PS	Power Supply Module

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

Executive processor error index codes—are listed in Table 3-10.

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

Error Index$_{hex}$	Hybrid/IC FRUs	Suspect Board FRUs
1F - 1C		MEM, MPU
1B - 18	FW	MPU
17 - 14	FW	MEMXPN, MPU
13 - 11		IO, MPU
10		MPU
0F		MPU, MEM
0E		FPCTRL, IO, MPU
0D		IO, MPU
0C		IO, MPU
0B - 09		REAR, IO, MPU
08 - 06		MMU, MPU
05		MPU, MEM
04		REAR, IO, MPU

Bit patterns for the above hexadecimal error index codes are displayed with the front panel MENUS LEDs in bottom-to-top bit order. The ENHANCED ACCURACY label represents the MSB (most significant bit) and the WAVEFORM label represents the LSB (least significant bit). When lit, the LEDs represent a one.

For example: Error index code 12_{hex} causes the ENHANCED ACCURACY and TRIGGER LEDs to light.

Reading the Executive/Processor subsystem error bits from the A17 Main Processor board test points TP201 (MSB) to TP205 (LSB) is also possible (see Fig. 3-36 for the location of these status LEDs). The bits are high (+5 V) true.

The Status LEDs DS307 (MSB) and DS306 (LSB) will flash while the Kernel diagnostics are executing (see Fig. 3-36 for the location of these status LEDs). If a kernel failure is detected, one or both LEDs will be lit. The pattern from the LEDs and the bit codes from the status LEDs are applicable only when the Executive processor is executing or stopped in Kernel diagnostics.

Table 3-11 lists the Executive processor manual tests and the verification procedures. If the conditions specified in the verification procedure 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-Tests 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.

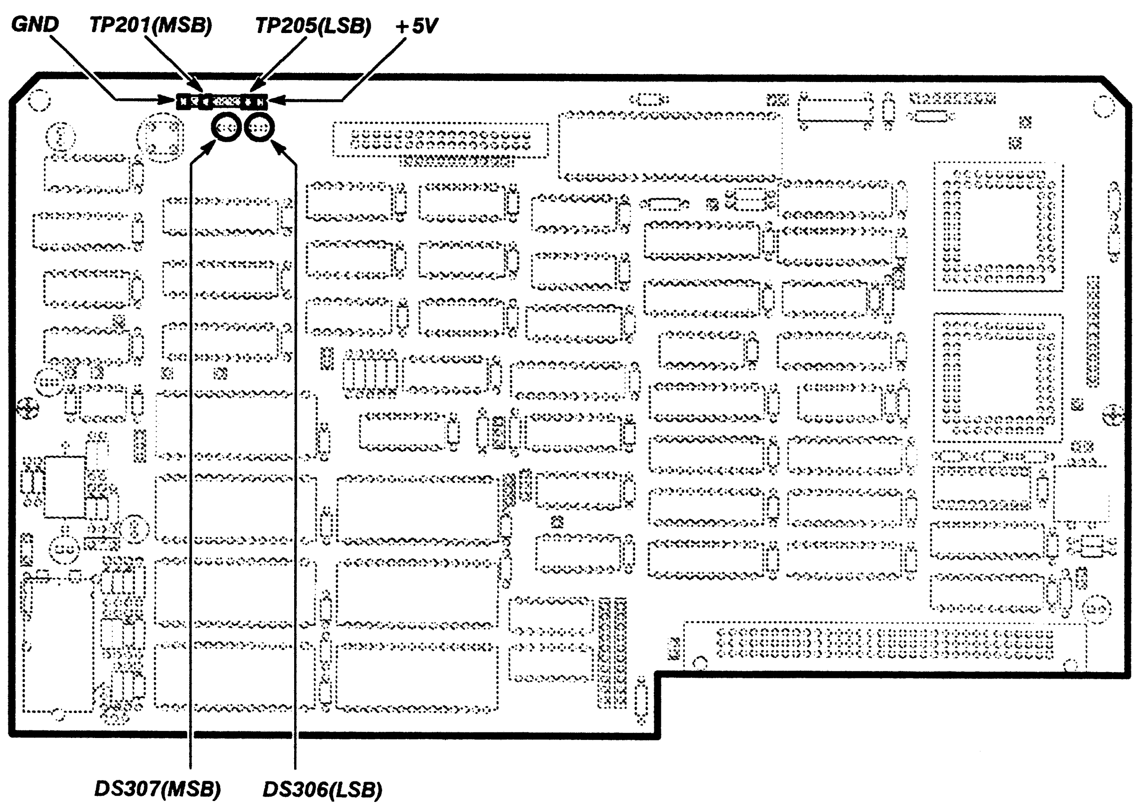


Figure 3-36 — A17 Main Processor Board Status Pins

Table 3-11 — Executive Processor Manual Tests

Test	Verification Procedure
Front Panel	
Verify	
Hard Keys	This test allows you to interactively press the hard keys to verify their operation. This test verifies the operation of a key with both visual and audio feedback. This test requires operator interaction and can be executed only in the Routine menu with the All and Loop modes set to Off. Once this test is invoked, you can press any of the hard keys in the oscilloscope and verify that the corresponding image of the key on the screen is highlighted, that the associated LED is turned on, and that an audio click is generated.
Soft Keys	This test allows you to touch any of the soft keys and verify their operation. This test verifies the operation of a key with both visual and audio feedback. This test requires operator interaction and can be executed only in the Routine menu with the All and Loop modes set to Off. Once this test is invoked, you can touch any of the soft keys in the oscilloscope and verify that a touch box is drawn around the soft key on the screen and that an audio click is generated.
Knobs	This test allows you to turn either of the knobs and verify their operation. This test verifies knob movement with visual feedback. This test requires operator interaction and can be executed only in the Routine menu with the All and Loop modes set to Off. Once this test is invoked, you can turn either of the knobs on the oscilloscope and verify that the corresponding knob pointer on the screen rotates and that its associated counter value changes.

***Table 3-11 (cont)** — Executive Processor Manual Tests*

Test	Verification Procedure
Input/Output	
Tone Gen	
Ramp Tone	This test verifies the capability of the oscilloscope to generate tones through its internal speaker. This test requires operator interaction and can be executed only in the Routine menu with the Loop mode set to On and the Terse and All mode set to Off. After invoking this test, you should verify that a high speed clicking sound occurs.
Real Time Clk	
Calibrate	This test allows you to check and adjust the Real Time Clock period. This test requires operator interaction and can be executed only in the Routine menu with the All and Loop modes set to Off. Once this test is invoked, you can examine/adjust the Real Time Clock period following the procedure outlined in Part 5, Checks and Adjustments.
Printer	
Pattern	This test prints a set of of patterns (all printable ASCII characters) to help you verify the external printer interface. This test requires operator interaction and can be executed only in the Routine menu with the All mode set to Off. Before executing this test, you should connect a Centronics-compatible printer to the printer connector on the rear panel of the oscilloscope.

Table 3-11 (cont) – *Executive Processor Manual Tests*

Test	Verification Procedure
Input/Output	
RS-232	
Extern Loop	This test verifies parts of the external RS-232-C interface. This test requires operator interaction and can be executed only in the Routine menu with the All mode set to Off. Before executing this test, you should connect an external loopback connector to the RS-232-C connector on the rear panel of the oscilloscope.
GPIB	
Intrpt Reset Reset Status Data Lines Interrupt	These tests verify the Executive processor interface to the internal GPIB circuitry. The major external GPIB functions are not tested. This test requires operator interaction and can be executed only in the Routine menu with the All and Loop modes set to Off. Before executing this test, you should disconnect the oscilloscope from the GPIB connector.

Display processor error index codes—are listed in Table 3-12.

Table 3-12 — *Display Processor Kernel Error Index Codes*

Error Indexhex	**Suspect Hybrid/ IC FRUs**	**Suspect Board FRUs**
FF - FE		DSY
FD - FA	FW	DSY
F9 - F5		DSY
F4		DSY, CMPR

The name of the first Display kernel test that fails is displayed on the screen. The Display processor error index codes are read from the A7 Display Controller board test points TPH (LSB annotated on the board as pin **2**) to TPA (MSB annotated on the board as pin **1**) next to the Status LEDs DS501 (MSB) and DS500 (LSB) (see Fig. 3-37 for the location of these LEDs). The bits are high (+5 V) true.

The patterns from the status LEDs and the bit codes from the status LEDs are applicable only when the Display processor is executing or stopped in Kernel diagnostics.

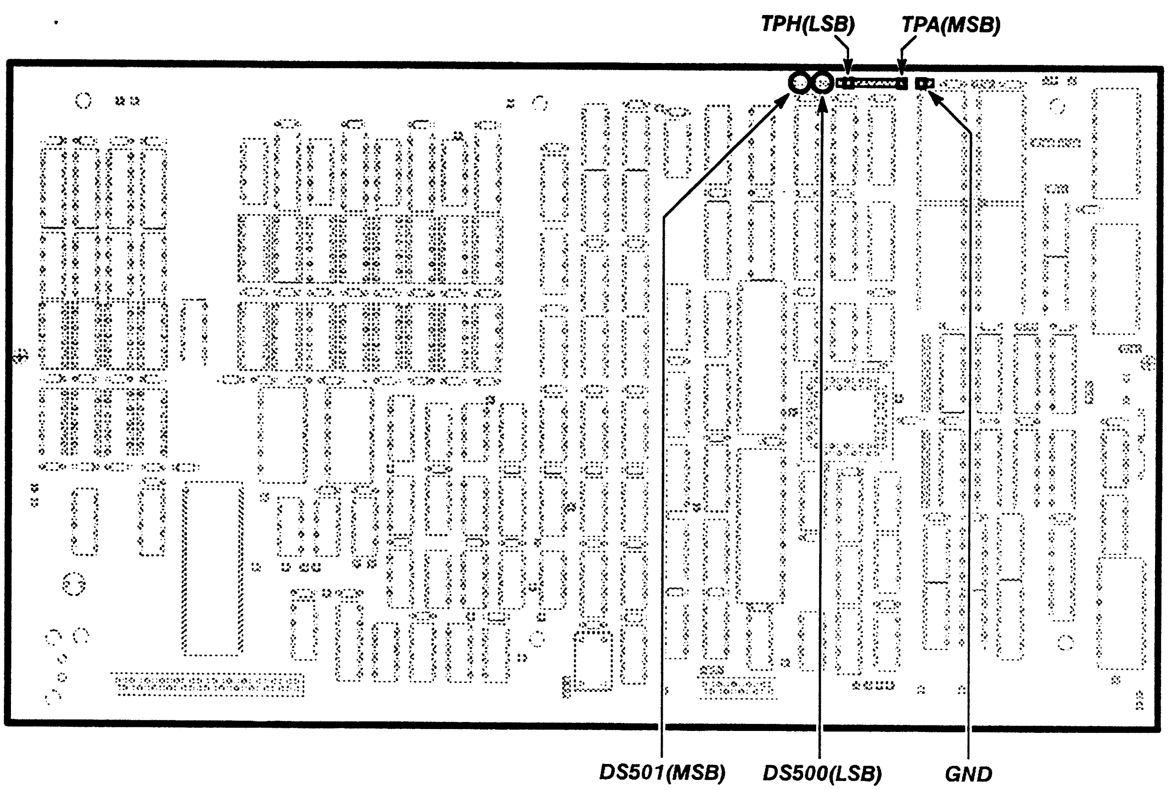


Figure 3-37 — *A7 Display Controller Board Status Pins*

Time Base processor error index codes – are listed in Table 3-13.

***Table 3-13** – Time Base Processor Kernel Error Index Codes*

Error Index	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 3-38 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.

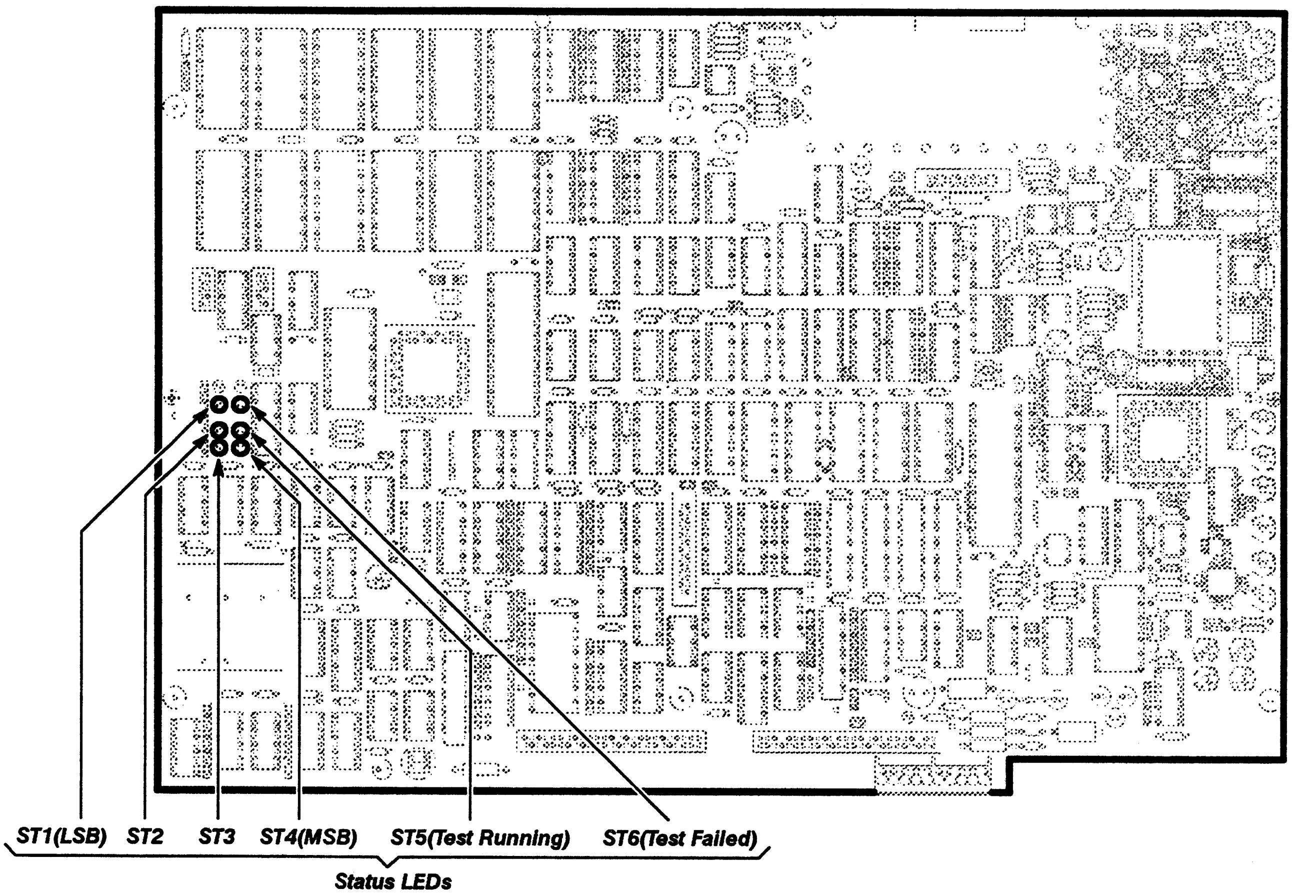


***Figure 3-38** – A5 Time Base/Controller Board Status Pins*

Acquisition processor error index codes—are listed in Table 3-14.

***Table 3-14** – Acquisition Processor Kernel Error Index Codes*

Error Index	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 A28 Acquisition MPU board status LEDs, DS101 (MSB) and DS100 (LSB). See Figure 3-39 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.

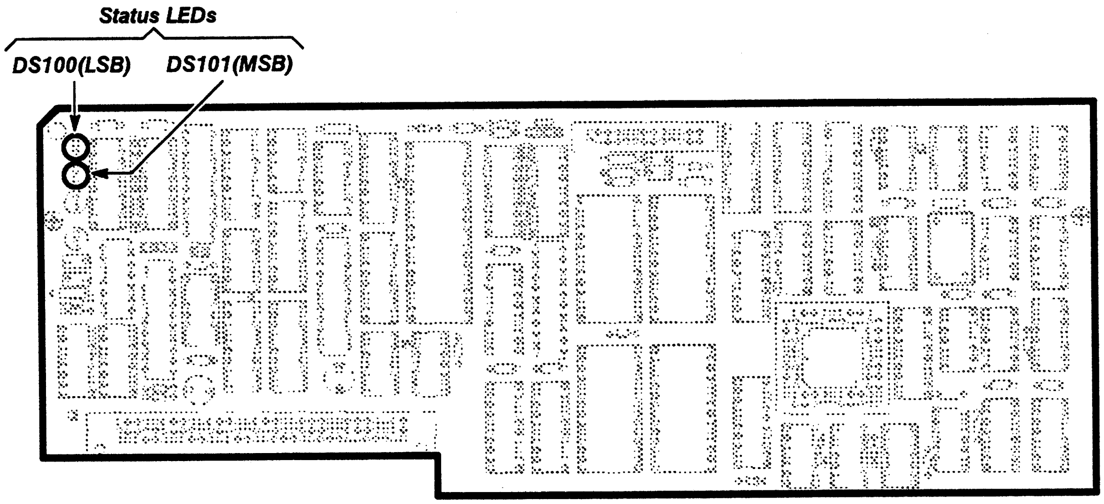


***Figure 3-39** — A28 Acquisition MPU Board Status Pins*

Other Troubleshooting

The following procedures are for troubleshooting a faulty Power Supply module, A13 Mother board, A4 Regulator board, CRT or A8 CRT Driver board, or faulty fuses.

Power Supply Module troubleshooting—requires an Extended Diagnostics Power Supplies Troubleshooting Fixture. Refer to Table 2-2, Test Equipment for a complete description of the equipment required.

If there is a problem with the Power Supply module, then it usually occurs when the front panel ON/STANDBY switch is pressed ON. If the green light near the ON label fails to light then do the following:

☐ Step 1: Check that the PRINCIPAL POWER SWITCH located on the rear panel is in the ON position.

☐ Step 2: Check that the line cord is connected to a functional power source with the same output voltage set with the LINE VOLTAGE SELECTOR on the rear panel.

☐ Step 3: Check that the fuse is good. If it is blown, replace the fuse then check out the power supply, as described under Fuse Testing.

☐ Step 4: Check that the fan is exhausting air from the oscilloscope when the ON/STANDBY switch is ON. A defective fan causes an over-temperature shutdown in the Power Supply module.

If these checks fail to correct the problem, then connect the Extended Diagnostics Power Supplies Test Fixture and refer to its accompanying documentation. The test fixture shows which power supply voltage source is having a problem. To help isolate the source of the problem disconnect the power connection to the board, using the defective source, and power-on again. This procedure is only effective for externally shorted power supplies. Once again, refer to documentation accompanying the test fixture for more troubleshooting tips.

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

CRT or A8 CRT Driver board troubleshooting—requires a test terminal and a compatible RS-232-C serial interface cable. Refer to Table 2-2, Test Equipment for a complete description of the equipment required.

If the oscilloscope powers-on (ON/STANDBY light on) but the display gives scrambled information or none at all, then the CRT and A8 CRT Driver board is suspect. Two different procedures are described here to help you determine whether the A7 Display Controller board, the CRT, or the A8 CRT Driver board is at fault.

☐ Step 1: With the power off, remove the top cover, then turn the power on. Observe the two LEDs on the A7 Display Controller board and those on the A17 Main Processor board in the card cage. They should flicker on and off until the diagnostic tests complete, then they should all turn off. If any of these LEDs remain lit, it indicates a problem with the board on which the LED resides. If all LEDs turn off, then the CRT are CRT Driver board is suspect. Several chips clustered around the J53 cable connection between the A7 Display Controller board and the A8 CRT Driver board are also suspect. (These chips generate the analog signals for the A8 CRT Driver board, but the diagnostics do not check these ICs.)

☐ Step 2: With the power off, connect a test terminal (ANSI 3.64-compatible) with an RS-232-C cable. Touch the screen through the full power-on cycle to force a diagnostic error so the oscilloscope enters Extended Diagnostics.

On the test terminal type **T** to produce an Extended Diagnostics menu display on the terminal display. If the displayed errors are only for the front panel touch screen, then the CRT or the A8 CRT Driver board is at fault. Note, any other errors and use Table 3-5 to identify the suspect subsystem.

A13 Mother 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. F200 supplies +5 V to the A12 Rear Panel board. F800 supplies +5 V to the A10 Front Panel Control board and the Touch Panel assembly. F600 supplies +15 V to the A14 I/O board, Card Cage, A10 Front Panel Control board, Touch Panel assembly, A11 Front Panel Button board, and A12 Rear Panel assembly (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 assembly (reduced to -12 V).

The A14 I/O board uses the +15 V and -15 V supplies on board to operate the Temperature Sensor and the Tone Generator. Of the other Card Cage boards, the A17 Main Processor board the +15 V supply to operate the NV RAM circuitry.

Table 3-15 will help you to identify a failure of one of these fuses.

The Line fuse (F99) used in the oscilloscope is located on the rear panel of the power supply. Replace the line fuse F99 with one of proper type and rating.

Note: *Line Fuse (F99) is used for both 115 and 230 V operation.This same fuse can be used when switching the LINE VOLTAGE SELECTOR switch between 115 V and 230 V.*

See Figure 3-2 and Figure 3-40 for the location of the line fuse and the fuses listed here, respectively. Also, see Figure 4-10 for a block diagram of the A14 I/O board.

CAUTION

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

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

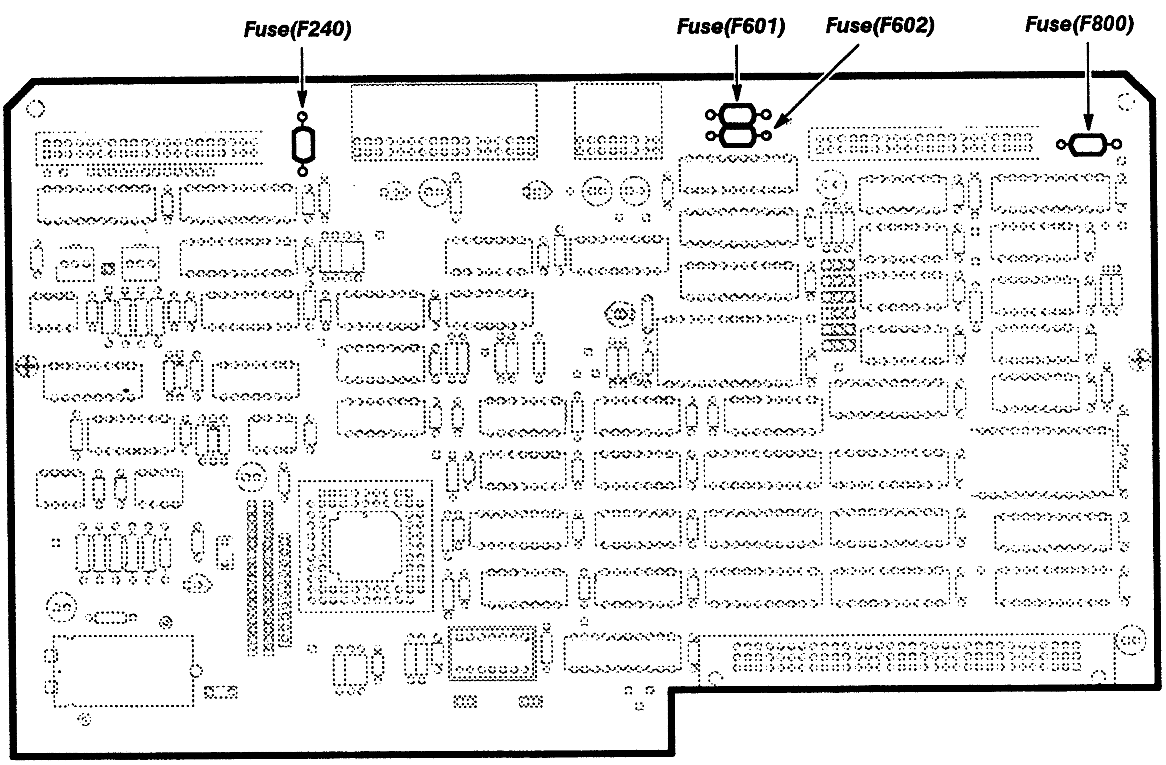


***Figure 3-40** — Fuse Locator Diagram*

Table 3-15 — A14 I/O Board Fuse Failures

Fuse	Kernel Error Index Code (Executive)	Self-Test/Extended Error Index Code
F200 open	OB*hex* (GPIB Interrupt)	
F800 open	OE*hex* (Front Panel Inter) **Note:** *Front panel lights do not work. The code must be read from the Error Status test points (TP201-TP205) on the A17 Main Processor board (see Fig. 3-36).*	
F600 open	Passes the Kernel Diagnostics, however the front panel lights are off.	Executive Memory NVRAM No Blank Battery E1711 *Data Lines E1721 *Address/Data E1731 Input/Output Temp Sensor Comparator E4111 Tone Gen *Ramp Tone (works) **Note:** *The front panel lights, soft keys and hard keys do not operate.*
F602 open	OE*hex* (Front Panel Inter) **Note:** *The tone generator has a very different tone.*	

***indicates a manual test forced by the operator. That is, this test is not automatically executed by Self-Test diagnostics.**

Time Base Calibration Errors

Table 3-16 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 3-16 – Time Base Calibration Errors

Error Message	Error Code	Suspect FRU
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 fault 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

Theory of Operation

The Tektronix 11802 Oscilloscope 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 one microsecond/division to one picosecond/division
- 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 11802 Oscilloscope (see Fig. 4-1).

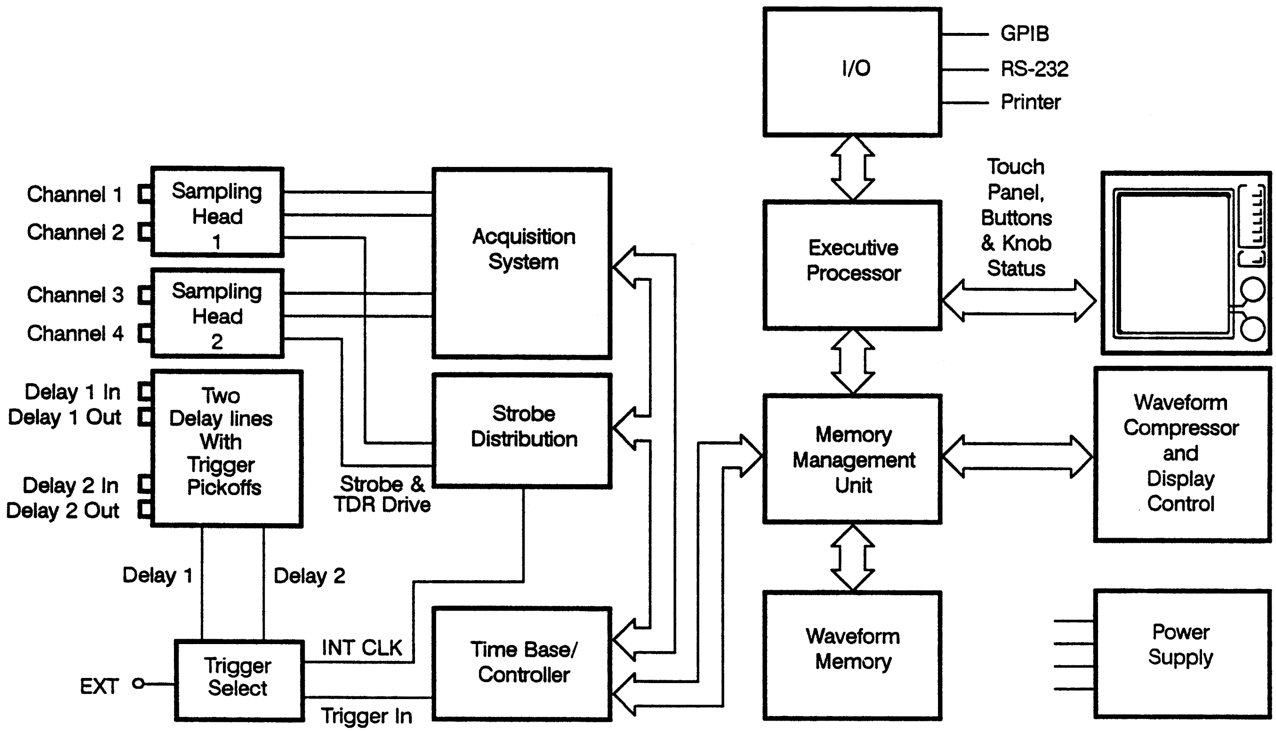


***Figure 4-1** — 11802 Oscilloscope-System Functional Block Diagram*

Acquisition System Block

The 11802 Oscilloscope 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 (with gain or attenuation) 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 oscilloscope when powering-on or at the user's request. To control operations the EXP controls and monitors the other circuit boards sharing the executive system bus. Through the executive bus boards, the EXP also indirectly controls all other oscilloscope boards. The EXP generates commands and status signals to control 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 oscilloscope.

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 oscilloscope. 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 oscilloscope.

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 either draws dots at the maximum and minimum values or a vector between the maximum and minimum values.

Power Supply

The oscilloscope operates from either a 115 V or 230 V nominal line voltage source at a line frequency between 48 and 440 Hz. The LINE VOLTAGE SELECTOR switch allows selection of AC line inputs of 90 to 132 V RMS or 180 to 250 V RMS.

To apply power to the oscilloscope:

1. Turn the rear panel PRINCIPAL POWER switch to ON.
2. Turn the front panel ON/STANDBY switch to ON.

A small green indicator lamp should light indicating the power is on.

Typical Waveform Processing Cycle

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

1. Analog input signals are connected to the 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 11802 Oscilloscope block diagram (see Fig. 4-2).

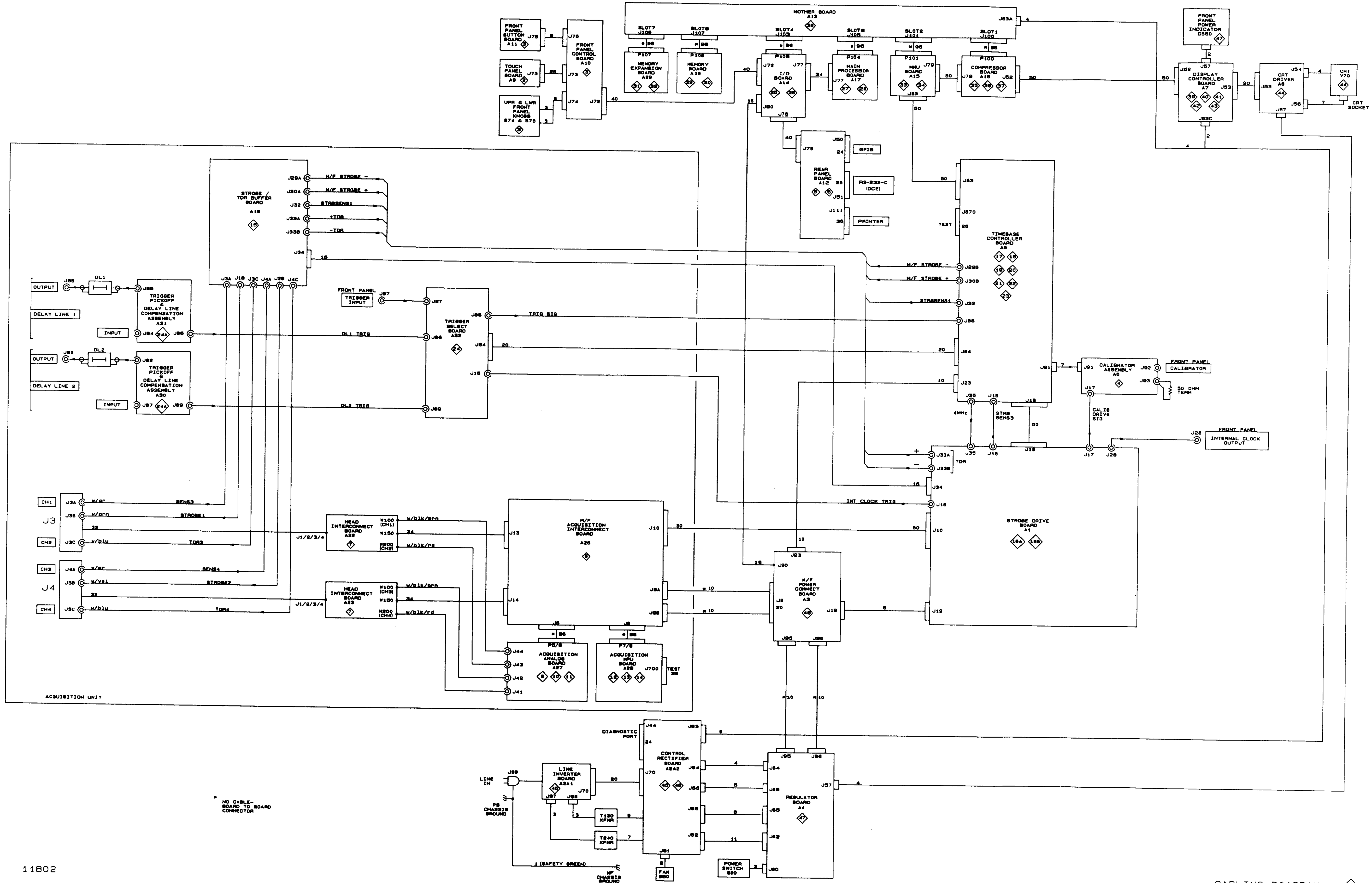


Figure 4-2—*11802 Oscilloscope Detailed Block (Cabling) Diagram*

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.

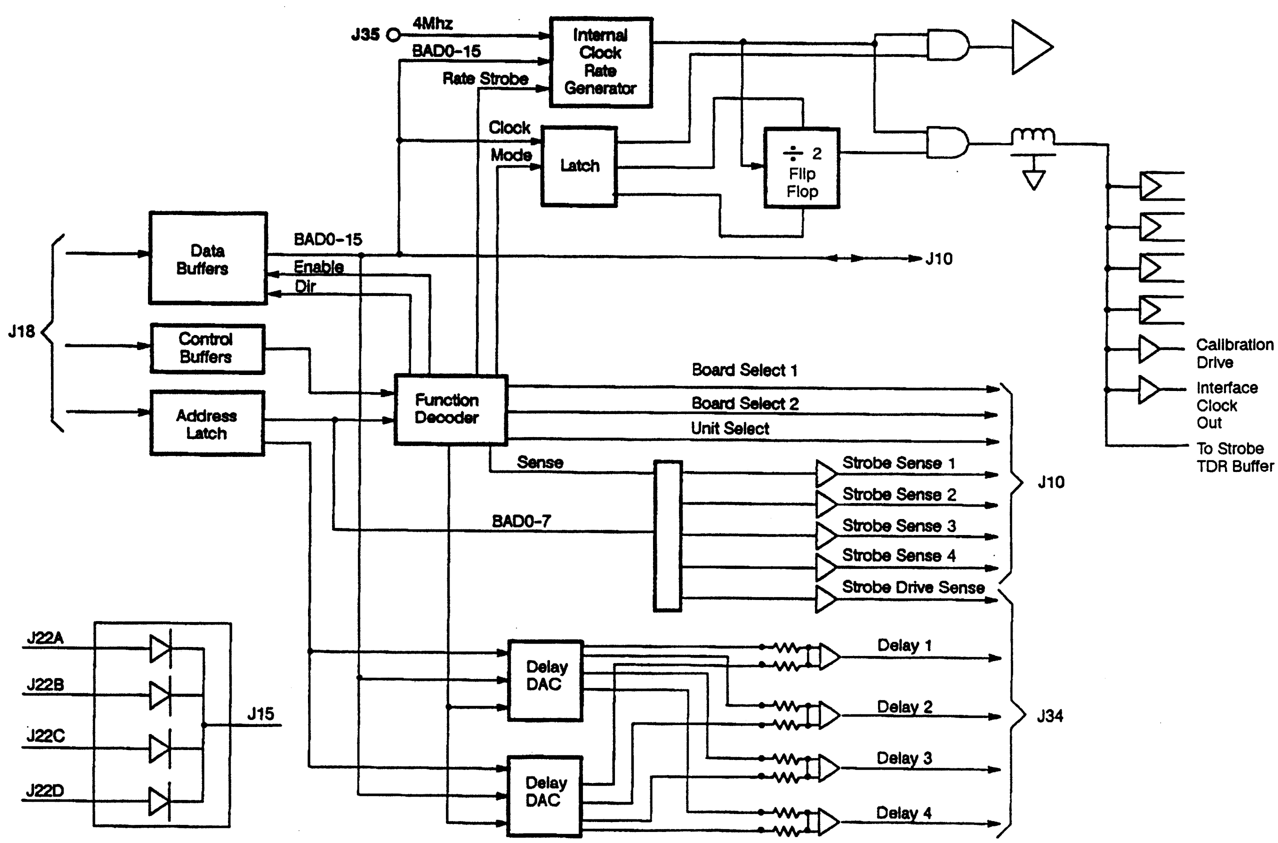


Figure 4-3 — A1 M/F Strobe Drive Board Block Diagram

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 A27 & 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 ÷ 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 ±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.

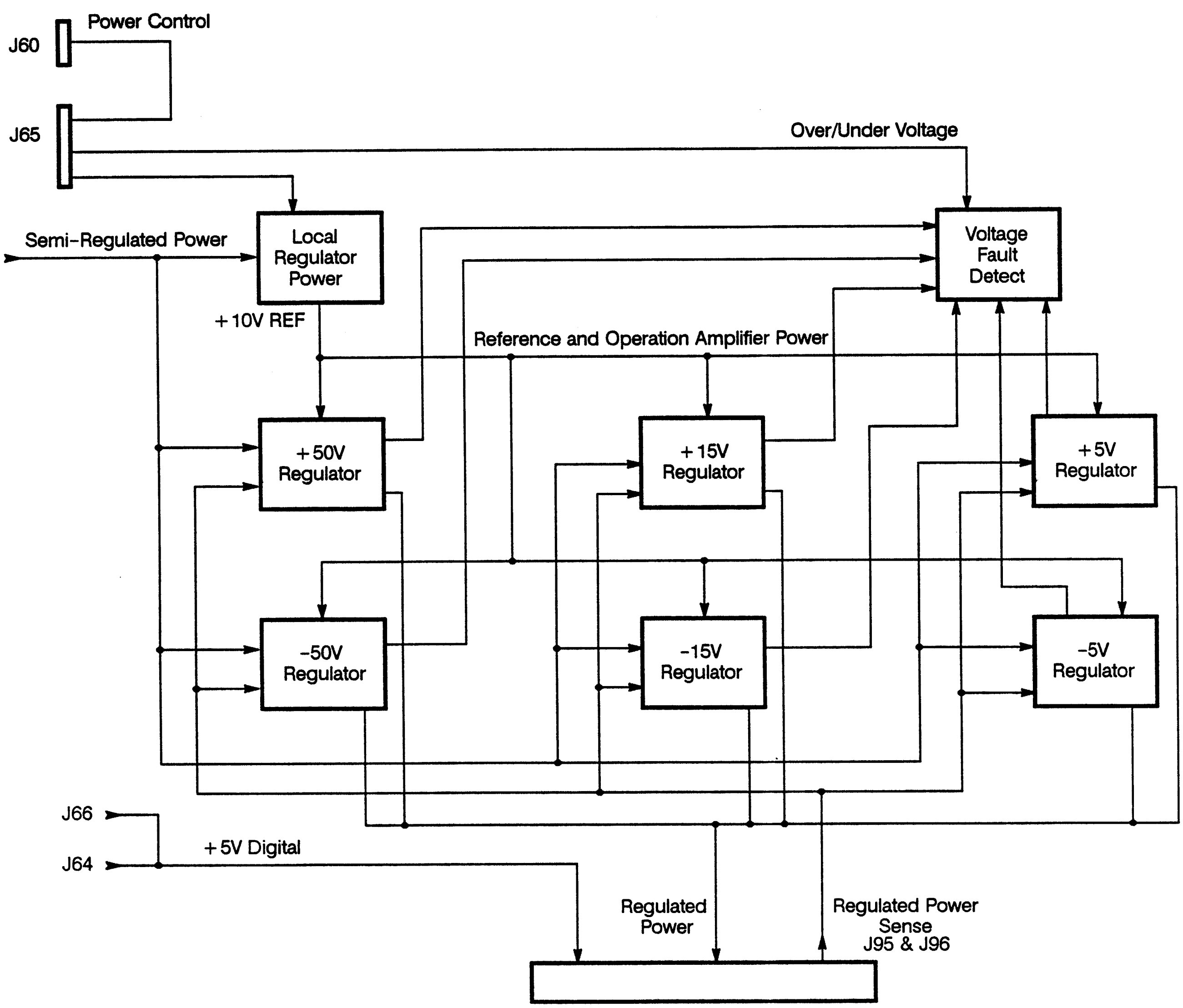


Figure 4-4 — A4 Regulator Board Block Diagram

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 of the 1 Mbyte of memory that the A5 Time Base/Controller board uses, the upper 256 Kbytes is reserved as ROM. Up to 128 Kbytes of static RAM is provided for dynamic data storage. There are 32 Kbytes of memory provided for hardware decoding for the oscilloscope's 8 channels, and another 32 Kbytes for the Strobe Distribution block of the oscilloscope and multiplexers. There is also 512 Kbytes of memory for the possible 128 additional channels available in the multi-channel units. There are 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.

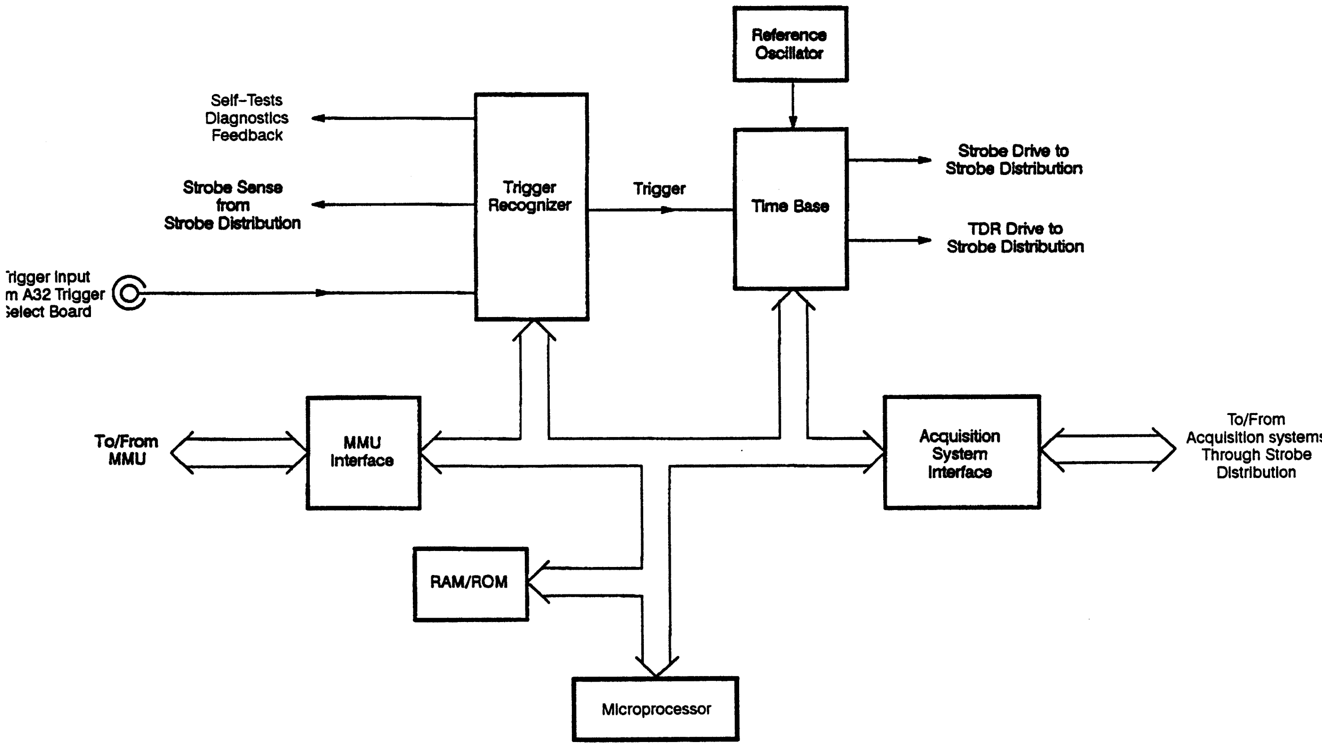


***Figure 4-5** — A5 Time Base/Controller Board Block Diagram*

The trigger circuitry—is comprised of the trigger recognizer and the gated voltage control oscillator. The trigger circuits accept trigger signals from the A32 Trigger Select board. 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 then recognizes a valid trigger signal and outputs this signal to the voltage control oscillator which sets the timing for the strobe signal.

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 an 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 × 10 divisions) divided by the number of points acquired.

The Acquisition system interface – contains 16 Kbytes of RAM (physically located on the 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.

A6 Calibrator Assembly

The A6 Calibrator assembly consists of:

- input/output circuitry
- quasi-thyristor circuitry
- capacitive discharge circuitry and step recovery diode (SRD)
- two current sources
- current switch step generator circuitry

This assembly is used as a front-panel calibration step generator. The generator outputs a square wave with an amplitude of 250 mV and at a frequency of 100 kHz.

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

The input drive circuitry—provides an input drive (INPUT) through a female SMA launcher. The drive signal is intended to be pulse with a rise time of 2 ns or less.

The fast shutoff output step occurs on the rising edge of the input signal; conversely, the reset output step occurs on the falling edge of the input signal.

The quasi-thyristor circuitry—consists of two secondaries on the ferrite toroid, both are used to drive the bases of a PNP/NPN transistor pair hooked up as a quasi-thyristor. The bistable characteristic of this step generator is derived from the latching nature of the quasi-thyristor, which is guaranteed by allowing a DC current through a pair of resistors to the sustain the base-emitter junctions. A Schottky clamp across the collector-base junctions prevents deep saturation, so that unlatching is always possible.

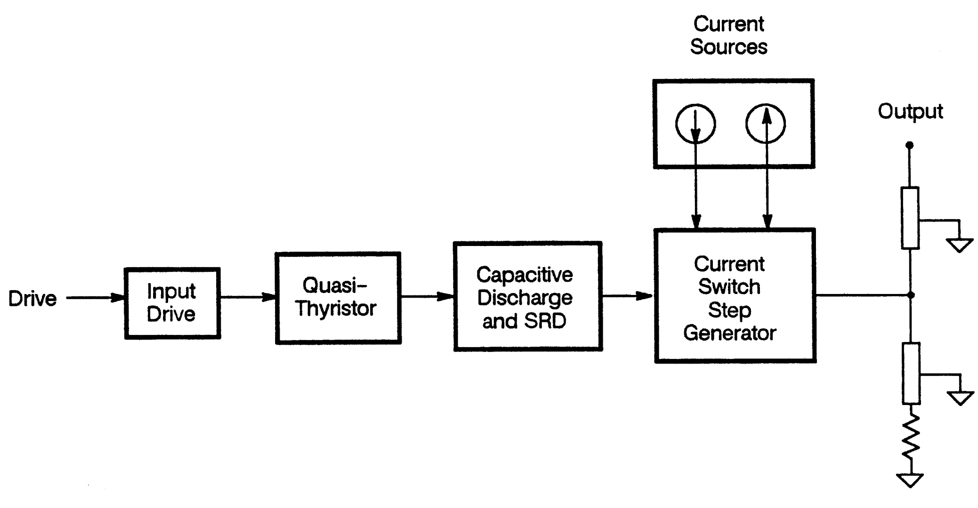


***Figure 4-6** — A6 Calibrator Assembly Block Diagram*

The capacitive discharge circuitry and step recovery diode (SRD) – implements a quasi-thyristor, whose output is coupled to capacitors and resistors to provide a CD current path to the step recovery diode (SRD) switch. When the quasi-thyristor latches on (conducting), a large reverse current is supplied to the SRD. The SRD will present a very low impedance to this current until it is totally discharged; at that time, it essentially opens circuits and allows a very fast, high amplitude voltage step to appear across its nodes.

The bias level in the SRD is adjustable from 0 to 10 mA. Since the SRD is capacitively coupled to both the quasi-thyristor and the current switch, the bias adjustment will not cause any asymmetry in either of these circuits coupled to it.

The SRD bias adjustment will directly affect insertion delay, amplitude, and slew rate of the SRD step; which is used to drive the switch. Thus, it will indirectly affect rise time and aberrations in the step output. This is the only electrical adjustment provided for these parameters.

The slow holdup circuitry insures that the SRD switch stays in the desired state once the SRD has fired and the charge on capacitors C1 and C2 begins to decay (since the SRD is capacitively coupled to the current switch step generator).

Two current sources – supply currents for the output . Nominal values are +4.0 mA and –14.0 mA, respectively, for a net –10.0 mA. With a 50 Ω load, and a parallel 50 Ω back termination, there will thus be a net 25 Ω load and a -250 mV step amplitude. The range of adjustment allows for a -225 mV to -275 mV step amplitude.

The current switch step generator circuitry – sends current from the current sources to and from the output to create a differential, traveling wave structure. The even mode impedance is 50 Ω to match the termination to the OUTPUT.

A7 Display Controller Board

The A7 Display Controller board is comprised of hardware and firmware working together to allow the Executive processor to present trace and other displays quickly and accurately. The hardware consists of:

- data communications circuitry
- a microprocessor
- a CRT controller
- bit map RAM
- video raster scan (VRS) and Display RAM circuitry

The Display RAM, whose description follows, is the only hardware used to configure displays. All display elements are placed into the bit map by firmware.

And, the hardware and firmware of the A7 Display controller board form the complete Display subsystem of the oscilloscope.

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

The Data Communications circuitry—is the intended method of communication with the Executive processor and is through the DMA channels incorporated in the microprocessor. A serial channel is incorporated for diagnostic purposes only.

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

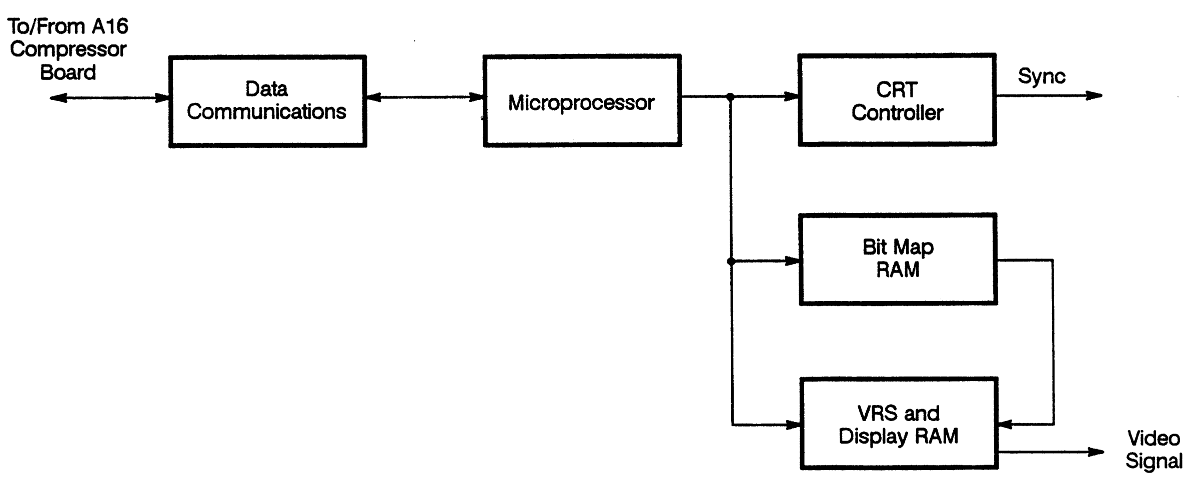


***Figure 4-7** —A7 Display Controller Board Block Diagram*

The CRT controller – is implemented with a VLSI IC. The controller is virtually automatic in operation and invisible to the firmware programmer, with the exception that it requires several internal registers must be initialized at power-on.

The bit map RAM – consists of 196,608 bytes of RAM, divided into three bit planes of 65,536 bytes each (only two of these planes are used). Each bit in a plane represents a single pixel of the display. Setting the representative pixel bit in each of the planes controls the color or intensity.

The video raster scan (VRS) and Display RAM circuitry – is where the hardware recognizes and displays specific data structures; while the raster-scan displays the contents of the bit map. The VRS and Display RAM consists of 65,536 bytes. These bytes contain minimum/maximum pairs of values, along with color index information and overrange/underrange settings. During the refresh of the screen, the hardware takes bit map data and combines it with any traces to be displayed, yielding a final color index that is used as an entry to the color map to determine a color or gray shade to be displayed.

A ninth data structure in this area is a clipping boundary, defined as the vertical height below which trace data (not bit map data) is suppressed during display. This height boundary can be set for each horizontal location across the screen, and is useful for the temporary suppression of traces within a specific area (for example, pop-up menus). When the boundary is completely reset to zero, all trace data is made visible again.

A8 CRT Driver Board

The A8 CRT Driver board consists of:

- horizontal sweep circuitry
- vertical sweep circuitry
- high voltage and grid voltage generator circuitry
- z-axis amplifier
- intensity circuit

The A8 CRT Driver board holds the circuitry necessary for driving the raster scan CRT. The video and sync signals from the A7 Display Controller board are used in generating the Z-Axis, sweep signals, and grid bias voltages for the CRT.

See Figure 4-8 for a block diagram of this board.

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

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

The high voltage and grid voltage generator circuitry—consists of the flyback transformer from the flyback waveform, which generate the 11.5 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 Z-axis amplifier—produces the video signals which are decoded to give four output levels; off, dim, norm and bright. These signals are amplified by the Z-axis amplifier. The resulting output is applied to the CRT through a peaking inductor. The Z-axis amplifier operates in a common-base configuration with a 50 MHz bandwidth.

The intensity circuit—sets the intensity of the CRT image. The intensity is proportional to the output of a digital to analog converter. This output is set by the serial input MON DATA and clocked in by MON CLK.

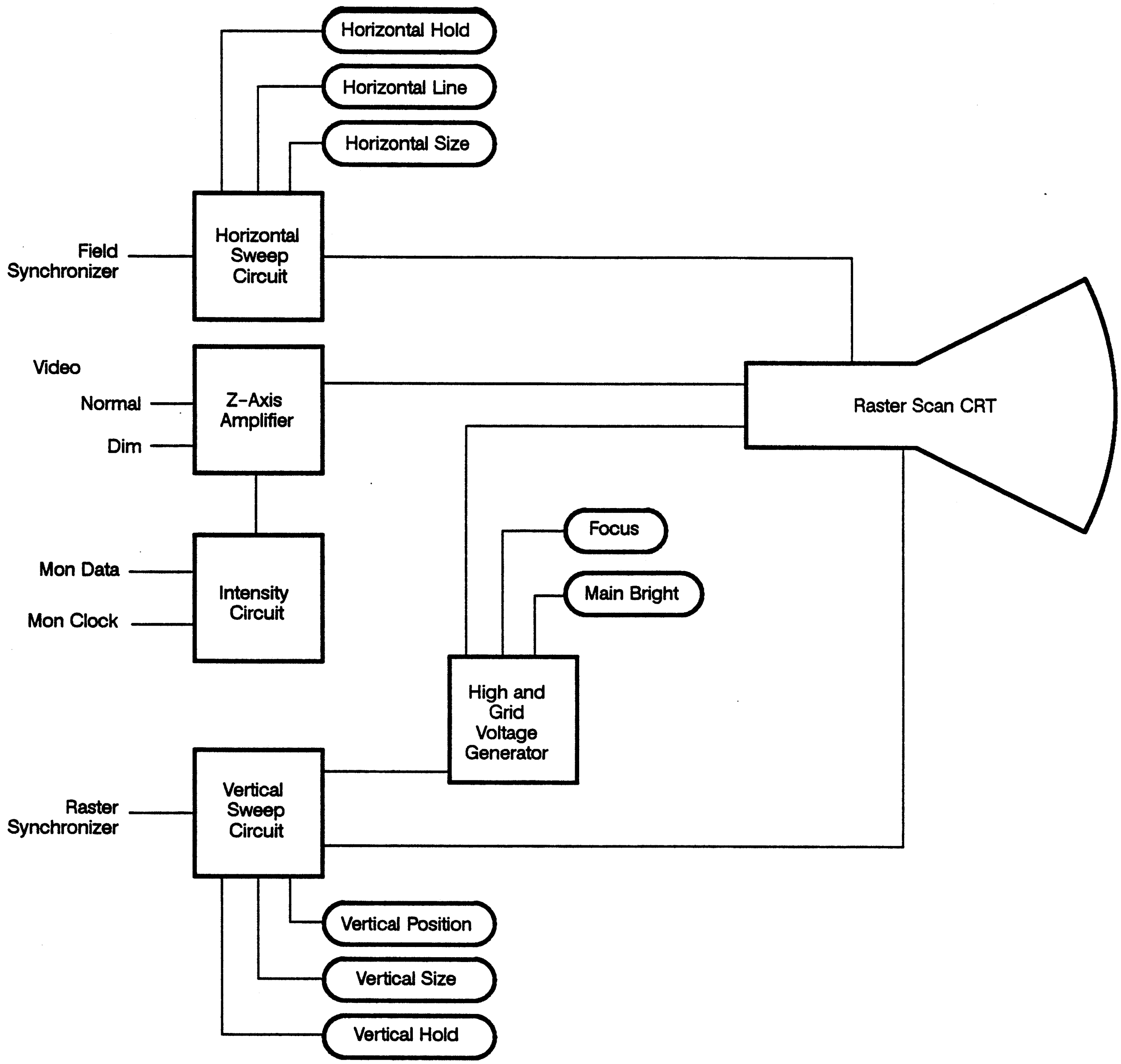


***Figure 4-8** — A8 CRT Driver Board Block Diagram*

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 4-9 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 Main 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 Main Processor board to communicate with the GPIB controller IC (if the DMAC IC is installed). The DMA can be programmed by the microprocessor to service either the Inbyte register or the Outbyte register.

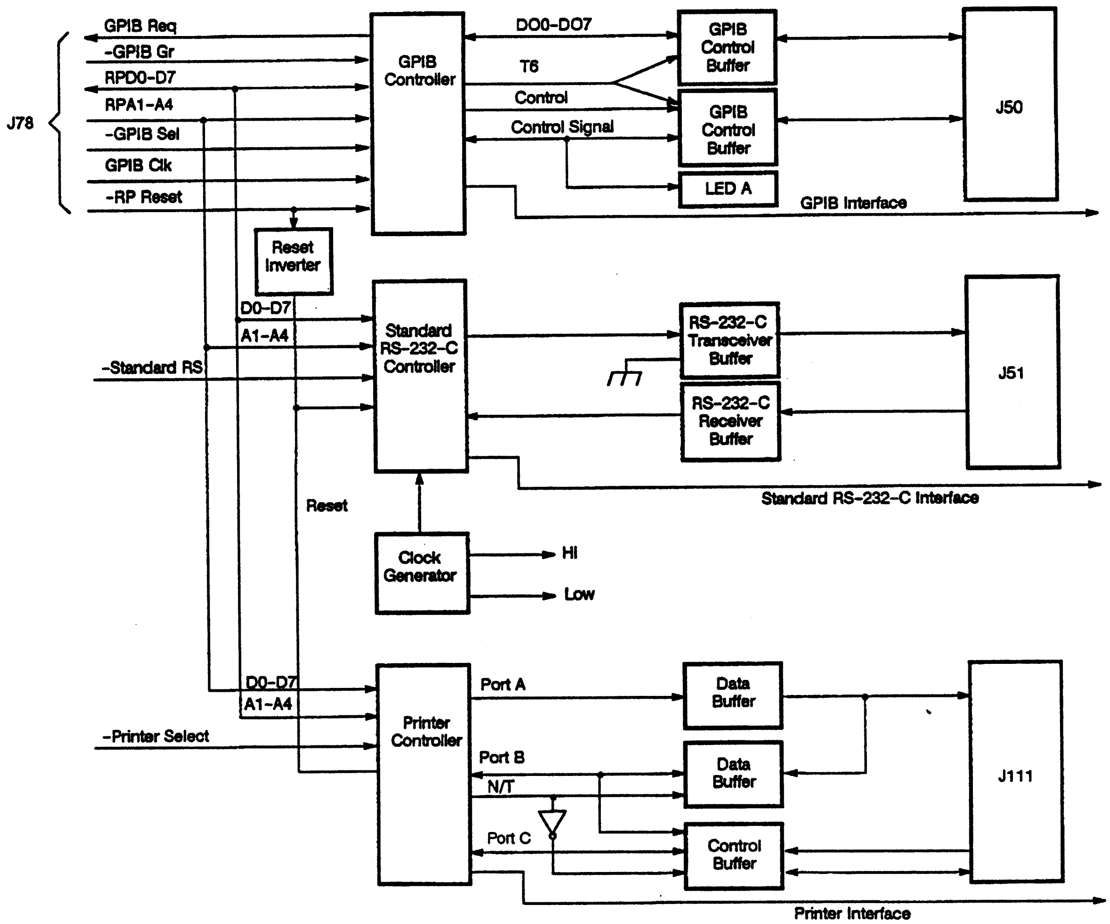


***Figure 4-9** — A12 Rear Panel Assembly Block Diagram*

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
- A15 MMU board
- A16 Compressor board
- A17 Main Processor board
- A18 Memory board
- A29 Memory Expansion board

A14 Input/Output (I/O) Board

The A14 I/O board contains:

- data buffers
- timer configuration logic
- real time clock
- serial data interface (SDI)
- temp/tone readback buffer
- tone generator

The A14 I/O board is an interface between the Executive processor and communications ports (for example, RS-232-C and GPIB), devices on the A9, A10, A11 Front Panel circuit boards, the A12 Rear Panel assembly, and the sampling heads. The EXP reads and writes to these I/O devices and the communication ports at specific I/O addresses. These I/O addresses are decoded to produce device select signals which enable the addressed device. Each I/O device is located on I/O address boundaries of at least 100_{hex}.

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

When the DMA controller is installed on the A17 Main Processor board, the A14 I/O board alters how it handles GPIB operations.

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

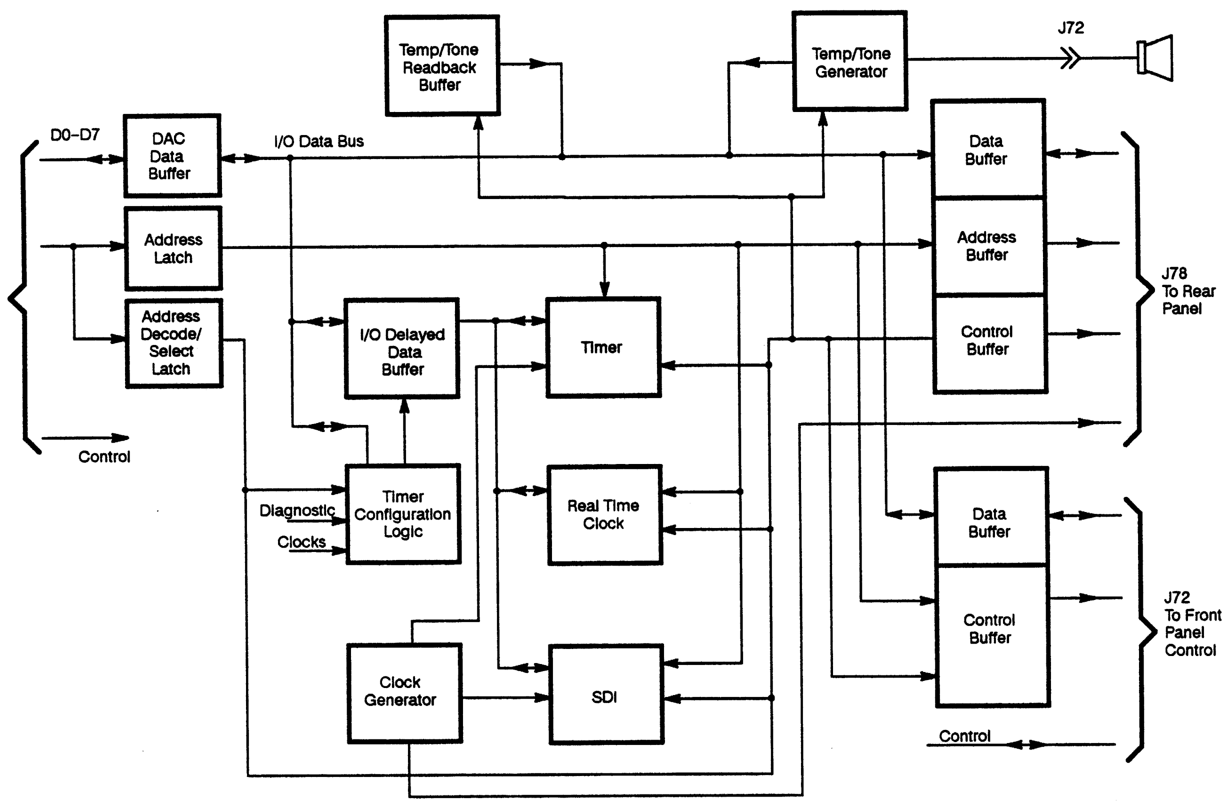


***Figure 4-10** — A14 I/O Board Block Diagram*

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 six different on-board devices, includes:

- I/O delayed data buffer
- rear panel data buffer
- front panel data buffer
- DAC data latch
- tone/temp readback buffer
- timer configuration logic)

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

The timer configuration logic—is comprised of a latch and three two-input data multiplexers built with discrete gates. When the EXP writes to I/O address 3200_{hex}, LS4(L) and BIOWC(L) go active and latch the I/O data bus. Some of the latched bits are used to individually configure the way that counters 1 and 2 are used. This lets the timer accept different inputs for different inputs for different system tasks. Counter 0 is used by the operating system as a real-time clock based on the 2 MHz CLK input from the clock generator, which is always on.

The real time clock—and its oscillator circuit maintains of the current time of day, which is set and read by the EXP.

The serial data interface (SDI)—is a custom IC that interfaces the EXP with both front panel knobs. It is controlled by the EXP and it interrupts the EXP when a device requires service.

The temp/tone readback buffer—is an eight-line buffer connected to the I/O data bus and used by the EXP to monitor the temperature.

The tone generator—is based on a 555 timer, with a special current driver to set its frequency. The timer puts out a square wave whose frequency is inversely proportional to the digital value written to the temp/tone digital-to-analog (DAC). A zero value into the DAC produces the highest tone.

A15 Memory Management Unit (MMU) Board

The A15 MMU board consists of:

- the MMU gate array
- the status and mode registration
- the display interface
- the Time Base/Controller interface
- the Executive Processor interface

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

- Display
- Time Base/Controller
- Executive Processor

The MMU gate array controls each interface with a different set of handshaking and buffer control lines. This board also contains buffers for each interface and two banks of DRAMS for Waveform Memory, address decode/select circuits and integrated diagnostic control circuitry. To perform transfers, the EXP sets bits in a control register called the status and mode register(SMR). It must also load addresses and byte count information into either the sequential address generator (SAG) or the random address generator (RAG), which reside within the MMU.

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

The MMU gate array—controls all data transfers to and from Waveform Memory. The MMU gate array controls high-speed transfers of waveform data and communication messages between Waveform Memory and the three subsystem interfaces the: Display, Time Base/Controller and Executive processors. Each subsystem interface is coordinated by a set of handshaking lines designed to the DMA facilities of each particular subsystem.

The Executive Processor interface—performs two main functions:

- provides the EXP access to Waveform Memory for subsystem message passing and manipulation of waveform record data
- provides access to the status mode register (SMR) and the diagnostic facilities; allowing the EXP to coordinate system operation

The status and mode register (SMR)—is used by the Executive processor to control the MMU gate array, which is located at the EXPs I/O address, 1860_{hex}. Upon power-on, the EXP must initialize the SMR to Display subsystem (bits 0 and 1) and the Time Base/Controller subsystem (bits 5 and 6). When set, bit 7 allows the EXP to access the normally inaccessible registers, which are associated with the RAG, SAG and refresh counter.

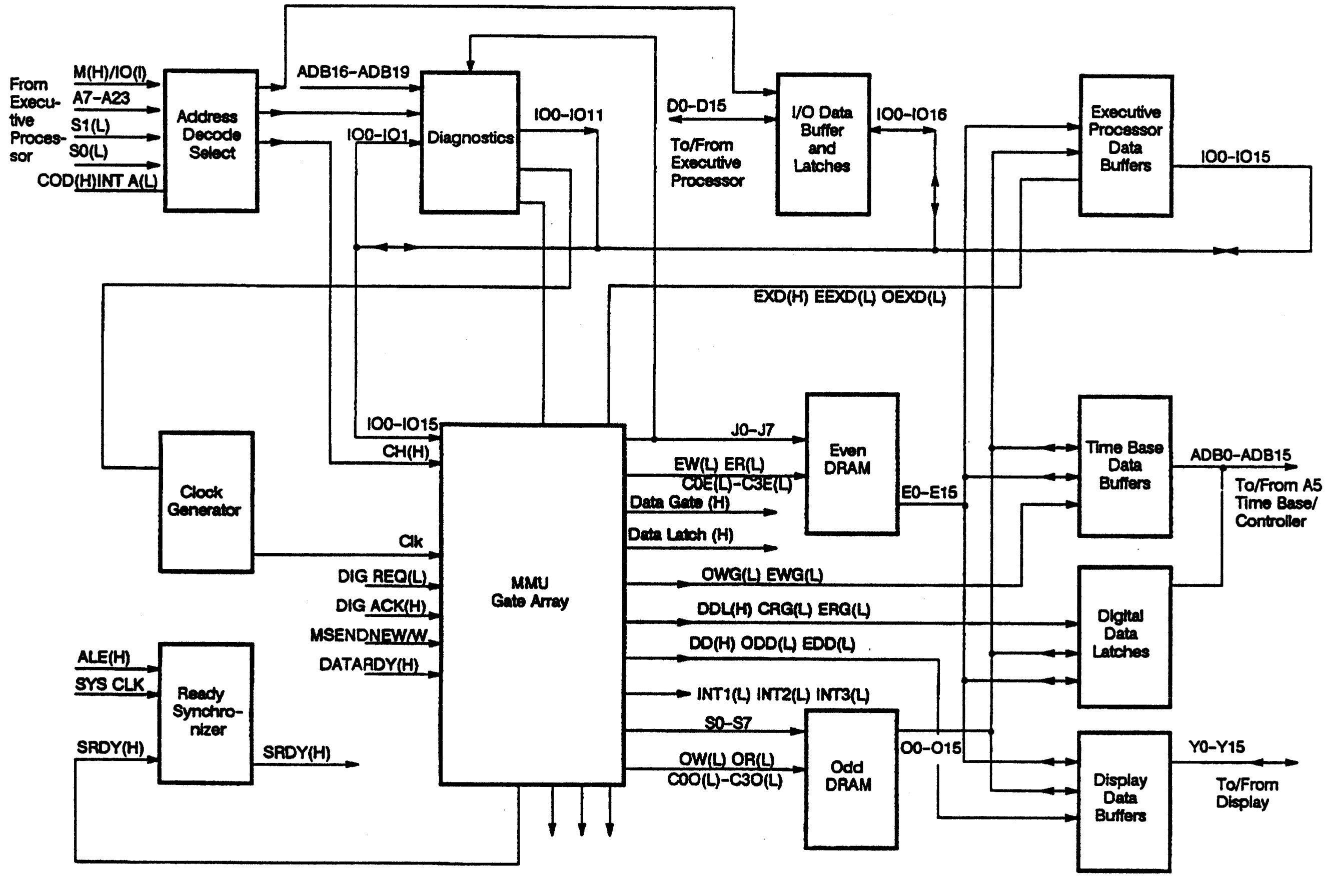


***Figure 4-11** — A15 MMU Board Block Diagram*

Through the Display interface – data is transferred to and from the display through the A16 Waveform Compressor board on a 16-bit data bus (Y0-Y15). These data transfers use the sequential address generator (SAG) to specify the destination or origin addresses in waveform memory. Data is buffered with the bi-directional Display data buffers for even and odd bank waveform memory accesses.

Through the Time Base/Controller interface – data is transferred to and from the Time Base/Controller on a 20-line multiplexed address/data bus, which is coordinated by dedicated handshaking lines. For transfers to Waveform Memory, the Time Base/Controller sends a 20-bit address, then a 16-bit data word. During transfers from Waveform Memory to the Time Base/Controller, only 16-bit data words are sent (while the MMU gate array's SAG provides the addressing for Waveform Memory).

The interface consists of address, data, and status/control inputs, EXP interrupt outputs and a data ready output.

A16 Compressor Board

The A16 Compressor board consists of:

- the adder circuitry
- the mode select latch
- the X and Y comparator output latch registers
- the X and Y comparators

The oscilloscope waveform display is comprised of 512 vertical lines; regardless of the waveform being displayed. The length of the individual vertical lines depends on the change in voltage at the time represented by the horizontal location of the particular vertical line.

See Figure 4-12 for a block diagram of this board.

The A16 Compressor board provides 512 pairs of data points to the display. The A15 MMU board always provides 512 groups of data points to the compressor. Hence, the name compressor, since the Waveform Compressor reduces its groups of input data points to pairs of data points.

The pairs of points transferred to the display are the minimum and the maximum of the input group.

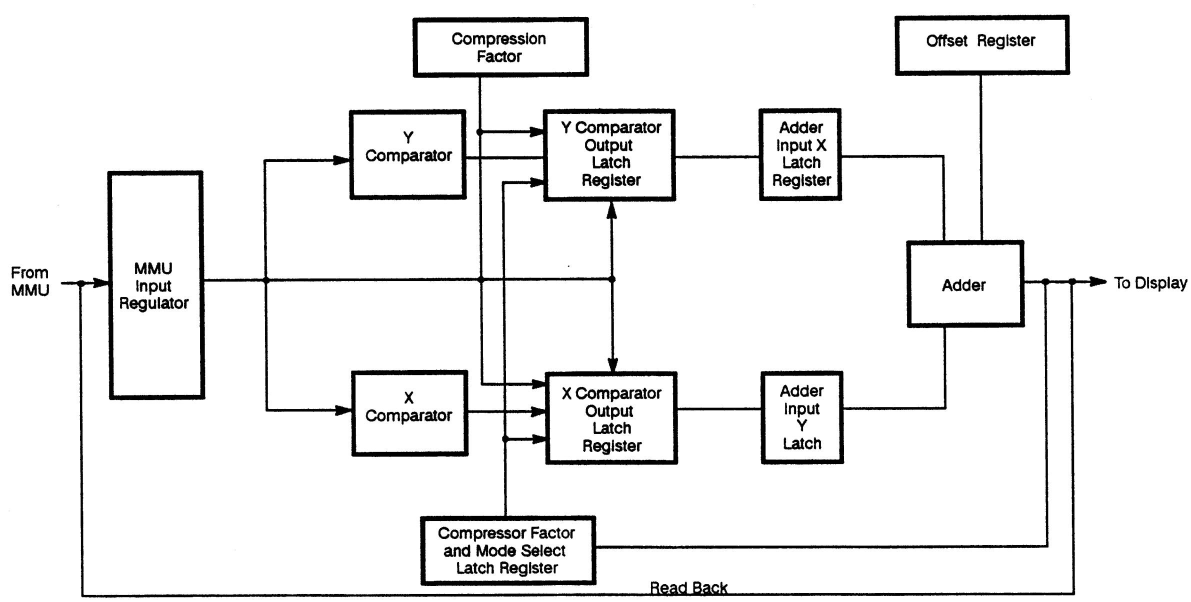


***Figure 4-12** — A16 Compressor Board Block Diagram*

The adder circuitry – provides vertical display position control for the user, by either adding a digital offset, which is stored in the offset register, or subtracting the same digital offset from the data points.

A normal, nonvectored display may have gaps, or holes, between adjacent points. If you want a continuous display, without holes, then you can select the vectored display.

Vectoring takes place by comparing each new data point in a set with a previous pair of displayed values to determine if the new point is greater than, equal to, or less than those values.

The compression factor (CF) is the number of data points from which the compressor will select a min-max pair for the adder. The CF is an 8-bit number, valid in the 1 to 255 range. This value is stored in the compression mode register.

The Mode Select Latch – has three separate mode control bits; which allow eight modes. All eight modes are theoretically possible, although not all are particularly useful. The three mode selections are compress/transparent, vectored/nonvectored, and normal/test.

In the compress/transparent mode the adder sends the X and Y register values; thus producing two output values for each input group. In the transparent mode, only the X or Y value is sent; that is, just one output for each input group.

The vectored/nonvectored mode determines whether previous data is considered when an operation is performed. When vectoring is on, consecutive data groups are compressed with respect to of the previous group's minimum and maximum values. With vectoring off, the compressor's X and Y values are marked undefined before performing an operation on a new group.

The normal/test mode specifies whether the adder output is to be transferred to the Display or presented to the Executive Processor subsystem. In normal mode, the adder state machine waits for the Display's SENDNEW(L) signal before sending the data. In test mode, the adder state machine waits for the decoded DREAD(L) (data read) signal.

The X comparator and Y comparator output latch registers – hold the intermediate values of a compress groups minimum and maximum values. The X com-parator output latch register can serve as either the minimum or maximum register; as determined by the M/M MUXSEL signal. The Y comparator output latch register will always be the opposite of X (that is, if X is min, then Y will be max; and vice versa). The outputs of the X and Y comparator output latch registers are connected directly to the input of the adder input and X and Y registers, respectively.

The X and Y comparators – are eight-bit comparators that permit the oscilloscope to compare the compressor's present contents with the current input from the MMU. The MMU input register is connected to the P input of the X and Y comparators, and the X and Y comparator output latches are connected to their Q inputs. The four output signals encode the relation between the values being compared; they are decoded in the min-max latch decoder.

A17 Main Processor Board

The A17 Main Processor board consists of the:

- numeric processor extension circuitry
- bus controller circuitry
- reset circuitry
- wait state circuitry
- interrupt controllers
- power-down circuitry

The Executive processor executes firmware routines stored in EPROMS located on the A17 Main Processor board and on the A18 Memory board to effectively control the operation of the oscilloscope. Along with the numeric processor extension, the Executive processor does all data processing not directly related to generating the display or digitizing the waveform. When power is first applied to the oscilloscope, the EXP executes local and system diagnostic tests, which are located in the on-board EPROMs and on the A18 Memory board.

See Figure 4-13 for a block diagram of this board.

The numeric co-processor circuitry – is a high-speed floating-point processor that executes instructions in parallel with the Executive processor. The numeric co-processor is programmed and controlled by the Executive processor as an I/O device at addresses $0F8_{hex}$ to $0FF_{hex}$. The numeric co-processor is enabled at the numeric processor select input, NPS1 (pin 34), by latched select line LS1.

Address decoders, address latches, and memory data buffers are all support circuits for input/output and memory devices.

The bus controller circuitry – consists of a data address/buffer and a control buffer that provide command and control signals for the microprocessor and the executive busses. The bus controller decodes the Executive processor's status and control lines to generate its command and control signals. (The bus controller's outputs are always enabled.) The bus controller produces optimal bus cycle timing (minimum number of CLK cycles per bus cycle) and inserts wait cycles only while the READY(L) input remains high past the fourth CLK cycle. The timing of all bus signals is referenced to the input signal, CLK. Then, the input signals are sampled and appropriate output signals are asserted.

The data, address, and control buffers increase the signal levels before sending these signals to the system bus.

The reset circuitry – generates the synchronized READY(L) and RESET control signals.

The Wait State circuitry – extends the bus cycle so that slower devices have sufficient time to transmit data.

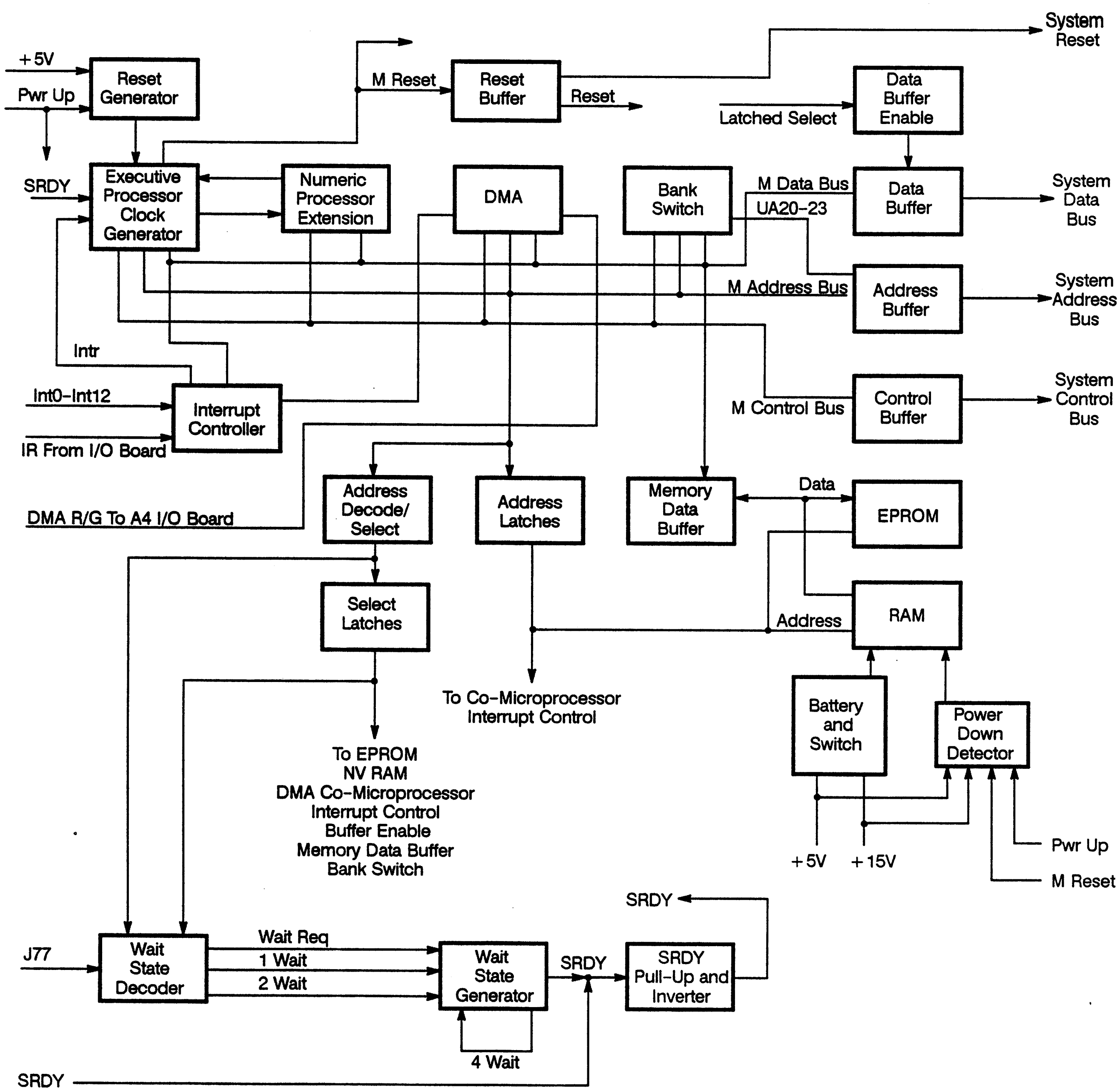


***Figure 4-13** — A17 Main Processor Board Block Diagram*

The EPROM—contains the operating system code and also some diagnostics code.

The Interrupt Controllers—constantly monitor the Executive processor'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 to ignore (mask) any of the interrupt lines.

The power-down circuitry—consists of the power-down detector and the battery and switch circuit, which disables the nonvolatile RAM (NV RAM) and provides battery-backup power when it detects the power supplies failing or an active MRESET signal or PWR UP false. During normal power supply operation, PWR UP is high, and MRESET is low, and after a one second time delay starts, the NV RAM is enabled.

A18 Memory Board

The A18 Memory board consists of:

- the address latches
- the address decode Programmable array of logic
- EPROMs
- the bank enable circuitry
- the memory wait state generator
- DRAM circuitry
- the DRAM configuration jumpers
- the DRAM controller reset generator

The A18 Memory Board provides the Executive processor (EXP) with DRAM and EPROM for most operations. Support circuitry for the memories and diagnostic circuitry for troubleshooting are located on-board. All accesses to DRAM or EPROMs are initiated by the A17 Main Processor board.

See Figure 4-14 for a block diagram of this board.

The address latches—buffer and hold the Executive address lines and BHE(L) for the EPROMS, DRAM controller IC, and other on-board devices. With the latch outputs always enabled and LE (An Early ALE) high, these latches are transparent; allowing any addresses to pass through as soon as they are available.

The address decoder Programmable array of logic (PAL)—decodes the address lines to produce RAM select signal RAM SEL(L) and four EPROM select signals, CS1(L) -CS4(L) (refer to Table 4-1). RAM SEL(L) enables the DRAM Controller to begin a DRAM access cycle.

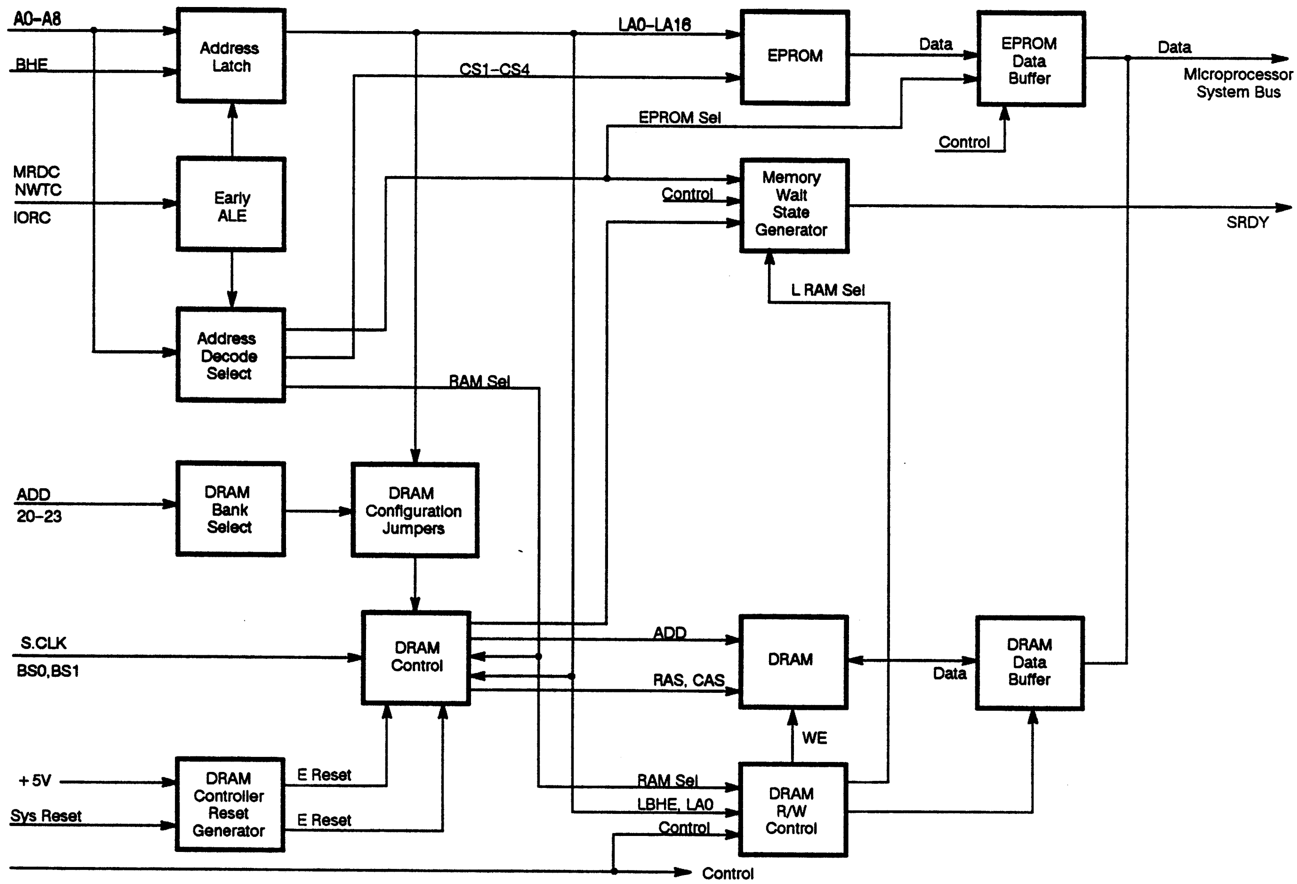


Figure 4-14 — A18 Memory Board Block Diagram

Table 4-1 — PAL Address Line Decoding

Select		Address Range*hex*		ICs Enabled
RAM SEL(L)	Low Bank Switch	x	0-01FFFFF	ALL RAM
		1	20000-3BFFF	ALL RAM
CS1(L)	High Bank Switch	0	C0000-DFFFF	U630, U730
CS2(L)		1	80000-9FFFF	U620, U720
CS3(L)		1	A0000-BFFFF	U612, U712
CS4(L)		1	C0000-DFFFF	U600, U700

Note: x= don't care condition

The EPROMs—contain most of the operating system code for the EXP. All the EPROMs share the latched address bus. (These address lines are buffered until the middle of the access cycle when they get latched. This is to allow the address information to be available to the EPROMs as early in the bus cycle as possible.) The EPROMs are organized into high- and low-byte pairs. Each pair is selected by a separate latched chip-select signal, which is generated by the address decode PAL. The output data drivers of an EPROM pair are enabled when the pair is selected.

The bank enable circuitry—buffers address lines A20–A23 to produce bank address lines for the RAM and ROM bank addresses.

The Memory Wait State Generator—signals the EXP to extend the bus cycle a specific number of clock cycles (PCLK) when a memory access starts.

When an EPROM pair is selected, the EPROM SEL line goes high. If jumper J800 is not set on zero waits, the high will be clocked to the Q output. The high Q output is SRDY(L); which is inverted to drive the system signal SRDY. When SRDY is driven low, it signals the EXP to begin inserting wait states. When jumper J800 causes SRDY to be reset, the wait request state is ended.

The DRAM controller—is configurable for DRAMs of different sizes and speeds in a two- or four-bank arrangement. It provides high speed access to the standard two banks of 64 k × 4-bit DRAM chips, and it also automatically provides refresh signals. Though the DRAM controller IC supports dual-port access to the DRAM, it uses only the port A interface. Therefore, in addition to the DRAM controller IC, a set of initialization shift registers and a high/low byte enable circuit are incorporated into this block.

The DRAM circuitry—in the standard configuration, is comprised of two groups of four 64 k × 4 bit DRAMs. The A18 Memory Board is designed to allow two more groups of RAM to be added later.

The DRAM controller IC and the buffered EXP control line DT/R control the DRAM. The DRAM may be written to with just a high- or low-byte of data. The high and low write-enable and the high and low output-enable lines provide this function.

The DRAM configuration jumpers—allow the DRAM to be arrange in different ways to facilitate various customer options and design considerations. The jumpers select which address and bank-address lines will be applied to the DRAM Controller.

The DRAM controller reset generator—monitors the system RESET line and uses it to generate a shorter reset pulse for the DRAM controller IC than the pulse for the system reset. The 45 ms system RESET pulse is buffered, then differentiated. The resultant quick 10 ms reset pulse appears on the output of the reset generator where it gets inverted and applied to the DRAM controller.

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 4-15 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.

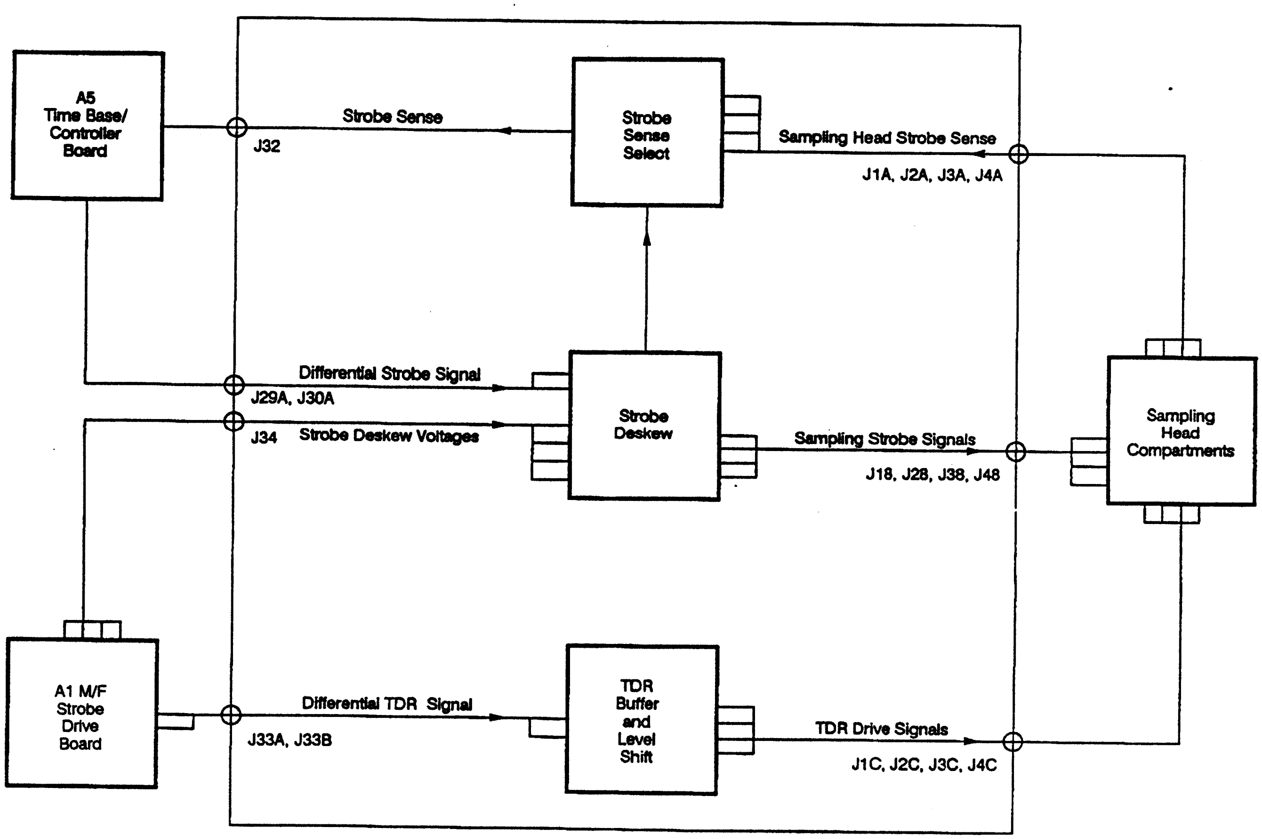


Figure 4-15 *— A19 Strobe/TDR Buffer Board Block Diagram*

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 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.

A22/A23 Head Interconnect Board

The A22/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 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 A27 Acquisition Analog board
- the A28 Acquisition MPU board
- the A22/A23 Head Interconnect boards

See Figure 4-16 for the block diagram of this board.

The A26 M/F Acquisition Interconnect board also has a precision voltage reference (V) to furnish the ±5 voltage reference required by the A27 Acquisition Analog board.

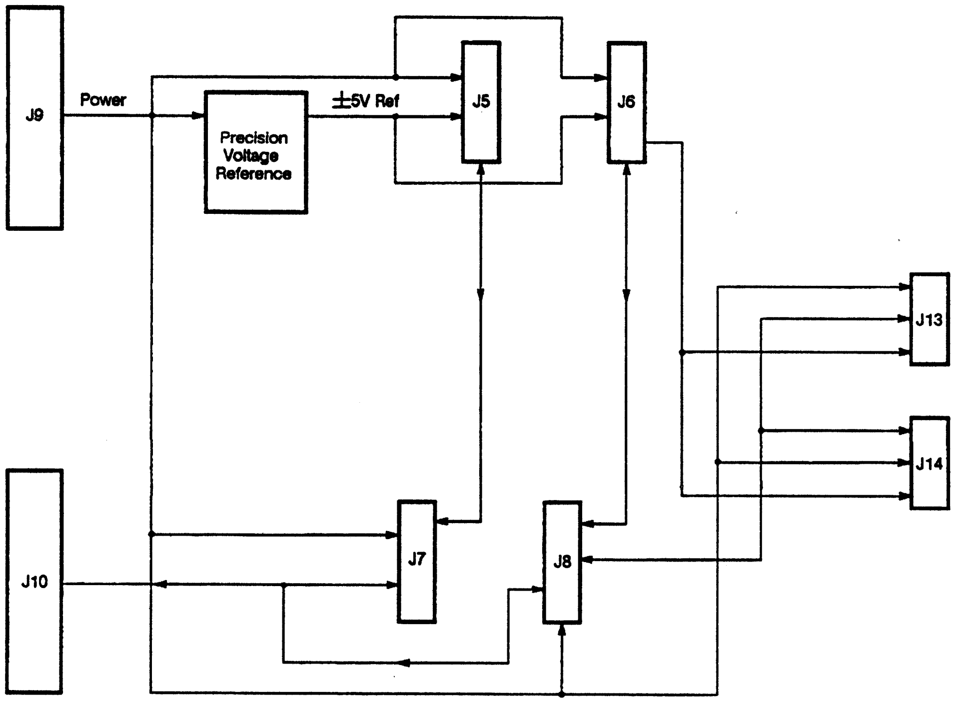


***Figure 4-16** — A26 M/F Acquisition Interconnect Board Block Diagram*

A27 & A28 Acquisition System Boards

The Acquisition system consists of two boards: the A27 Acquisition Analog board and the A28 Acquisition MPU board.

The A27 Acquisition Analog board consists of the following major blocks:

- programmable gain amplifiers
- A/D converters
- measurement hardware
- timing and sampling head control

The 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 4-17 and 4-18 for the block diagrams of these boards.

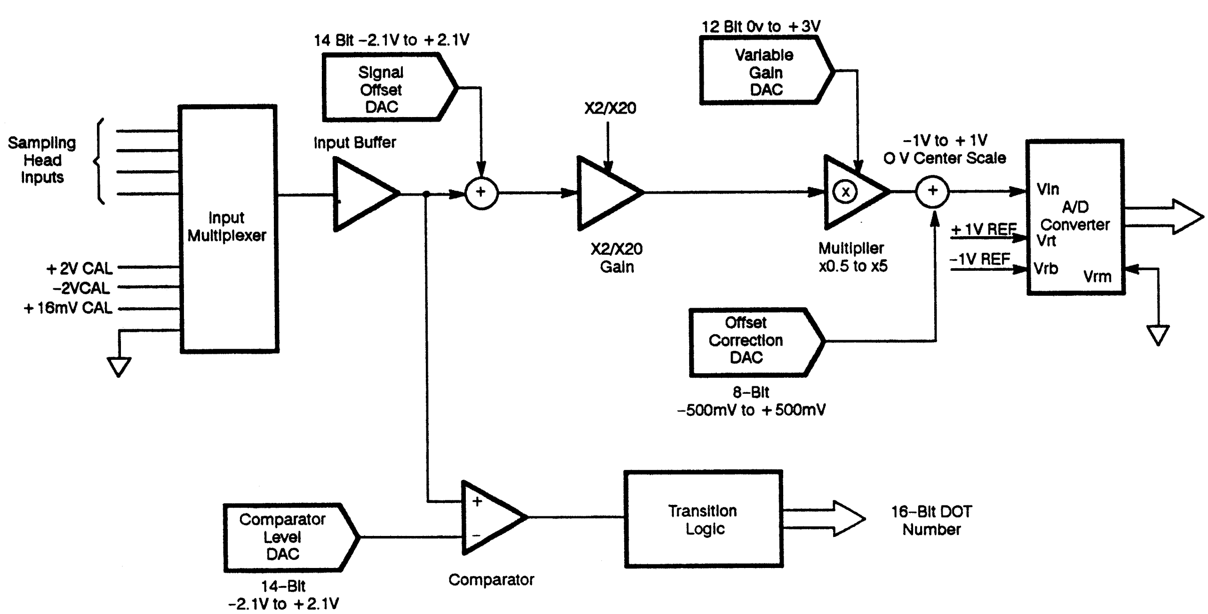


***Figure 4-17** — A27 Acquisition Analog Board Block Diagram*

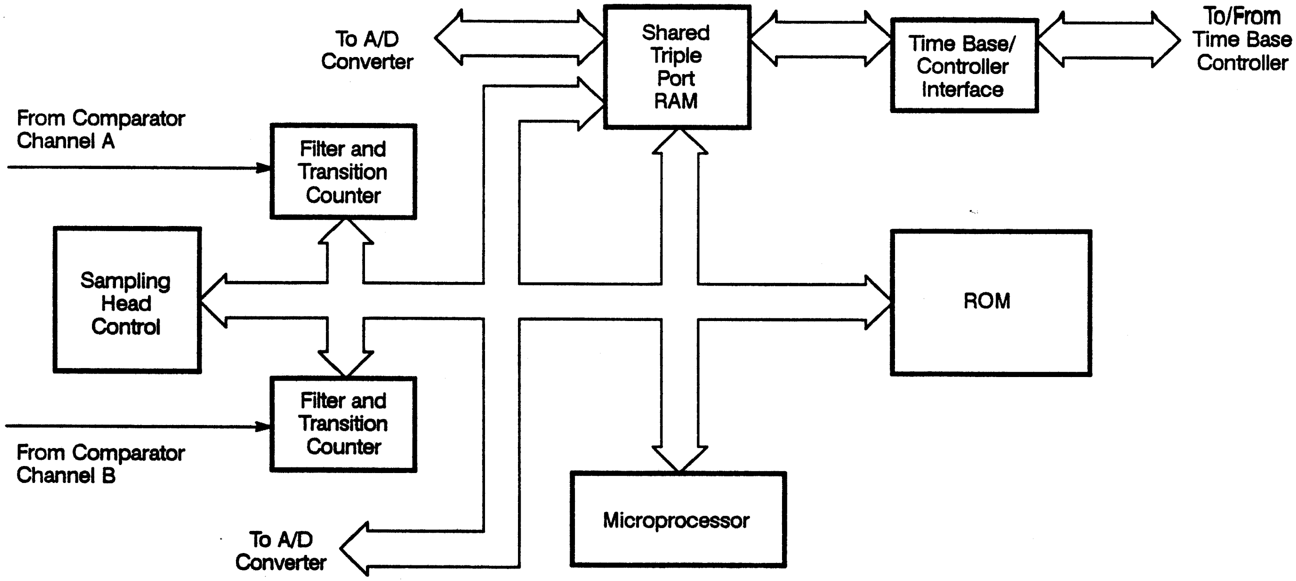


***Figure 4-18** — A28 Acquisition MPU Board Block Diagram*

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 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 – exits for the 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 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 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 is 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.

A29 Memory Expansion Board

The A29 Memory Expansion board adds an additional system ROM board and an additional battery-backed system RAM to expand the memory of the oscilloscope.

The address decoder and latch – decodes this address to select what portion of memory to use. The address buffers also generate a signal to enable the data buffers.

The data buffers – isolate the memory and the system bus.

Standby power and control – supplies battery power to the RAM when the ON/STANDBY switch is on STANDBY. The standby power and control also performs the appropriate compensation when there is a change between battery and system power to prevent the loss of data in the RAM.

The RAM – consists of 32K × 8 CMOS RAMs.

The ROM – consists of 64 × 8 EPROMs.

See Figure 4-19 for a block diagram of this board.

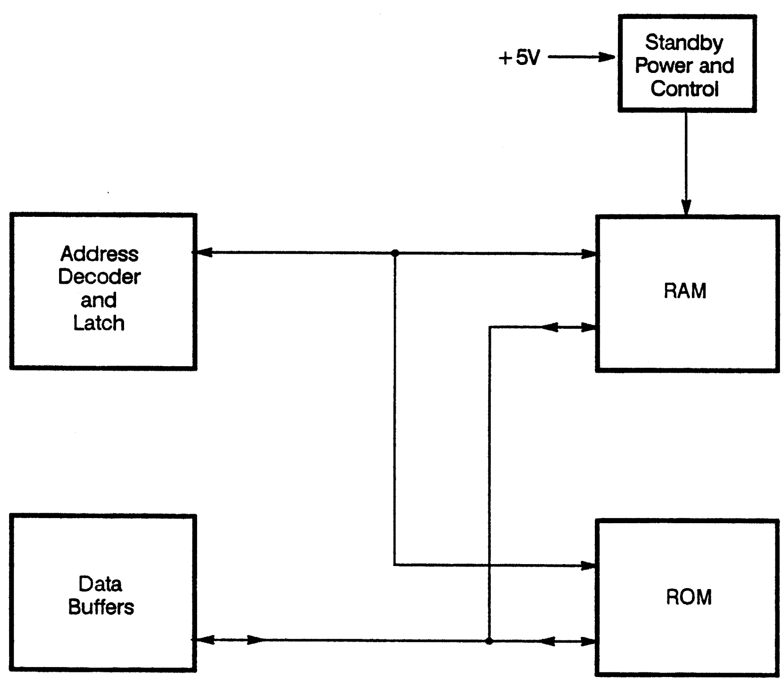


Figure 4-19 *— A29 Memory Expansion Board Block Diagram*

A30/A31 Trigger Pickoff and Delay Line Compensation Board

The A30/A31 Trigger Pickoff and Delay Line Compensation board consists of:

- the delay line compensator module
- the compensator hybrid circuitry

See Figure 4-20 for a block diagram of this board.

The Delay Line compensator – equalizes the amplitude and time response of the delay line for the 11802 Oscilloscope. At high frequencies, skin effect causes loss in the delay line cable which increases portionally to the square root of the frequency. The delay cable is chosen so that this loss in nearly 6 dB at 5 GHz.

The compensator is inversely proportional to the cable loss characteristic: that is, the compensator has a 6 dB loss at low frequencies, however the loss tapers off at the square root of rolloff

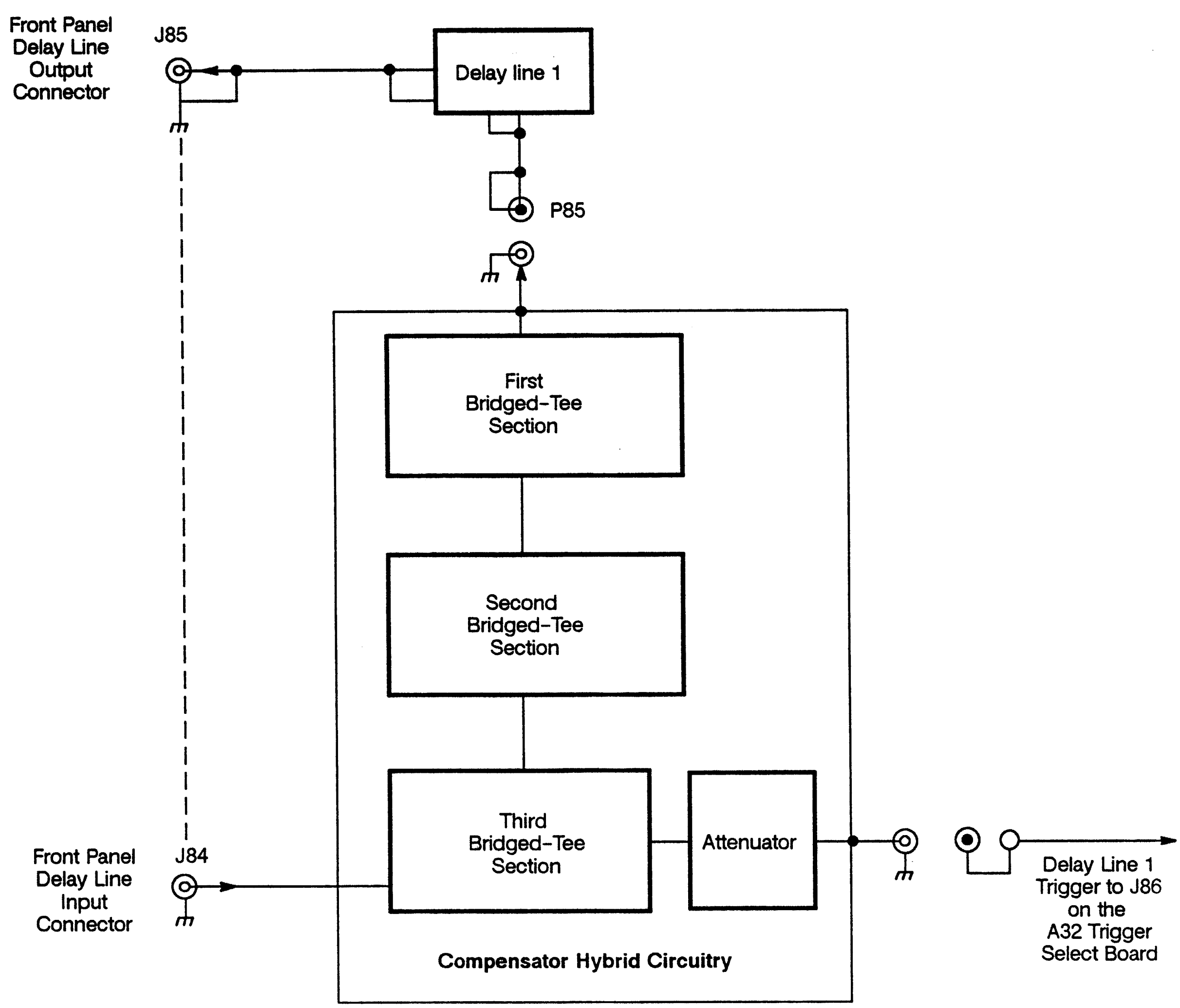


Figure 4-20 *— A30/A31 Trigger Pickoff and Delay Line Compensation Board Block Diagram*

The compensator module—mounts directly to the front panel of the 11802 Oscilloscope and serves as the delay line input. The delay line then hooks up to the output of the compensator. The pickoff trigger signal is thus in front of the delay signal provided by the delay line. Each delay line in an 11802 Oscilloscope has a compensator (thus, since the 11802 Oscilloscope has two delay lines, there are two compensators).

The compensator circuitry—is built on a hybrid for excellent high-frequency performance and repeatability.

Three bridged-Tee sections are used to obtain a constant-R characteristic, which is necessary for good time response. The grounded leg of the first (and highest-frequency) section is connected through a small attenuator to jack J85 on the A32 Trigger Select board to serve as trigger signal. The loss through the trigger output is set to be a factor of four (through about 2.2 GHz) with this attenuator. The loss through the main signal path is 6 dB, for frequencies through approximately 5 GHz.

A32 Trigger Select Board

The A32 Trigger Select board receives trigger input signals from the EXTERNAL TRIGGER INPUT (front panel), the two DELAY LINE trigger pickoffs, and the A1 M/F Strobe Driver board internal clock (INT CLK) and processes these signals for use by the trigger circuits on the A5 Time Base/Controller board. This signal processing generally consists of AC/DC coupling selection, gain or attenuation selection, switching between the various trigger inputs, and protection/disconnection.

The A32 Trigger Select board consists of:

- AC/DC Coupling relays
- the X1/X10 Attenuator select relay
- the DELAY LINE/EXTERNAL TRIGGER select relay
- the delay line source select relay
- the X1/X10 gain select amplifier
- the protection/disconnection circuitry
- EXTERNAL/DELAY LINE or INT CLK select relay

The EXTERNAL TRIGGER signal from the front panel jack J87 is first routed to relay.

See Figure 4-21 for a block diagram of this board.

The AC/DC coupling relay—switches between AC coupling using a capacitor or DC coupling.

The X1/X10 Attenuator Select relay—can attenuate a signal by approximately ten times.

The signal then the X1/X10 Attenuator Select relay.

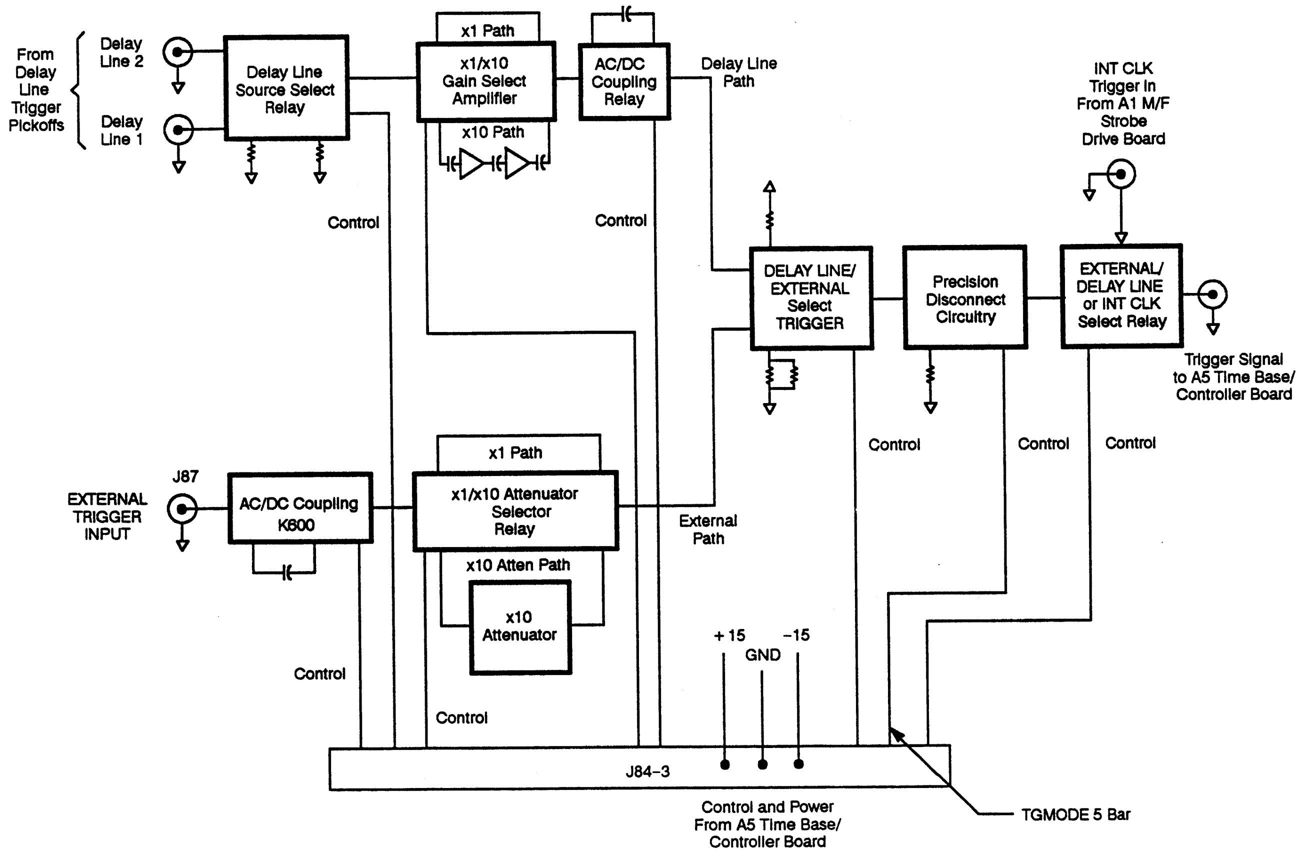


***Figure 4-21** — A32 Trigger Select Board Block Diagram*

The DELAY LINE/EXTERNAL TRIGGER select relay— selects between the EXTERNAL TRIGGER path and the DELAY LINE path.

The two DELAY LINE TRIGGER signals from the delay line trigger pickoffs enter the Trigger Select board at jacks J86 (for DELAY LINE 1) and J89 (for DELAY LINE 2).

The Delay Line Source select relay—selects between these two sources where the unselected source is terminated by termination resistors.

The X1/X10 Gain Select amplifier—can amplify to a gain of approximately ten times. Each amplifier has approximately 10 dB of gain at 1000 MHz.

The other AC/DC coupling relay— switches to AC coupling network on command 1 from the control line. Then, the signal enters the DELAY LINE/EXTERNAL TRIGGER source, which again selects between the DELAY LINE trigger path and the EXTERNAL TRIGGER path. If the DELAY LINE path is not selected, then this path is terminated.

The protection disconnection circuitry—which provides protection and isolation when required. That is, a diode bridge can be switched on, connecting the signal path to a termination resistor. While this diode bridge is switched on, another diode bridge is switched to OFF; disconnecting the signal from the circuitry. These bridges isolate the trigger input when the INT CLK trigger is selected and when Time Base Self-Tests are occurring. The later bridge will also start to turn to OFF if the trigger input exceeds safe values. These diode bridges are switched by a control signal (TGMODE5-bar) at J84-3 from the A5 Time Base/Controller board.

The DL/EXT or INT CLK select relay—then selects between the EXTERNAL/DELAY LINE signal and INT CLK, which operates at the TDR rate. When the INT CLK is selected, an OR-gate formed also causes the diode bridges to switch, further isolating the EXTERNAL/DELAY LINE signal from the INT CLK. Power in the form of +15 V for the amplifier and relays and −15 V for the circuitry controlling the diode bridges also comes from the Time Base Controller via J84.

Replaceable Parts

This section contains a list of the components that are replaceable for the 11802 Oscilloscope. As described below, use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts are available from or through your local Tektronix, Inc. Service Center or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they be come available and to give you the benefit of the latest circuit improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- Part Number
- Instrument Type or Model Number
- Instrument Serial Number
- Instrument Modification Number, if applicable

If a part you order has been replaced with a different or improved part, your local Tektronix Service Center or representative will contact you concerning any change in the part number.

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

Module Replacement

The 11802 Oscilloscope is serviced by module replacement so there are three options you should consider:

- **Module Exchange.** In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1 800 TEKWIDE, extension BV 5799.
- **Module Repair.** You may ship your module to us for repair, after which we will return it to you.
- **New Modules.** You may purchase new replacement modules in the same way as other replacement parts.

Using the Replaceable Parts List

The tabular information in the Replaceable Parts List is arranged for quick retrieval. Understanding the structure and features of the list will help you find the all the information you need for ordering replacement parts.

Item Names

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

Indentation System

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

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
(END ATTACHING PARTS)
  Detail Part of Assembly and/or Component
  Attaching parts for Detail Part
  (END ATTACHING PARTS)
    Parts of Detail Part
    Attaching parts for Parts of Detail Part
    (END ATTACHING PARTS)

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are in dented to the right. Indented items are part of, and included with, the next higher indentation. Attaching parts must be purchased separately, unless otherwise specified.

Abbreviations

Abbreviations conform to American National Standards Institute (ANSI) standard Y1.1

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
01536	TEXTRON INC CAMCAR DIV SEMS PRODUCTS UNIT	1818 CHRISTINA ST	ROCKFORD IL 61108
04348	LAWRENCE ENGINEERING AND SUPPLY INC	500 S FLOWER ST P O BOX 30	BURBANK CA 91503
06383	PANDUIT CORP	17301 RIDGELAND	TINLEY PARK IL 07094-2917
11897	PLASTIGLIDE MFG CORP	2701 W EL SEGUNDO BLVD	HAWTHORNE CA 90250-3318
12327	FREEWAY CORP	9301 ALLEN DR	CLEVELAND OH 44125-4632
16428	COOPER BELDEN ELECTRONIC WIRE AND CA SUB OF COOPER INDUSTRIES INC	NW N ST	RICHMOND IN 47374
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
26805	M/A-COM OMNI SPECTRA INC MICROWAVE CONNECTOR DIV SUB OF M/A-COM INC	140 4TH AVE	WALTHAM MA 02154-7507
28520	HEYCO MOLDED PRODUCTS	750 BOULEVARD P O BOX 160	KENILWORTH NJ 07033-1721
61058	MATSUSHITA ELECTRIC CORP OF AMERICA PANASONIC INDUSTRIAL CO DIV	ONE PANASONIC WAY PO BOX 1502	SECAUCUS NJ 07094-2917
70903	COOPER BELDEN ELECTRONICS WIRE AND C SUB OF COOPER INDUSTRIES INC	2000 S BATAVIA AVE	GENEVA IL 60134-3325
71400	BUSSMANN DIV OF COOPER INDUSTRIES INC	114 OLD STATE RD PO BOX 14460	ST LOUIS MO 63178
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076-9749
74445	HOLO-KROME CO	31 BROOK ST	ELMWOOD CT 06110-2350
75915	LITTELFUSE INC SUB TRACOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016-3049
77900	ILLINOIS TOOL WORKS SHAKEPROOF DIV	ST CHARLES RD	ELGIN IL 60120
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 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
86928	SEASTROM MFG CO INC	701 SONORA AVE	GLENDALE CA 91201-2431
92101	SCHULZE MFG	50 INGOLD RD	BURLINGAME CA 94010-2206
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61108-5181
S3109	FELLER	ASA ADOLF AG STOTZWEID CH8810	HORGEN SWITZERLAND
S3629	SCHURTER AG H C/O PANEL COMPONENTS CORP	2015 SECOND STREET	BERKELEY CA 94170
TK0510	PANASONIC COMPANY DIV OF MATSUSHITA ELECTRIC CORP	ONE PANASONIC WAY	SECAUCUS NJ 07094
TK0861	H SCHURTER AG DIST PANEL COMPONENTS	2015 SECOND STREET	BERKELEY CA 94170
TK1262	MURPHY ELECTRONICS INC (DIST)	14933 NE 40TH ST	REDMOND WA 98052-5326
TK1373	PATELEC-CEM (ITALY)	10156 TORINO	VAICENTALLO 62/45S ITALY
TK1456	PAPST MECHATRONIC CORP	AQUIDNECK INDUSTRIAL PK	NEWPORT RI 02840
TK1546	DTM PRODUCTS INC	4725 NAUTILUS COURT S	BOULDER CO 80301
TK1653	CHASSIS AND TRAK CORP	P O BOX 29100	INDIANAPOLIS IN 46239
TK1869	ALPS	100 N CNTRE AVE	ROCKVILLE CENTRE NY 11570
TK6020	DAINICHI-NIPPON CABLES	NEW KOKUSAI BLDG 4-1 MARUNOUCHI 3-CHOME CHIYODA-KU	TOKYO 100 JAPAN

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-1	200-3126-00			1	COVER,CABINET:LIFT OFF,UPPER	80009	200-3126-00
-2	214-0603-02			4	.PIN ASSY,SECRG:W/SPRING WASHER	80009	214-0603-02
-3	386-1151-00			4	.CLAMP,RIM CLENC:SPG STL CD PL	83553	ORDER BY DESCR
-4	386-0227-00			4	.STOP,CLP,RIM CL:	80009	386-0227-00
-5	200-3415-00			1	COV,CAB LIFTOFF:LOWER,AL,BLUE PAINT	80009	200-3415-00
-6	214-0603-02			4	.PIN ASSY,SECRG:W/SPRING WASHER	80009	214-0603-02
-7	386-1151-00			4	.CLAMP,RIM CLENC:SPG STL CD PL	83553	ORDER BY DESCR
-8	386-0227-00			4	.STOP,CLP,RIM CL:	80009	386-0227-00
-9	348-0596-00			4	PAD,CAB.FOOT:0.69 X 0.255 X 0.06,PU	80009	348-0596-00
-10	348-0879-00			4	FOOT,CABINET:BOTTOM,BLUE,POLYCARBONATE	80009	348-0879-00
					(ATTACHING PARTS)		
-11	211-0711-00			4	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-12	348-0875-00			1	FLIPSTAND,CAB.:	80009	348-0875-00

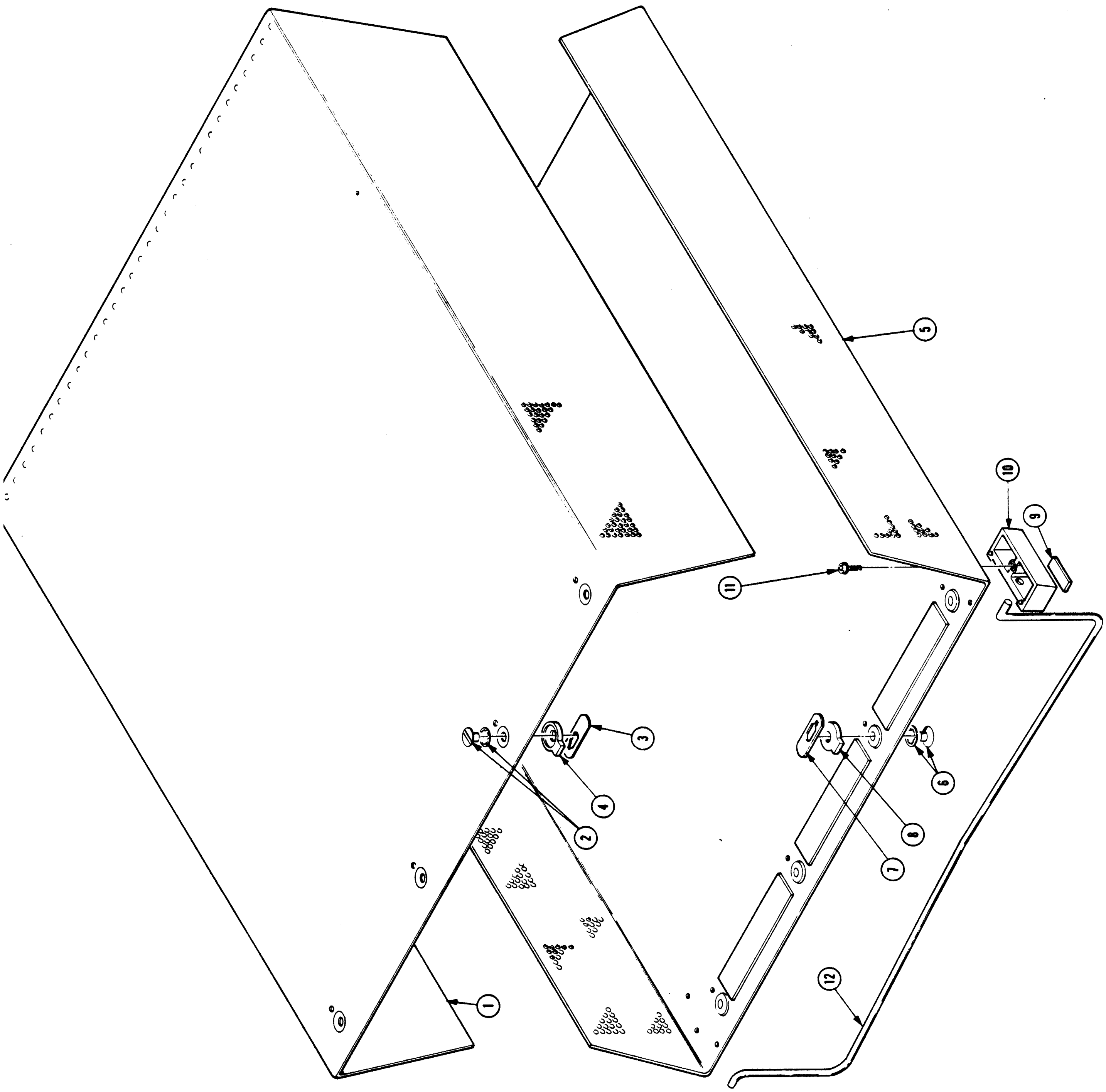


Figure 1—Cabinet
11802 Service Reference Manual

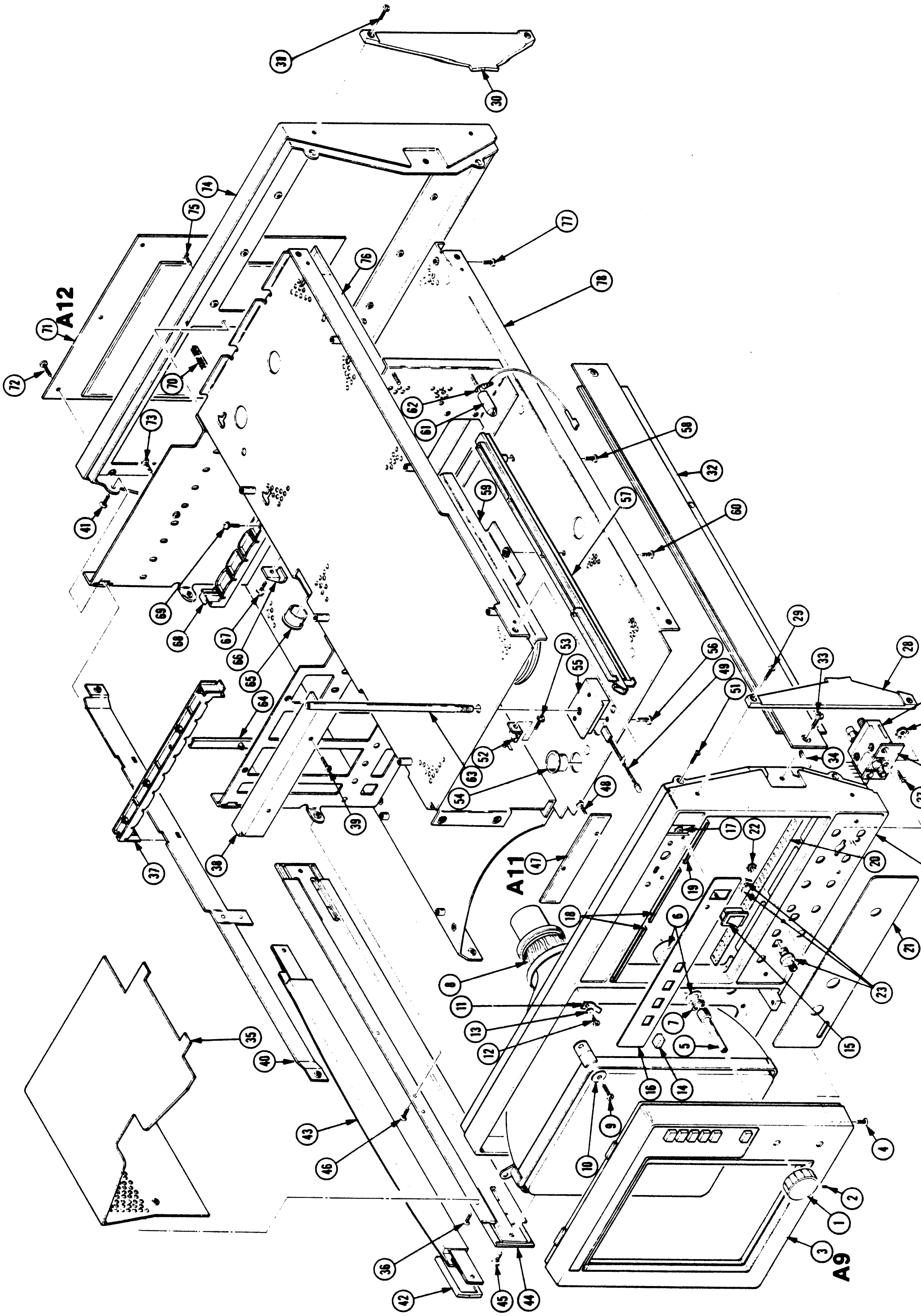


***Figure 2**—Front, Chassis, Rear*
11802 Service Reference Manual

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-1	366-0582-00			2	KNOB:ENCODER	TK1546	ORDER BY DESCR
-2	213-0022-00			2	SETSCREW:4-40 X 0.188,STL	74445	ORDER BY DESCR
-3	614-0822-00			1	PANEL SUBASSY:TOUCH	80009	614-0822-00
					(SEE A9,EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-4	211-0373-00			2	SCREW,MACHINE:4-40 X 0.25,PNH,STL	80009	211-0373-00
					(END ATTACHING PARTS)		
-5	384-1682-00			2	EXTENSION SHAFT:2.375 L,POLYCARBONATE	80009	384-1682-00
-6	311-2320-00			2	ENCODER,DIGITAL:INCREMENTAL,50PPR,50 DETENT	TK1869	LA22661
					,QUAD OUTPUT,LOC LUG AT 9 O'CLOCK		
					(ATTACHING PARTS)		
-7	220-0052-00			2	NUT,PLAIN,HEX:M9 X 0.75	73743	ORDER BY DESCR
-8	154-0898-00			1	ELECTRON TUBE:CRT W/DEFLECTION YOKE	61058	M22JPT3GH/M-ITC
					(ATTACHING PARTS)		
-9	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
-10	210-0949-00			4	WASHER,FLAT:0.141 ID X 0.5 OD X 0.062,BRS	12327	ORDER BY DESCR
					(END ATTACHING PARTS)		
-11	131-1688-00			1	TERM,QIK DISC.:MALE,0.032 X 0.25 BL	00779	42577-4
					(ATTACHING PARTS)		
-12	211-0721-00			1	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
-13	210-0006-00			1	WASHER,LOCK:#6 INTL,0.018 THK,STL	77900	1206-00-00-0541C
					(END ATTACHING PARTS)		
-14	366-0600-00			4	PUSH BUTTON:0.269 X 0.409,ABS	80009	366-0600-00
-15	260-2275-00			1	SWITCH,ROCKER:SPST,30MA,12V	TK1262	ME010-D
-16	333-3418-00			1	PANEL,FRONT:	80009	333-3418-00
					(ATTACHING PARTS)		
-17	210-0586-00			4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
					(END ATTACHING PARTS)		
-18	348-0876-00			2	SHLD GSKT,ELEK:SOLID TYPE,2.480 L	80009	348-0876-00
-19	348-0877-00			1	SHLD GSKT,ELEK:SOLID TYPE,1.860 L	80009	348-0877-00
-20	348-0878-00			1	SHLD GSKT,ELEK:SOLID TYPE,7.646 L	80009	348-0878-00
-21	333-3419-00			1	PANEL,FRONT:	80009	333-3419-00
					(ATTACHING PARTS)		
-22	210-0586-00			4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
					(END ATTACHING PARTS)		
-23	103-0269-00			2	ADAPTER,CONN:SMA TO PELTOLA	24931	39JR198-1
-24	657-0058-00			1	MODULAR ASSY:CAL STEP GENERATOR	80009	657-0058-00
					(SEE A6,EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-25	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
					(END ATTACHING PARTS)		
-26	386-5582-00			1	PLATE,ADAPTER:ALUMINUM	80009	386-5582-00
					(ATTACHING PARTS)		
-27	211-0734-00			2	SCREW,MACHINE:6-32 X 0.25,FLH,100 DEG,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-28	101-0107-00			2	TRIM,DECORATIVE:RIGHT SIDE,FRONT CASTING	80009	101-0107-00
					(ATTACHING PARTS)		
-29	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-30	101-0106-00			2	TRIM,DECORATIVE:LEFT SIDE,FRONT CASTING	80009	101-0106-00
					(ATTACHING PARTS)		
-31	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-32	426-2099-01			1	FRAME SECT,CAB.:RIGHT SIDE	80009	426-2099-01
					(ATTACHING PARTS)		
-33	212-0681-00			2	SCREW,MACHINE:10-32 X 0.25,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-34	348-0886-00			4	SHLD GSKT,ELEK:FINGER TYPE,18.310 L	80009	348-0886-00
-35	200-3142-00			1	COVER,CRT:GUARD	80009	200-3142-00
					(ATTACHING PARTS)		
-36	211-0718-00			2	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-37	351-0746-00			2	GUIDE,CKT BOARD:NYLON 6.803 L	80009	351-0746-00
-38	343-1267-01			1	RTNR,CARD CAGE:ALUMINUM	80009	343-1267-01
					(ATTACHING PARTS)		
-39	211-0722-00			2	SCREW,MACHINE:6-32 X 0.25,PNH,STL	80009	211-0722-00
					(END ATTACHING PARTS)		
-40	407-3438-01			1	BRACKET,CHASSIS:ALUMINUM	80009	407-3438-01

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-					(ATTACHING PARTS)		
-41	211-0725-00			4	SCREW,MACHINE:6-32 X 0.375,FLH	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-42	200-2191-00			2	CAP,RETAINER:PLASTIC	80009	200-2191-00
-43	367-0248-01			1	HANDLE,CARRYING:16.341 L,W/CLIP	80009	367-0248-01
-44	426-2098-01			1	FRAME SECT,CAB.:LEFT SIDE	80009	426-2098-01
					(ATTACHING PARTS)		
-45	212-0681-00			2	SCREW,MACHINE:10-32 X 0.25,PNH,STL	83486	ORDER BY DESCR
-46	211-0718-00			1	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
					(END AATTACHING PARTS)		
-47	670-9367-00			1	CIRCUIT BD ASSY:FRONT PANEL BUTTON (SEE A11)	80009	670-9367-00
					(ATTACHING PARTS)		
-48	211-0410-00			2	SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-49	150-0121-05			1	LAMP,CARTRIDGE:5V,0.06A,GREEN LENS	80009	150-0121-05
-50	386-5559-00			1	SUBPANEL,FRONT:	80009	386-5559-00
					(ATTACHING PARTS)		
-51	211-0725-00			6	SCREW,MACHINE:6-32 X 0.375,FLH	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-52	344-0133-00			2	CLIP,SPR TNSN:CKT BOARD MT,WHITE	80009	344-0133-00
					(ATTACHING PARTS)		
-53	211-0408-00			2	SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-54	348-0518-00			2	GROMMET,PLASTIC:BLACK,ROUND,0.5 ID	28520	2073(SB 625-8)BL
-55	220-0061-00			1	NUT,MDL LOCKING:0.5 X 1.25 X 2.0,AL ALY	80009	220-0061-00
					(ATTACHING PARTS)		
-56	211-0721-00			2	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-57	351-0744-00			2	GUIDE,PLUG-IN:POLYAMIDE	80009	351-0744-00
					(ATTACHING PARTS)		
-58	211-0722-00			2	SCREW,MACHINE:6-32 X 0.25,PNH,STL	80009	211-0722-00
					(END ATTACHING PARTS)		
-59	119-2662-00			1	DELAY LINE,ELEC:50NS,50 OHM,TAPED	80009	119-2662-00
					(ATTACHING PARTS)		
-60	211-0722-00			2	SCREW,MACHINE:6-32 X 0.25,PNH,STL	80009	211-0722-00
					(END ATTACHING PARTS)		
-61	214-4082-00			2	PIN,GUIDE:0.850 L,METAL	80009	214-4082-00
	210-0007-00			2	WASHER,LOCK:#8 EXT,0.02 THK,STL	78189	1108-00-00-0541C
-62	174-1406-00			1	CA ASSY,SP,ELEC:18,AWG,6.0 L	80009	174-1406-00
-63	384-1729-00			1	ROD,MDL LOCKING:0.25 OD X 6.75 L,PASSIVATE (ATTACHING PART FOR ACQUISITION MODULE)	80009	384-1729-00
-64	351-0764-00			16	SLIDE ASSEMBLY:19.88 L	TK1653	3017-99-0006
-65	348-0532-00			2	GROMMET,PLASTIC:BLACK,ROUND,0.625 ID	28520	SB-750-10
-66	343-0081-00			1	STRAP,RETAINING:0.125 DIA,NYLON	85480	CPNY-172BK
					(ATTACHING PARTS)		
-67	211-0722-00			1	SCREW,MACHINE:6-32 X 0.25,PNH,STL	80009	211-0722-00
					(END ATTACHING PARTS)		
-68	351-0746-00			1	GUIDE,CKT BOARD:NYLON 6.803 L	80009	351-0746-00
					(ATTACHING PARTS)		
-69	211-0722-00			1	SCREW,MACHINE:6-32 X 0.25,PNH,STL	80009	211-0722-00
					(END ATTACHING PARTS)		
-70	255-0334-00			1	PLASTIC CHANNEL:12.75 X 0.175 X 0.155,NYLON	11897	122-37-2500
-71	614-0811-00			1	SUBPANEL ASSY:REAR (SEE A12,EXCHANGE ITEM)	80009	614-0811-00
					(ATTACHING PARTS)		
-72	211-0721-00			8	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-73	211-0721-00			1	SCREW,MACHINE:6-32 X 0.375,PNH,STL (ATTACHING PART FOR GROUND WIRE)	83486	ORDER BY DESCR
-74	386-5269-02			1	SUBPANEL,REAR:PLATED	80009	386-5269-02
					(ATTACHING PARTS)		
-75	211-0725-00			2	SCREW,MACHINE:6-32 X 0.375,FLH	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-76	386-5283-00			2	SUPPORT,CHASSIS:POWER SUPPLY,POLYCARBONATE	80009	386-5283-00
-77	211-0711-00			1	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (ATTACHING PART FOR PWR SPLY GROUND WIRE)	01536	ORDER BY DESCR
-78	610-0755-00			1	CHASSIS ASSY:MAIN	80009	610-0755-00

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-1	670-8846-03			1	CIRCUIT BD ASSY:CRT DRIVER	80009	670-8846-03
					(SEE A8,EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-2	211-0711-00			4	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
					CRT DRIVER BOARD ASSEMBLY INCLUDES:		
-3	159-0103-00			1	.FUSE,CARTRIDGE:0.4A,125V,0.25SEC	75915	279.400
-4	159-0279-00			1	.FUSE,WIRE LEAD:0.375A,250V,SLOW	75915	230.375
-5	670-8847-01			1	CIRCUIT BD ASSY:FRONT PANEL CONTROL	80009	670-8847-01
					(SEE A10,EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-6	211-0711-00			2	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-7	670-8851-00			1	CIRCUIT BD ASSY:MOTHER	80009	670-8851-00
					(SEE A13)		
					(ATTACHING PARTS)		
-8	211-0711-00			6	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-9	671-0823-00	B010100	B029999	1	CIRCUIT BD ASSY:MEMORY	80009	671-0823-00
	671-0823-01	B030000		1	CIRCUIT BD ASSY:MEMORY	80009	671-0823-01
					(SEE A18,EXCHANGE ITEM)		
-10	671-0264-50	B010100	B029999	1	CIRCUIT BD ASSY:MEMORY EXPANSION	80009	671-0264-50
	671-0264-51	B030000		1	CIRCUIT BD ASSY:MEMORY EXPANSION	80009	671-0264-51
					(SEE A29,EXCHANGE ITEM)		
-11	146-0055-00			2	.BATTERY,DRY:3.0V,1200 MAH,LITHIUM	TK0510	BR-2/3A-E2P
-12	671-0822-00	B010100	B029999	1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	671-0822-00
	671-0822-01	B030000		1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	671-0822-01
					(SEE A17,EXCHANGE ITEM)		
-13	146-0055-00			1	.BATTERY,DRY:3.0V,1200 MAH,LITHIUM	TK0510	BR-2/3A-E2P
-14	670-8854-01			1	CIRCUIT BD ASSY:INPUT/OUTPUT	80009	670-8854-01
					(SEE A14,EXCHANGE ITEM)		
-15	146-0055-00			1	.BATTERY,DRY:3.0V,1200 MAH,LITHIUM	TK0510	BR-2/3A-E2P
-16	159-0245-00			4	.FUSE,WIRE LEAD:1A,125V,FAST	75915	R251001T1
-17	156-2622-00			1	.MICROCKT,DGTL:HMOS,SEMI CUSTOM,STANDARD	80009	156-2622-00
					.CELL,SERIAL DATA INTERFACE		
-18	670-8858-51			1	CIRCUIT BD ASSY:MEM MGT UNIT	80009	670-8858-51
					(SEE A15,EXCHANGE ITEM)		
-19	670-8859-00			1	CIRCUIT BD ASSY:COMPRESSOR	80009	670-8859-00
					(SEE A16,EXCHANGE ITEM)		
-20	670-8848-50	B010100	B029999	1	CIRCUIT BD ASSY:DISPLAY CONT	80009	670-8848-50
	670-8848-51	B030000		1	CIRCUIT BD ASSY:DISPLAY CONTROLLER	80009	670-8848-51
					(SEE A7,EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-21	211-0711-00			6	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-22	670-9655-00			1	CIRCUIT BD ASSY:REGULATOR	80009	670-9655-00
					(SEE A4,EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-23	211-0721-00			2	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
					REGULATOR BOARD ASSEMBLY INCLUDES:		
-24	159-0220-00			1	.FUSE,WIRE LEAD:3A,125V,FAST	71400	TRA3
-25	670-9640-00			1	CIRCUIT BOARD:M/F POWER CONNECT	80009	670-9640-00
					(SEE A3)		
					(ATTACHING PARTS)		
-26	211-0408-00			5	SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-27	670-9365-00	B010100	B010129	1	CIRCUIT BD ASSY:M/F STROBE DRIVE	80009	670-9365-00
	670-9365-01	B010130		1	CIRCUIT BD ASSY:M/F STROBE DRIVER	80009	670-9365-01
					(SEE A1,EXCHANGE ITEM)		
					(ATTACHING PARTS)		
-28	211-0711-00			5	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-29	670-9362-50	B010100	B029999	1	CIRCUIT BD ASSY:TIMEBASE CONTROLLER	80009	670-9362-50
	670-9362-52	B030000		1	CIRCUIT BD ASSY:TIMEBASE CONTROLLER	80009	670-9362-52
					(SEE A5,EXCHANGE ITEM)		
					(ATTACHING PARTS)		

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-30	211-0711-00			6	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS) TIMEBASE CONTROLLER BD ASSEMBLY INCLUDES:	01536	ORDER BY DESCR
-31	159-0194-00			1	.FUSE,WIRE LEAD:5A,125V,0.125 SEC	71400	TR-A5
-32	119-2746-00			2	.ELECTRONIC ASSY:MICROCKT SOCKET,W/BATTERY .BACK UP & CONTROL FOR CMOS SRAMS	80009	119-2746-00
-33	671-0326-50			1	CIRCUIT BD ASSY:TRIGGER SELECT (SEE A32,EXCHANGE ITEM) (ATTACHING PARTS)	80009	671-0326-50
-34	211-0711-00			3	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
	020-1717-00			1	COMPONENT KIT:	80009	020-1717-00
					WIRE ASSEMBLIES (SEE MAINT. SECTION FOR CABLING DIAGRAM)		
	174-0562-00			1	CA ASSY,SP,ELEC:10,18 AWG,9.0 L (FROM A2A2J66 TO A4J66)	80009	174-0562-00
	174-0563-00			1	CA ASSY,SP,ELEC:8,18 AWG,8.0 L (FROM A2A2J64 TO A4J64)	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 A5J83 TO A15J83)	80009	174-0580-00
	174-0609-00			1	CABLE ASSY,RF:50 OHM COAX,11.0 L,9-0-5 (FROM A1J35 TO A5J35)	80009	174-0609-00
	174-0616-00			1	CABLE ASSY,RF:50 OHM COAX,30.0 L,9-8 (FROM OUTPUT BNC J28 TO A1J28)	80009	174-0616-00
	174-0617-00			1	CABLE ASSY,RF:50 OHM COAX,6.3 L,9-7 (FROM INPUT BNC J87 TO A30J87)	80009	174-0617-00
	174-0619-00			1	CABLE ASSY,RF:50 OHM COAX,18.5 L,9-5 (FROM A1J16 TO A24J16)	80009	174-0619-00
	174-0621-00			1	CABLE ASSY,RF:50 OHM COAX,13.0 L,9-1 (FROM A19J32 TO A5J32)	80009	174-0621-00
	174-0623-00			1	CABLE ASSY,RF:50 OHM COAX,6.0 L,9-0 (FROM A5J30B TO A19J30A)	80009	174-0623-00
	174-0624-00			1	CABLE ASSY,RF:50 OHM COAX,6.0 L,9-N (FROM A5J29B TO A19J29A)	80009	174-0624-00
	174-0625-00			1	CABLE ASSY,RF:50 OHM COAX,17.5 L,9-3 (FROM A1J33A TO A19J33A)	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 A1J33B TO A19J33B)	80009	174-0827-00
	175-1726-00			1	CA ASSY,SP,ELEC:50,28 AWG,3.0 L (FROM A5J18 TO A1J18)	80009	175-1726-00
	175-9799-00			1	CA ASSY,SP,ELEC:16.5 L (FROM A4J57 TO A8J57)	80009	175-9799-00
	175-9803-00			2	CA ASSY,SP,ELEC:7,26 AWG,7.5 L,RIBBON (FROM A5J91 TO CAL PULSER,A6) (FROM A4J65 TO A2A2J65)	80009	175-9803-00
	175-9807-00			1	CA,ASSY,SP,ELEC: (FROM ENCODER TO A10J74)	80009	175-9807-00
	175-9809-00			1	CA ASSY,SP,ELEC:50,3.0 L (FROM A15J79 TO A16J79)	80009	175-9809-00
	175-9810-00			1	CA ASSY,SP,ELEC:50,4.0 L (FROM A16J52 TO A7J52)	80009	175-9810-00
	175-9811-00			1	CA ASSY,SP,ELEC:20,6.0 L (FROM A7J53 TO A8J53)	80009	175-9811-00
	175-9814-00			1	CA ASSY,SP,ELEC:34,3.0 L (FROM A14J77 TO A17J77)	80009	175-9814-00
	175-9854-00			1	CA ASSY,SP,ELEC:36,28 AWG,7.0 L (FROM A14J72 TO A10J72)	80009	175-9854-00
	175-9855-00			1	CA ASSY,SP,ELEC:7 PIN CONN W/CRT SKT,4.5 L (FROM A8J56 TO CRT)	80009	175-9855-00
	175-9856-00			1	CA ASSY,SP,ELEC:20,28 AWG,3.75 L	80009	175-9856-00

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-					(FROM A30J84 TO A5J84)		
	175-9857-00			1	CA ASSY,SP,ELEC:11,18 AWG,7.25 L,RIBBON (FROM A2A2J62 TO A4J62)	80009	175-9857-00
	175-9873-00			1	CA ASSY,SP,ELEC:2,14,2,16 AWG,18 L (FROM A13J63 TO A2A2J63)	80009	175-9873-00
	175-9941-00			1	CABLE ASSY,RF:50 OHM COAX,3.05 L,9-N (FROM A30J88 TO A5J88)	80009	175-9941-00

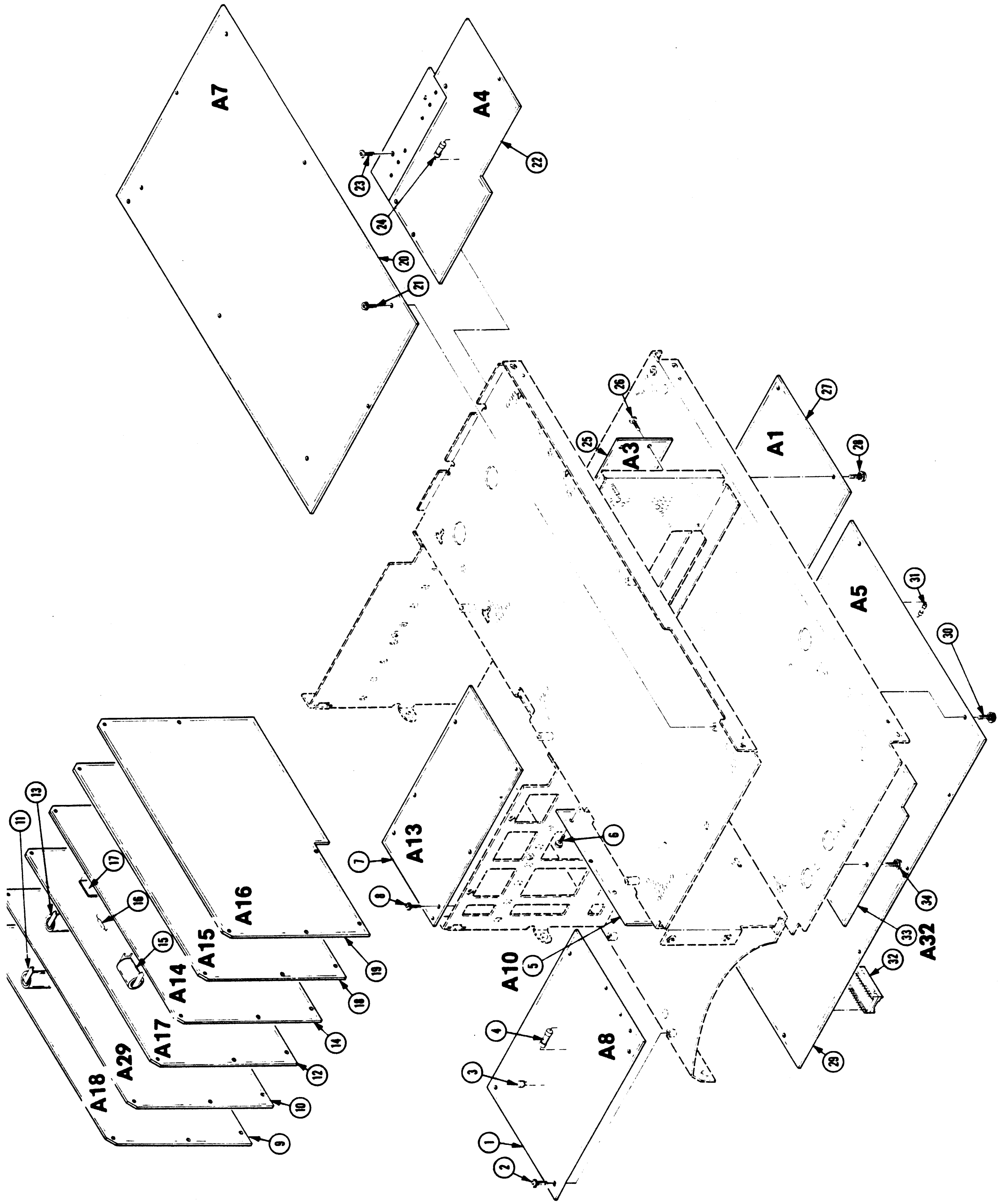


Figure 3—Circuit Boards
11802 Service Reference Manual

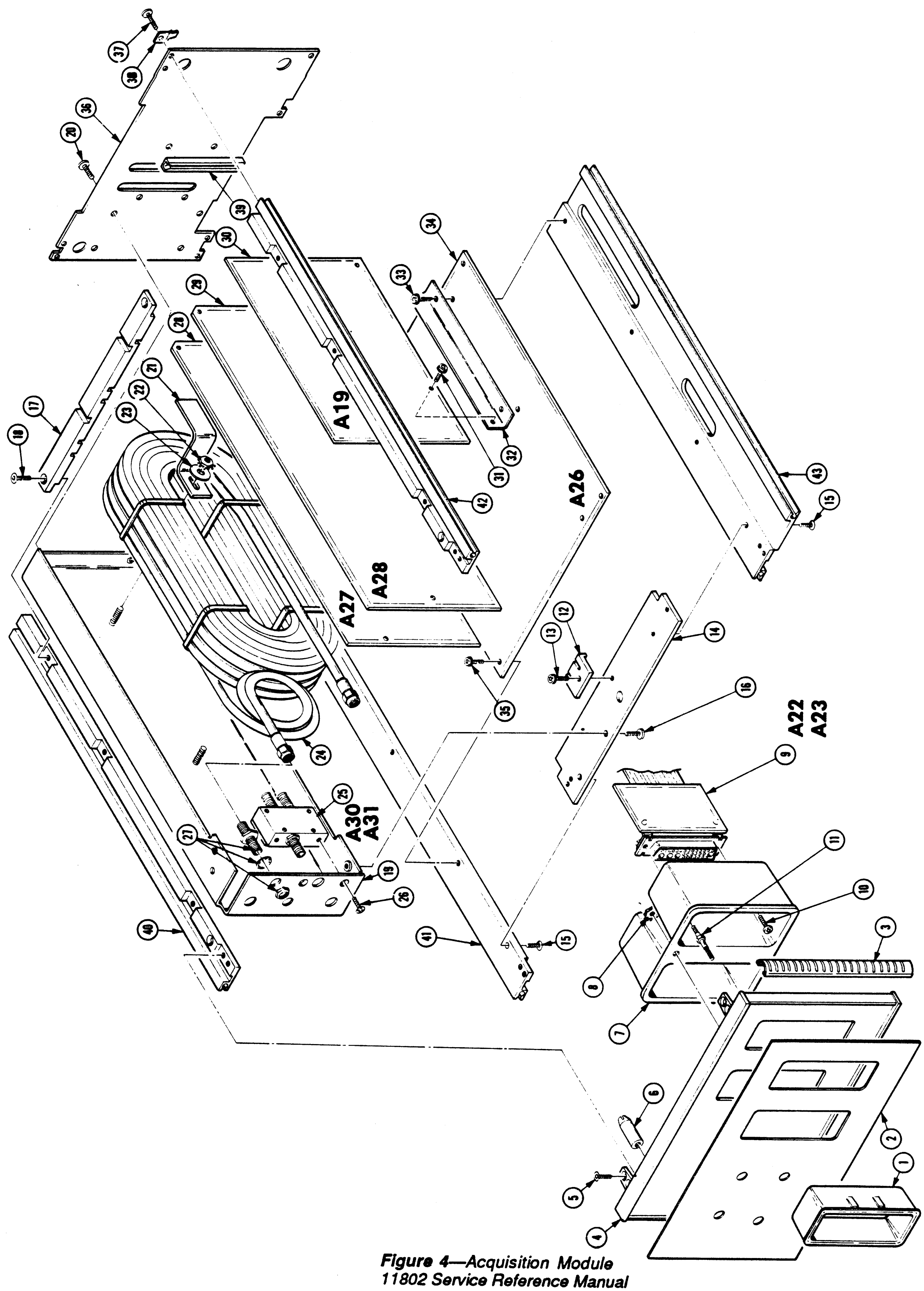


Figure 4—Acquisition Module
11802 Service Reference Manual

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
4-	657-0059-00			1	MODULAR ASSY:ACQUISITION DELAYLINE MDL (EXCHANGE ITEM)	80009	657-0059-00
-1	351-0786-00			2	.GUIDE,PLUG-IN:PC,3.167 L	80009	351-0786-00
-2	333-3537-00			1	.PANEL,FRONT:	80009	333-3537-00
-3	348-0235-00			2	.SHLD GSKT,ELEK:FINGER TYPE,4.734 L	92101	ORDER BY DESCR
-4	386-5681-00			1	.SUBPANEL,FRONT:	80009	386-5681-00
					(ATTACHING PARTS)		
-5	211-0718-00			8	.SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-6	214-4082-00			4	.PIN,GUIDE:0.850 L,METAL	80009	214-4082-00
-7	136-0894-00			1	.SKT,PL-IN,ELEK:3.5 X 3.5 X 1.86,ALUMINUM	80009	136-0894-00
					(ATTACHING PARTS)		
-8	210-0458-00			2	.NUT,PL,ASSEM WA:8-32 X 0.344,STL CD PL	78189	511-081800-00
					(END ATTACHING PARTS)		
-9	670-9366-01			2	.CIRCUIT BD ASSY:HEAD INTERCONNECT .(SEE A22,A23)	80009	670-9366-01
					(ATTACHING PARTS)		
-10	211-0410-00			2	.SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL	93907	ORDER BY DESCR
-11	355-0259-00			2	.STUD,LOCKING:0.850 X 0.188 HEX,SST	80009	355-0259-00
					(END ATTACHING PARTS)		
-12	386-5687-00			1	.SUPPORT,CKT BD:PLASTIC	80009	386-5687-00
					(ATTACHING PARTS)		
-13	211-0408-00			1	.SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-14	381-0452-00			2	.BAR,LOCKING MDL:	80009	381-0452-00
					(ATTACHING PARTS)		
-15	211-0718-00			4	.SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
-16	211-0721-00			4	.SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-17	351-0784-00			3	.GUIDE,CKT BD:UPPER,PP,7.0 L	80009	351-0784-00
					(ATTACHING PARTS)		
-18	211-0392-00			6	.SCREW,MACHINE:4-40 X 0.25,FLH,82 DEG,STL	80009	211-0392-00
					(END ATTACHING PARTS)		
-19	441-1820-00			2	.CHASSIS,MODULE:DELAY LINE	80009	441-1820-00
					(ATTACHING PARTS)		
-20	211-0721-00			4	.SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-21	343-1373-00			4	.CLAMP,DLY LINE:1.430 X 1.350,ALUMINUM	80009	343-1373-00
					(ATTACHING PARTS)		
-22	210-0458-00			4	.NUT,PL,ASSEM WA:8-32 X 0.344,STL CD PL	78189	511-081800-00
-23	210-1061-00			4	.WASHER,FLAT:0.203 ID X 0.625 OD X 0.062,STL	86928	A371-141-62
					(END ATTACHING PARTS)		
-24	119-2957-00			2	.DELAY LINE,ELEC:45NS,50 OHM	80009	119-2957-00
-25	657-0063-00			2	.MODULAR ASSY:DELAY LINE COMPENSATOR .(SEE A30,A31)	80009	657-0063-00
					(ATTACHING PARTS)		
-26	211-0718-00			4	.SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-27	131-0850-00			2	.CONN,FEEDTHRU:3MM FEMALE EA END	26805	2084-5059-02
-28	670-9364-00			1	.CIRCUIT BD ASSY:ACQUISITION ANALOG .(SEE A27,EXCHANGE ITEM)	80009	670-9364-00
-29	670-9363-00	B010100	B029999	1	.CIRCUIT BD ASSY:ACQUISITION MPU	80009	670-9363-00
	670-9363-01	B030000		1	.CIRCUIT BD ASSY:ACQUISITION MPU .(SEE A28,EXCHANGE ITEM)	80009	670-9363-01
-30	670-9879-00			1	.CIRCUIT BD ASSY:STROBE TDR BUFFER .(SEE A19,EXCHANGE ITEM)	80009	670-9879-00
					(ATTACHING PARTS)		
-31	211-0408-00			2	.SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-32	407-3562-00			1	.BRACKET,CKT BD:MODULE DISCONNECT,ALUMINUM	80009	407-3562-00
					(ATTACHING PARTS)		
-33	211-0304-00			2	.SCR,ASSEM WSHR:4-40 X 0.312,PNH,STL,T9 TORX	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-34	670-9361-50			1	.CIRCUIT BD ASSY:M/F ACQ INTERCONNECT .(SEE A26,EXCHANGE ITEM)	80009	670-9361-50
					(ATTACHING PARTS)		
-35	211-0304-00			4	.SCR,ASSEM WSHR:4-40 X 0.312,PNH,STL,T9 TORX	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
4-36	386-5535-00			1	.PLATE,REAR:ALUMINUM	80009	386-5535-00
					(ATTACHING PARTS)		
-37	213-0904-00			8	.SCREW,TPG,TR:6-32 X 0.5,PNH,STL	83385	ORDER BY DESCR
					(END ATTACHING PARTS)		
-38	131-1247-00			1	.TERM,QIK DISC.:0.187 X 0.02 BLADE,45 DEG	00779	61664-1
-39	351-0761-00			1	.GUIDE,CKT BD:PLASTIC,2.5 L	18677	11633-1
-40	426-2167-00			1	.FRAME SECT,CAB.:MODULE	80009	426-2167-00
-41	426-2165-00			1	.FRAME SECT,CAB.:MODULE	80009	426-2165-00
-42	426-2168-00			1	.FRAME SECT,CAB.:MODULE	80009	426-2168-00
-43	426-2166-00			1	.FRAME SECT,CAB.:MODULE	80009	426-2166-00
					WIRE ASSEMBLIES		
					(SEE MAINT. SECTION FOR CABLING DIAGRAM)		
	174-0626-00			2	.CABLE ASSY,RF:50 OHM COAX,16.5 L,9-6	80009	174-0626-00
					.(FROM A19J3C TO A22J3C)		
					.(FROM A19J4C TO A23J4C)		
	174-0627-00			2	.CABLE ASSY,RF:50 OHM COAX,15.0 L,9-5	80009	174-0627-00
					.(FROM A19J3A TO A22J3A)		
					.(FROM A19J4A TO A23J4A)		
	174-0630-00			1	.CABLE ASSY,RF:50 OHM COAX,8.2 L,9-3	80009	174-0630-00
					.(FROM A19J1B TO A22J3B)		
	174-0631-00			1	.CABLE ASSY,RF:50 OHM COAX,5.8 L,9-4	80009	174-0631-00
					.(FROM A19J2B TO A23J4B)		
	174-1071-00			1	.CABLE ASSY,RF:50 OHM COAX,8.0 L	80009	174-1071-00
					.(FROM A30J89 TO A32J89)		
	174-1233-00			1	.CABLE ASSY,RF:50 OHM COAX,8.0 L	80009	174-1233-00
					.(FROM A31J86 TO A32J86)		
	343-0549-00			2	.STRAP,TIEDOWN,E:0.091 W X 4.0 L,ZYTEL	06383	PLT1M

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
5-1	620-0022-01	B010100	B010213	1	POWER SUPPLY:ET,RT,HIRES MAIN FRAMES	80009	620-0022-01
	620-0022-02	B010214		1	POWER SUPPLY:ET,RT,HIRES MAIN FRAME (EXCHANGE ITEM)	80009	620-0022-02
					(ATTACHING PARTS)		
-2	211-0721-00			8	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
-3	200-2222-00			1	.GUARD,FAN:	81041	6-182-033
					(ATTACHING PARTS)		
-4	211-0744-00			4	.SCREW,MACHINE:6-32 X 2.0,PNH,TORX,STL,CD	04348	ORDER BY DESCR
					(END ATTACHING PARTS)		
-5	407-3362-00			1	.BRACKET,FAN:0.050 5005 H-34	80009	407-3362-00
-6	200-2264-00			1	.CAP,FUSEHOLDER:3AG FUSES	S3629	FEK 031 1666
-7	159-0013-00			1	.FUSE,CARTRIDGE:3AG,6A,250V,FAST BLOW .(FUSE USED IN FUSE HOLDER)	71400	MTH-CW-6
	159-0021-00			1	.FUSE,CARTRIDGE:3AG,2A,250V,FAST BLOW .(FUSE USED ON LINE INVERTER BOARD)	71400	AGC-CW-2
-8	204-0832-00			1	.BODY,FUSEHOLDER:3AG & 5 X 20MM FUSES	TK0861	031 1673
-9	119-1725-01			1	.FAN,TUBEAXIAL:8 14.5VDC,6W,3200RPM,106CFM	TK1456	4112 KX

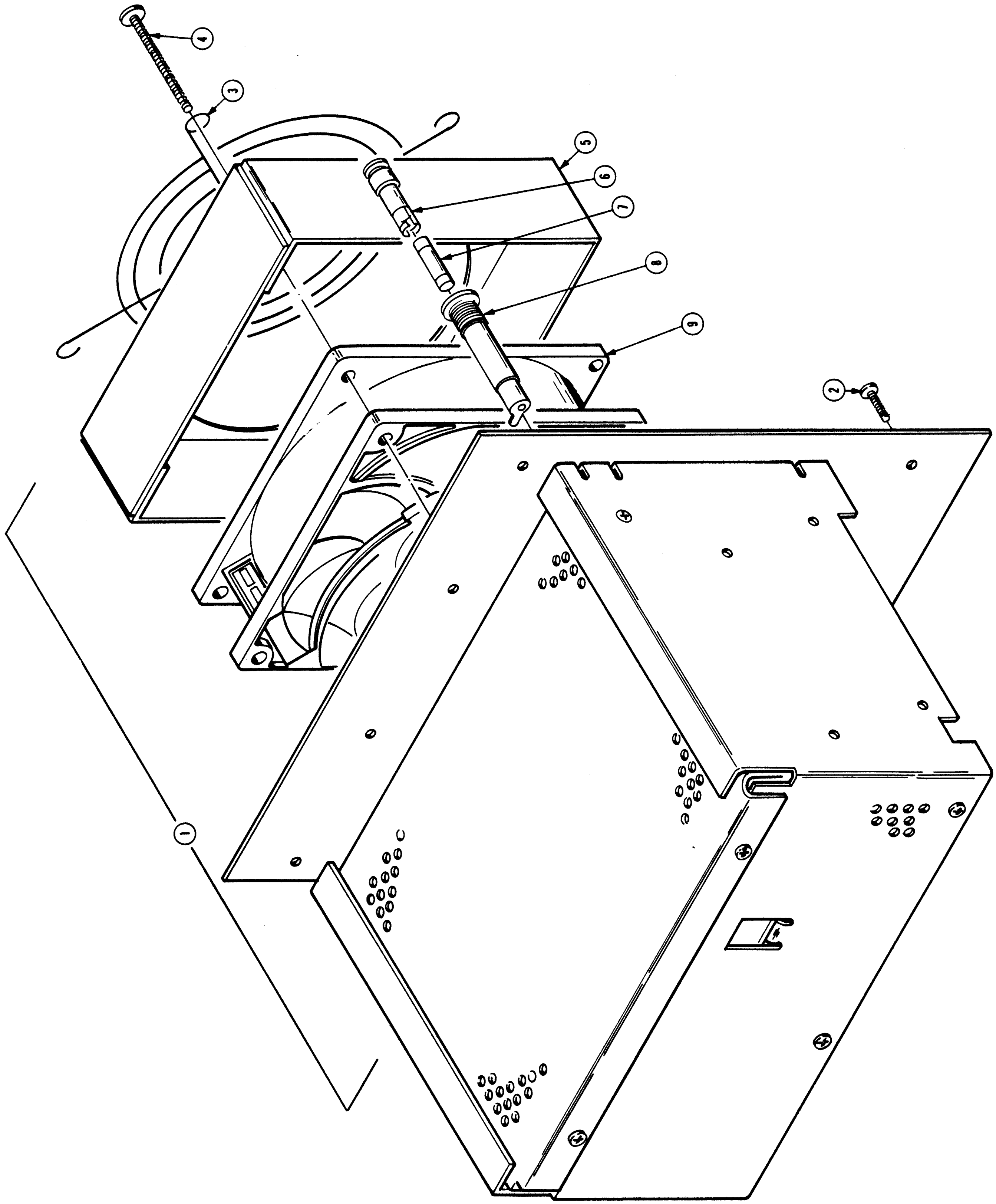


Figure 5—Power Supply
11802 Service Reference Manual

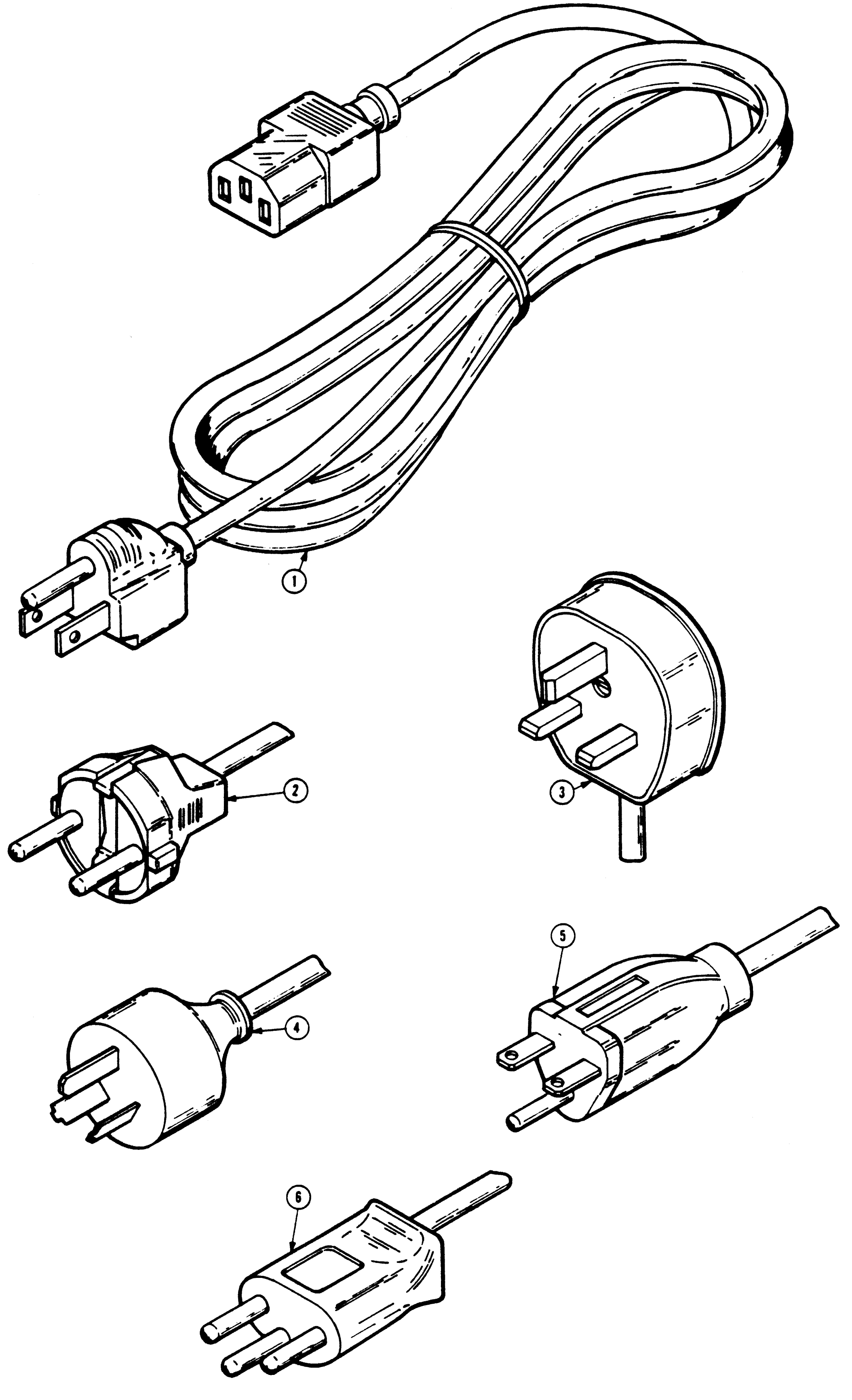


Figure 6—Accessories
11802 Service Reference Manual

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
6-					STANDARD ACCESSORIES		
-1	161-0066-00			1	CABLE ASSY,PWR,:3,18AWG,115V,98.0 L	16428	CH8481, FH8481
-2	161-0066-09			1	CABLE ASSY,PWR,:3,0.75MM SQ,220V,99.0 L (OPTION A1 ONLY)	S3109	86511000
-3	161-0066-10			1	CABLE ASSY,PWR,:3,0.75MM SQ,240V,96.0 L (OPTION A2 ONLY)	TK1373	24230
-4	161-0066-11			1	CABLE ASSY,PWR,:3,0.75MM,240V,96.0 L (OPTION A3 ONLY)	S3109	ORDER BY DESCR
-5	161-0066-12			1	CABLE ASSY,PWR,:3,18 AWG,250V,99.0 L (OPTION A4 ONLY)	70903	CH-77893
-6	161-0154-00			1	CABLE ASSY,PWR,:3,0.75MM SQ,240V,6A,2.5M L (OPTION A5 ONLY)	S3109	86515000
	070-6274-00			1	MANUAL,TECH:INSTR,11000-SER RACKMOUNT (OPTION 1R ONLY)	80009	070-6274-00
	070-7040-00			1	MANUAL,TECH:11801 & 11802	80009	070-7040-00
	070-7042-00			1	MANUAL,TECH:INTRODUCTION,11802	80009	070-7042-00
	070-7043-00			1	MANUAL,TECH:USERS REF,11802	80009	070-7043-00
	070-7044-00			1	MANUAL,TECH:PROGRAMMERS REF,11802	80009	070-7044-00
	070-7045-00			1	MANUAL,TECH:POCKET REF,11802	80009	070-7045-00
	070-7047-00			1	MANUAL,TECH:SERVICE REF,11802	80009	070-7047-00
	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
					OPTIONAL ACCESSORIES		
	012-0555-00			1	CABLE,INTCON:3 METERS	80009	012-0555-00
	012-0911-00			1	CABLE,INTCON:144.0 L, RS 232	TK6020	ESF-85249
	012-0991-00			1	CABLE,GPIB:LOW EMI,2 METER	00779	553577-3
	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
	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

Tektronix® COMMITTED TO EXCELLENCE

MANUAL CHANGE INFORMATION

Date: 2/20/89 **Change Reference:** C1/0289 Rev 1

Product: 11802 Service Reference

Manual Part No.: 070-7047-00

Product Group: 47

DESCRIPTION

These changes are effective at serial number B030000 and on instruments in which parts kit 040-1286-00 has been installed.

Revised: 7-SEP-89

TEXT & PARTS LIST CHANGES

Checks and Adjustments, page 2-12, **Procedure to Invoke Extended Diagnostics**

CHANGE TO READ:

Step 3: Touch **Diag/Self Test**.

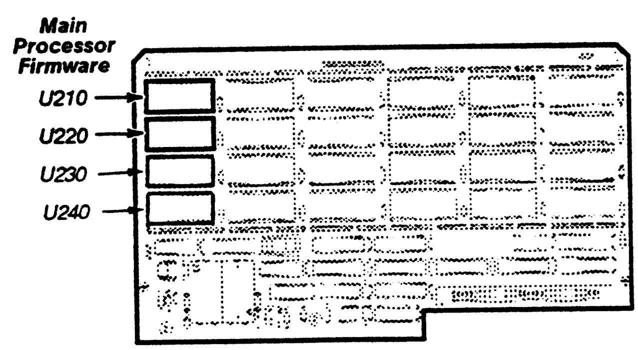
Step 4: Touch **Extended Diagnostics** in the **Diag/Self Test** pop-up menu.

Page 2-25, after Step 2:, **ADD:**

Touch **Diag/Self Test.**

Touch **Extended Diagnostics** in the **Diag/Self Test** pop-up menu.

Maintenance, page 3-59, Figure 3-33, board **A29-Memory Expansion**, **ADD**: U230 and U240 as shown in the diagram below:



A29-Memory Expansion

Page 3-63, **CHANGE** Step 2 to read:

Step 2: On the A29 Memory Expansion board, replace ICs U210, U220, U230 and U240 (see Fig. 3-33 in this section).

Page 3-76, after the first paragraph **ADD**:

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.

Page 3-78, **CHANGE** the Note to read:

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

Page 3-79, Replace the second paragraph to **READ**:

Clearing NV RAM

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 (ie. closed) during this time, then the Executive processor resets its NV RAM to a default state. This essentially destroys all stored settings and saved trace descriptions (there are no stored waveforms in NV RAM). When this occurs, the NV RAM is initialized by filling all but a few locations with a default value. The following items are left intact after the NV RAM is reset:

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

Page 3-82, fourth paragraph, **CHANGE TO READ**:

Table 3-11 lists the Executive processor manual tests and the verification procedures. If the conditions specified in the verification procedure are not met, then the suspect FRU's can be found using the (?) Help function.

Pages 3-83, 3-84 and 3-85, Table 3-11, **REMOVE** the third column,**"Verification Procedure Failure: Suspect Board FRUs"**. Also, in Table 3-11 , **CHANGE** all headings **"Internal I/O"** to read: **"Input/Output"**. **CHANGE "External I/O"** to : **"Input/Output"**, and **CHANGE "GPIB"**, to read: **"Input/Output GPIB"**.

REMOVE page 3-88.

ELECTRICAL PARTS CHANGES

CHANGE TO:

Fig. 3 -9	671-0823-01	CKT BD ASSY:MEMORY
Fig. 3 -10	671-0264-51	CKT BD ASSY:MEMORY EXPANSION
Fig. 3 -12	671-0822-01	CKT BD ASSY:MAIN PROCESSOR
Fig. 3 -20	670-8848-51	CKT BD ASSY:DISPLAY CONTROLLER
Fig. 3 -29	670-9362-52	CKT BD ASSY:TIME BASE/CONTROLLER
Fig. 4 -29	670-9363-01	CKT BD ASSY:ACQUISITION MPU

Tektronix
COMMITTED TO EXCELLENCE

MANUAL CHANGE INFORMATION

Date: 2/20/89 Change Reference: C2/0289

Product: 11802 Service Reference

Manual Part No.: 070-7047-00

Product Group: 47

DESCRIPTION

These changes are effective at all serial numbers.

TEXT CHANGES

Pull and replace pages 2-1 thru 2-4 and 2-9 thru 2-10 attached to this insert.

Checks and Adjustments, page 2-4, Table 2-2, Termination, 50 Ω, **CHANGE** BNC to SMA. Also, **CHANGE** Tektronix Part to 015-1022-00.

Page 2-12, **Procedure to Invoke Extended Diagnostics**

CHANGE TO READ:

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

11802 Oscilloscope
ON/STANDBY switch . . . . .ON

Sampling head
SELECT CHANNEL On/Off. .Off

Page 2-29, Step 2: **CHANGE** pin 8 to read pin 1.

Page 2-38, after Step 15, **ADD**:

Step 16: Repeat all of Part 9 for all sampling head compartments in the oscilloscope.

Maintenance, page 3-10, Figure 3-1, **CHANGE** A10 Memory to read A18 Memory.

Page 3-22, Figure 3-5, **SWITCH** callouts A18 and A17.

Page 3-51, Figure 3-27, **REMOVE**, the Torx head screws from the diagram.

Page 3-65, first line after Step 7: **CHANGE TO READ**

Uid main : "BXXXXXX" <CR>

Page 3-81, Table 3-10, third column, last two rows, **SWITCH** MPU, MEM with REAR, IO, MPU.

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 and examines 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 *11802 Digital Sampling Oscilloscope User Reference* manual for more information about specifications and oscilloscope operation. Then, the setup provides information concerning test equipment setup or interconnection. Refer to Table 2-2 for more information concerning test equipment used in the setups.

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

Part and Description	**Measurement Limits *(Examine)***	**Specifications *(Check)***	**Adjustments *(Adjust)***	**Functional Test**
Part 1 Power-On Diagnostics	none	none	none	yes
Part 2 Extended Diagnostics	none	none	none	yes
Part 3 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	
Regular Reference	+9.95 V to +10.05 V	none	R730 +10 V Ref for +10.00 V	

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

Part and Description	Measurement Limits *(Examine)*	Specifications *(Check)*	Adjustments *(Adjust)*	Functional Test
Part 4 Display				no
Vertical Size	±0.050 inch	none	■ R202 Main Brite until raster appears ■ R620 Horiz Hold and R530 Vert Hold for stable display ■ R530 Vert Hold so bottom line at bottom of raster ■ R520 Vert Pos and L120 Vert Size to align grid with index bumps ■ R541 Horiz Lin, R621 Horiz Size, and R540 Horiz Pos for optimum overall linearity and position ■ R202 Main Brite until retrace lines just extinguished ■ R100 Focus for optimum overall focus	
Horizontal Size	±0.050 inch	none		
Vertical Linearity	3.7 ±0.4 lines /half inch	none		
Horizontal Linearity	5.6 ±0.6 lines /half inch	none		
Part 5 Real Time Clock	1,000,000 µs ± 5 µs		Real Time Clock for 1,000,000 µs	no
Part 6 Vertical Reference Voltage	none	5 ±200 µV and -5 ±200 µV	none	no
Part 7 Horizontal Reference Clock	none	200,000 kHz ±5 kHz	none	no
Part 8 Vertical Input Offset	none	±2 mV	none	no
Part 9 Vertical Accuracy				
Vertical Gain	none	±1.2%	none	yes
Offset Accuracy	none	±2 mV	none	yes
Vertical Linearity	none	±1%	none	no
Part 10 Vertical RMS Noise	■ ≤50 dB for 20–200 mV/div full scale ■ ≤40 dB for 20 mV/div full scale	none	none	no

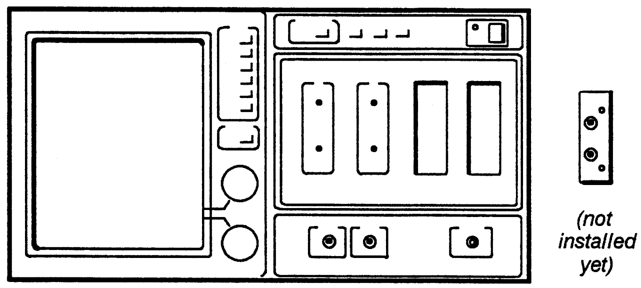
Table 2-1 (cont) — *Measurement Limits, Specifications, and Adjustments*

Part and Description	Measurement Limits *(Examine)*	Specifications *(Check)*	Adjustments *(Adjust)*	Functional Test
Part 11 Time Base Accuracy				yes
1 ns/division	none	±0.2%	none	
5 μs/division	none	±0.1%	none	
100 ps/division	none	±2%	none	
10 ps/division	none	±10%	none	
1 ps/division	none	±25%	none	
Part 12 System Rise Time and Calibrator Output Accuracy				yes
System Rise Time	none	≤18 ps	none	
Calibrator and System Rise Time	none	≤35 ps	none	
Calibrator Amplitude	none	250 mV ±10%	none	
Part 13 Triggering				yes
1 GHz Sensitivity	none	250 mV display	none	
800 MHz Sensitivity	none	150 mV display	none	
100 MHz Sensitivity	none	50 mV display	none	
Trigger Pickoff				yes
1 GHz Sensitivity	none	1 V display	none	
800 MHz Sensitivity	none	600 mV display	none	
100 MHz Sensitivity	none	200 mV display	none	
Part 14 Internal Clock				yes
Rise Time	≤3 ns	none	none	
Frequency	100 kHz ±1%	none	none	
Duty Cycle	50% ±1%	none	none	
Part 15 Aberrations				no
100 ns and up	≤1%		none	
4 ns to 100 ns	≤2%		none	
1 ns to 4 ns	≤4%		none	
0 ns to 1 ns	≤10% and ≥7%		none	

Part 1 Power-On Diagnostics

This part must be performed within the ambient temperature range of +18° and +28° C to assure that the oscilloscope operates properly.

Setup to Power-On Diagnostics



Setup to Perform Power-on.

Procedure to Power-on Diagnostics

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

11802 Oscilloscope
ON/STANDBY switch .... STANDBY
Sampling head .... Not installed yet

☐ 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 into the left compartment.

☐ 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 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 remain in the ON position. Then, use the front panel ON/STANDBY switch to perform all subsequent power switching.

☐ Step 6: Power-on the following test equipment, so that it is warmed up with the oscilloscope to be tested. A complete list of test equipment is listed in Table 2-2, Test Equipment.

- Digital voltmeter
- HF sine wave generator
- Time mark generator
- Medium frequency sine wave generator
- Calibration generator
- Calibration step generator