Service Manual

Tektronix

11401 & 11402
Digitizing Oscilloscopes

070-6779-03

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

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

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Instrument Serial Numbers

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

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

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

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

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Contents

Section 3 — Maintenance

Related Documentation

The Parts List at the rear of this manual lists the Tektronix part numbers for all Standard Accessories provided with this product.

Manuals (Standard Accessories)

Introduction to the 11401 and 11402 Digitizing Oscilloscopes
11401 and 11402 User's Reference Manual
11401 and 11402 Incoming Inspection Procedure
Option 1R Rackmounting Instructions

List of Illustrations

List of Tables

Safety Summary

The general safety information in this part of the summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

Terms

In This Manual

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

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

As Marked on Equipment

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

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

Symbols

In This Manual

Static-Sensitive Devices.

This symbol indicates where applicable cautionary or other information is to be found.

As Marked on Equipment

DANGER—High Voltage.

Protective ground (earth) terminal.

ATTENTION—refer to manual.

Warnings

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 mainframe 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 electric 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 power is on.

Disconnect 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 the parts list for your product.

Section 1
General Information

This section gives all the information needed to apply power to the 11401/11402 Digitizing Oscilloscope.

Information on operating voltage and power cord needs, as well as environmental conditions such as operating temperature and ventilation requirements, is included here.

Introduction

The 11401/11402 Service Reference Manual is designed for use by qualified service personnel. It contains information necessary to check, troubleshoot, and maintain the 11401/11402 mainframe. Troubleshooting is primarily based upon internal power-up diagnostics. These diagnostics isolate problems to the FRU (Field Replaceable Unit) level. Defective FRUs not detected by diagnostics are isolated using other means. Once the faulty FRU is identified, use the instructions provided in this manual to remove and replace it. The removal and immediate replacement of the faulty FRU allows a minimum of downtime for the user. Section 5, Replaceable Parts gives a complete list of the FRUs in this instrument.

Operating Power Information

This instrument can be operated from either a 115 V or 230 V nominal supply source, 48 to 440 Hz. The 6 ampere, 250 V line fuse is used for both 115 V and 230 V operation.

WARNING

AC POWER SOURCE AND CONNECTION. The 11401/11402 operates from a single-phase power source. It has a three-wire power cord and two-pole, three-terminal grounding type plug. The voltage to ground (earth) from either pole of the power source must not exceed the maximum rated operating voltage, 250 volts.

Before making connection to the power source, check that the 11401/11402 LINE VOLTAGE SELECTOR is set to match the voltage of the power source, and has a suitable two-pole, three-terminal grounding-type plug.

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

WARNING

The power input plug must be inserted only in a mating receptacle with a grounding contact where earth ground has been verified by a qualified service person. Do not defeat the grounding connection. Any interruption of the grounding connection can create an electric shock hazard.

For electric shock protection, the grounding connection must be made before making connection to the instrument's input or output terminals.

Power Cord Information

A power cord with appropriate plug configuration is supplied with each 11401/11402. Table 1–1 gives the color–coding of the conductors in the power cord. If you require a power cord other than the one supplied, refer to Table 1–2, Power–Cord and Plug Identification.

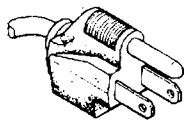
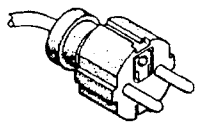
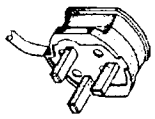
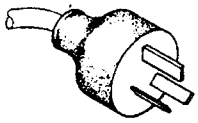
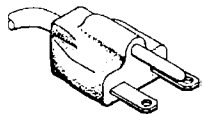
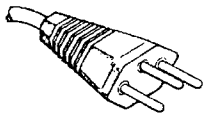
TABLE 1–1
Power–Cord Conductor Identification

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

Operating Voltage

The LINE VOLTAGE SELECTOR (located on the rear panel) allows you to select 115 V or 230 V nominal line–voltage operation. The same line fuse is used for both 115 V and 230 V operation.

TABLE 1-2
Power-Cord and Plug Identification

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

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

Memory Backup Power

A self–contained power source within the 11401/11402 allows the retention of volatile memory upon loss of the ac power source. The self–contained power source provides memory backup power which stores the last selected front– and Crt touch–panel settings of the mainframe and plug–ins. Waveforms stored in memory are not retained. The self–contained power source also supplies power to the IC that generates the Time/Date parameters, and records the hours of instrument on–time and the number of power–up sequences.

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

Operating Environment

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

Operating Temperature

The 11401/11402 can be operated where the ambient air temperature is between 0° and +50° C and can be stored in ambient temperatures from –40° to +75° C. After storage at temperatures outside the operating limits, allow the chassis to reach the safe operating temperature before applying power.

Enhanced system accuracy is available after a 20–minute warmup period. After entry into Enhanced accuracy, the instrument will revert to not–enhanced accuracy if the internal mainframe temperature changes more than ±5° C.

Ventilation Requirements

The 11401/11402 is cooled by air drawn in through the side panels of the instrument by the fan and blown out through the rear. To ensure proper cooling of the instrument, allow at least two inches clearance on both sides and the rear of the instrument. The top and bottom of the instrument does not require ventilation clearance.

CAUTION

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

Packaging for Shipment

If the 11401/11402 is to be shipped for long distances by commercial transportation, we we recommend that it be packaged in the original manner. The carton and packaging material in which your instrument was shipped should be saved and used for this purpose.

Also, if the 11401/11402 is to be shipped to a Tektronix Service Center for service or repair, attach a tag to the instrument showing the following:

- Owner of the instrument (with address);
- Name of person to contact at your firm;
- Complete instrument type and serial number;
- If possible, furnish complete system firmware versions as displayed in the **Instrument Options** popup menu selected from the UTILITIES major menu.
- Describe the service required, or the symptoms of trouble the instrument exibited.

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

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

Instrument Options

Your instrument 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 Table 1-3 and the Table of Contents for location of option information. For further information and prices of instrument options, see your Tektronix Products catalog or contact your Tektronix Field Office.

WARNING

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

List of Options

Option 1C Option 1C adds eight bnc connectors to the front- and rear-panels so that signals may be internally routed directly between the two panels. This is especially useful for rackmounted applications. This option can be added at any time.

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

Option 2D Option 2D expands total waveform memory from 64K to 128K points for storage of waveform records. This option can be added at any time.

Option 4D Option 4D increases GPIB transfer speed as much as ten times. Improves the overall throughput of the oscilloscope system, especially the transmission of waveform and measurement data. This option can be added at any time.

Option A1 Replaces the standard power cord with the Universal European 220 V type power cord.

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

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

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

Option A5 Replaces the standard power cord with the Switzerland 240 V type power cord.

TABLE 1–3
Option Information Locator

Option	Location in Manual		Information
	Section	Heading	
Option 1C (Provides back to front to connectors)	1 General Information	List of Options	Gives brief description of Option 1C.
Option 1R (Provides rackmount hardware	1 General Information	List of Options	Gives brief description of Option 1R.
Option 2D (Provides memory expansion)	1 General Information	List of Options	Gives brief description of Option 2D.
Option 4D (Provides increased GPIB data transfer speed)	1 General Information	List of Options	Gives brief description of Option 4D.
Option A1 (Provides Universal European power cord)	1 General Information	Table 1–2, Power–Cord and Plug Identification	Gives plug configurations ratings, and referenced standards.
		List of Options	Gives brief description of Option A1.
Option A2 (Provides United Kingdom power cord)	1 General Information	Table 1–2, Power–Cord and Plug Identification	Gives plug configurations ratings, and referenced standards.
		List of Options	Gives brief description of Option A2.
Option A3 (Provides Australian power cord)	1 General Information	Table 1–2, Power–Cord and Plug Identification	Gives plug configurations ratings, and referenced standards.
		List of Options	Gives brief description of Option A3.
Option A4 (Provides North American power cord)	1 General Information	Table 1–2, Power–Cord and Plug Identification	Gives plug configurations ratings, and referenced standards.
		List of Options	Gives brief description of Option A4.
Option A5 (Provides Switzerland power cord)	1 General Information	Table 1–2, Power–Cord and Plug Identification	Gives plug configurations ratings, and referenced standards.
		List of Options	Gives brief description of Option A5.

Section 2
Checks and Adjustments

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

Refer to the *11401 and 11402 User's Reference* manual for more information about advertised specifications and oscilloscope operation. At the beginning of each part the specifications or measurement limits are given. Then, the setup for each procedure in that part provides information concerning test equipment setup or interconnection. Refer to Table 2-2, Test Equipment for more information concerning test equipment used in these setups.

Table 2–1
Measurement Limits, Specifications, and Adjustments

Part and Description	Measurement Limits *(Examine)*	Specifications *(Check)*	Adjustments *(Adjust)*	Functional Test
Part 1 Power Up Diagnostics	none	none	none	yes
Part 2 Extended Diagnostics	none	none	none	yes
Part 3 Enhanced Accuracy		successful execution	none	yes
Part 4 Power Supply	none	none	none	no
+ 5 V Supply	+ 4.85 V to + 5.25 V	none	none	
+ 5.2 V Reference	+ 5.15 V to + 5.25 V	none	R800 + 5.2 V REF ADJ for + 5.20 V	
Regulator Reference	+ 9.95 V to + 10.05 V	none	R830 + 10 V REF ADJ for + 10.00 V	
Part 5 Display				no
Crt Driver			R202 MAIN BRITE until raster appears R620 HORIZ HOLD and R530 VERT HOLD for stable display R530 VERT HOLD so bottom line is at (or near) bottom of raster	

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

Part and Description	Measurement Limits *(Examine)*	Specifications *(Check)*	Adjustments *(Adjust)*	Functional Test
Part 5 (cont)				
Crt Driver (cont)			R520 VERT POS and L120 VERT SIZE for alignment of grid with the index bumps along the inside vertical edge of the front-panel bezel	
Horizontal Linearity	3.7 ±0.4 horizontal lines per half-inch increment, at the top, center, and bottom of the screen		R541 HORIZ LIN, R621 HORIZ SIZE, and R540 HORIZ POS for best overall linearity and position	
Vertical Linearity	5.6 ±0.6 vertical lines per half-inch increment, at the top, center, and bottom of screen		R202 MAIN BRITE until retrace lines are just extinguished R100 FOCUS for best overall focus	
Part 6 Calibration Output Accuracy				yes
Probe Calibration Output Voltage Accuracy	±0.6% (or ±6 mV)		R1576 OFFSET for −10.000 V ±0.002 V R1582 GAIN for +9.9951 V ±0.002 V	
Attenuator Ratios and Calibrator DAC Linearity	attenuator ratios within ±0.04% (or ±8 mV) linearity within ±0.75 of LSB		none	
Part 7 Probe Compensation Voltage				no
Output Voltage Accuracy	6.0 V ±0.18 V		none	
Part 8 Acquisition				no
10 MHz Signal Amplitude	≥1.0 V p-p		C217 10 MHz, for maximum signal amplitude (must be ≥0.8 V p-p)	
Phase Lock Loop	+6.0 V ±1.0 V		C500 VCO, for 6.0 V ±0.3 V	
Differential Amplifier V+	10.500 V ±10 mV		R666 Diff Amp V + for 10.500 V	
Differential Amplifier Step Response	optimum adjustment as shown in Figure 2–9C		C253 DIFF AMP COMP for fastest rise time with minimum overshoot	

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

Part and Description	Measurement Limits *(Examine)*	Specifications *(Check)*	Adjustments *(Adjust)*	Functional Test
Part 9 Vertical Input Offset		±0.2 div (±200 mU)	none	no
Part 10a Sampler and Digitizer: Performance Verification Procedure	within 1% when checked with an 067-0587-02 calibration fixture referenced to 8 divisions		set cal constant	no
Part 10b Sampler and Digitizer: Functional Test Procedure	refer to Table 2–3, Vertical Accuracy Error Limits, for the measurement limits for this part		none	yes
Part 11 Equivalent Time Step Response 11401 Oscilloscope				no
Rise Time	≤450 ps		none	
Aberrations	≤4% p-p within the first 20 ns after the step; ≤1% p-p after first 20 ns from the step		none	
11402 Oscilloscope				
Rise Time	≤300 ps		none	
Aberrations	≤5% p-p within the first 20 ns after the step; ≤1% p-p after first 20 ns from the step		none	
Part 12a Bandwidth: Performance Verification Procedure	≥5.16 div at 500 MHz and 4.94 div at 1 GHz for the 11401 and 11402 respectively		none	no
Part 12b Bandwidth: Functional Test Procedure	p-p amplitude of sine wave must be ≥70.7% of the reference amplitude at the maximum bandwidth		none	yes
Part 13 A/D Converter Linearity		≤1% (2 LSBs)	none	no
Part 14 A/D Converter RMS Noise		≤10 mV (60 dB of full scale)	none	no
Part 15 Trigger Sensitivity at 500 MHz		triggered with 1.5 div (1.5 U) at 500 MHz	none	no

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

Part and Description	Measurement Limits *(Examine)*	Specifications *(Check)*	Adjustments *(Adjust)*	Functional Test
Part 16a Time Base: Performance Verification Procedure				no
Time Base Accuracy		±(0.002% + 100 ps)	none	
Trigger Window Position Accuracy		±(0.002% + 100 ps)		
Part 16b Time Base: Functional Test Procedure	±(0.002% + 100 ps)		none	yes
Part 17 Events Window Position Accuracy		150 MHz Maximum Event Frequency	none	no
Part 18 Input/Output				no
Real Time Clock	1,000,000 µs ±5 µs		C510 REAL TIME CLOCK for 1,000,000 µs	
Temperature Sensor Voltage Reference	+6.500 V ±5 mV		R112 +6.5 V REF for +6.500 V	
Part 19 Trigger Enhancement Adjustment	delay limit is 400 ps ±80 ps		C200 to obtain the most transitions on the CH 2 signal	
Part 20 Triggering		Trigger-Level dc Accuracy within 2.0% of full scale (20 LSBs) Ac and Dc noise-reject coupled of 1.2 divisions or less from dc to 50 MHz, increasing to 3 divisions at 500 MHz Ac coupled of 0.5 divisions from 60 Hz to 50 MHz, increasing to 1.5 divisions at 500 MHz Ac and Dc HF reject coupled of 0.65 divisions from dc to 30 kHz LF reject coupled of 0.65 divisions from 80 kHz to 50 MHz, increasing to 1.5 divisions at 500 MHz	none	yes

Plug-In Installation and Removal

CAUTION

To avoid instrument damage, set the mainframe ON/STANDBY switch to STANDBY before installing or removing plug-ins.

Moving Plug-Ins Quickly

When moving a plug-in from one compartment to another in this procedure, a quick transfer (i.e., about 15 seconds) and power-up will essentially preserve the Enhanced Accuracy state and will not require the 20 minute warmup period. Disconnect any cables or probes before beginning the move. Any delay in powering-up (beyond 15 seconds) will make the warmup period necessary to guarantee instrument accuracy.

Test Equipment

The test equipment in Table 2-2 contains suggested test equipment for use in this manual. The Functional Test column of Table 2-2 indicates, with a check mark (✓), the test equipment that is recommended if you are performing a functional test. Procedure steps are based on the test equipment samples 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	Functional Test
Test Oscilloscope	≥80 MHz bandwidth	TEKTRONIX SC 504 Oscilloscope	
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	
Function Generator	50 Hz to 3 MHz, Variable offset, Amplitude variable from 0 to 10 V, Sine Wave and Square Wave output	TEKTRONIX FG 503 3 MHz Function Generator with a TM 500-series Power Module	✓
High Frequency Sine Wave Generator	250 MHz to 1000 MHz, Variable amplitude, 6 MHz reference	TEKTRONIX SG 504 Leveled Sine Wave Generator with a TM 500-series Power Module	✓
Medium Frequency Sine Wave Generator	250 kHz to 250 MHz, Variable amplitude, 50 kHz reference	TEKTRONIX SG 503 Leveled Sine Wave Generator with a TM 500-series Power Module	✓
Plug-in Unit	11000-Series	Any Tektronix 11000-series Plug-in Unit	✓
Time Mark Generator	1 ns through 5 s markers in a 1-2-5 sequence, at least 5 parts in 10^7 accuracy	TEKTRONIX TG 501 Time Mark Generator with a TM 500-Series Power Module	✓
Calibration Generator	5 V Output amplitude, accuracy within 0.23%	TEKTRONIX PG 506 Calibration Generator with a TM 500-Series Power Module	✓
Digital Voltmeter (w/test leads)	≤0.005% Accuracy	a. Fluke 8842A Digital Voltmeter	✓
Frequency Counter	1 part in 10^6 accuracy	TEKTRONIX DC 503A Universal Counter/Timer with a TM 5000-series Power Module	
Signal Standardizer	Tektronix Calibration Fixture with interface connector modified for 11000-series mainframes ((Service Kit 040-1212-00)	TEKTRONIX 067-0587-10 Signal Standardizer	

TABLE 2–2 (cont)
Test Equipment

Description	Minimum Specification	Examples of Applicable Test Equipment	Functional Test
Coaxial Cable (3 required)	50 Ω, 36-inch, male BNC connectors	Tektronix Part 012–0482–00	✓ (1)
Adapter, (2 required)	BNC Female to Dual Banana	Tektronix Part 103–0090–00	
Connector, T	Two female and one male BNC connector	Tektronix Part 103–0030–00	
50 Ω Terminator	Impedance, 50 Ω; accuracy, within 2%; connectors, bnc	Tektronix Part 011–0049–01	
Attenuator, 5X (2 required)	14 dB attenuation, 50 Ω, one male and one female BNC connector	Tektronix Part 011–0060–02	✓
Probe, 10X	Probe capacitance of ≤12 pF. Dc to 150 MHz, 10X, w/ground lead	TEKTRONIX P6106A	
Logic Probe		TEKTRONIX P6401 Logic Probe	
Power Supplies Troubleshooting Fixture		TEKTRONIX 067–1264–00 Extended Diagnostics 11000–series Power Supplies troubleshooting fixture	
Adapter, Probe-Tip to Ground	Used on Probe Bayonet Ground assembly	Tektronix Part 013–0085–00	
Term Conn Link	Shorting strap	Tektronix Part 131–0993–00	
Alignment Tool (plastic hex)	Plastic hex	Tektronix Part 003–0301–00	
Alignment Tool (insulated slot)	Insulated slot	Tektronix Part 003–0675–01	
Alignment Tool (square-tip ceramic)	Square-Tip (ceramic)	Tektronix Part 003–1400–00	
Magnetic Screwdriver	Holder for Torx tips	Tektronix Part 003–0293–00	

TABLE 2–2 (cont)
Test Equipment

Description	Minimum Specification	Examples of Applicable Test Equipment	Functional Test
Torx Screwdriver Tips	#10 tip #15 tip #20 tip	Tektronix Part 003–0814–00 003–0966–00 003–0866–00	
Shorting Strap	Two alligator clips on a short pigtail conductor		
Integrated Circuit Extracting Tools	IC Extraction Pliers	General Tool P/N 821566–1 or equiv	
	IC Insertion–Extraction Pliers 28–pin type	General Tool P/N U505BG or equiv	
Circuit Board Removal Tools	Straight–slot screwdriver, large.		
	Torx screwdriver. T–7, T–8, T–10, T–15 T–20, T–25		
	Allen (Hex) Wrench, 1/16–inch		
	Nutdrivers, 3/16", 1/4", 7/16"		
	Needle–nose pliers		

Using This Procedure

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

NOTE

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

Conventions in this Manual

In these procedures, the following conventions are used:

- CAPITAL letters within the body of text identify front–panel controls, indicators, and connectors (for example, MEASURE) on the mainframe and plug–in.
- **Bold** letters identify menu labels and display messages.
- Initial Capital letters identify connectors, controls, and indicators (for example, Position) on associated test equipment. Initial Capital letters also identify adjustments inside the plug–in (for example Vert Pos).

A heading system is used to readily identify the steps that contain performance verification and/or adjustment instructions. 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 instrument 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 instrument features are located in the User's Reference manual.

Warm–up

For the first 20 minutes after power–on, the 11401/11402 oscilloscope is in either **Warmup** or **New configuration–partial enhanced accuracy occurring** mode, depending on whether or not a plug–in unit has been added or removed since the last Enhanced Accuracy procedure. In either case, the oscilloscope is fully operational but its accuracy is not specified.

In many of the Setup illustrations, a Signal Standardizer or a plug-in unit is shown installed in the oscilloscope for the sole purpose of keeping the Signal Standardizer or plug-in unit warmed-up. If you are performing a functional test, you should replace the Signal Standardizer with a plug-in unit in the left plug-in compartment of the oscilloscope for Part 6—Calibration Output Accuracy.

Tutorial Manual

The tutorial manual, Introducing the 11401 and 11402 Digitizing Oscilloscopes, is strongly recommended to familiarize the first-time user with 11401/11402 controls and features.

Part 1—Power-Up Diagnostics

The following Checks and Adjustment procedure must be performed within the ambient temperature range of +18° and +28° C, to assure proper instrument operation.

CAUTION

To avoid instrument damage, set the mainframe ON/STANDBY switch to STANDBY before installing or removing plug-ins.

Setup

a. Remove the top and bottom covers from the 11401/11402.

b. Install a Signal Standardizer (or a plug-in unit if you are performing a functional test) in the Left plug-in compartment.

c. With the rear-panel PRINCIPAL POWER SWITCH set to OFF, connect the 11401/11402 to a suitable power source.

d. Set the rear-panel PRINCIPAL POWER SWITCH to ON, and then the front-panel ON/STANDBY switch to ON.

When the 11401/11402 is first installed, the rear-panel PRINCIPAL POWER SWITCH should be set to the ON position and left there. Thereafter all power switching should be done by using the front-panel ON/STANDBY switch.

e. Power on the following test equipment, so that it is warmed up with the instrument to be tested. A complete list of test equipment is shown in Table 2–2.

- Digital Voltmeter
- Function Generator
- Test Oscilloscope (not required if you are performing a functional test)
- Test Terminal (not required if you are performing a functional test)
- HF Sine Wave Generator
- MF Sine Wave Generator
- Time Mark Generator

Procedure

Each time the front-panel ON/STANDBY switch is set to ON, the 11401/11402 performs Power-Up Diagnostics on its microprocessor subsystems and Self-Test Diagnostics on all of its major circuits.

CAUTION

To avoid instrument damage, set the mainframe ON/STANDBY switch to STANDBY before installing or removing plug-ins.

Turning the instrument power off during probe calibration, enhanced accuracy, or Extended Diagnostics may result in some internal data being corrupted. If corruption occurs, refer to Restoring Data in Section 3.

Power-Up Diagnostics begin by displaying "**Diagnostics in Progress**" and "**Comm Test in Progress**" on the screen. Diagnostic routines are then performed on each of the instrument's microprocessor subsystems, Display, Executive, and Digitizer, followed by testing of the communication between these subsystems. If the instrument is being powered-up from a "cold" condition, the diagnostics may be complete before the Crt warms up enough to display these messages.

Successful completion of Power-Up Diagnostics is indicated by the start of Self-Test Diagnostics. Failure will be indicated by the message, "**Dsy Kernel Failure,**" or by a beep and illuminated menu button indicators.

Self-Test Diagnostics

Self-Test diagnostics begin by displaying "**Self-Test in Progress**". Test progress will be obvious due to flashing and pattern changes on the display. Successful completion of Self-Test Diagnostics is indicated by return to normal operation or entry into the New Configuration, as discussed below. Any failures cause the instrument to run the remaining tests, then display the Extended Diagnostics menu. Record the displayed error codes for the failed circuit block(s) and refer to the Diagnostic Troubleshooting portion of the Maintenance section.

Front-panel controls are active during the Self-Test sequence and any disturbance will cause a test failure. If such a failure occurs, the instrument will automatically enter the Extended Diagnostics mode and display the Extended Diagnostics menu. The menu can be removed and normal operation resumed by touching the **(E)Exit** label. However, if a fatal Digitizer fault is detected by the Diagnostics, exiting the menu to normal operation will not be possible.

Self-Test Diagnostics test the following circuits:

- Executive Control
- Front Panel
- Internal I/O
- External I/O
- Subsystem Communication
- Display Control
- Video Generator
- Digitizer

- Timebases
- Points Acquisition
- Triggers
- Points/Address Generator
- Left Compartment Plug-in
- Center Compartment Plug-in
- Right Compartment Plug-in

New Configuration

When a plug-in is first installed in a mainframe or when one is moved to a different compartment in the mainframe, the instrument will be in a new configuration mode. After the instrument runs the Power-Up Diagnostics, it Self-Tests for the new configuration. During this Self-Test, the message **New configuration partial enhanced accuracy occurring** will appear at the top of the display. If the operation is successful (as indicated by a message), the instrument will enter the normal operating mode.

Completion of Power-Up Diagnostics

When the graticule is displayed and the front-panel settings in effect at the last power-down are restored, the instrument has passed Power-Up Diagnostics. Perform the next Part of the Checks and Adjustments Procedure.

Part 2—Extended Diagnostics

Setup

As left from previous test.

Procedure

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

Perform the following steps to enter the **Extended Diagnostics** mode and run the indicated tests.

a. Press the UTILITY button.

b. Select the **Extended Diagnostics** label.

c. Select the **(x)All** label (toggles to **On** status), then the **(r)Run** label to start the tests.

d. Ensure that all tests have run and have a Pass status.

e. Select the following labels in order:

d)External I/O

(2)Area

c)GPIB

(3)Routine

f. Select **(r)Run** to start the **a)Intrpt Reset** test.

g. Select **b)Reset Status** then **(x)Run** to start the test.

h. Select **c)Data Lines** then **(x)Run** to start the test.

i. Select **d)Interrupt** then **(x)Run** to start the test.

j. Ensure that all four tests ran and passed.

k. Select **(E)Exit** to leave Extended Diagnostics.

Part 3—Enhanced Accuracy

Setup

As left from previous test.

Procedure

a. Twenty minutes after power up, the instrument must Self-Test to achieve the Enhanced Accuracy state. If the instrument is set for Automatic enhanced accuracy (UTILITY menu Instrument Options function), it will immediately start the operation and indicate this with a message. If the enhanced accuracy mode is Manual then you will be prompted to press the 11401/11402 ENHANCED ACCURACY button. The prompt, **"Press ENHANCED ACCURACY again to confirm request,"** will appear at the top of the display. Press the ENHANCED ACCURACY button again. Enhanced accuracy will take a couple of minutes.

CAUTION

To avoid instrument damage, set the mainframe ON/STANDBY switch to STANDBY before installing or removing plug-ins.

Turning the instrument power off during probe calibration, enhanced accuracy, or Extended Diagnostics may result in some internal data being corrupted. If corruption occurs, refer to Restoring Data in Section 3.

b. *CHECK*—for the message, **"Enhanced Accuracy in Progress, Please Leave Instrument on Until Complete"** indicating that the 11401/11402 began entering the enhanced accuracy mode.

c. *CHECK*—for the message, **"Enhanced Accuracy completed and passed"** indicating a successful operation. The **EA** indicator will appear below the Vertical Scale Factor on the let side of the display when the instrument has entered the enhanced accuracy mode.

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

For more information about the Enhanced Accuracy state, see Enhanced Measurement accuracy Indicator in Section 2 of the User's Reference manual.

Part 4—Power Supply

Description

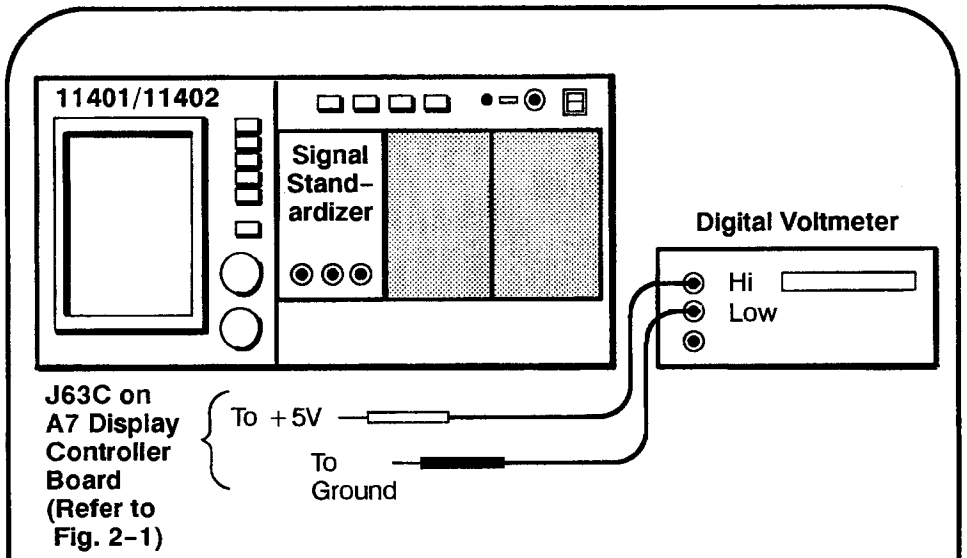
The power supply +5 V is checked at J63C on the A7 Display Controller board.

Measurement Limits

The measured +5 V supply must be within the limits of +4.85 V and +5.25 V.
The measured +5.25 V supply must be within the limits of +5.15 V and +5.25 V.
The regulator reference voltage must be within the limits of +9.95 V and +10.05V.

Examine +5 V Supply

Setup



Perform the following in the order listed:

11401/11402 Oscilloscope Mainframe

No setting changes required.

Digital Voltmeter

Mode ..... DC Voltage

Signal Standardizer

Not used in this part.

Procedure

a. *EXAMINE*—the Digital Voltmeter for a reading within the limits of +4.85 V and +5.25 V.

b. If the reading in step a. is within these limits, skip to Part 5—Display.

DO NOT attempt to optimize the power supply adjustment settings if the reading is within the stated limits. If the reading noted in step a. is outside the stated limits, proceed to the following Adjust steps.

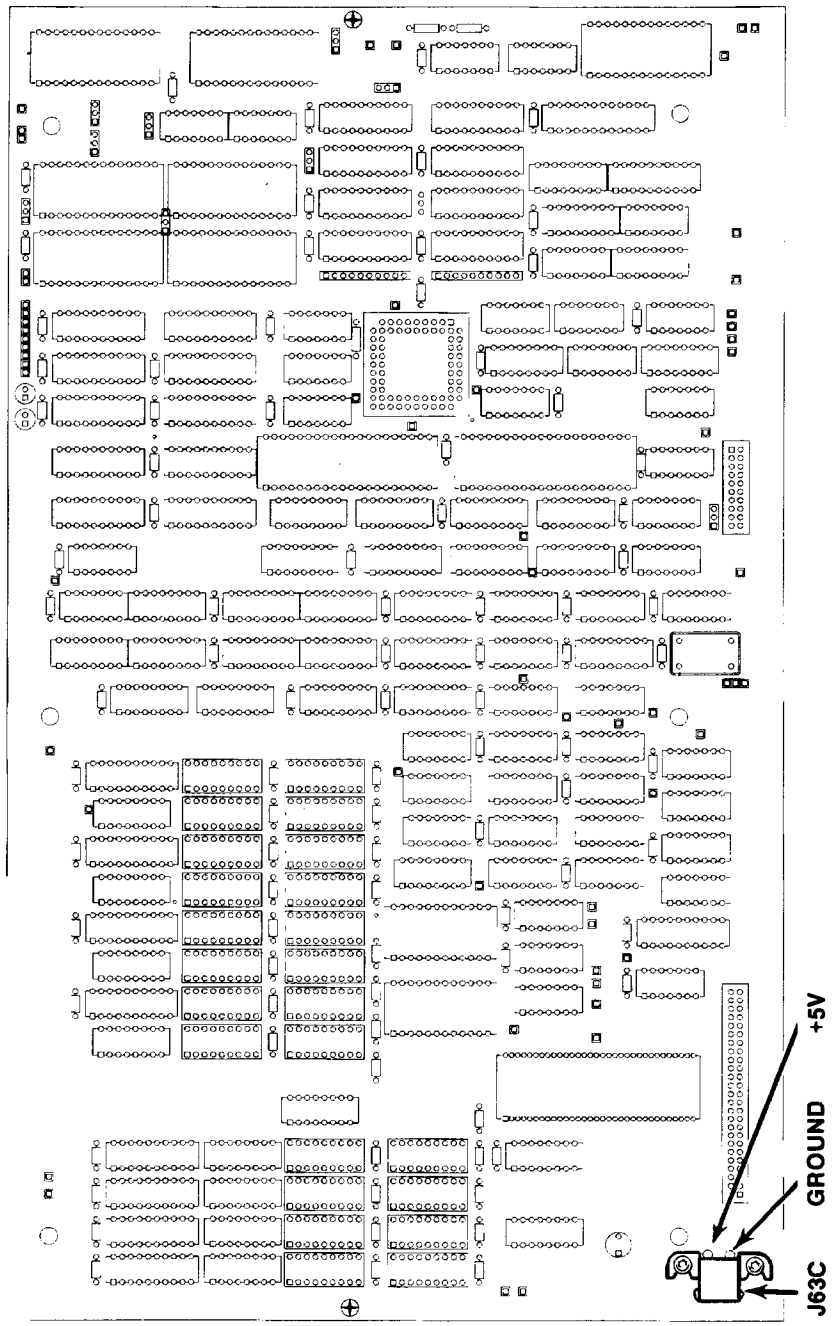
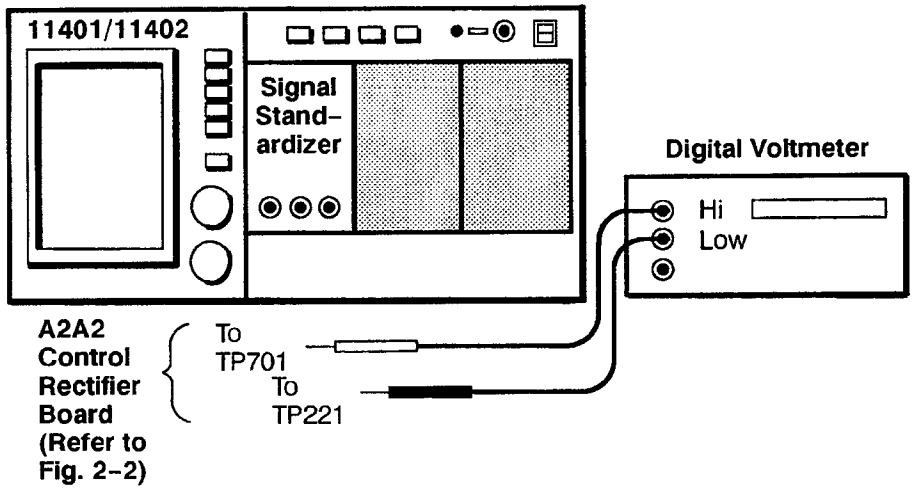


Figure 2–1. A7 Display Controller board test point locations.

Examine/Adjust +5.2 V Reference (A2A2R800)

Setup



Perform the following in the order listed:

11401/11402 Oscilloscope mainframe

a. Set the front-panel ON/STANDBY switch and the rear-panel PRINCIPAL POWER SWITCH to OFF. Disconnect the 11401/11402 from the power source.

b. Remove the power supply module, following the instructions given under "A2 Power Supply Removal" in Section 3—Maintenance.

c. Short circuit test points TP830 and TP831 on the A2A2 Control Rectifier board using a shorting strap. Refer to Figure 2-2.

d. Connect the 11401/11402 power supply module to a suitable line power source.

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

Digital Voltmeter

Mode ..... DC Voltage

Signal Standardizer

Not used in this part.

Procedure

WARNING

Extreme caution must be used when making the following adjustment due to the dangerous potentials present.

a. ***EXAMINE***—the Voltmeter for a reading of +5.20 V, within the limits of +5.25 and +5.15 V. Do not adjust if the reading is within the stated limits.

b. ***ADJUST***— +5.2 V REF adjustment R800 for +5.20 V.

c. Remove the Digital Voltmeter leads from the test points.

d. Set the rear-panel PRINCIPAL POWER SWITCH to OFF. Disconnect the instrument from the power source. Remove all test leads and the **shorting strap**.

e. Replace the power supply module.

f. Set the rear-panel PRINCIPAL POWER SWITCH to ON, and the front-panel ON/STANDBY switch to ON.

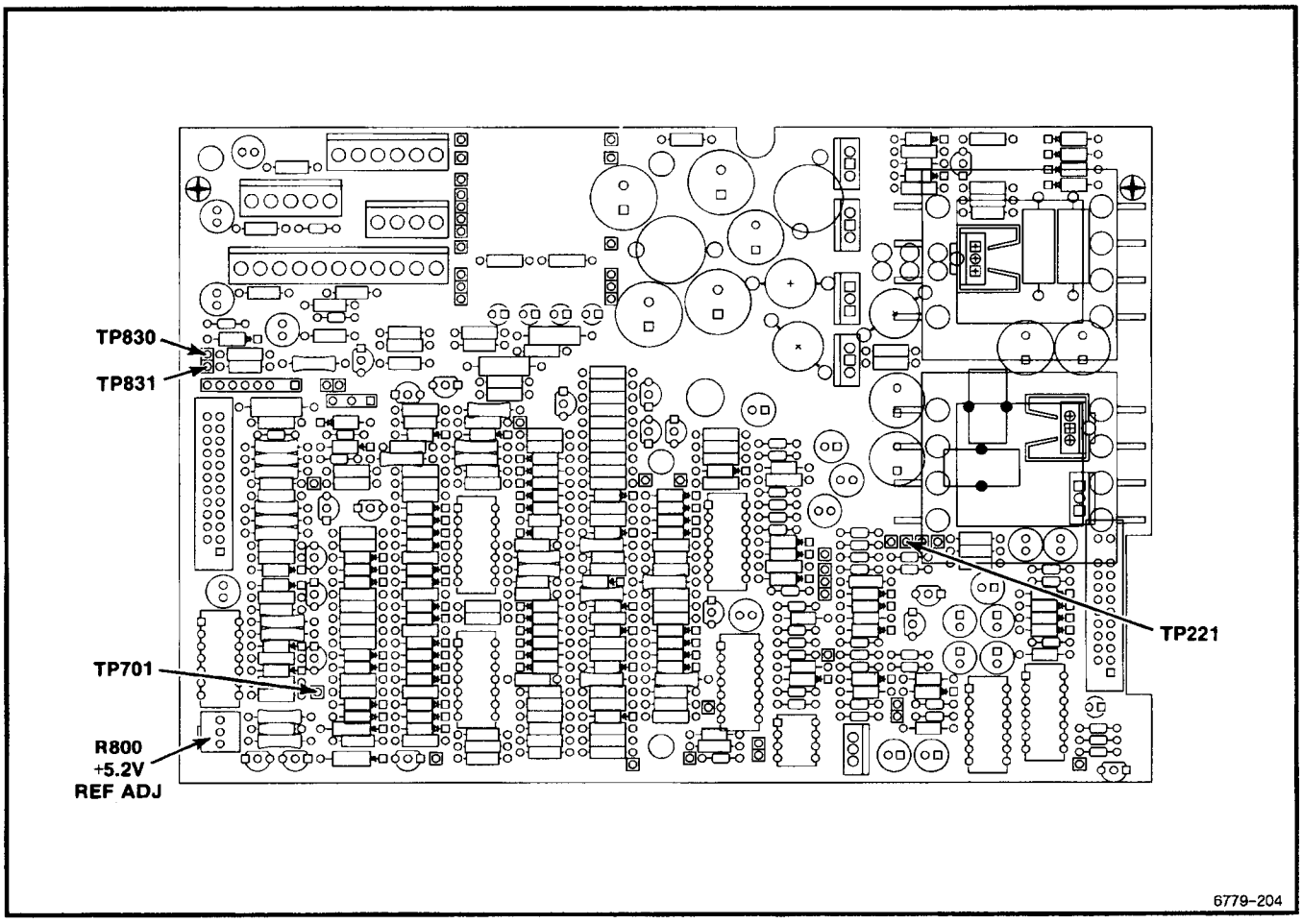
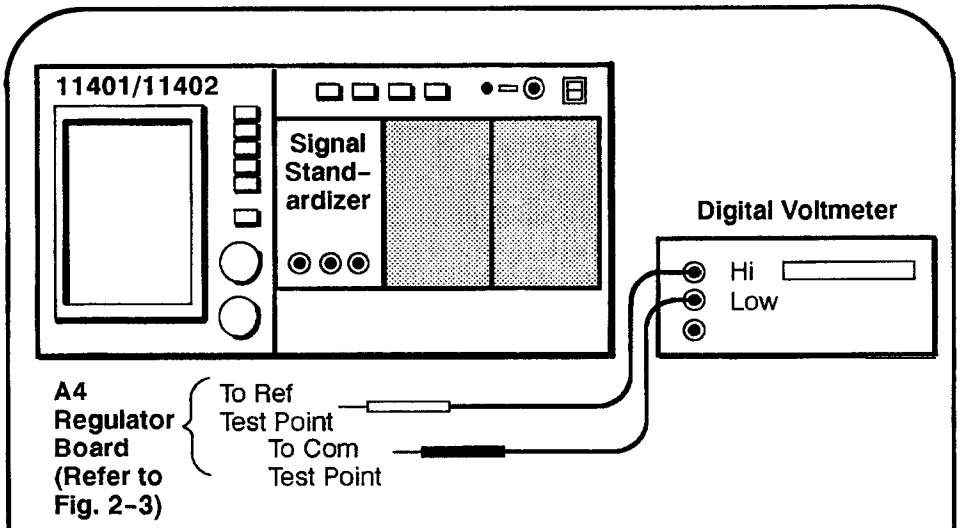


Figure 2-2. A2A2 Control Rectifier board test point and adjustment locations.

Examine/Adjust Regulator Reference (A4R830)

Setup



Perform the following in the order listed:

11401/11402 Oscilloscope Mainframe

No setting changes required.

Digital Voltmeter

Mode ..... DC Voltage

Signal Standardizer

Not used in this part.

Procedure

WARNING

Extreme caution must be used when making the following adjustment due to the dangerous potentials present.

a. ***EXAMINE***—the voltmeter for a reading of +10.00 V, within the limits of +9.95 V and +10.05 V. Do not adjust if the reading is within the stated limits.

b. ***ADJUST***— +10 V REF adjustment R830 on the A4 Regulator board for +10.00 V.

c. Remove the test leads.

d. Repeat the Setup in Part 1—Power-Up Diagnostics.

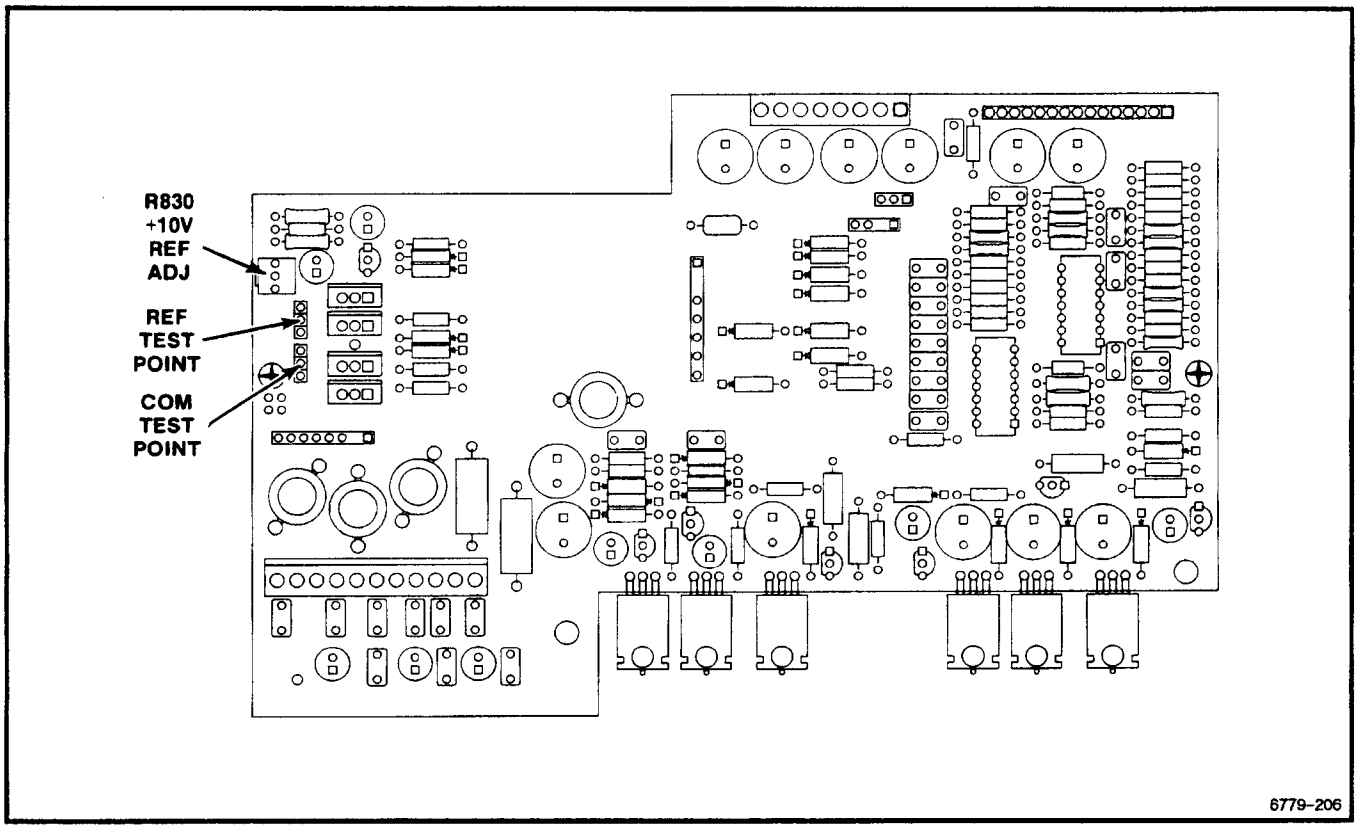


Figure 2-3. A4 Regulator board test point and adjustment locations.

Part 5—Display

Description

The adjustments in this part affect only the visual aspects of the Crt display, and are to be made only when the Crt or Crt driver components are replaced. These adjustments do not affect instrument accuracy since all measurements are made on the acquired data not the displayed data. Unless alignment or brightness difficulties are apparent, skip to Part 6—Calibration Output Accuracy.

Specifications

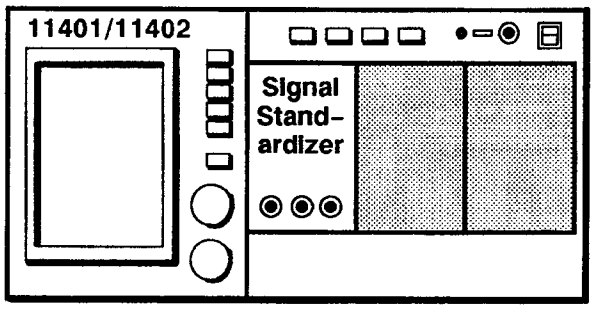
Display Vertical linearity (nonadjustable) checked for 3.7 ±0.4 lines per half inch using internally generated horizontal lines. Display horizontal linearity adjusted for best appearance using internally generated vertical lines and checked for 5.6 ±0.6 lines per half inch.

Examine/Adjust Crt Driver (A8R202, A8R520, A8R530, A8R620, A8L120, A8R541, A8R621, A8R540, A8R100)

WARNING

Extreme caution must be used when making the following adjustments due to the dangerous potentials present.

Setup



Perform the following in the order listed:

a. Remove the 2 screws in the Crt protector shield and remove shield.

b. No instrument setting changes are required.

Signal Standardizer

Not used in this part.

Procedure

a. *ADJUST*—Main Brite adjustment R202 clockwise until the raster appears. (Refer to Fig. 2-4.)

b. *ADJUST*—Horiz Hold adjustment R620 and Vert Hold adjustment R530 for a stable display on the screen.

c. Press the 11401/11402 UTILITY menu button.

d. Select **Extended Diagnostics** in the menu/status area, **Front Panel** from the Block menu appearing in the display area, and **Area** from the menu/status area.

e. Select **Verify** from the Area menu, **Routine** from the menu/status area, and **Softkeys** from the Routine menu.

f. Select **Run** from the menu/status area. A grid pattern will fill the display area.

g. *ADJUST*—Vert Hold adjustment R530 so the bottom line is at (or near) the bottom of the raster.

h. *ADJUST*—Vert Pos adjustment R520 and Vert Size adjustment L120 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 near each corner and one in the center. Looking straight into the Crt to eliminate any parallax error, align the top of the grid display with the top vertical index, the bottom of the grid with the bottom index, and the grid center line with the center index. Optimize the settings of R520 and L120 for best overall alignment.

i. Select **Exit(E)**.

j. Select **(E)Exit**.

k. Select the **Extended Diagnostics** label in the Utility menu.

l. Select the **Front Panel** label in the **Block** menu.

m. Select the **Verify** label in the **Area** menu.

n. Select the **Soft Keys** label in the **Routine** menu.

o. Select the **(r)Run** label in the Utility menu.

p. Use a small ruler (or piece of paper with a one-half inch increment marked on edge) to measure the number of horizontal lines within 0.5 inch. Measure at the top, center, and bottom of the screen. Count both the light and heavy lines.

q. *CHECK*—for 3.7 $\pm$0.4 horizontal lines per half-inch increment, at the top, center, and bottom of the screen (do not count the starting line).

r. *ADJUST*—Horiz Lin adjustment R541, Horiz Size adjustment R621, and Horiz Pos adjustment R540 for best 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 for the vertical adjustments.

s. *CHECK*—for 5.6 $\pm$0.6 vertical lines per half-inch increment at the top, center, and bottom of the screen.

t. *INTERACTION*—R621 Horiz Size, R541 Horiz Lin, and R540 Horiz Pos interact and may need readjustment.

u. Select the **Exit (E)** label in the grid display then the **(E) Exit** label in the menu/status area.

v. *ADJUST*—Main Brite adjustment R202 counterclockwise until the retrace lines are just extinguished.

w. Select **Exit(E)**.

x. Select **(E)Exit**.

y. Select **Instr Options** from the menu/status area and **Display Intensity** from the **Instr Option** menu.

z. Use either control knob to set the display intensity to 100%.

aa. *ADJUST*—Focus adjustment R100 for best overall focus.

bb. Set control knob for normal intensity (approximately 70%).

cc. Replace Crt protective shield.

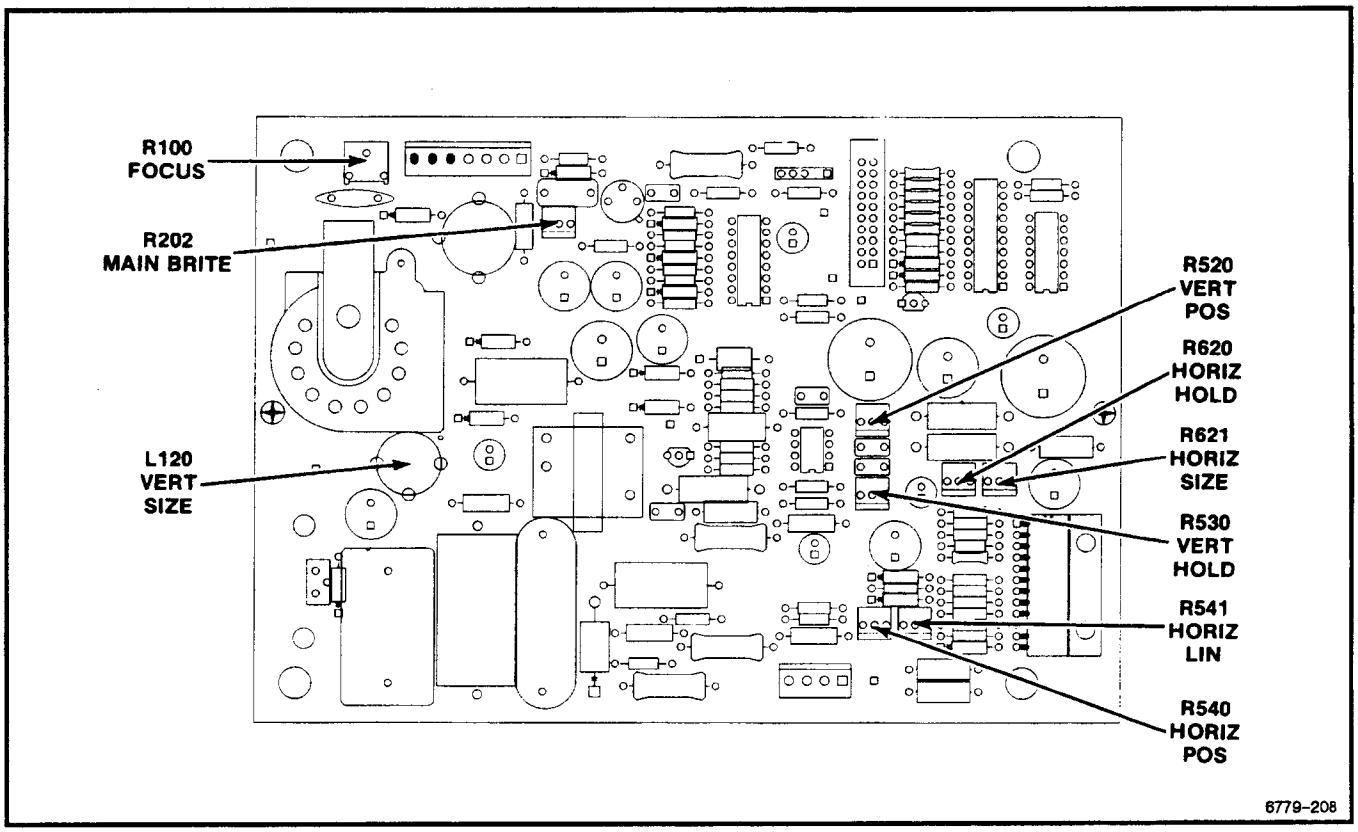


Figure 2–4. A8 CRT Driver board adjustment locations.

Part 6—Calibration Output Accuracy

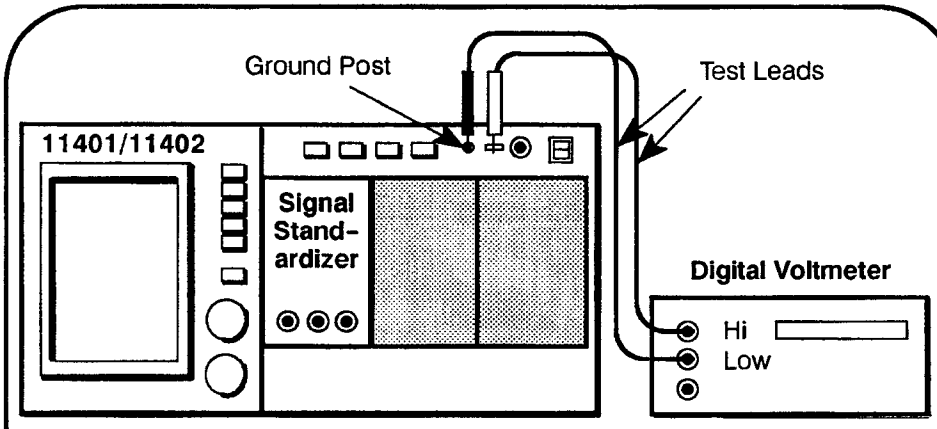
Description

The extended diagnostics are set to apply specific voltages to the front-panel connector which is then measured with a digital voltmeter.

Measurement Limits

Probe calibration output voltage accuracy ±0.06% (or ±6 mV).
Attenuator Ratios ±.04% (±8 mV).
Calibrator DAC Linearity of ±0.75 LSB.

Setup



First Initialize the oscilloscope settings, then perform the following settings in the order listed:

11401/11402 Oscilloscope Mainframe

UTILITY button ..... Press
Utility menu ..... **Extended Diagnostic**
Extended Diagnostic menu
Block ..... **(j) Points Acq**
(2) Area
Area ..... **(d) Cal Refs**
(3) Routine
Routine ..... **(i) FP -10.0000 V**
(r) Run

Digital Voltmeter

Set to measure ..... 10.0000 volts dc.

Signal Standardizer

Not used in this part.

Procedure

a. *EXAMINE*—the Digital Voltmeter reads within the limits of -10.0060 V and -9.9940 V. Proceed to step c.

DO NOT attempt to optimize the adjustment setting if the Digital Voltmeter reading is within the stated limits or if you are performing a functional test. Proceed to step c.

b. *ADJUST*—Offset adjustment R1576 on the A5 Acquisition board for -10.000 V within the limits of -9.998 V and -10.002 V. (Refer to Fig. 2-5.)

c. Select the **Exit (E)** label.

d. Select **FP +9.9951 V** from the **Routine** menu, and **(r)Run** in the menu/status area.

e. *EXAMINE*—the Voltmeter for +9.9951 V, within the limits of +9.9891 V and +10.0011 V.

DO NOT attempt to optimize the adjustment setting if the Digital Voltmeter reading is within the stated limits or if you are performing a functional test. Proceed to step g.

f. *ADJUST*—Gain adjustment R1582 on the A5 Acquisition board for +9.995 V within the limits of +9.993 V and +9.997 V.

g. Select the **Exit(E)** label.

h. Select the **(E)Exit** label to clear the diagnostics menu.

i. If step b. or f. has been performed, press the front-panel ENHANCED ACCURACY button.

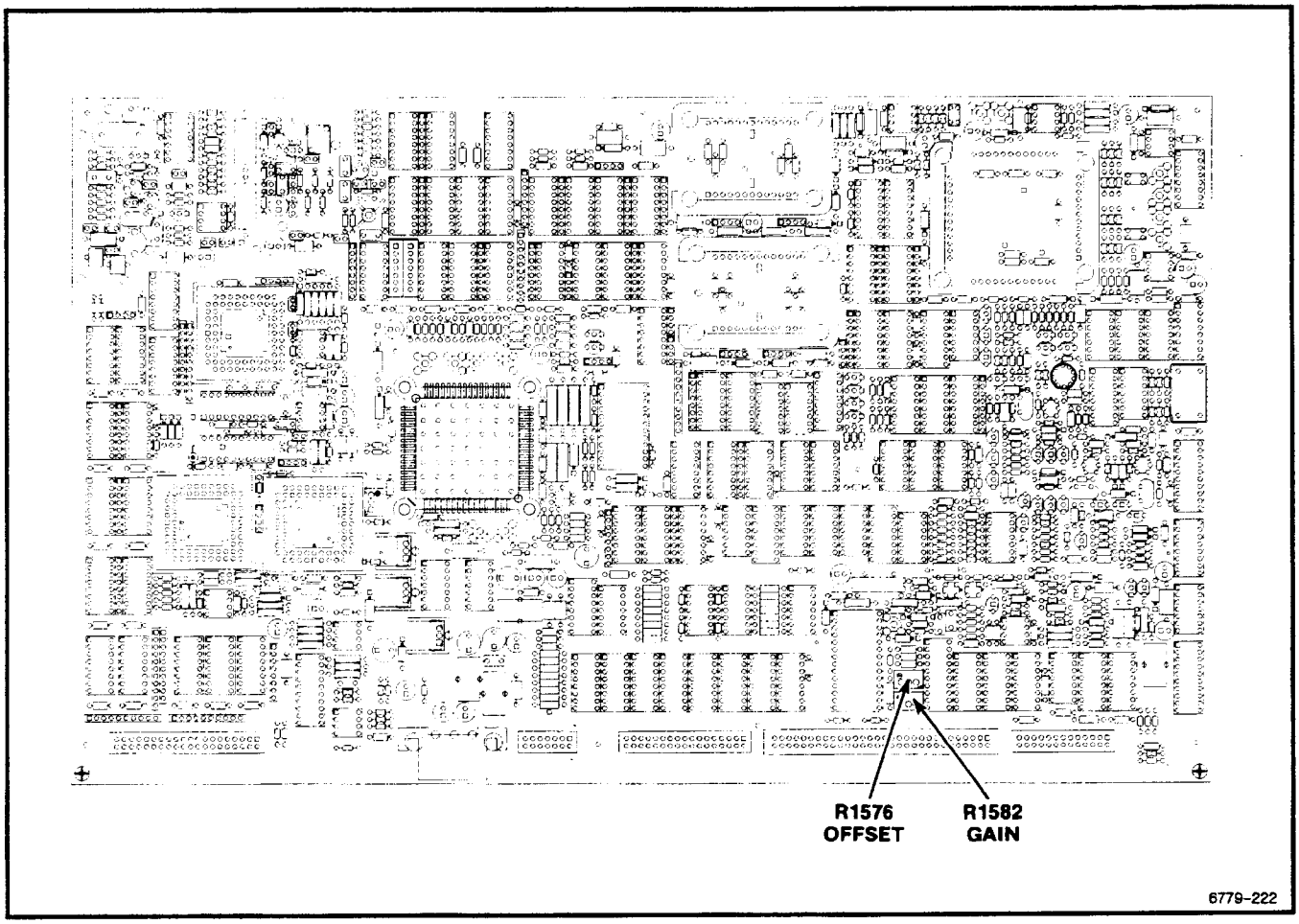
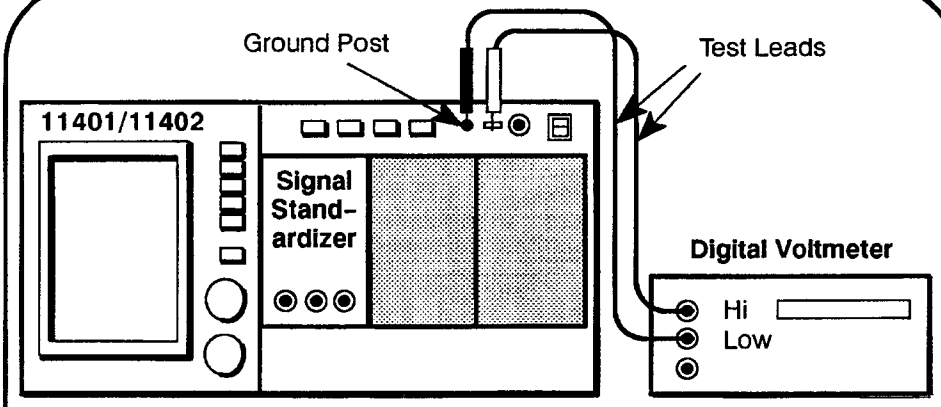


Figure 2–5. A5 Acquisition board (Offset & Gain) adjustment locations.

Examine Attenuator Ratios and Calibrator DAC Linearity

Setup



First Initialize the oscilloscope settings, then perform the following settings in the order listed:

11401/11402 Oscilloscope Mainframe

UTILITY button ..... Press

Utility menu ..... **Extended Diagnostic**

Extended Diagnostic menu

Block ..... **(j) Points Acq**
(2) Area

Area ..... **(d) Cal Refs**
(3) Routine

Routine ..... **(i) FP -10.0000 V**
(r) Run

Digital Voltmeter

Mode ..... Dc Voltage

Signal Standardizer

Not used in this part.

Procedure

a. Push the offset button on the DVM. Recorded Voltage_____

b. Select the **Exit(E)** label.

c. Select **FP +9.9951 V** from the **Routine** menu.

d. Select the **(r)Run** label in the menu/status area.

e. Record the voltage reading on the DVM. Recorded Voltage_____

f. Select the **Exit(E)** label.

g. Select **FP -5.0000 V** from the **Routine** menu. (Refer to Step g Voltage in Table 2-3 for selecting the voltages for the 2nd, 3rd, and 4th repetitions.)

h. Select the **(r)Run** label in the menu/status area.

i. Push the offset button on the DVM.

j. Select the **Exit(E)** label.

k. Select **FP +4.9976 V** from the **Routine** menu. (Refer to Step k Voltage in Table 2-3 for selecting the voltages for the 2nd, 3rd, and 4th repetitions.)

l. Select the **(r)Run** label in the menu/status area.

m. Record the voltage reading on the DVM and multiply 2. (Refer to Step m Voltage in Table 2-3 for selecting voltages for the 2nd, 3rd, and 4th repetitions.) Recorded Voltage_____

n. *EXAMINE*—that the difference between the voltages recorded in steps e and m is $\leq \pm .008$ V ($\pm 0.04\%$).

o. Repeat steps f through n using the voltages supplied in Table 2-3 for Steps g, k, and m on repetitions 2, 3, and 4.

TABLE 2-3
Voltages for Checking Attenuator Ratios

Repetition	Step g Voltage	Step k Voltage	Step m Voltage	Recorded Voltages
2	FP -2.5000 V	FP +2.4988 V	multiply by 4	_____
3	FP -1.000 V	FP +999.51 mV	multiply by 10	_____
4	FP -100.00 mV	FP +99.951 mV	multiply by 100	_____

q. Select the **Exit(E)** label.

r. Select **FP 0.0000 V** from the **Routine** menu.

s. Select the **(r)Run** label in the menu/status area.

t. Record the voltage reading on the DVM. Recorded Voltage_____

u. *EXAMINE*—that

$$\left(\frac{(step\ a\ Voltage + step\ e\ Voltage + 4.9mV)}{2} - step\ t\ Voltage\right)$$

is within the limits of ±3.7 mV.

v. Select the **Exit(E)** label once to clear the routine, and then touch the **Exit(E)** label twice to clear the diagnostics menu.

Part 7—Probe Compensation Voltage & Resistance

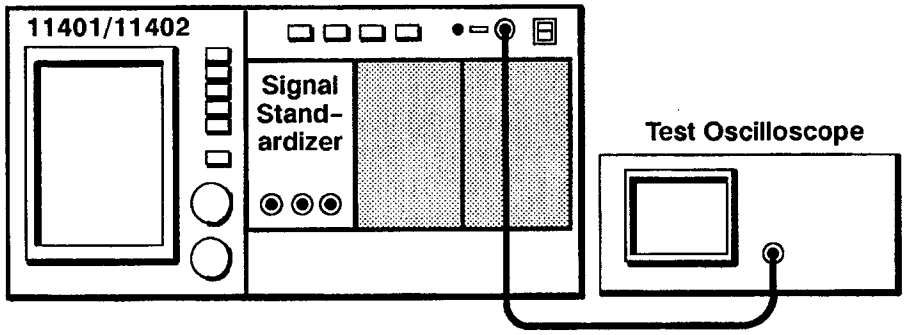
Description

The extended diagnostics are set to provide a calibrator output voltage that is checked on a test oscilloscope.

Measurement Limit

Probe compensation output voltage 6.0 V, ±3% into a 1 MΩ load.

Setup



First Initialize the oscilloscope settings, then perform the following in the order listed:

11401 and 11402 Oscilloscope Mainframe

Extended Diagnostic menu

(1) Block ..... **Points Acq**

(2) Area ..... **Cal Refs**

(3) Routine ..... **(I) FP 1 KHz**

Run ..... touch

Test Oscilloscope

Set controls to measure a 6 V peak-to-peak square wave signal.

Signal Standardizer

Not used in this part.

Examine Output Voltage Accuracy

Procedure

a. ***EXAMINE***—test oscilloscope display for a 6 volt peak-peak square wave, within the limits of 5.820 V and 6.180 V.

Part 8—Acquisition

Description

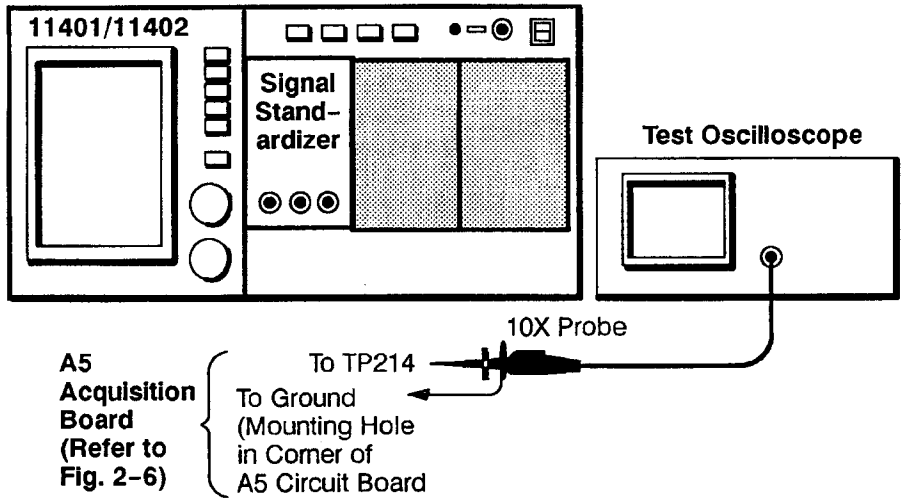
The 10 MHz peak-to-peak signal amplitude is checked with a test oscilloscope. The phase lock loop voltage is checked with a DVM at a circuit board test point. The differential amplifier V+ voltage is checked with a DVM at a circuit board test point. The Difference amplifier step response is checked on a circuit board test point using a test oscilloscope.

Measurement Limits

10 MHz signal amplitude $\geq$1.0 V p-p. Phase lock loop +6.0 V, $\pm$1.0 V. Differential amplifier V+ 10.500 V, $\pm$10 mV. Difference amplifier step response for fastest rise time with minimum overshoot.

Examine/Adjust 10 MHz Signal Amplitude (A5C217)

Setup



Perform the following in the order listed:

11401/11402 Oscilloscope Mainframe

a. Set the ON/STANDBY switch to STANDBY.

b. Turn instrument on its right side to expose the bottom.

c. Remove the eight screws securing the A5 Acquisition board (located on the bottom of the instrument).

d. Swing board out on hinges and lock in place.

e. Connect 10X probe as shown in illustration.

f. Set the ON/STANDBY switch to ON.

Test Oscilloscope

Vertical Sensitivity (at probe tip) ..... 500 mV/division
Horizontal ..... 50 ns/division
Triggering ..... Internal

Signal Standardizer

Not used in this part.

Procedure

a. *EXAMINE*—the signal amplitude display on the Test Oscilloscope is at least 1 V p-p.

STOP

DO NOT attempt to optimize the adjustment setting if the signal amplitude is within the stated limits. Proceed to step c.

b. *ADJUST*—10 MHz adjustment C217 for MAXimum signal amplitude (0.8 V minimum). Rotate the adjustment slowly, as this is a very high Q circuit.

c. Remove probe.

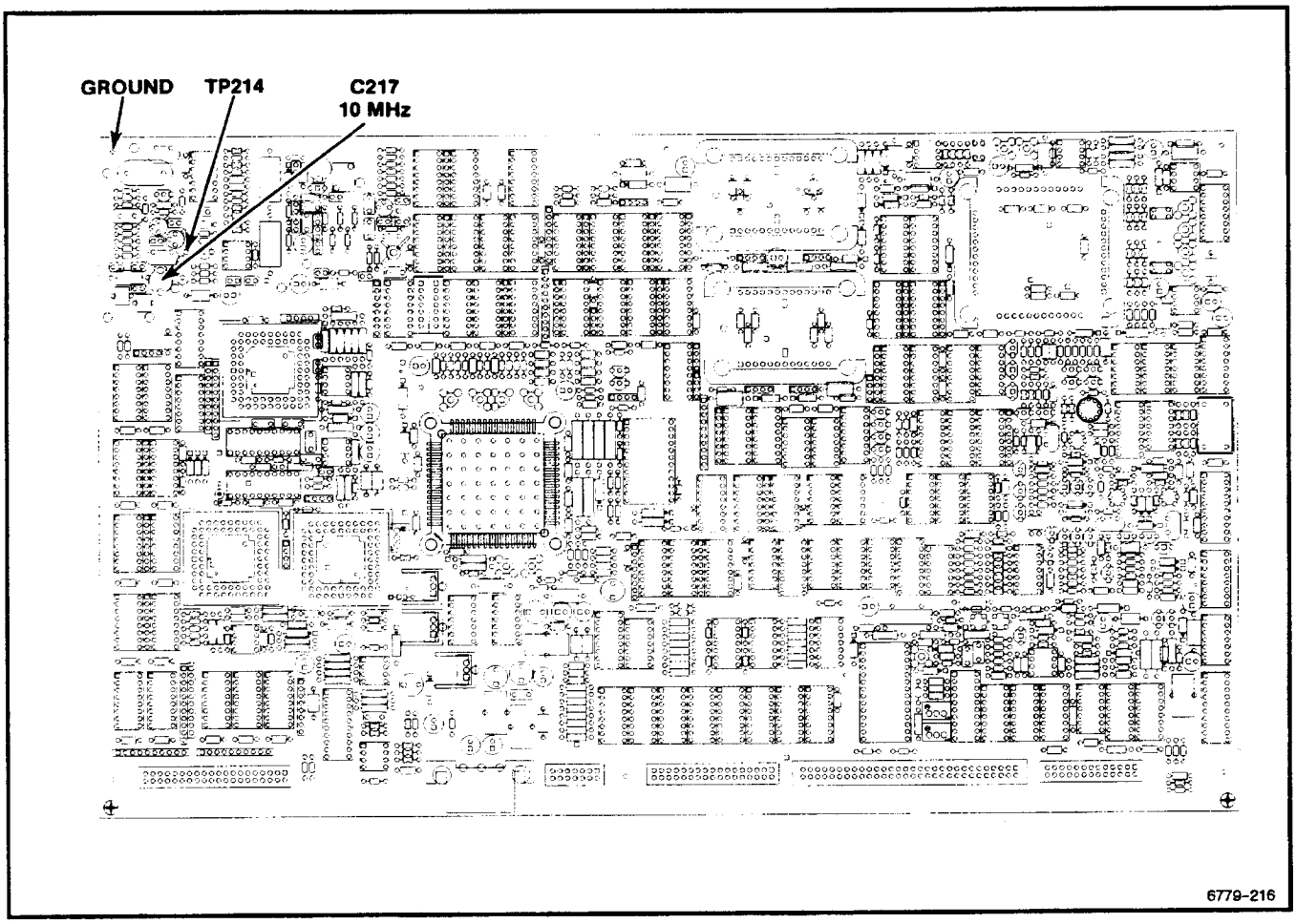
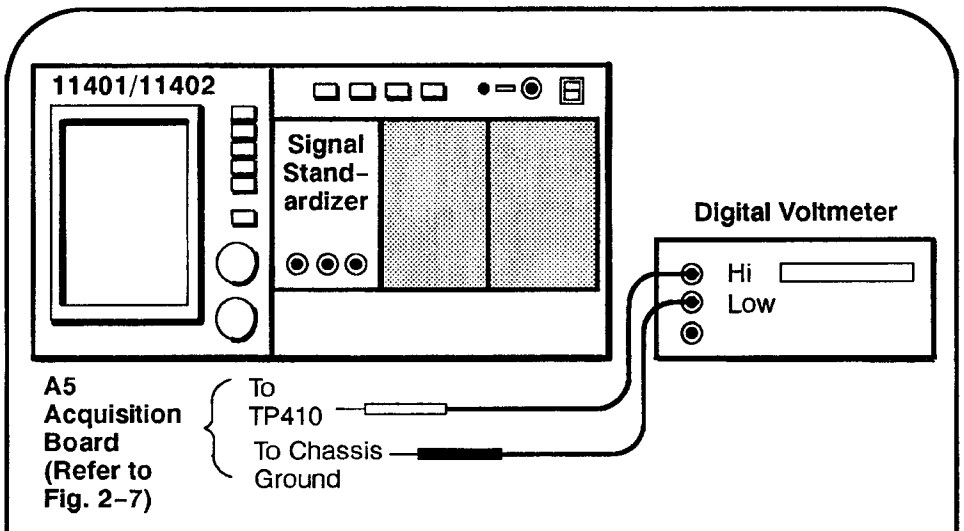


Figure 2–6. A5 Acquisition board (10 MHz) test point and adjustment location.

Examine/Adjust Phase Lock Loop (A5C500)

Setup



Perform the following in the order listed:

11401/11402 Oscilloscope Mainframe

As left from previous test.

Digital Voltmeter

Mode ..... DC Voltage

Signal Standardizer

Not used in this part.

Procedure

a. *EXAMINE*—the Digital Voltmeter reads within the limits of +7.0 V and +5.0 V.

STOP DO NOT attempt to optimize the power supply adjustment settings if the Digital Voltmeter reading is within the stated limits. Proceed to step c.

b. *ADJUST*—VCO adjustment C500 for +6.0 V, ±0.3 V.

c. Remove the meter leads.

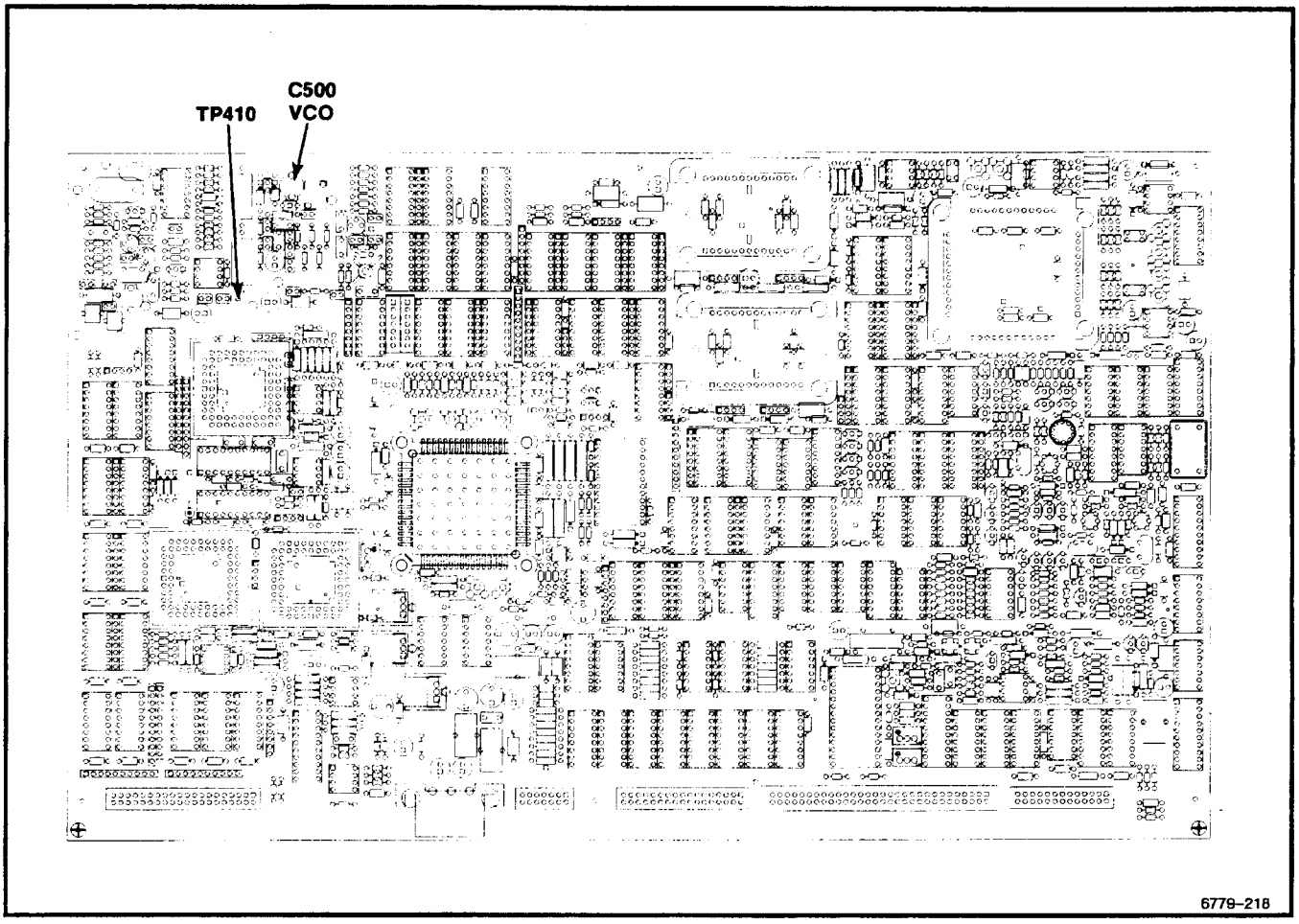
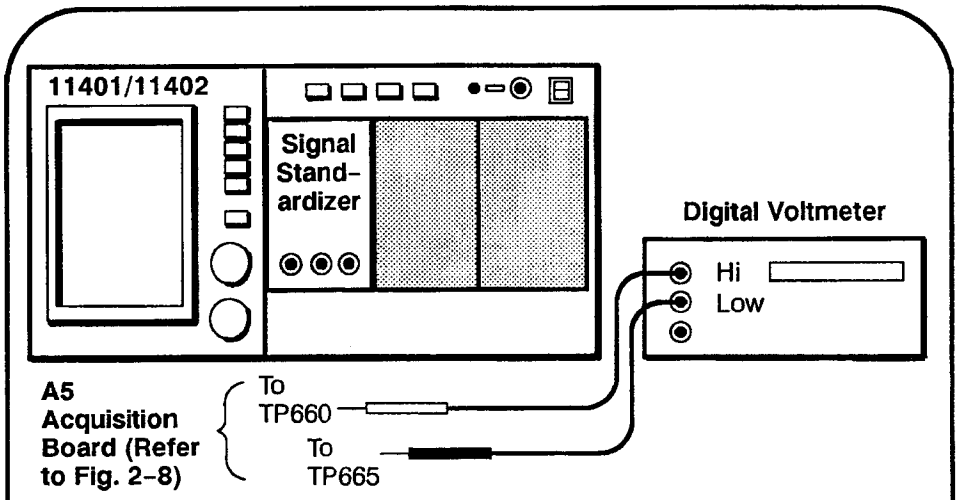


Figure 2–7. A5 Acquisition board (VCO) test point and adjustment location.

Examine/Adjust Differential Amplifier V+ (A5R666)

Setup



Perform the following in the order listed:

11401/11402 Oscilloscope Mainframe

As left from previous test.

Digital Voltmeter

Mode ..... DC Voltage

Signal Standardizer

Not used in this part.

Procedure

a. *EXAMINE*—the Digital Voltmeter reads within the limits of 10.510 V and 10.490 V.

STOP DO NOT attempt to optimize the adjustment settings if the Digital Voltmeter reading is within the stated limits. Proceed to step c.

b. *ADJUST*—Diff Amp V+ adjustment R666 for 10.500 V.

c. Remove the meter leads.

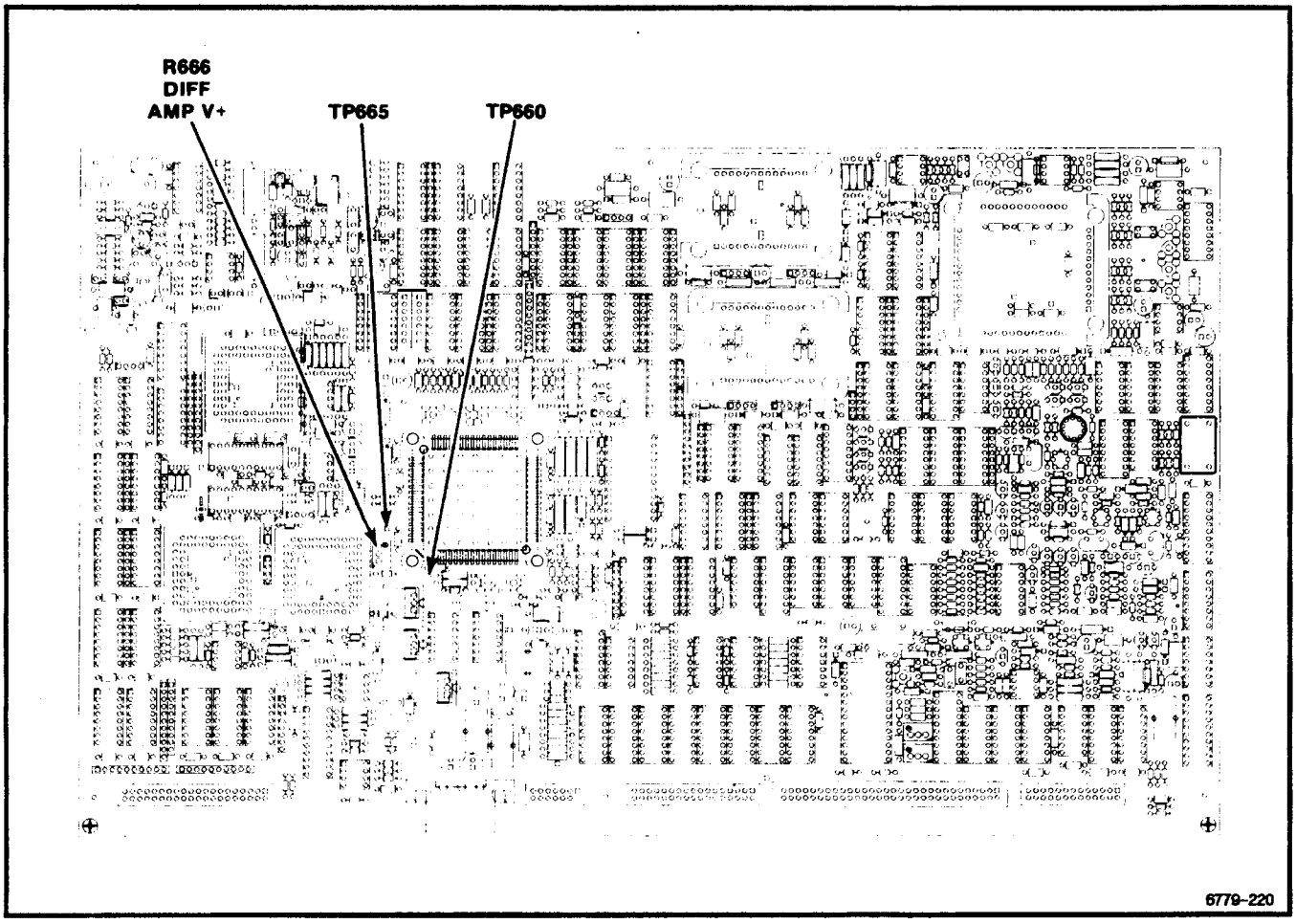
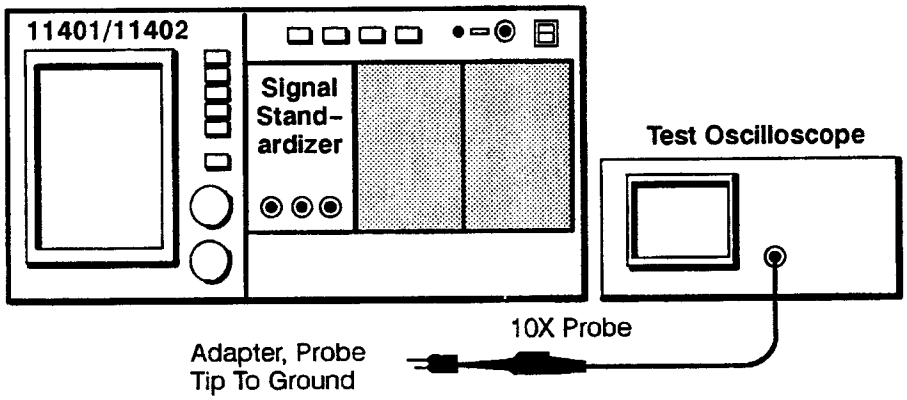


Figure 2–8. A5 Acquisition board (Diff Amp V+) test point and adjustment location.

Examine/Adjust Difference Amplifier Step Response (A5C253)

Setup



First Initialize the oscilloscope settings, then perform the following in the order listed:

11401/11402 Oscilloscope Mainframe

Def Wfm ..... Left

Signal Standardizer

Test ..... Vert or Horiz + Step Resp

Rep Rate ..... 1 MHz

Amplitude ..... Fully clockwise

Test Oscilloscope

Vertical ..... 200 mV/div, DC

Horizontal ..... 20 ns/division

Triggering ..... DC, +, Normal

Procedure

a. Position the top of the square wave to the center horizontal graticule line on the 11401/11402 display graticule.

b. Connect the Test Oscilloscope to R650, on the A5 Acquisition board. Connect the ground contact of the probe-tip ground adapter to a near-by ground point, such as the ground end of C255. (Refer to Fig. 2-10.)

c. Set the Test Oscilloscope center horizontal graticule line to 0 V.

d. Set the Test Oscilloscope Trigger Level to the maximum positive level, then slowly lower it until triggering occurs on the most positive spike (refer to Fig. 2-9B).

NOTE

If the waveform envelope is not visible on the Test Oscilloscope display as shown in Figure 2-9, slowly rotate the Signal Standardizer Position control until the envelope appears. If the envelope is not equally positioned around the 0 V point, temporarily remove the probe and press the 11401/11402 ENHANCED ACCURACY button. The envelope is actually the step response waveform that will be adjusted in the following steps.

e. ***EXAMINE***—The Difference Amplifier waveform for optimum adjustment as shown in Figure 2-9C.

DO NOT attempt to optimize the adjustment setting if the displayed waveform matches that shown in Figure 2-9C. Proceed to step k.

f. ***ADJUST***—DIFF AMP COMP adjustment C253 (using the square-tip alignment tool) for the fastest rise time with minimum overshoot. Note that C253 adjusts both the + and - steps and they become optimum at different settings. Compromise the adjustment for best + and - step response. Figure 2-9C shows optimum adjustment.

g. Set the ON/STANDBY switch to STANDBY.

h. Ensure that all Peltola cables are still securely connected.

i. Reposition the A5 Acquisition board and secure with the eight screws removed earlier.

j. Set the ON/STANDBY switch to ON.

k Remove the Test Oscilloscope from the Power Module and install the Frequency Counter and Function Generator. This allows ample warmup time before they are needed.

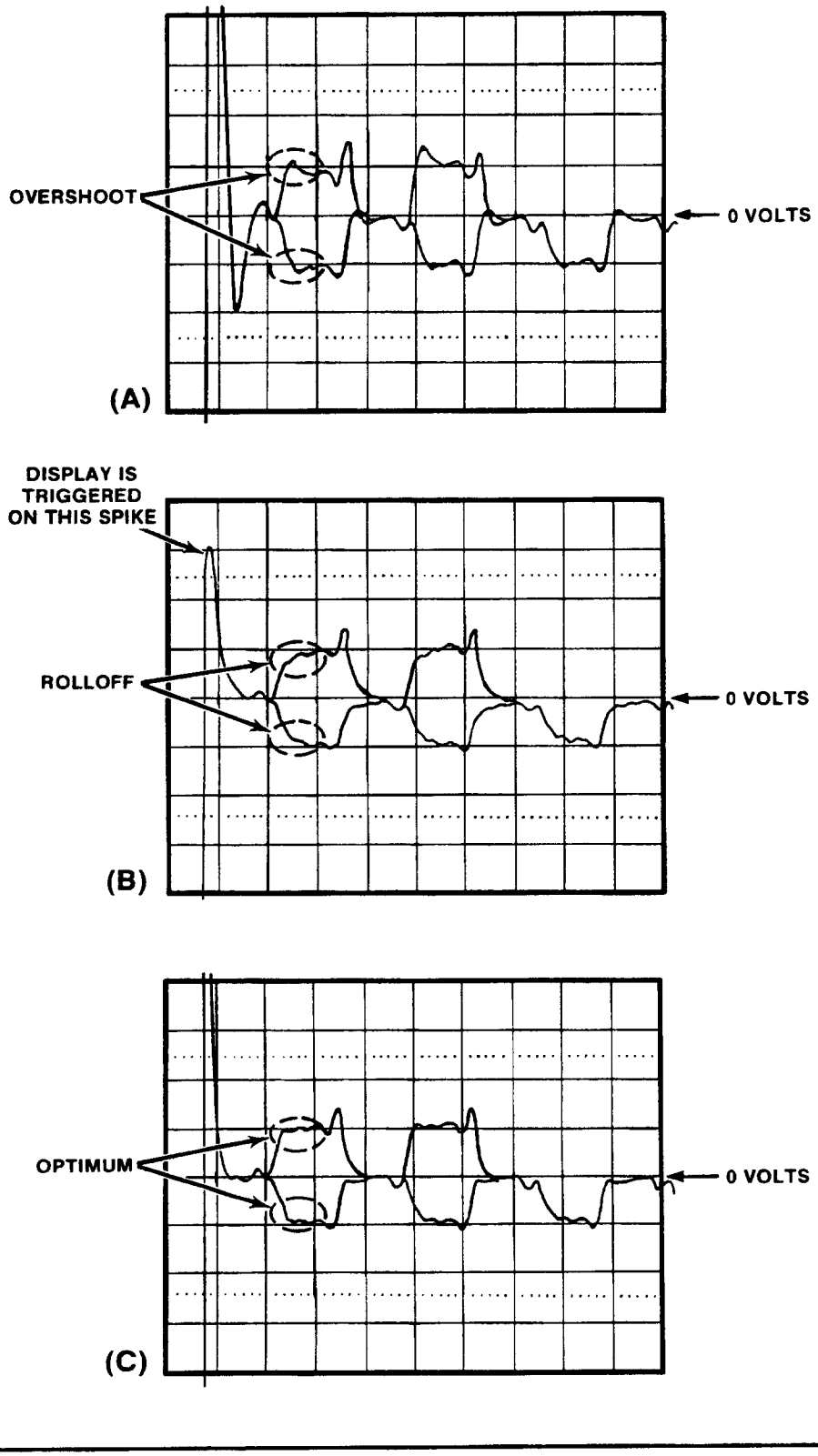


Figure 2–9. Difference Amplifier Waveform displays.

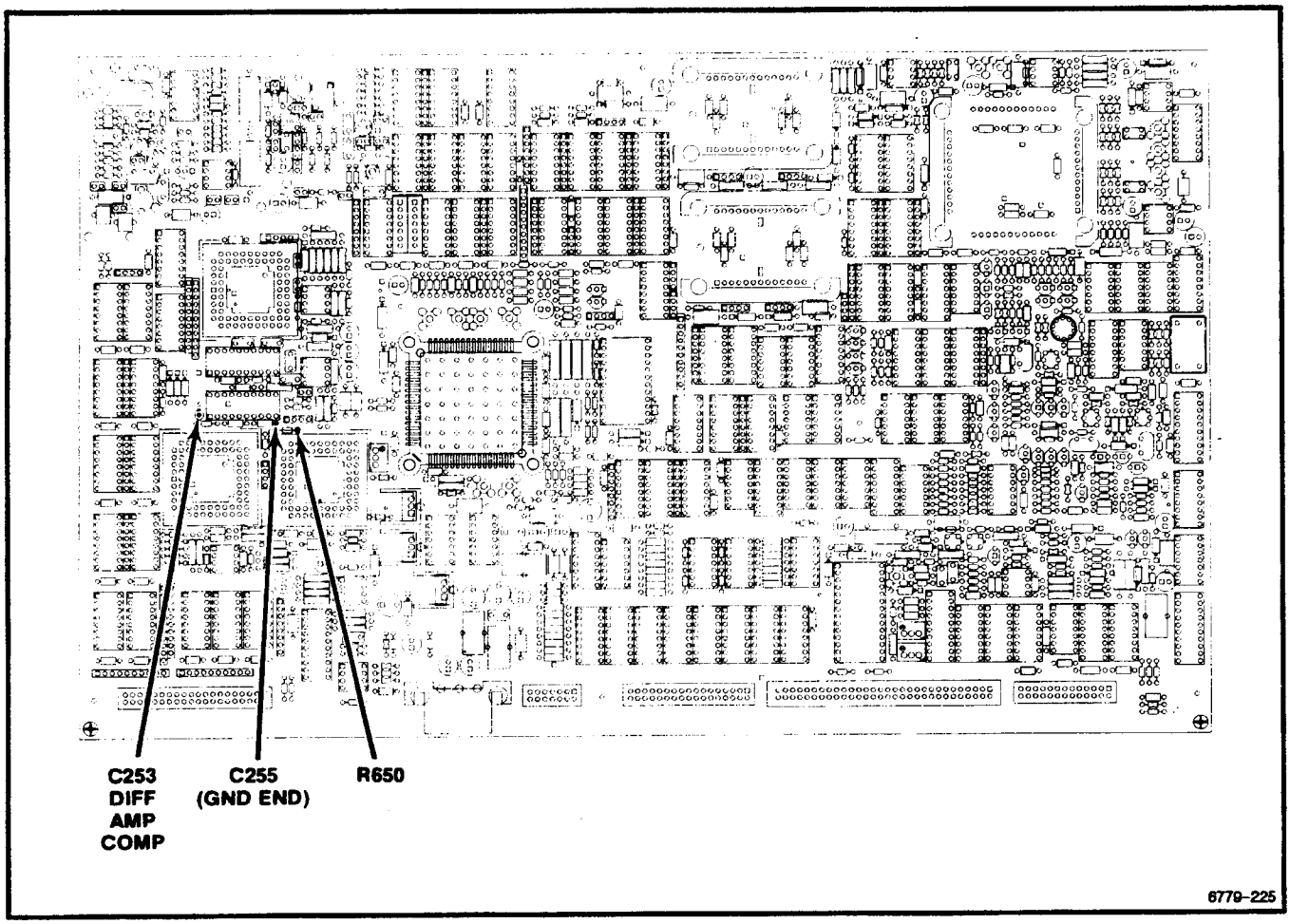


Figure 2–10. A5 Acquisition board (Diff Amp Comp) test point and adjustment locations.

Part 9—Vertical Input Offset

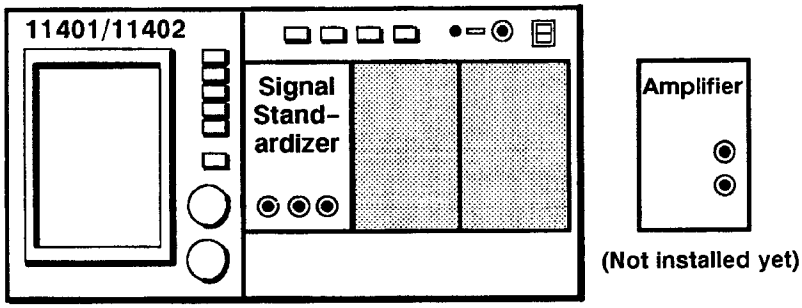
Description

The trace offset is checked/set in the Mean measurement mode.

Specification

Vertical input offset ±0.2 division after self cal.

Setup



First Initialize the oscilloscope settings, then perform the following in the order listed:

11401/11402 Oscilloscope Mainframe

Def Wfm icon ..... Left

Measurement Functions ..... **Mean**

Mean menu

Data Interval ..... **Whole Zone**

Signal Standardizer

Vert or Horiz ..... Com Mode

Amplifier

Not used in this part unless necessary.

Check Offset

Procedure

a. *CHECK*—the Mean readout on the screen is within the limits of -200 mU and +200 mU.

b. Repeat this procedure with the Center and Right plug-in compartments selected.

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

Set Input Offset

Procedure

a. Set the ON/STANDBY switch to STANDBY.

b. Install a Term Conn Link (shorting strap) on the CAL-LOCK terminals located on the bottom of the A6 Time Base board. Refer to Figure 2–11.

c. Install an Amplifier Plug-in in the left compartment.

d. Set the ON/STANDBY switch to ON. Ignore any plug-in diagnostic errors that may be displayed on the screen.

e. Repeatedly press the Enhanced Accuracy button until the message **"Enhanced Accuracy in Progress, Please Leave Instrument on Until Complete"** appears on the screen. Proceed to step f when the message **"Enhanced Accuracy completed and passed"** appears on the screen (you do not have to wait 20 minutes).

f. Repeat this procedure for the center and right compartments.

g. Remove the plug-in and the shorting strap and repeat the Check Offset procedure above.

Part 10a — Sampler and Digitizer: Performance Verification Procedure

Description

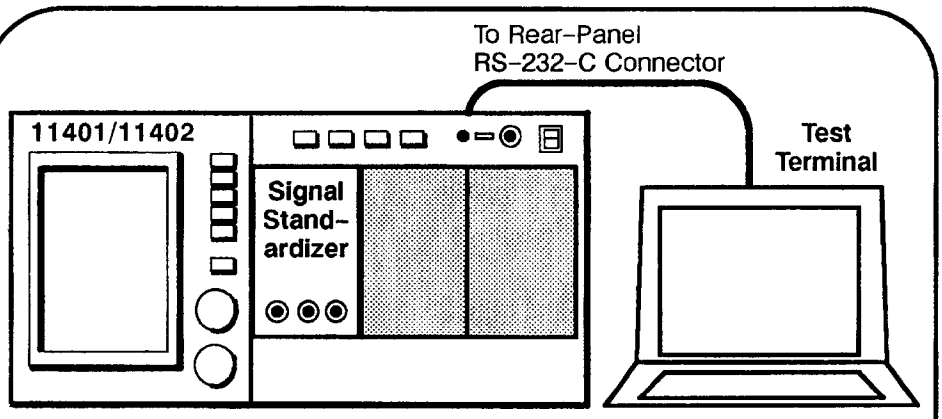
Sampler gain is checked using the Signal Standardizer calibration fixture as a signal source. The delta voltage between the 1st and 9th steps is measured with the cursors function. The sampler gain is set using a terminal to reset the internal cal constants.

Measurement Limits

Vertical Input Sensitivity Accuracy must be within 1% when checked with an 067–0587–02 calibration fixture referenced to 8 divisions.

Examine/Set Sampler Gain

Setup



First Initialize the oscilloscope settings, then perform the following in the order listed:

11401/11402 Oscilloscope Mainframe

Utility Menu ..... Initialize
Def Wfm ..... Left
Main Size ..... **2 ms/div**
Acquire Desc
Average N ..... **On**
Time Holdoff Control Knob ..... **15.5 ms**
(set knob resolution to Medium for final setting)
Mode ..... **Auto**
RS232C Parameters
Echo ..... **On**
Verbose ..... **On**
Baud Rate ..... **9600 Bd** (depends on test terminal)

Signal Standardizer

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

Examine Sampler Gain

Procedure

a. Set the Signal Standardizer Position control to center the waveform on the screen.

b. Touch the Cursors icon and position Cursor 1 to the center of the first step and Cursor 2 to the center of the last step (refer to Fig. 2–12).

c. *EXAMINE*—the ΔV readout is within the limits of 7.920 V and 8.080 V.

d. Repeat this procedure for the center and right plug-in compartment and record the results. The Trigger source must be selected for each plug-in compartment. If any of the ΔV values are outside the limits stated in part c, proceed to the following adjustment procedure.

DO NOT attempt to optimize the sampler gain setting if the ΔV readout is within the stated limits. Proceed to Part 11—Equivalent Time Step Response.

Set Sampler Gain

Procedure

a. Set the ON/STANDBY switch to STANDBY.

b. Install a Term Conn Link (shorting strap) on the CAL-LOCK terminals located on the bottom of the A6 Time Base board. Refer to Figure 2–11.

c. Set the ON/STANDBY switch to ON.

d. Determine the Existing Cal Constant as follows:

- Type **mcalconst? 134** on the Test Terminal.
- The Test Terminal Crt display will respond:

  MCALCONSTANTS 134:XXXX (where XXXX is the cal constant number currently loaded into NV RAM).

e. Calculate the median amplitude gain from the three ΔV voltage readings noted above in steps c and d, as follows:

$$Median\ \ Amplitude = \frac{Min + Max}{2}$$

where:

Min = the lowest of the three measured ΔV signal amplitudes (in volts).

Max = the highest of the three measured ΔV signal amplitudes (in volts).

EXAMPLE:

The three measured gain values are 8.012, 7.981, and 7.954.

$$Median\ \ Amplitude = \frac{8.012 + 7.954}{2} = 7.983$$

f. Calculate the Cal Constant that will be used to set the sampler gain as follows:

$$CalConstant = \frac{MedianAmplitude}{8} \times Existing\ \ Cal\ \ Constant\ \ (see\ \ step\ \ a.)$$

EXAMPLE:

$$CalConstant = \frac{7.983}{8} \times 9012 = 8993$$

g. Set the 11401/11402 sampler gain by entering the result of the Cal Constant (8993 in the example) calculation with the Terminal Cal Constant command as follows:

- Type **mcalconst 134:8993** on the Test Terminal keyboard.
- Press RETURN button.
- Test Terminal Crt display should respond "**OK**".
- Press ENHANCED ACCURACY button on 11401/11402 front panel.

h. To ensure that the new cal constant has been incorporated in nonvolatile RAM:

- Type **mcalconst? 134** on the Test Terminal.
- The Test Terminal Crt display will respond:

  MCALCONSTANTS 134:XXXX (where XXXX is the cal constant number loaded into NV RAM).

i. Record the Cal Constant number (loaded into NV RAM) on the MCALCONSTANT 134 tag on the back of the A5 Acquisition board.

j. Remove the Term Conn Link (shorting strap) from the CAL-LOCK terminals on the A6 Time Base board.

k. Disconnect the RS-232-C cable.

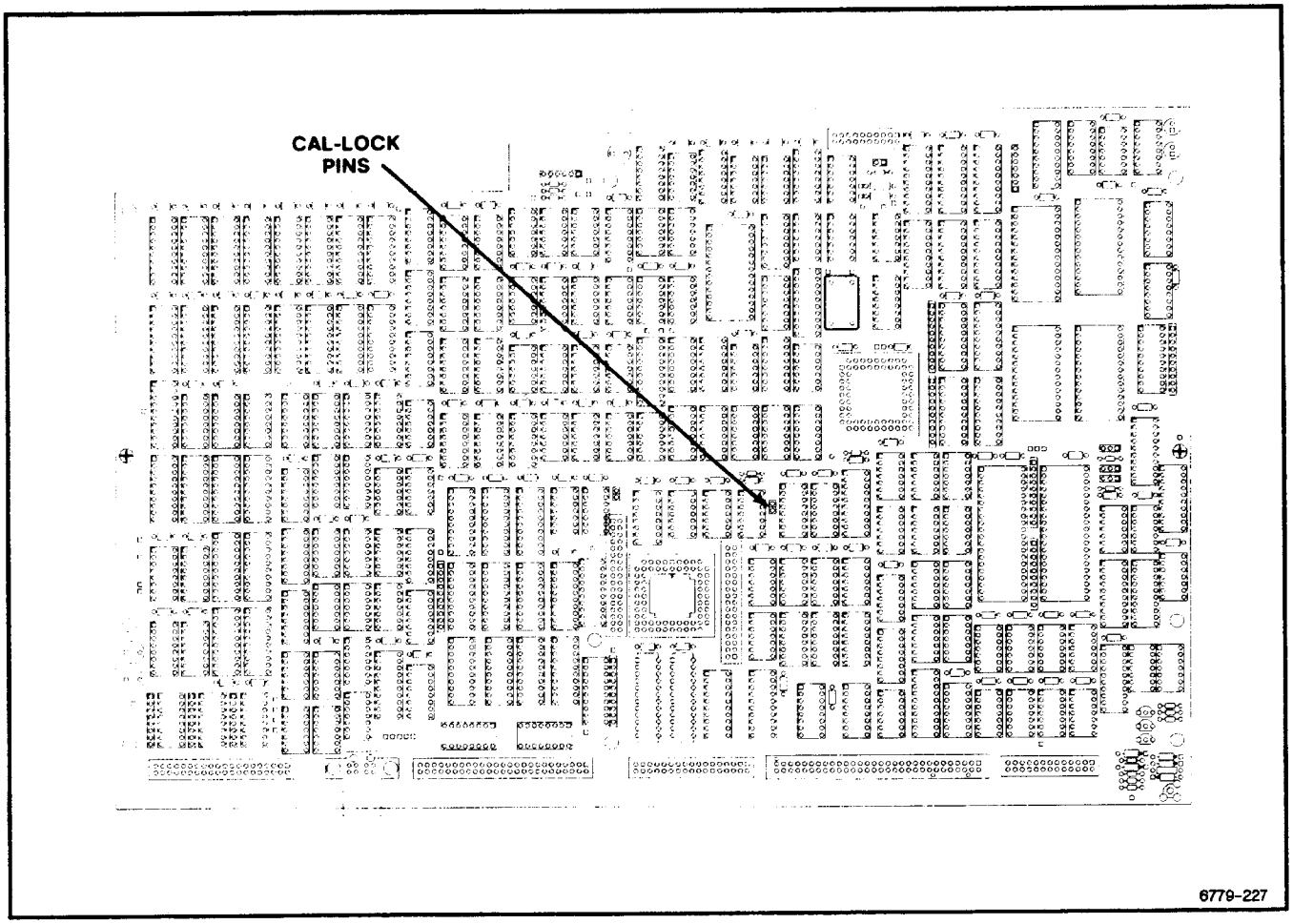


Figure 2–11. Location of CAL-LOCK PINS on the A6 Time Base board.

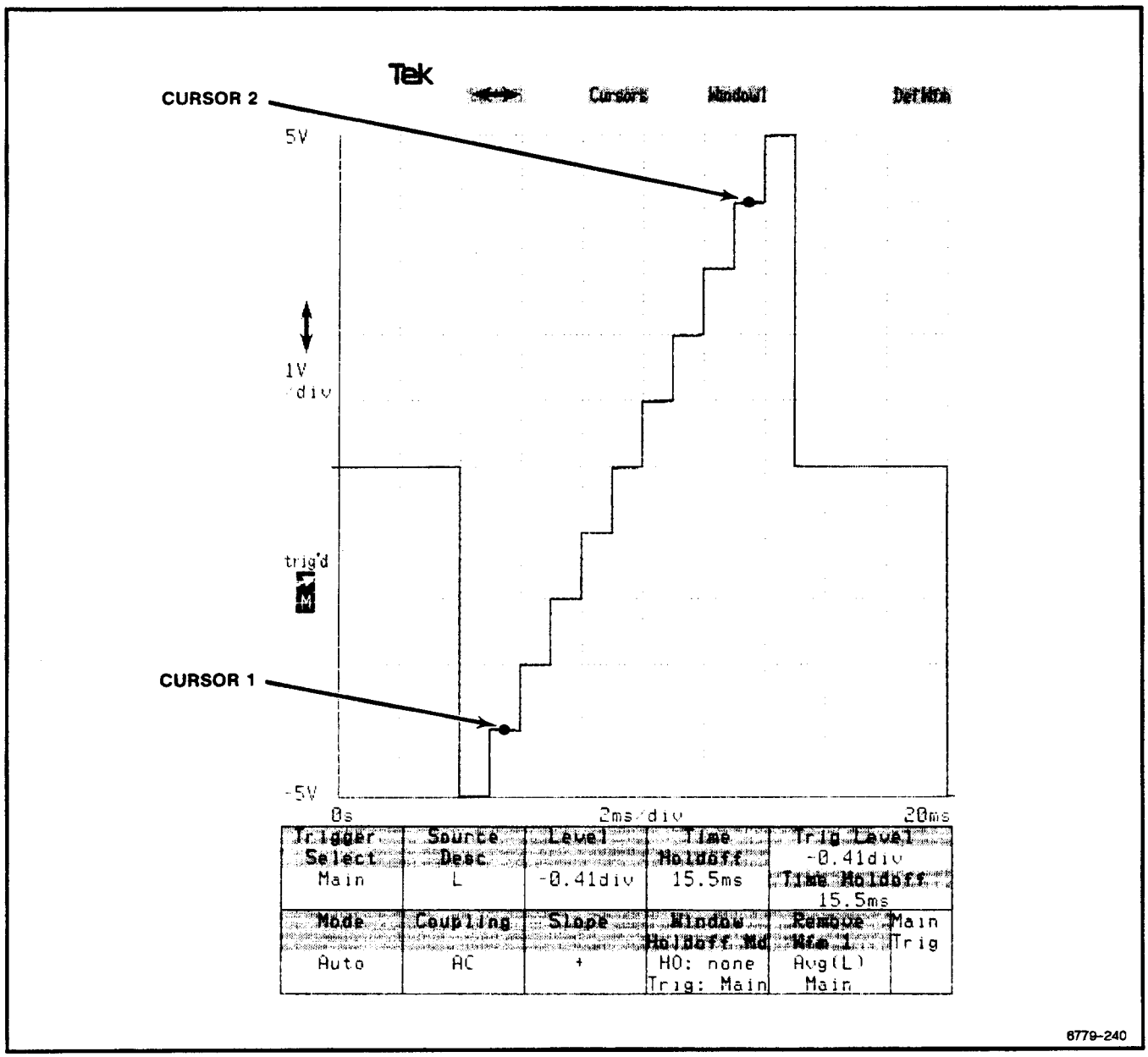


Figure 2-12. Cursor placement on the staircase waveform.

NOTE

For version 3.0 or greater, the coupling shown above will be DC.

Part 10b — Sampler and Digitizer: Functional Test Procedure

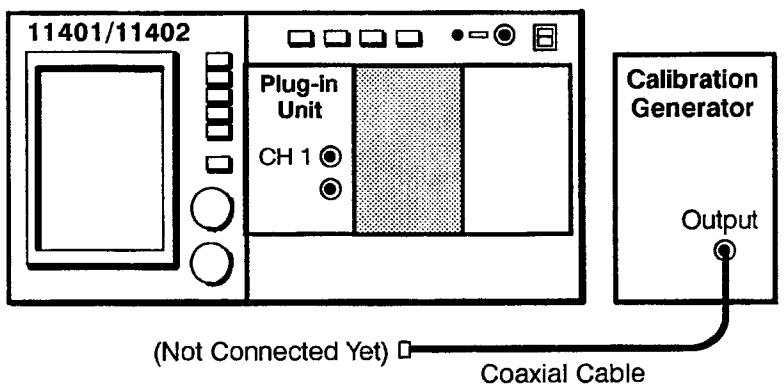
Description

This part shows the setup and lists the procedure to functionally test the vertical accuracy. You should only perform this part if you are performing a functional test. Otherwise, perform Part 10a, Sampler and Digitizer: Performance Verification Procedure, and then proceed to Part 11, Equivalent Time Step Response.

Measurement Limits

Refer to Table 2–3, Vertical Accuracy Error Limits for the appropriate measurement limits in this part.

Setup



First Initialize the oscilloscope settings, then perform the following in the order listed:

Plug-in Unit

CH 1 display on/off ..... On

11401/11402 Oscilloscope Mainframe

Acquire Desc ..... **Average N** to **On**

MEASURE button ..... press

Measurements pop-up menu ..... **Mid, Peak-Peak**

Calibration Generator

Mode ..... Std Ampl

Amplitude ..... 5 V

Procedure

a. *EXAMINE*—that the **Mid** measurement is equal to or less than the value listed in the DC Balance column of Table 2–3.

b. Connect the 5 V signal from the Calibration Generator to the CH 1 input connector.

NOTE

If the plug-in unit has only a 50 Ω input impedance you must increase the Calibration Generator Amplitude to 10 V.

c. Set the **Vert Offset:L1** to positive 2.5 V to center the waveform.

d. Touch the horizontal icon, and set the **Main Size** to 100 µs/div.

e. *EXAMINE*—that the **Peak-Peak** measurement is 5 V, plus or minus the value listed in the ΔV DC Accuracy column of Table 2–4.

Table 2–4
Vertical Accuracy Error Limits

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

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

Part 11—Equivalent Time Step Response

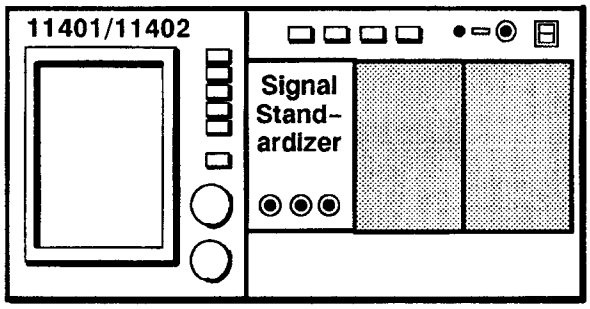
Description

Rise time and aberrations are checked using an 067–0587–02 Signal Standardizer Calibration Fixture plug–in. The Rise and Peak–Peak measurement functions of the mainframe are used to provide the specific value readout.

Measurement Limits

	Rise Time	Aberrations
11401	450 ps or less	4% or less p–p within first 20 ns after step. 1% or less p–p after 20 ns from step.
11402	300 ps or less	5% or less p–p within first 20 ns after step. 1% or less p–p after 20 ns from step.

Setup



First Initialize the oscilloscope, then perform the following in the order listed:

11401/11402 Oscilloscope Mainframe

Def Wfm ..... Left

Acquire Description menu

Average N ..... **On**

Horizontal Description

Main Record Length ..... **512 points**

Window Record Length ..... **512 points**

Main Size ..... **500 ps/div**

Main Pos ..... **-2.2 ns**

Measurement Functions ..... **Rise**

Peak-Peak

Signal Standardizer

Test Vert or Horiz ..... + Step Response

Rep Rate ..... 1 MHz

Procedure

a. Adjust the Signal Standardizer Position and Amplitude controls for a 6 division step centered on the screen.

b. *EXAMINE*—the rise time readout on the screen as follows:
11401—450 ps or less.
11402—300 ps or less.

c. Set the Main Size to 5 ns/division.

d. Set the Main Pos to position the 50% amplitude of the step 1 division from the left edge of the screen.

e. Set the Peak-Peak Left Limit readout to 13%, and the Right Limit readout to 50%.

f. ***EXAMINE***—the Peak-Peak voltage readout on the screen as follows:
11401—240 mV or less.
11402—300 mV or less.

g. Set the Main Size to 50 ns/division.

h. Set the Main Pos control to position the step 1 division from the left side of the screen.

i. Set the Peak-Peak Left Limit readout to 15%.

j. Set the Peak-Peak Right Limit readout to 100%.

k. ***EXAMINE***—the Peak-Peak voltage readout on the screen as follows:
11401—60 mV or less.
11402—60 mV or less.

l. Repeat this procedure for the center and right plug-in compartments. The trigger source must be set for the appropriate plug-in compartment.

Part 12a — Mainframe Bandwidth: Performance Verification Procedure

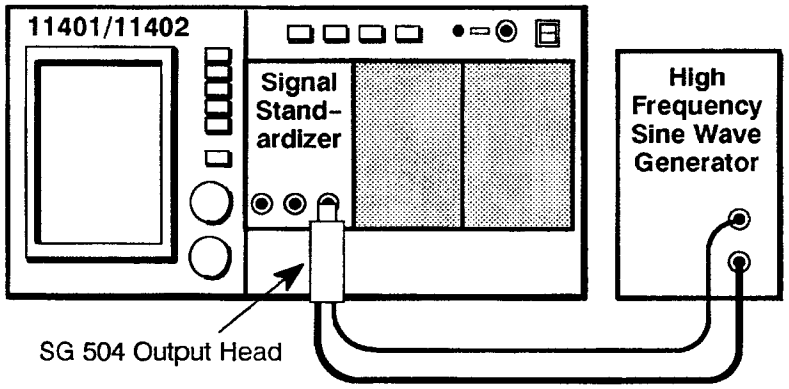
Description

A reference frequency of 6 MHz is set to a displayed amplitude of 6 divisions. The reference frequency is increased to (500 MHz for the 11401 or 1 GHz for the 11402) and the displayed amplitude is checked for at least 5.16 div or 4.94 div, respectively.

Specification

11401: Frequency = 500 MHz, Relative Amplitude = -1.21 dB (0.860)
11402: Frequency = 1000 MHz, Relative Amplitude = -1.69 dB (0.823)

Setup



First Initialize the oscilloscope settings, then perform the following in the order listed:

11401/11402 Oscilloscope Mainframe

Def Wfm ..... Left

Measurements menu ..... **Peak-Peak**

Signal Standardizer

Test Vert or Horiz ..... Freq Resp

High Frequency Sine Wave Generator

Reference Frequency ..... 6 MHz

Amplitude ..... Set to turn on the Signal Standardizer CW Leveled light.

Procedure

a. Position the waveform to the screen center and adjust the displayed amplitude to 6 divisions (6 V peak-peak readout) using the Signal Standardizer Position and Amplitude controls.

b. Set the High Frequency Sine Wave Generator to 500 MHz (11401) or 1 GHz (11402).

c. ***CHECK***—that the peak-peak voltage readout on the screen is at least 5.16 division (11401) or 4.94 division (11402).

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

Part 12b — Mainframe Bandwidth: Functional Test Procedure

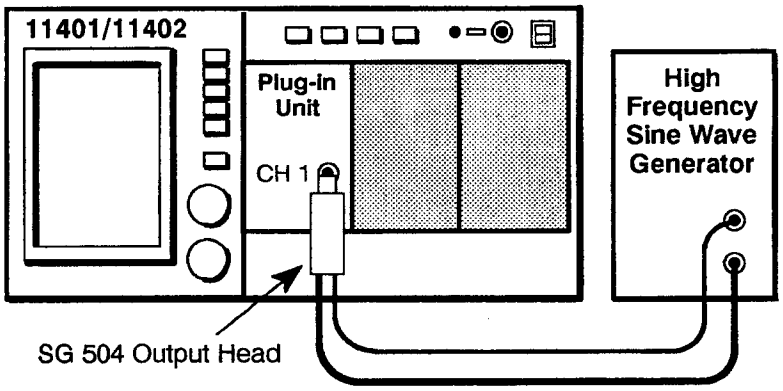
Description

This part shows the setup and lists the procedure to functionally test the bandwidth of the oscilloscope. You should only perform this part if you are performing a functional test. Otherwise, perform Part 12a, Mainframe Bandwidth: Performance Verification Procedure, and then proceed to Part 13, A/D Converter Linearity.

Measurement Limits

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

Setup



First Initialize the oscilloscope settings, then perform the following in the order listed:

Plug-in Unit

CH 1 display on/off ..... On

High Frequency Sine Wave Generator

Frequency ..... Ref

11401/11402 Oscilloscope Mainframe

Impedance ..... **50 Ω**

Vert Size ..... 200 mV/div

MEASURE button ..... press

Measurements pop-up menu ..... **Peak-Peak**

Procedure

a. Set the High Frequency Sine Wave Generator output for a 1.2 V **Peak-Peak** measurement.

b. Set the High Frequency Sine Wave Generator for variable-frequency output and the Frequency control to the maximum bandwidth frequency specified for the system under test. The **BW Limit** selector (press the WAVEFORM button) shows this upper limit for the plug-in unit under test.

c. Touch the horizontal icon, and then set the **Main Size** to 1 ns/division.

d. *EXAMINE*—that the **Peak-Peak** measurement readout is at least 848 mV (70.7% of the **Peak-Peak** measurement in step a of this part).

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

NOTE

In order to avoid a 20-minute warmup period, set the ON/STANDBY switch to STANDBY, move the amplifier to an adjacent compartment, and then set the ON/STANDBY switch to ON within 15 seconds. If the power is off longer than 15 seconds, the oscilloscope will cool, and another 20-minute warmup will be required. If this occurs, wait 20 minutes with the power on and then perform the Enhanced Accuracy procedure (refer to Part 3, Enhanced Accuracy).

Part 13—A/D Converter Linearity

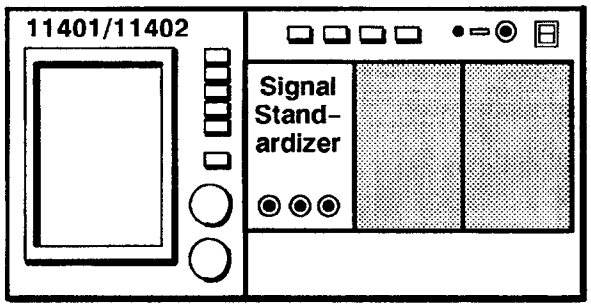
Description

Delta Voltage levels at the top, center, and bottom of a staircase waveform are matched against each other within a certain specification.

Specification

A/D converter linearity — Compression or expansion of a center screen 2 division signal positioned anywhere vertically within the graticule $\leq$2 LSBs. (2 LSBs of 200 LSBs = 1%).

Setup



First Initialize the oscilloscope settings, then perform the following in the order listed:

11401/11402 Oscilloscope Mainframe

Def Wfm ..... Left
Main Size ..... 200 ms/div
MEASURE button ..... press
Measurements ..... **Peak-Peak**

Signal Standardizer

Test ..... +Step Response
Rep Rate ..... 1 kHz

Procedure

a. Set the signal standardizer Position knob so that the top of the square wave is one division above the horizontal centerline.

b. Set the Signal Standardizer Amplitude so that the **Peak-Peak** reading is between 1.950 U and 2.050 U. Recorded Voltage _____.

NOTE

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

c. Set the Signal Standardizer Position knob so that the top of the square wave is four divisions above the horizontal centerline.

d. Wait ten seconds for the **Peak-Peak** reading to settle, then record the **Peak-Peak** reading. Recorded Voltage _____.

e. Set the Signal Standardizer Position knob so that the top of the square wave is two divisions below the horizontal centerline.

f. Wait ten seconds for the **Peak-Peak** reading to settle, then record the **Peak-Peak** reading. Recorded Voltage _____.

g. *CHECK*—the following:

The voltage recorded in step d minus the voltage recorded in step b is within ±0.020 U (±1% of 2 divisions)

The voltage recorded in step f minus the voltage recorded in step b is within ±0.020 U (±1% of 2 divisions)

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

Part 14—A/D Converter RMS Noise

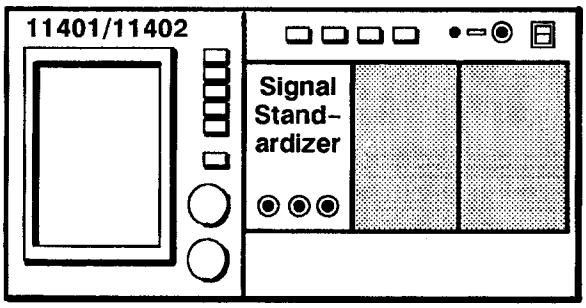
Description

RMS noise is measured using the RMS measurement function to measure the noise on the trace from that compartment.

Specification

A/D converter linearity noise (relative to full scale) ≤60 dB.

Setup



First Initialize the oscilloscope settings, then perform the following in the order listed:

11401/11402 Oscilloscope Mainframe

Def Wfm ..... **L–Avg (L)**

Measurements Menu ..... **RMS**

RMS label ..... touch

Data Interval ..... **whole zone**

Signal Standardizer

Test Vert or Horiz ..... Com Mode

Procedure

a. *CHECK*—that RMS readout on screen is ≤10 mV.

b. With the Signal Standardizer in the Left Compartment, repeat setup and check for the center and Right Compartments.

Part 15—Trigger Sensitivity at 500 MHz

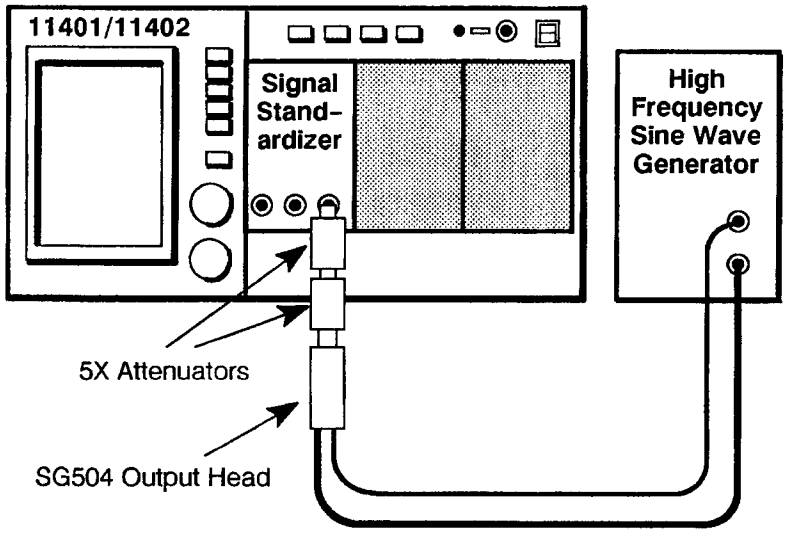
Description

Trigger sensitivity is verified using the specified output frequency and amplitude of a HF Sine Wave generator into a Signal Standardizer and checking for a screen-displayed trigger indicator.

Specification

Trigger Sensitivity—0.5 division from dc to 50 MHz, increasing to 1.5 division at 500 MHz.

Setup



First Initialize the oscilloscope settings, then perform the following in the order listed:

11401/11402 Oscilloscope Mainframe

Def Wfm ..... Left

Trigger

Mode ..... **Auto**

Coupling ..... **DC**

Level ..... **0 V**

Measurement ..... **Peak-Peak**

High Frequency Sine Wave Generator

Output Frequency ..... 500 MHz

Signal Standardizer

Test Vert or Horiz ..... Freq Resp

Amplitude ..... fully clockwise

Procedure

a. Set HF Sine Wave Generator output amplitude control for a screen-displayed peak-peak readout of 1.5 V.

b. Set the Signal Standardizer to Test Trigger Freq Resp.

c. *CHECK*—that the "**not**" display above the **trig'd** icon can be extinguished by rotating the Signal Standardizer Position control.

Part 16a — Time Base:
Performance Verification Procedure

Description

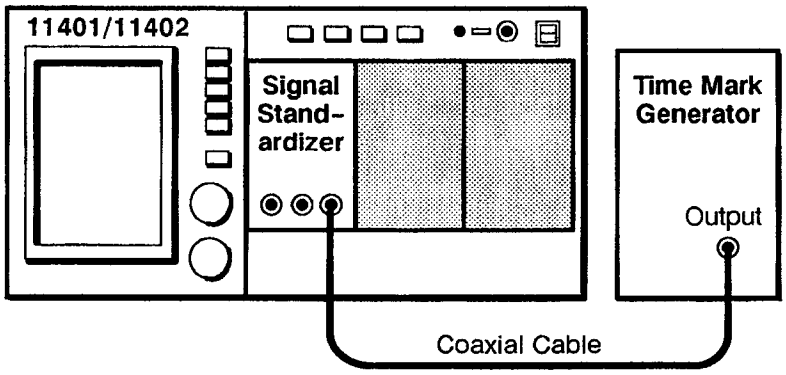
The time base accuracy is checked by setting the horizontal size/marker generator to 1 ns/5 μs and checking that the Period readout is within the stated limits.

Specifications

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

Check Time Base Accuracy

Setup



First Initialize the oscilloscope settings, then perform the following in the order listed.

11401/11402 Oscilloscope Mainframe

Def Wfm ..... Left
Horizontal Size ..... 1 ns/division
Main Trigger Mode ..... Auto

Time Mark Generator

Marker(Sec) ..... 5 ns

Signal Standardizer

Vert or Horiz ..... Freq Resp
Amplitude ..... Adjust for ≈6 division display

1 ns/Division Accuracy

Procedure

a. Adjust Trigger Level and Holdoff for stable display.

b. Set the **Acquire Desc** (Description), **Average N** to **On**.

c. Select the Measurement Function **Period**.

d. *CHECK*—that the **Period** result is 5 ns ±0.1 ns.

e. Set the **Acquire Desc** (Description), **Average N** to **Off**.

5 μs/Division Accuracy

Procedure

a. Set Main Size to 5 μs/division. Set Main Pos to 0 Sec. Ignore the main waveform in the following steps, as it will appear unstable.

b. Select the **Window 1** label.

c. Set the **Window1 Pos** (Position) to 0 seconds.

d. Select the Main waveform by pressing the WAVEFORM button, selecting the **Page to All Wfms Status** label, then selecting the **1:L1 Main** label. Return to the normal Waveform menu by selecting the **Page to Single Wfms Status** label.

e. Select the **Window 2** label.

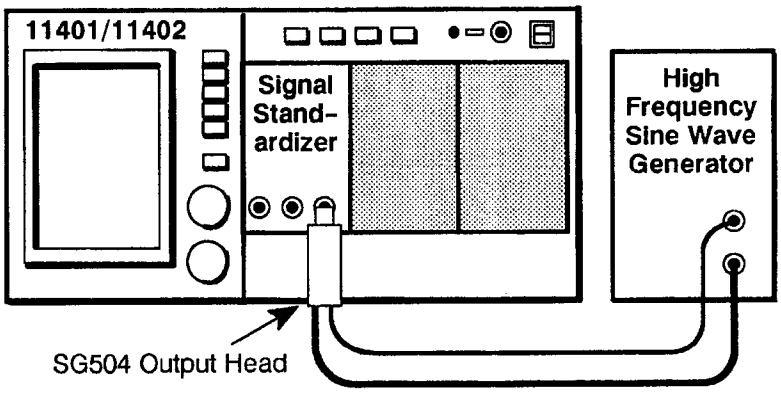
f. Set the **Window2 Pos** (Position) to 50 μs.

g. Set the **Window Size** to 1 ns/division.

h. *CHECK*—that the horizontal positions of the two waveforms match within 1 ns. Use vertical **Trace Sep** (separation) to reposition a Window waveform and make the difference easier to see.

Check Window Position Accuracy

Setup



First Initialize the oscilloscope settings, then perform the following in the order listed.

11401/11402 Oscilloscope Mainframe

Def Wfm ..... Left
Main Size ..... **2 ns/div**
Trigger
Mode ..... **Auto**
Slope ..... – (negative)
Level **0**

Signal Standardizer

Vert or Horiz ..... Freq Resp

High Frequency Sine Wave Generator

Frequency ..... 333 MHz (approx)

Procedure

a. Set the HF Sine Wave Generator and Signal Standardizer Amplitude controls to illuminate the CW Level indicator on the Signal Standardizer.

b. Set the HF Sine Wave Generator and Signal Standardizer Amplitude controls for an ≈6 division signal centered on the screen.

c. Set the mainframe Holdoff control knob for a stable display (use **Fine Resolution**).

d. Set the **Average N** to **On**.

e. Select the delay measurement, then touch the **Delay** label, and the **Left Limit** label.

f. Set the Left Limit knob to position the limit line on the signals first negative peak.

g. Set the Right Limit knob to position the limit line on the signals sixth positive peak (intensified zone of 5 complete cycles).

h. *CHECK*—set the HF Sine Wave Generator frequency control for a Delay readout on the screen of 15 ns, within the limits of 14.99 ns and 15.01 ns.

i. Set the Right Limit knob to display an intensified zone of 6 complete cycles.

j. *CHECK*—the Delay readout on the screen is within the limits of 17.9 ns and 18.1 ns.

k. *CHECK*—set the Right Limit and check the Delay readout as shown in Table 2–5.

TABLE 2–5
Main Delay Readout

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

l. Touch the **Window 1** label on the screen.

m. Set the **Window Size** knob to **2 ns/div.**

n. Select the Delay Left and Right Limits.

o. Set the Left and Right Limits to display 6 intensified cycles.

p. *CHECK*—the Delay readout on the screen is within the limits of 17.9 ns and 18.1 ns.

q. *CHECK*—the Delay readout as shown in Table 2–6.

TABLE 2–6
Window Delay Readout

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

Part 16b — Time Base: Functional Test Procedure

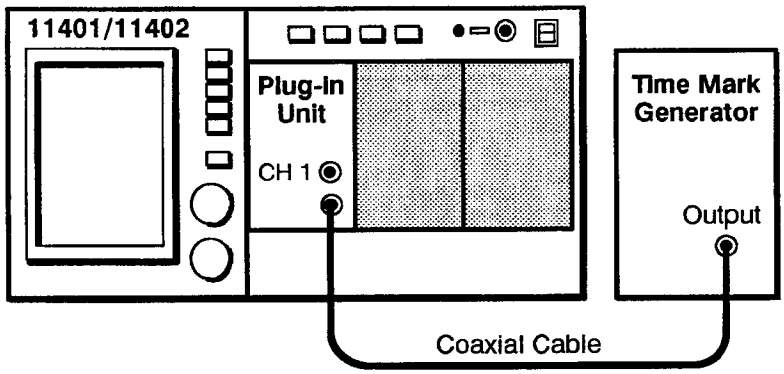
Description

This part shows the setup and lists the steps to functionally test the horizontal timing accuracy. You should only perform this part if you are performing a functional test. Otherwise, perform Part 16—Time Base: Performance Verification, and then proceed to Part 17—Check Events Window Position Accuracy.

Measurement Limit

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

Setup



First Initialize the oscilloscope settings, then perform the following in the order listed.

Time Mark Generator

Marker(Sec) ..... 5 ns

Plug-in Unit

CH 1 display on/off ..... On

11401/11402 Oscilloscope Mainframe

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

1 ns/Division Accuracy

Procedure

a. Press the MEASURE button, and then touch **Measurements**.

b. Touch **Period** in the **Measurements** pop-up menu.

c. *EXAMINE*—that the **Period** reading is 5 ns ±100 ps (the 0.002% of the measurement interval is negligible).

d. Press the WAVEFORM button, and then touch **Acquire Desc**.

e. Set **Average N** to **Off** in the **Acquire Description** pop-up menu.

5 μs/Division Accuracy

Procedure

a. Touch the horizontal icon, and then set **Main Size** to 5 μs/div. (Ignore the main waveform in the following steps, since it will appear unstable.)

b. Touch **Window 1**.

c. Set the **Window1 Pos** to 0 s.

d. To select the main waveform perform the following:

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

e. Touch **Window 2**.

f. Set the **Window2 Pos** to 50 μs.

g. Set the **Window Size** to 1 ns/div.

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

Part 17—Check Events Window Position Accuracy

(11401 SN B02XXXX & Above) (11402 SN B02XXXX & Above)

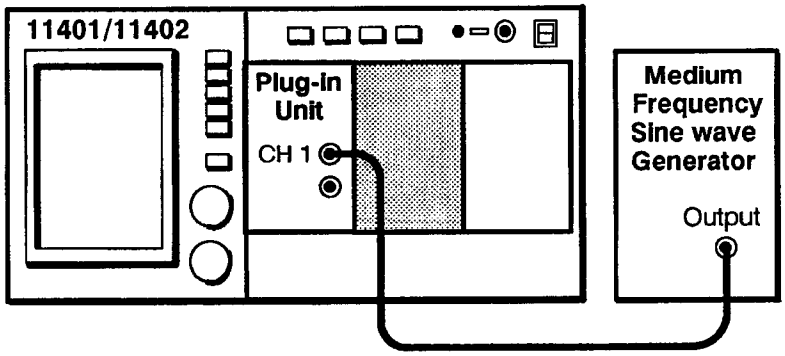
Description

Triggering events on the screen are counted with relation to an equal number set by the Events Holdoff Control knob.

Specification

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

Setup



First Initialize the oscilloscope settings, then perform the following in the order listed:

Amplifier

Channel 1 display on/off ..... On

11401/11402 Oscilloscope Mainframe

Vert Size: L1 ..... **500 mV/div**

Main Size ..... **10 ns/div**

Trigger

Mode ..... **Auto**

Coupling ..... **DC**

Trigger Level knob ..... **0 V**

Medium Frequency Sine Wave Generator

Frequency ..... 150 MHz

Amplitude ..... Approx 6 div display

11401/11402 Oscilloscope Mainframe

Window1 icon ..... touch

Window Holdoff Md ..... **Holdoff by Events Triggered from Window**

Procedure

a. Set the **Window1 Pos** knob to **0s**.

b. Touch the **trig'd** icon, and set the **Events Holdoff** knob to 1.

c. Set the Window Trigger **Coupling** to **DC**.

d. Set the Window **Trig Level** to **0 V**.

e. ***CHECK***—that the two trigger indicator arrows on the waveform are one cycle apart.

f. Set the Events Holdoff knob to 2.

g. ***CHECK***—that the two trigger indicator arrows on the waveform are two cycles apart.

h. ***CHECK***—that each Events Holdoff knob setting from 3 to 10 reflect an equal number cycles between the trigger indicator arrows.

Part 18—Input/Output

Description

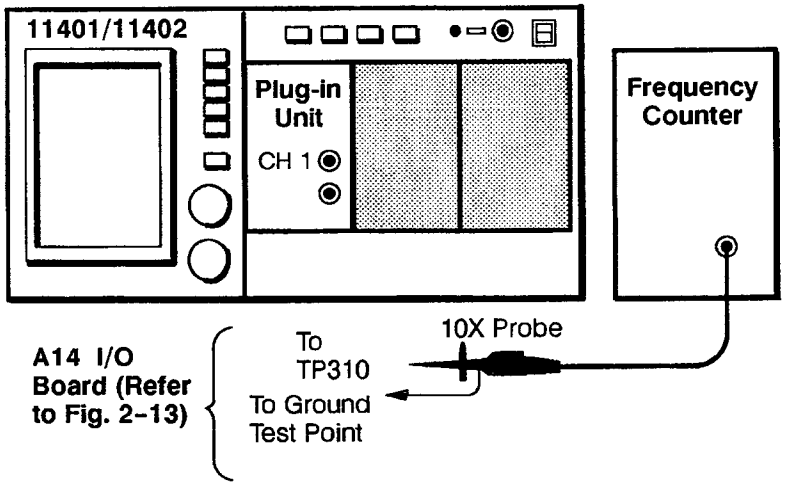
Real time clock frequency is measured using a frequency counter. The temperature sensor voltage and voltage reference is measured with a digital voltmeter.

Measurement Limits

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

Examine/Adjust Real Time Clock (A14C510)

Setup



Perform the following in the order listed:

11401/11402 Oscilloscope Mainframe

a. Set the 11401/11402 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 top of card cage.

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

e. Remove the A14 I/O board and place in 3rd slot.

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

g. Reconnect cables to A14 I/O board.

h. Set the 11401/11402 front-panel ON/STANDBY switch to ON.

Frequency Counter

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

Amplifier

Not used in this part (warming up for a later part).

Procedure

a. Press the 11401/11402 UTILITY menu button.

b. Select **Extended Diagnostics** from the menu/status area and **Internal I/O** from the Block menu.

c. Select **Realtime Clk** from the Area menu and **Calibrate** from the Routine menu.

d. Select **Run**.

e. *EXAMINE*—the Frequency Counter reads within the limits of 1,000,050 µs and 999,995 µs.

DO NOT attempt to optimize the adjustment setting if the period is within the stated limits. Proceed to the Temperature Sensor Voltage Reference check.

f. *ADJUST*—Real Time Clock adjustment C510 for 1,000,000 µs.

g. Remove the Frequency Counter from the Power Module and install the Medium Frequency Sine Wave Generator in its place. This allows ample warmup time before it is needed.

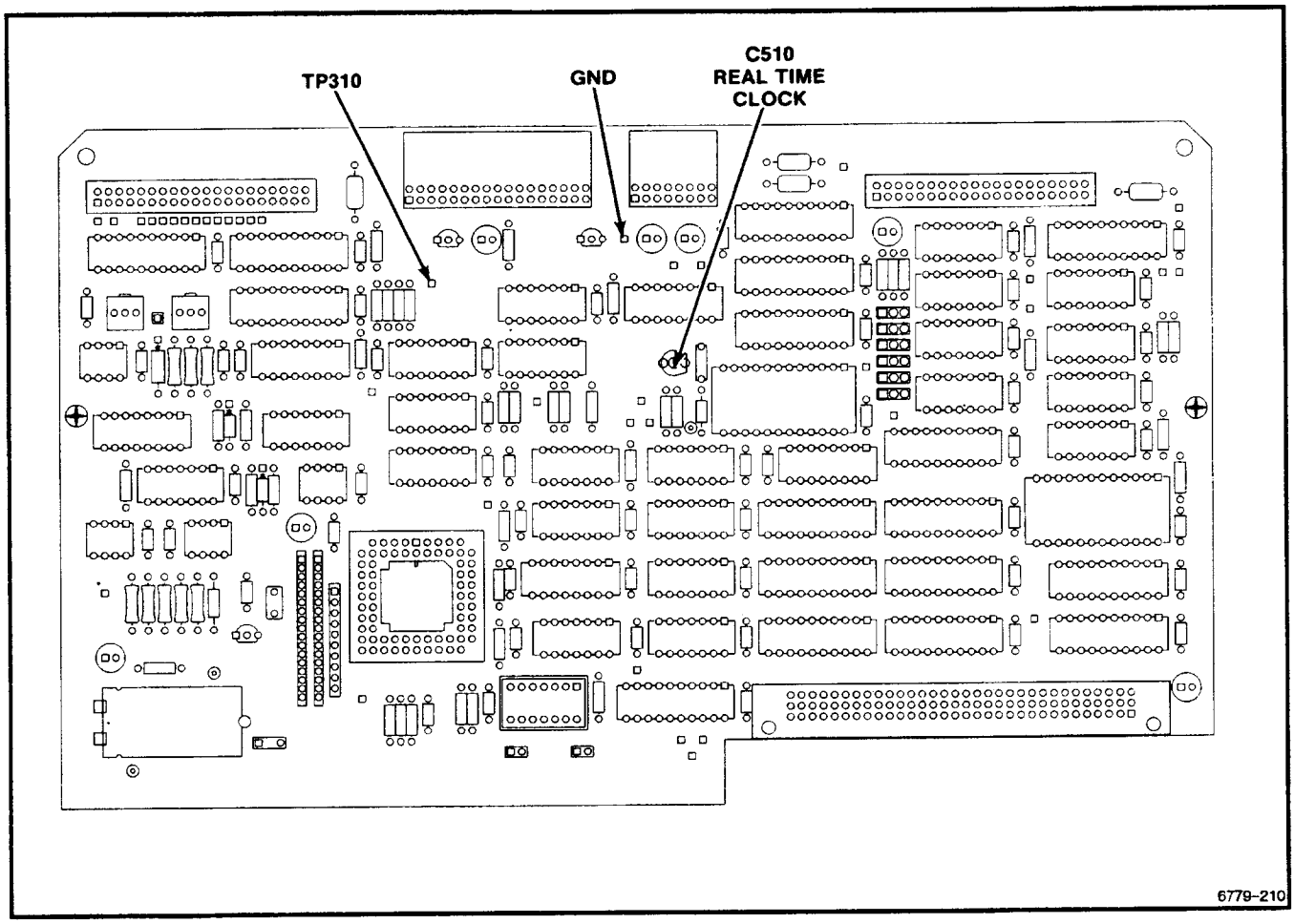
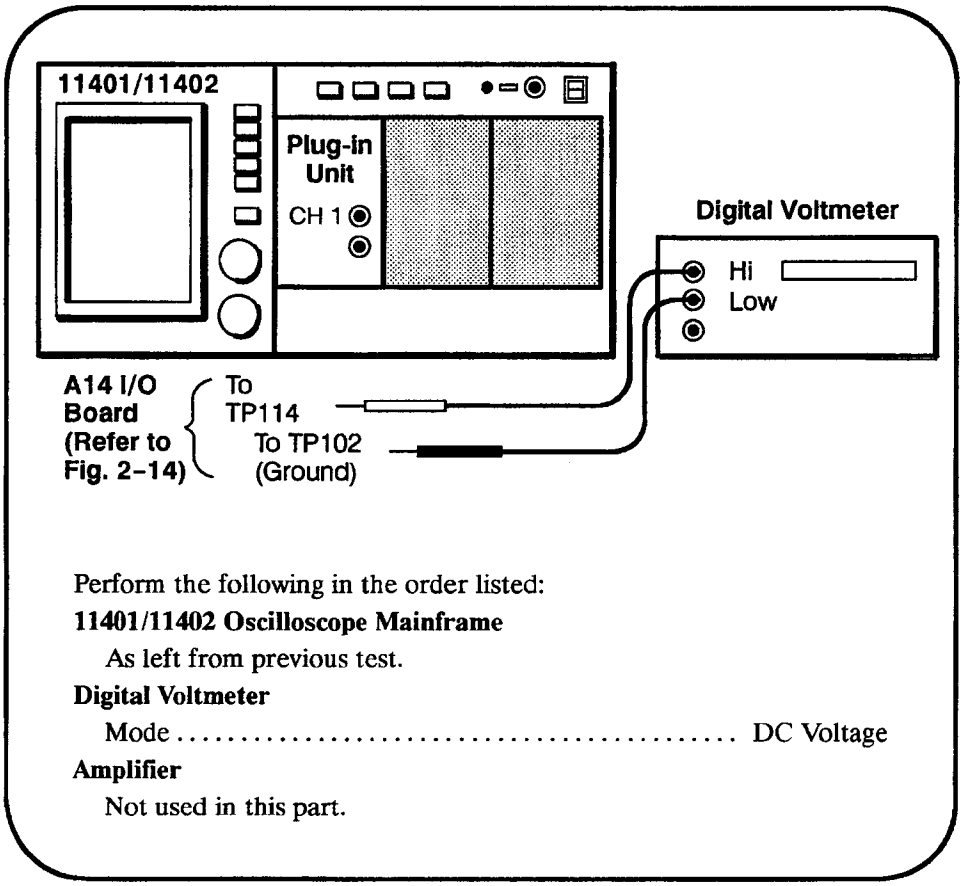


Figure 2–13. A14 I/O board (Real Time Clock) test point and adjustment locations.

Examine/Adjust Temperature Sensor Voltage Reference (A14R112)

Setup



Perform the following in the order listed:

11401/11402 Oscilloscope Mainframe

As left from previous test.

Digital Voltmeter

Mode ..... DC Voltage

Amplifier

Not used in this part.

Procedure

a. *EXAMINE*—the Digital Voltmeter reads within the limits +6.505 V and +6.495 V.

STOP

DO NOT attempt to optimize the adjustment setting if the Digital Voltmeter reading is within the stated limits. Proceed to Adjust Temperature Sensor.

b. *ADJUST*— +6.5 V REF adjustment R112 for +6.500 V.

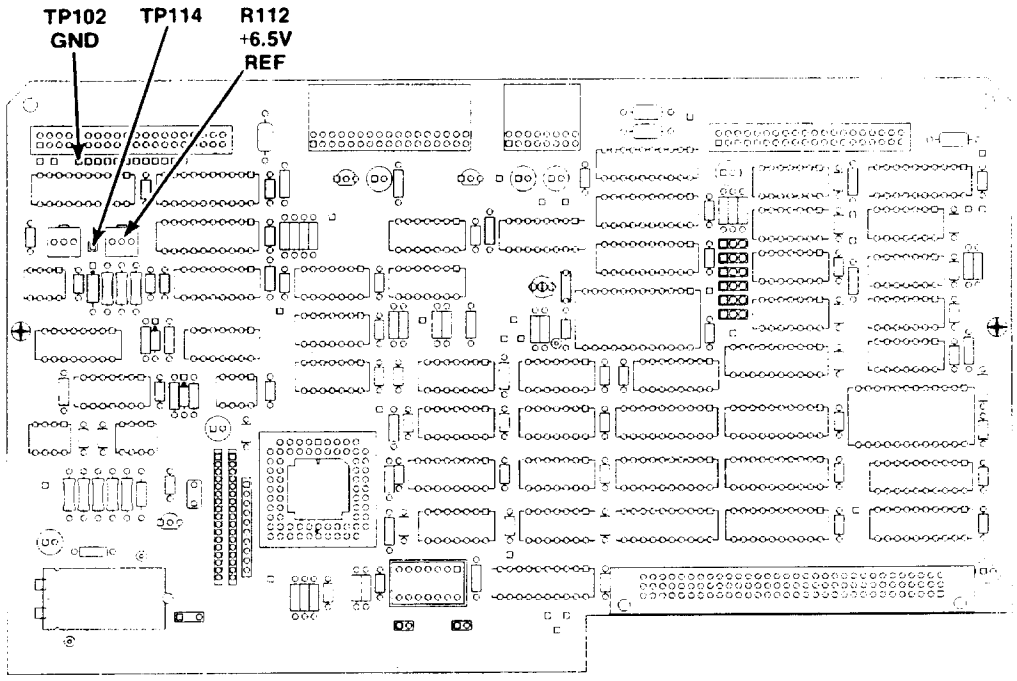
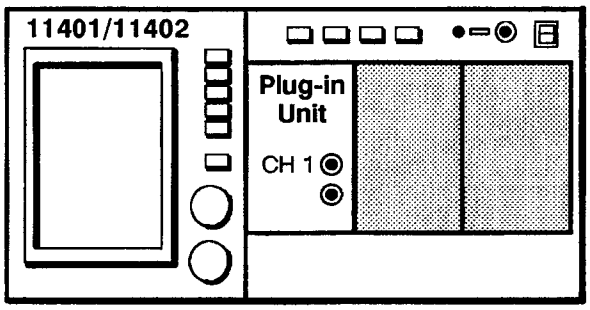


Figure 2-14. A14 I/O board (+6.5 V Reference) test point and adjustment locations.

Set Temperature Sensor (A14R110)

Setup



A14 I/O Board (Refer to Fig. 2–15)

Perform the following in the order listed:

11401/11402 Oscilloscope Mainframe

As left from previous test.

Amplifier

Not used in this part.

Procedure

a. Set R110 to the center of its range mechanically (see Fig. 2–15). Its position is not critical. (If this potentiometer is not present on the A14 I/O board, then no adjustment is necessary.)

b. Set the 11401/11402 front-panel ON/STANDBY switch to STANDBY.

c. Move all boards back to their original location, and replace the L bracket and plastic retaining strips.

d. Set the 11401/11402 front panel ON/STANDBY switch to ON.

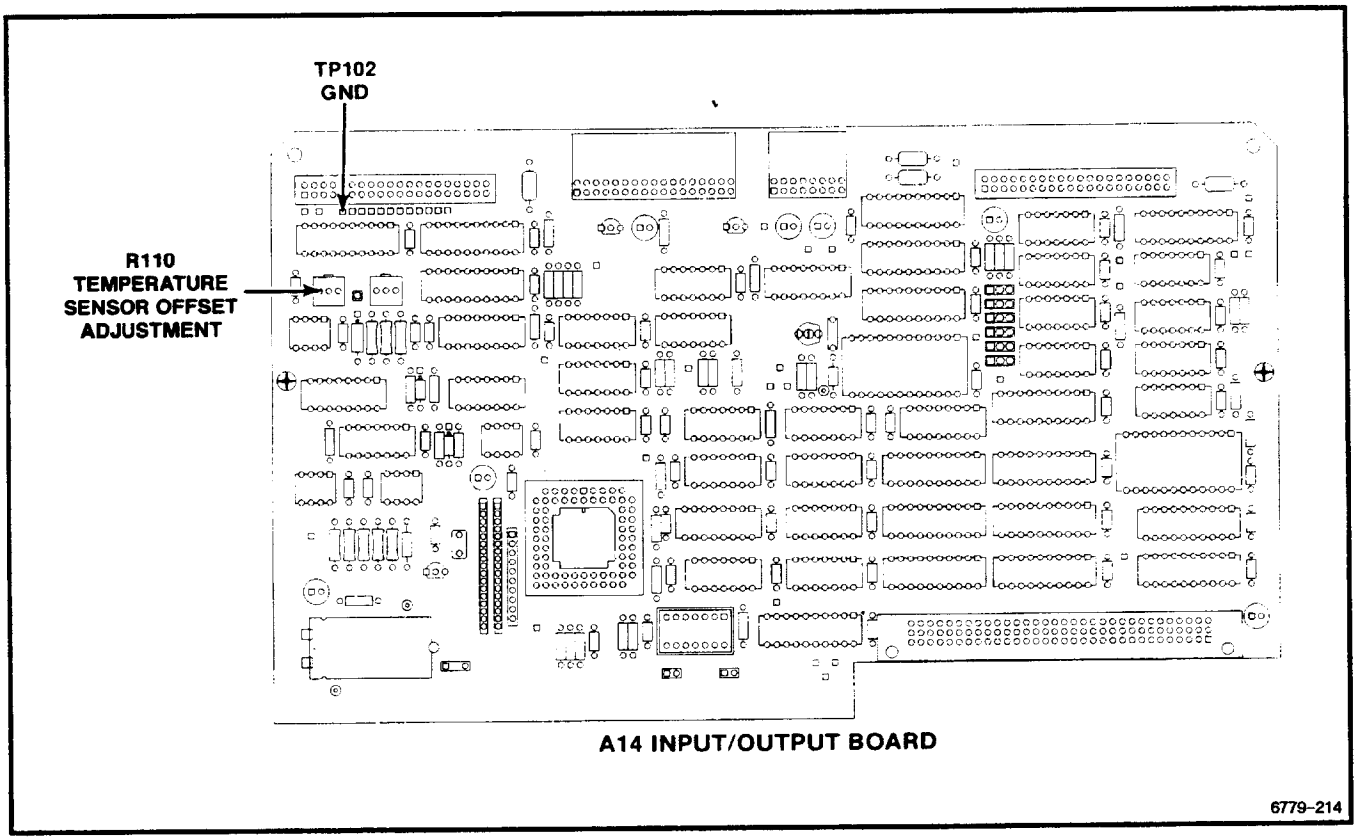


Figure 2–15. A14 I/O board (Temperature Sensor) test point and adjustment locations.

Part 19—Trigger Enhancement Adjustment

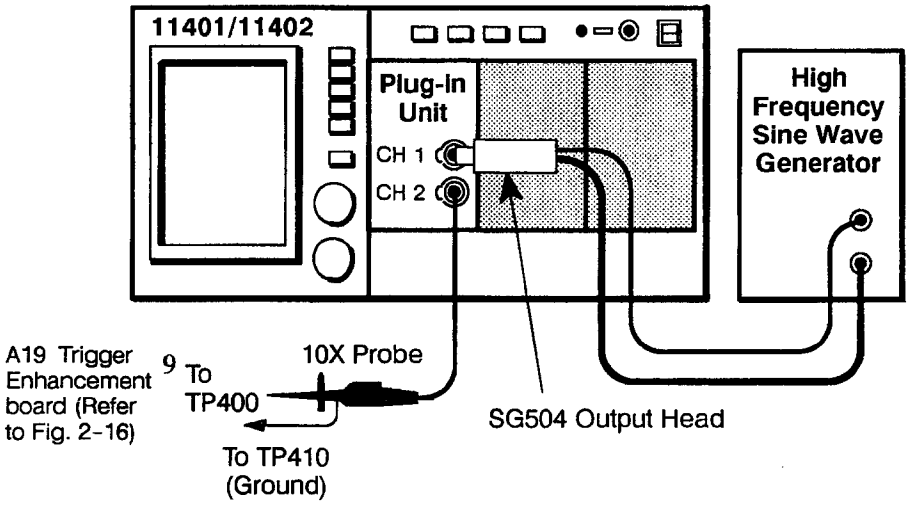
Description

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

Measurement Limit

Delay limit is 400 ps, ±80 ps.

Setup



a. Install a shorting strap across J3 on the Trigger Enhancement board (see Fig. 2–16).

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

Amplifier

Channel 1 display on/off ..... On
Impedance ..... **50 Ω**
Vert Size ..... **500 mV/div**

Amplifier

Channel 2 display on/off ..... On
Vert Size ..... **500 mV/div**
Vert Offset ..... **3 V**

11401 and 11402 Oscilloscope Mainframe

Main Size ..... **50 ns/div**
Main Record Length **512**
Window Record Length **512**

High Frequency Sine Wave Generator

Frequency ..... ≈500 MHz
Amplitude ..... ≈6 div

Procedure

a. Select the Channel 1 trace.

b. Select the **Window1** label.

c. Set the **Window1 Pos** knob to 400 ns.

d. Set the **Window1 Size** knob to 500 ps/div.

e. Set the HF Sine Wave Generator (**Fine**) frequency knob to a setting that displays spikes on the sine wave, then maximize the number of spikes displayed.

NOTE

The maximum number of spikes are achieved when the Channel 2 trace (main display) has the maximum number of transitions displayed.

f. Select the **Window1** cursors label.

g. Select the **Vertical Bar** cursors and **Fine** knob resolution.

h. Position the Cursor 1 Vertical Bar to the first rising zero crossing point on the sine wave.

i. Rotate the HF Sine Wave Generator (**Fine**) frequency knob counterclockwise (lowers frequency) through a null of the channel 2 transitions to the next maximum number of displayed transitions.

j. Set Cursor 2 Vertical Bar to the position on the sine wave that was previously occupied by Cursor 1.

k. *EXAMINE*—that the Cursor **Δt** readout on the screen is 400 ps, within the limits of 320 ps and 480 ps.

STOP

DO NOT attempt to optimize the adjustment setting if the Cursor **Δt** readout is within the stated limits. Remove Shorting strap and probe. Proceed to Part 20—Triggering.

l. Set the **Window1 Pos** knob to 0 s.

m. Set the **Main Holdoff** knob to 490.5 ns.

n. Set the HF Sine Wave Generator (**Fine**) frequency knob to a setting that displays spikes on the sine wave, then maximize the number of spikes displayed.

o. Set **Main Holdoff** to 490 ns.

p. *ADJUST*—C200 to obtain the most transitions between the high and low logic level on the CH 2 signal (this display is not triggered).

q. Set **Main Holdoff** to 490.5 ns.

r. Set the HF Sine Wave Generator (**Fine**) frequency to obtain the most transitions on the Channel 2 signal.

s. Set **Main Holdoff** to 490 ns.

t. *ADJUST*—C200 slightly to obtain the most transitions on the Channel 2 signal.

u. Remove the shorting strap and 10X probe.

v. Set the HF Sine Wave Generator (**Fine**) frequency knob from end to end and observe that no spikes appear on the sine wave.

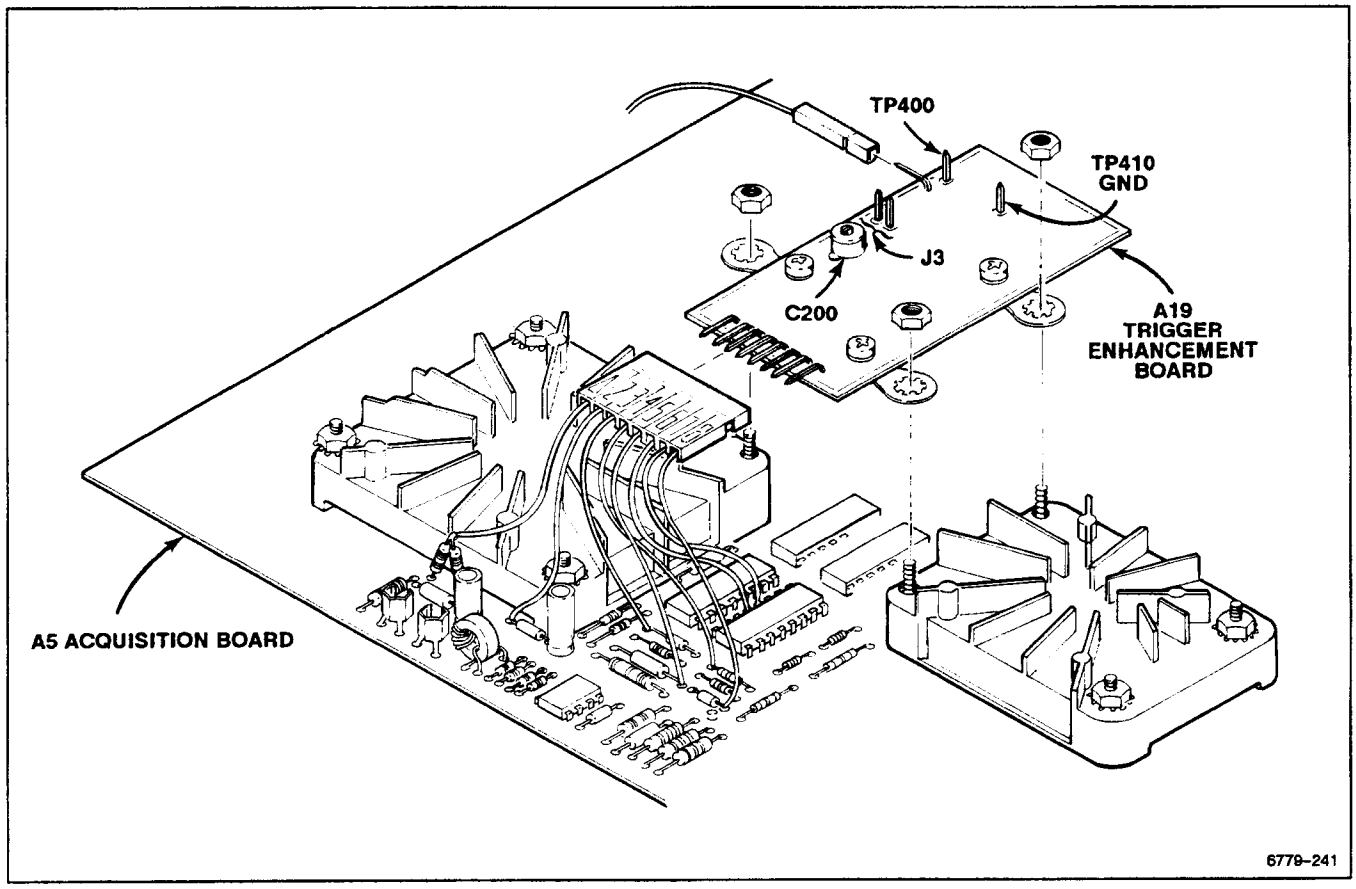


Figure 2–16. A19 Trigger Enhancement board test point and adjustment locations.

Part 20—Triggering

Description

The trigger voltage is set to various values and is checked using the cursors readout on the screen.

Specifications

Trigger level dc accuracy within 2% of full scale (20 LSBs).

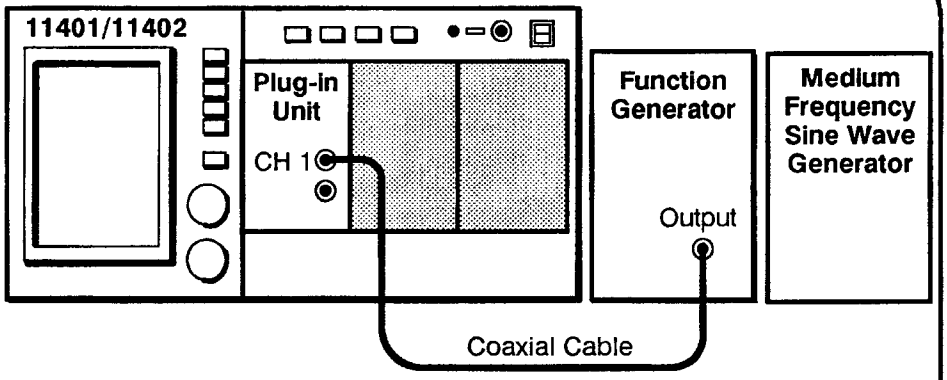
AC and DC noise-reject coupled—1.2 divisions or less from dc to 50 MHz, increasing to 3 divisions at 500 MHz.

AC coupled—0.5 divisions from 60 Hz to 50 MHz, increasing to 1.5 divisions at 500 MHz. Attenuates signals below 60 Hz.

AC & DC HF reject coupled—0.65 divisions from dc to 30 kHz.

LF reject coupled—0.65 division from 80 kHz to 50 MHz, increasing to 1.5 divisions at 500 MHz.

Setup



a. First perform the Part 3—Enhanced Accuracy procedure at the beginning of this section.

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

Amplifier

Channel 1 display on/off ..... On

11401/11402 Oscilloscope Mainframe

Input impedance ..... 50 Ω

Vertical Size ..... 100 mV/division

Main Size ..... 100 µs/division

Main Position ..... 0 seconds

Trigger menu, Main Trigger Coupling ..... DC

Main Trigger Mode ..... Auto

Main Trigger Level ..... 0 V

Store Current Settings ..... Setting 1

Function Generator

Waveform ..... triangular

Frequency ..... 1 kHz

Amplitude ..... 10 division signal

11401/11402 Oscilloscope Mainframe

Main Size ..... 50 µs/div

Acquire Description ..... Average N to On

Cursors icon ..... touch

Trigger icon ..... touch

Trigger Level Resolution ..... Course

Trigger Level ..... 400 mV

Medium Frequency Sine Wave Generator

Not used yet.

Check Trigger Level DC Accuracy

Procedure

a. *CHECK*—that the cursor readout is V1 = 400 mV, ±20 mV.

b. Set the Trigger Level to -400 mV.

c. *CHECK*—that the cursor readout is V1 = -400 mV, ±20 mV.

d. Set the Main Size to 100 µs/division.

e. Select the Window 1 label, then set the Window 1 Pos to 0 seconds.

f. Set the Window Holdoff Mode to Holdoff by Time Triggered from Window.

g. Touch the Trigger Select label to select the Window trigger.

h. Set the Window Trigger Coupling to DC.

i. Select the Cursors label.

j. Select the Trigger Icon, then set the Window 1 Trigger level to 400 mV.

k. *CHECK*—that the Cursor readout is V1 = 400 mV, ±20 mV.

l. Set the Window 1 Trigger Level to -400 mV.

m. *CHECK*—that the Cursor readout is V1 = -400 mV, ±20 mV.

Check 50 MHz Sensitivity

Procedure

a. Connect the MF Sine Wave Generator through a 5X attenuator to the CH 1 input connector.

b. Set the MF Sine Wave Generator frequency to 50 MHz.

c. Recall the stored Setting 1 (stored in the Setup at the beginning of this part).

d. Set the Main Size to 10 ns/division.

e. Adjust the generator output for a Peak-Peak measurement of 50 mV.

f. *CHECK*—that you can adjust the Trigger Level and achieve a stable display (use **Fine Resolution**).

g. Select the window 1 label.

h. Set Window Size to 10 ns/division.

i. Set the Window Holdoff Mode to Holdoff by Time Triggered from Window.

j. Touch the Trigger Select label to select the Window trigger.

k. *CHECK*—that you can adjust the Window Trigger Level and achieve a stable display.

Check DC Noise Reject

Procedure

a. Adjust the generator output for a Peak–Peak measurement of 120 mV.

b. Select the Window Trigger, then set its coupling to DC Noise Reject.

c. ***CHECK***—that you can adjust the Window Trigger Level and achieve a stable display.

d. Select the Main Trigger, then set its coupling to DC Noise Reject.

e. ***CHECK***—that you can adjust the Main Trigger Level and achieve a stable display.

Check DC Coupling

Procedure

a. Connect the coaxial cable from the Amplifier CH 1 input to the mainframe CALIBRATOR output connector.

b. Select the UTILITY button.

c. Select the Probes menu, then select L1 this dekews the system).

d. Recall the stored Setting 1 (stored in the Setup at the beginning of this part).

e. Set the MF Sine Wave Generator output to its 50 kHz Reference frequency.

f. Adjust the generator Output Amplitude for a Peak–Peak measurement of 600 mV.

g. Set the Main Size to 2 µs/division.

h. Adjust the Main Position to position the trigger indicator (arrow) to the center vertical graticule line (–10.2 µs readout).

i. ***CHECK***—that the rising portion of the sine wave crosses the center of the screen, ±0.2 divisions.

j. Adjust the Vertical Offset to move the waveform above and below its original position and CHECK that the trigger indicator (arrow) remains at the same level, at the center of the screen.

k. Set the Vertical Offset control for 0 V readout.

Check DC HF Reject

Procedure

a. Set the Trigger Coupling to DC HF Reject.

b. *CHECK*—that the waveform moved left of the trigger indicator (arrow) between 0.5 and 2.0 divisions.

Check AC LF Reject

Procedure

a. Set the trigger Coupling to AC LF Reject.

b. *CHECK*—that the trigger indicator (arrow) disappears and that the zero crossing of the positive-going edge of the waveform now appears between 0.5 and 2.0 divisions to the right of the center vertical graticule line.

Check AC Coupling

Procedure

a. Set the Trigger Coupling to AC.

b. Adjust the Vertical Offset and note the waveform remains triggered at the same point regardless of the vertical offset.

Section 3
Maintenance

This section of the manual contains information for performing preventive maintenance and corrective maintenance for the 11401/11402 Digitizing Oscilloscopes.

Preventive Maintenance

Preventive maintenance, performed regularly, can prevent instrument breakdown and may improve the reliability of the instrument. The severity of the environment to which the instrument is subjected will determine the frequency of maintenance. A convenient time to perform preventive maintenance is preceding electrical adjustment of the instrument.

Cabinet Panel Removal

WARNING

Dangerous potentials exist at several points throughout this instrument. When the instrument is operated with the covers removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect power before cleaning the instrument or replacing parts.

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

Cleaning

The 11401/11402 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket and prevents efficient heat dissipation. It also provides an electrical conduction path which may result in instrument failure. The side panels reduce the amount of dust reaching the interior of the instrument. Keep the side panels in place for safety and cooling.

CAUTION

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

Exterior

Loose dust accumulated on the outside of the instrument can be removed with a soft cloth or small brush. The brush is also useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened in a mild detergent and water solution. Do not use abrasive cleaners.

Crt

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

Interior

Cleaning the interior of the instrument should seldom be necessary. The best way to clean the interior is to blow off the accumulated 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.

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 this area may cause high-voltage arcing and result in improper instrument operation.

Visual Inspection

The 11401/11402 should be inspected occasionally for such defects 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. Overheating usually indicates other trouble in the instrument; therefore, correcting the cause of overheating is important to prevent recurrence of the damage.

Periodic Electrical Adjustment

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

Corrective Maintenance

Corrective maintenance consists of module replacement for instrument repair. Special techniques required to replace modules in the 11401/11402 Digitizing Oscilloscope mainframes are given here.

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 any disassembly.

An electric–shock hazard exists when the 11401/11402 is NOT grounded. Do not remove the ground wire (green–yellow) that connects the power supply chassis to the mainframe.

Ordering Parts

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

1. Instrument type
2. Instrument serial number
3. A description of the part
4. Tektronix Part Number

Static-Sensitive Device Classification

CAUTION

Static discharge can damage any semiconductor component in this instrument.

This instrument contains electrical components that are susceptible to damage from static discharge. See Table 3-1 for the relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

TABLE 3-1
Relative Susceptibility to Damage From Static Discharge

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 ohms.)

Observe the following precautions to avoid damage:

1. Minimize handling of static-sensitive components.
2. 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.

3. 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 use of the Static Control Mat, Tektronix Part Number 006-3414-00, and Wrist Strap, Tektronix Part Number 006-3415-00.

4. Allow nothing capable of generating or holding a static charge on the work station surface.

5. Keep the component leads shorted together whenever possible by storing them in conductive foam or rails.

6. Pick up components by the body, never by the leads.

7. Do not slide the components over any surface.

8. Avoid handling components in areas that have a floor or work-surface covering capable of generating a static charge.

Removing and Replacing FRUs

WARNING

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

The exploded-view drawings associated with the Replaceable Parts list may be helpful in the removal or disassembly of individual Field Replaceable Units (FRUs) or subassemblies.

The top and/or bottom covers will need to be removed for most repairs. Such removal is not mentioned in each procedure. As the covers would need to be removed before the individual circuit boards are located, it is assumed that they were off the instrument. Use a coin or a straight-slot screwdriver with a large-sized tip to loosen the cover fasteners. Rotating the fastener a quarter turn counterclockwise will loosen it.

Whenever a specific area is mentioned (such as the right side), it will usually be in reference to the front of the 11401/11402. If another reference is intended, it will be so described (such as the left side, as facing the rear).

NOTE

Refer to Table 3–2, "Checks Required After FRU Replacement," at the end of this section.

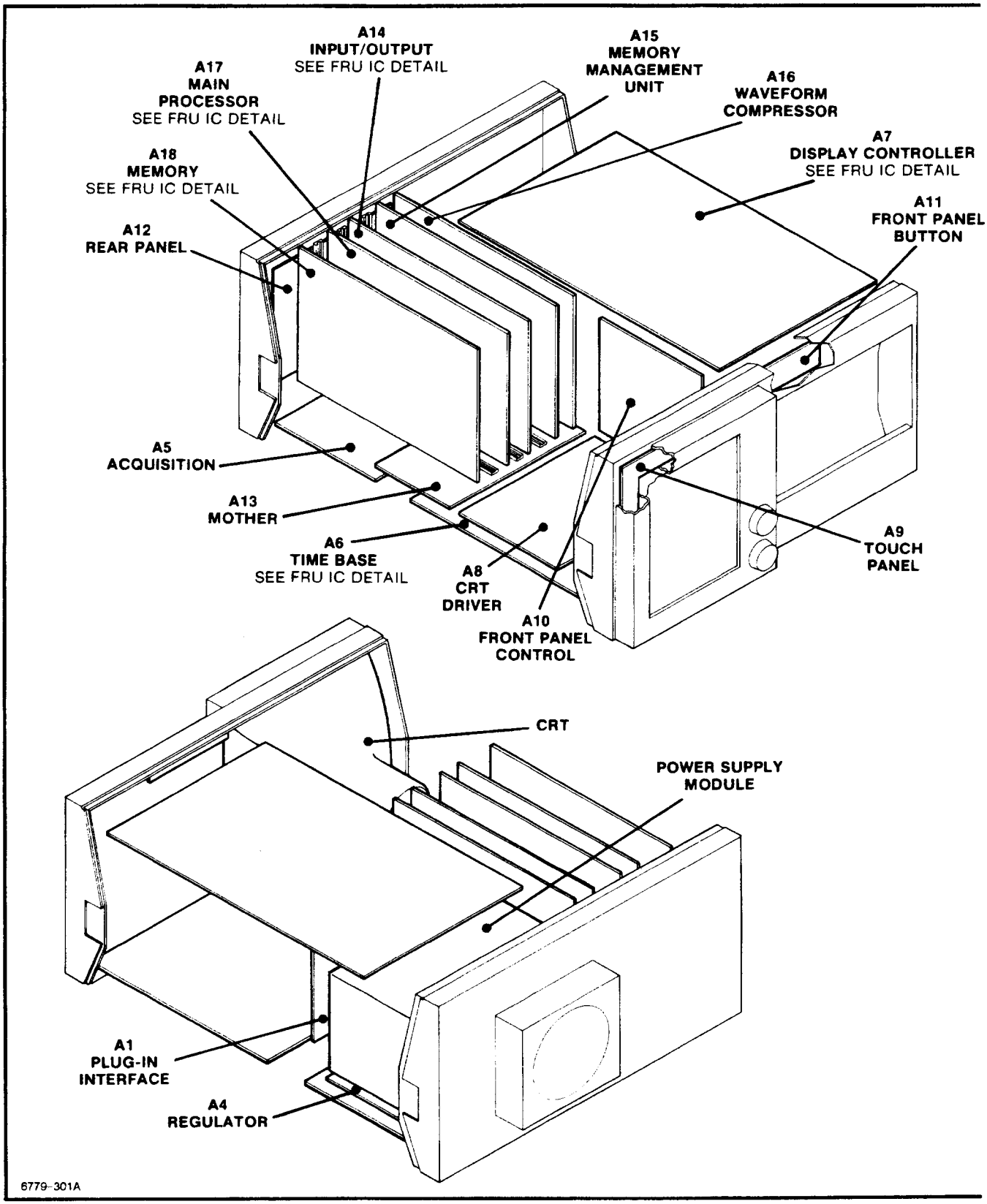


Figure 3–1. Field Replaceable Units (FRU) Locator.

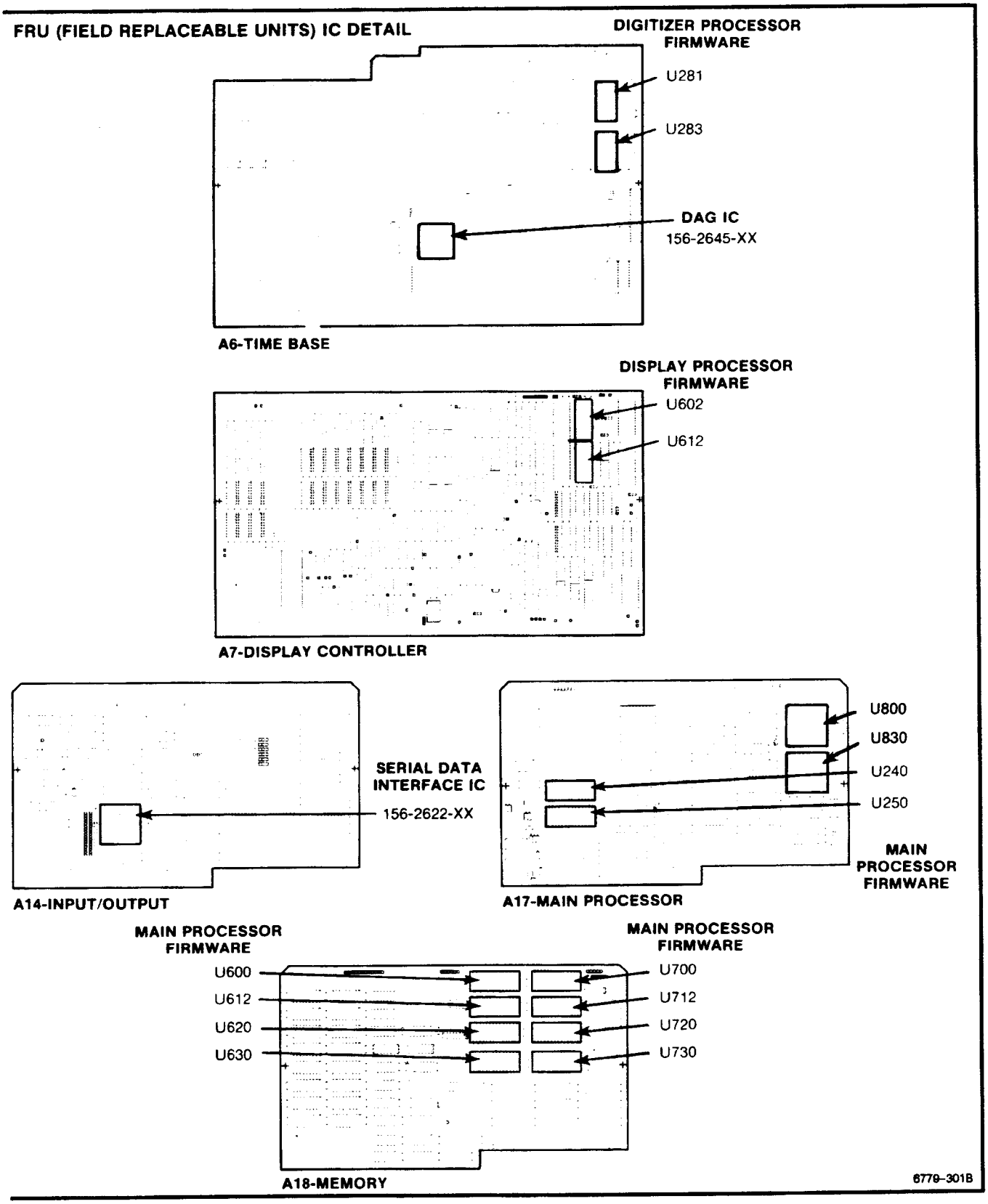


Figure 3–1 (cont). Field Replaceable Units (FRU) Locator.

Electrical Lock-on of the On/Standby Power Switch

Some applications of the 11401/11402 Digitizing Oscilloscope may require that the power remain on. To electrically lock on the power (disable the front-panel ON/STANDBY power switch), use the following procedure:

1. Switch the PRINCIPAL POWER SWITCH to OFF (rear panel). Remove the AC power cable.
2. Position the instrument on its left (handle) side, as facing the front.
3. Remove the bottom cover.
4. Locate the A4 Regulator board as shown in Figure 3–1.
5. Locate the J820 jumper on the A4 Regulator board (see Fig. 3–7).
6. Reposition the J820 jumper from its two outer (right side) pins to its two inner (left side) pins. Do not drop the jumper while moving it.
7. Replace the bottom cover. Turn the instrument right side up.
8. Reconnect the AC power cable and switch the PRINCIPAL POWER SWITCH to ON.

CAUTION

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

Do not install or remove a plug-in while the power is on. Doing so may damage the mainframe and/or the plug-in.

9. To turn the power off while the front-panel ON/STANDBY Power Switch is disabled, use the rear-panel PRINCIPAL POWER SWITCH.

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

Power Supply Module Removal

The Power Supply Module slides out of the rear of the 11401/11402 mainframe for maintenance and troubleshooting. It may also be removed to gain better access to the A1 Plug-In Interface board, or the A4 Regulator board.

To remove the Power Supply Module from the mainframe, proceed as follows:

1. Turn the mainframe on its left side (as viewed facing the rear panel). The Power Supply Module will now be at the bottom of the instrument.
2. Remove the eight Torx screws that secure the power supply (see Fig. 3–2).
3. Carefully pull the Power Supply Module part way out of the mainframe. Stop before the wires (to the A2A2 Control Rectifier board connectors) begin to stretch taut or bind.

CAUTION

Excessive pulling on the power supply beyond this point may damage connector pins.

NOTE

Record connectors' location for correct replacement. (See Fig. 3–3)

4. Remove the wire connectors from their pins on the A2A2 Control Rectifier board.
5. Remove the chassis ground (green-yellow) wire.
6. Remove the Power Supply Module.

To replace the Power Supply Module, follow the previous instructions in 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 mainframe.

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

Refer to Table 3–2, "Checks Required After FRU Replacement" at the end of this section.

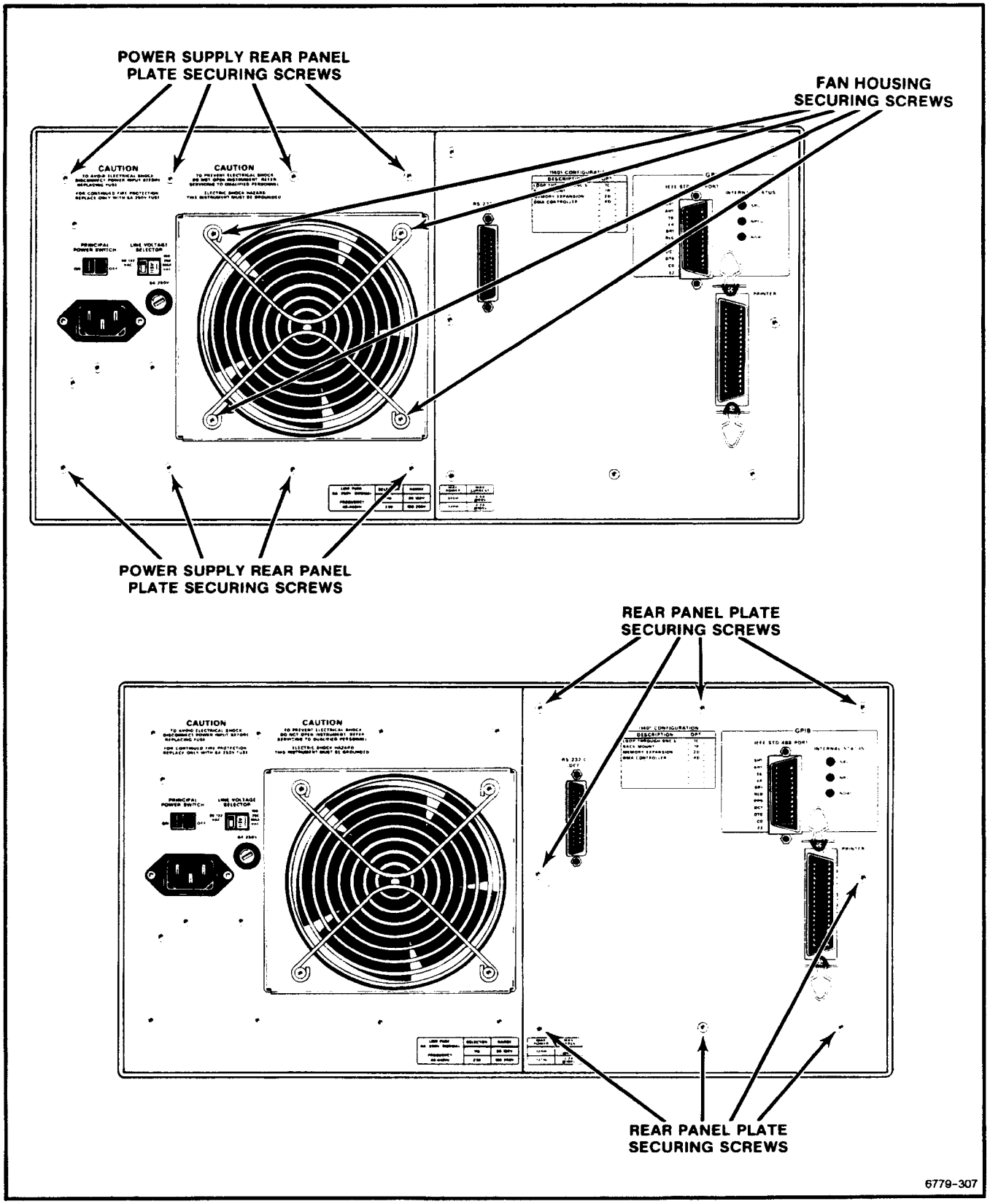


Figure 3-2. Rear panel location of screws securing the Power Supply Module and the rear panel plate.

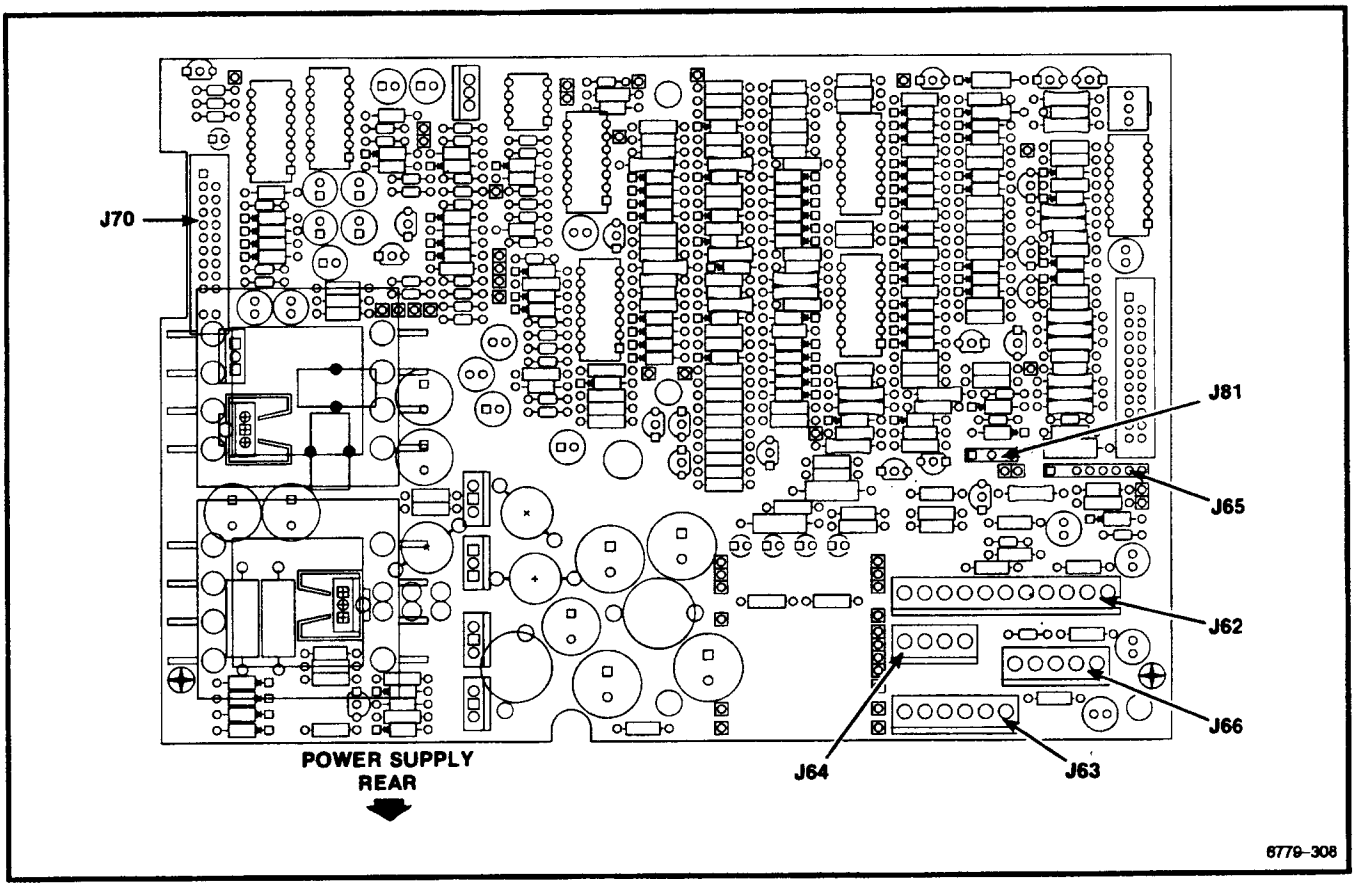


Figure 3-3. Bottom view of the A2A2 Control Rectifier board showing connector locations.

Fan Motor Removal

Remove and replace the fan motor as follows:

1. Using a pencil or tape, mark the top of the fan motor housing. (It reassembles only one way.) Remove the four screws holding the assembly together. (See Fig. 3–2.)
   - Hold the housing as the last screws are removed.
2. Separate the grill and the housing from the motor.
3. Remove the two wires at their motor connections.
   - Note that the red wire is (+) and the brown wire is (–).
4. Remove the fan motor.

NOTE

Observe the position in which the motor was mounted. Replace it the same way, or the fan wires may not reach.

5. To replace the fan motor, follow the removal procedure in reverse order.
   - Don't pinch the wires under the fan housing.
   - Tighten the screws securely. Remove the mark from the top of the housing.
   - Check that no wires contact the fan blades.

Cathode-Ray Tube Removal

Remove the cathode-ray tube (crt) as follows:

WARNING

The 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 crt.*

Use care when handling. 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. Otherwise, set it face down in a protected location. Be certain it is on a smooth surface with a soft mat under the crt faceplate.

1. Turn the 11401/11402 so that its front is at your right. Remove the two flat, Torx screws holding the crt shield to the chassis.
2. Lift up the outside of the shield.
   - The inner edge of the shield is held in place by two tabs. These 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 instrument's handle. At that point, remove the shield carefully. Don't allow it to strike the crt.

WARNING

Crt anode voltage is 12 kV. Ground the lead to the chassis to short any stored charge remaining in the crt.

Wait about ten minutes and ground the anode lead again.

3. Use a non-conducting tool to pry up the rubber cap of the anode lead. (It is on the upper part of the crt behind the front casting. See Fig. 3-4) 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.
4. Remove the base-pin socket from the rear of the crt.
5. Disconnect connector J54 from the A8 CRT Driver board. It is located on the right front side, as viewed facing the crt. (See Fig. 3-4.)

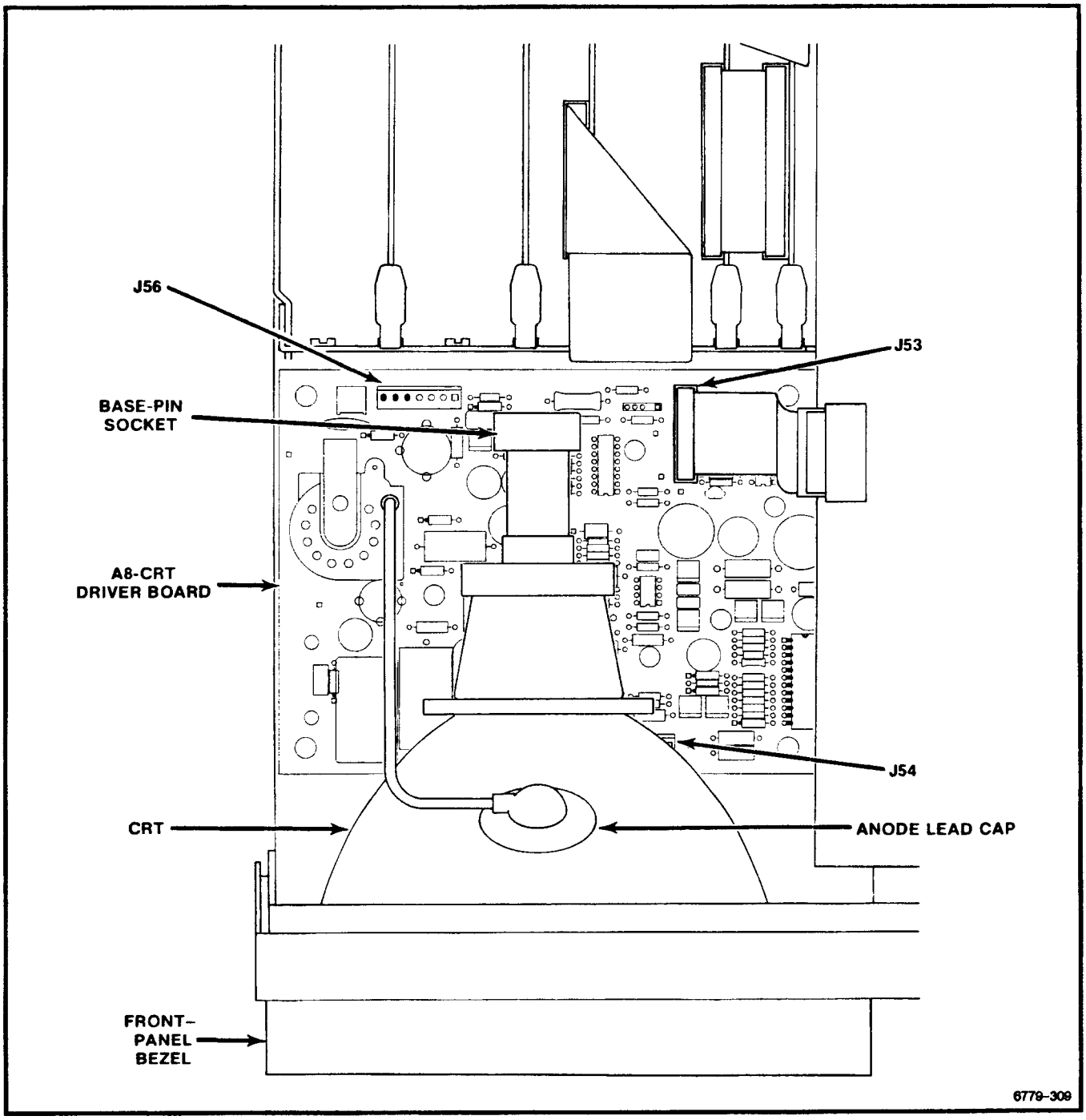


Figure 3-4. Top view of the crt and A8 CRT Driver board.

6. Turn the mainframe on its right side. The crt will be at the top.
7. Remove the two flat-head screws from the bottom of the bezel. Turn the mainframe right side up.
8. Remove the two Control knobs from the front of the bezel. (Use an Allen wrench to loosen the knob setscrews.)

9. Lift up on the bottom of the bezel and swing it outward.

NOTE

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

The wire cable from P73 on the A10 Front-Panel Control board may be removed (see Fig. 3–13). Disconnect connector P73 from the A10 Front-Panel Control board. Note the position of connector index triangles in order to correctly replace the connector. Carefully remove the wire cable through the slot provided in the front casting.

10. Remove the bezel.

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

CAUTION

Be careful not to damage the interconnecting cable to P73, if it remains connected.

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

11. Remove the four Torx screws and washers from the corner prongs of the band fastened to the faceplate.

CAUTION

Don't allow the crt to drop when loosening screws.

12. 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 11401/11402.

Cathode-Ray Tube Replacement

Replace the crt as follows:

1. Replace connector J54 on the A8 Crt Driver board (see Fig. 3–4). Replace the wire connector to the quick–disconnect contact on the front casting.

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 screws and washers. Tighten securely.

3. Clean the crt faceplate with a soft lint–free cloth dampened with denatured alcohol. Be careful not to scratch the glass.

NOTE

If the P73 connector 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. Dress any cable slack toward the center of the chassis.

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

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. Don't pinch the interconnecting wire cable.

5. Replace the two Control knobs on their shafts. Tighten their setscrews securely.

6. Turn the mainframe on its right side. (The crt will be at the top.) Replace the two flathead screws in the bezel and tighten securely.

7. Turn the mainframe right side up.

8. Remove the protective cap from the crt base pins. 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.

9. 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.

10. 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.

11. Reinstall the two flathead Torx screws. Tighten them securely.

NOTE

Replacing the crt will require that the instrument be readjusted. Refer to Table 3–2, "Checks Required After FRU Replacement," at the end of this section.

Lithium Battery Disposal and First Aid

Two lithium batteries are connected to A14 I/O and the A17 Main Processor circuit boards in the 11401/11402.

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.*

Disposal

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 & First Aid Information

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**

Should you come in contact with battery solvent

By:	**Do This:**
Contact with skin	Wash promptly with plenty of water.
Contact with 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.

Circuit Board Removal

To determine the location of a circuit board, see the view in Figure 3–1.

Most circuit boards in the 11401/11402 are mounted on the chassis. Pin connectors are used for electrical interconnection with chassis–mounted components and other circuit boards. Five boards (A14 I/O, A15 MMU, A16 Waveform Compressor, A17 Main Processor, and A18 Memory) plug onto the top of the A13 Mother board. Feed–through connectors join the plug–on boards to the A13 Mother board. (See Fig. 3–15 for an illustration of the five plug–on boards in the card cage.)

CAUTION

After removing a circuit board from the instrument, place it upon a grounded anti–static surface. *This will minimize the chance of static charge damage to the integrated circuits and/or related circuitry.*

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

NOTE

Refer to Table 3–2, "Checks Required After FRU Replacement" at the end of this section.

Chassis-Mounted Boards

A1 Plug-In Interface Board

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

1. Remove the plug-ins.
2. Remove the nine screws that fasten the three interface connector receptacles to the chassis. (See Fig. 3-5).
3. Remove all the connectors from the A7 Display Controller board. Note the position of their index triangles so that the connectors can be correctly replaced. Remove the six Torx screws that fasten the board to the chassis. Remove the A7 Display Controller board. (See Fig. 3-10 and "A7 Display Controller board" later in this section.)
4. Remove the Power Supply Module (see "Power Supply Module Removal," in this section). Remove the connectors from the A2A2 Control Rectifier board, except for J70 and J81 (see Fig. 3-3 in this section).

NOTE

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

*Record the positions of **ALL** connectors for correct replacement.*

Return the 11401/11402 to its right-side up position (if the instrument is on its side).

5. Disconnect connectors J57 and J60 from the A4 Regulator board (see Fig. 3-7). Remove the two Torx screws from the metal heatsink at the rear of the board.

NOTE

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

Carefully disconnect the J95 and J96 interconnecting pins from the A1 Plug-In Interface board by pulling the A4 Regulator board towards the rear. Remove the A4 Regulator board.

6. Disconnect connector J90 from the A14 Input/Output board (see Fig. 3-16).
7. Remove the A5 Acquisition board (see "A5 Acquisition board" later in this section).

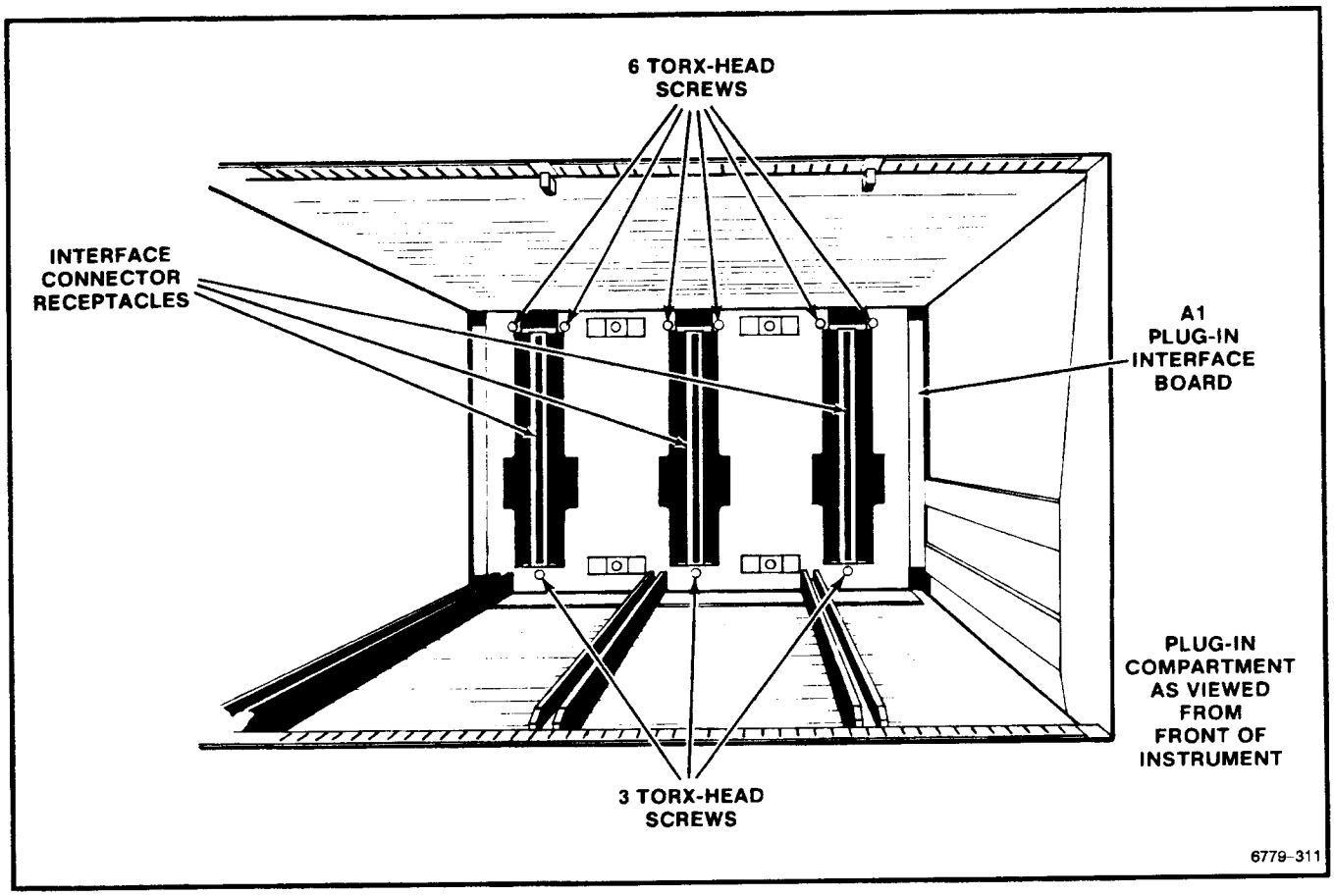


Figure 3–5. Plug-in compartment showing mounting screws for the A1 Plug-In Interface board.

8. Disconnect connector J91 from the A6 Time Base board (see Fig. 3–9).

NOTE

The A1 Plug-In Interface board is no longer attached to the instrument. However, care must be taken when removing the board and attached wire assemblies.

9. Position the instrument so that the A1 Plug-In Interface board can be removed through the top of the mainframe chassis.
10. Remove the A1 Plug-In Interface board.
11. Disconnect connector J91 from the A1 Plug-In Interface board (see Fig. 3–6).

NOTE

The J91 Ribbon cable assembly is NOT part of the FRU. Retain this cable for use on the replacement A1 Plug-In Interface board. All wires remaining attached to the board ARE part of the FRU and must remain with it.

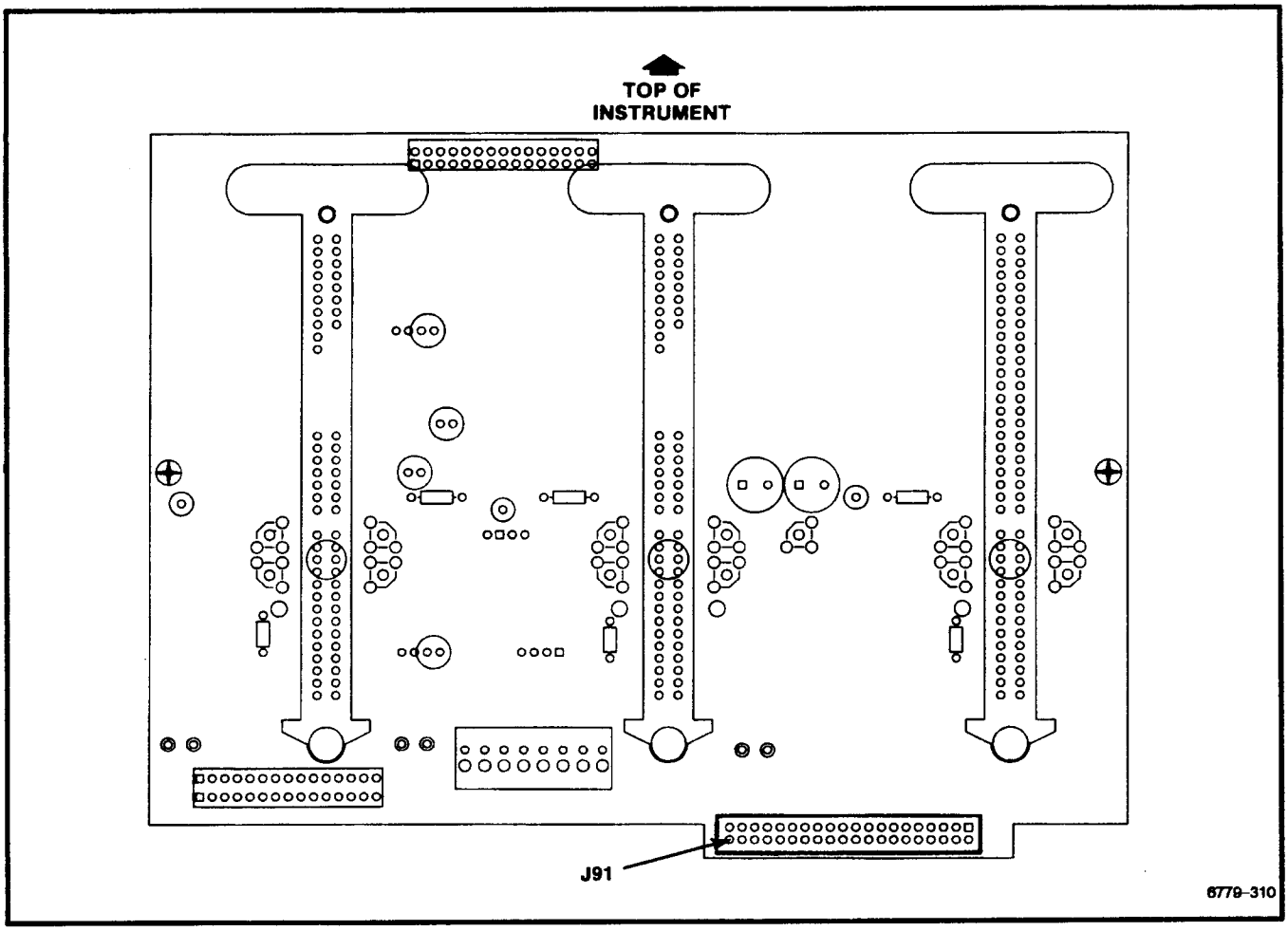


Figure 3–6. Connector location for removal of the A1 Plug-In Interface board.

12. To replace the A1 Plug–In Interface board, follow the removal procedure in reverse order. Match the index triangle on the pin connectors to the corresponding triangle on the circuit boards or connectors.

    Insert the coaxial–type end lead connectors using the proper circuit board illustrations. (See also "Cables and Connectors" in this section).

    Reconnect the J91 connector on the A1 Plug–In Interface board before placing it in the instrument.

CAUTION

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

NOTE

To ease replacement of the screws in the A1 Plug–In Interface connector receptacles (see Fig. 3–5), start the screws when the A1 Plug–In Interface board is replaced into the instrument. Then, tighten all nine screws in the connector receptacles.

A4 Regulator Board

Remove and replace the A4 Regulator board as follows:

1. Remove the Power Supply Module. (See "Power Supply Module Removal," in this section.)
2. If on its side, set the 11401/11402 right side up.
3. Disconnect connectors J57 and J60 from the A4 Regulator board (see Fig. 3–7). Note the connector index triangle locations for correct orientation.
4. Remove the two Torx screws from the metal heat-sink attached to the rear of the board (see Fig. 3–7).

NOTE

The A4 Regulator board is now unfastened from the chassis. However, it remains connected to the A1 Plug-In Interface board through interconnecting pins.

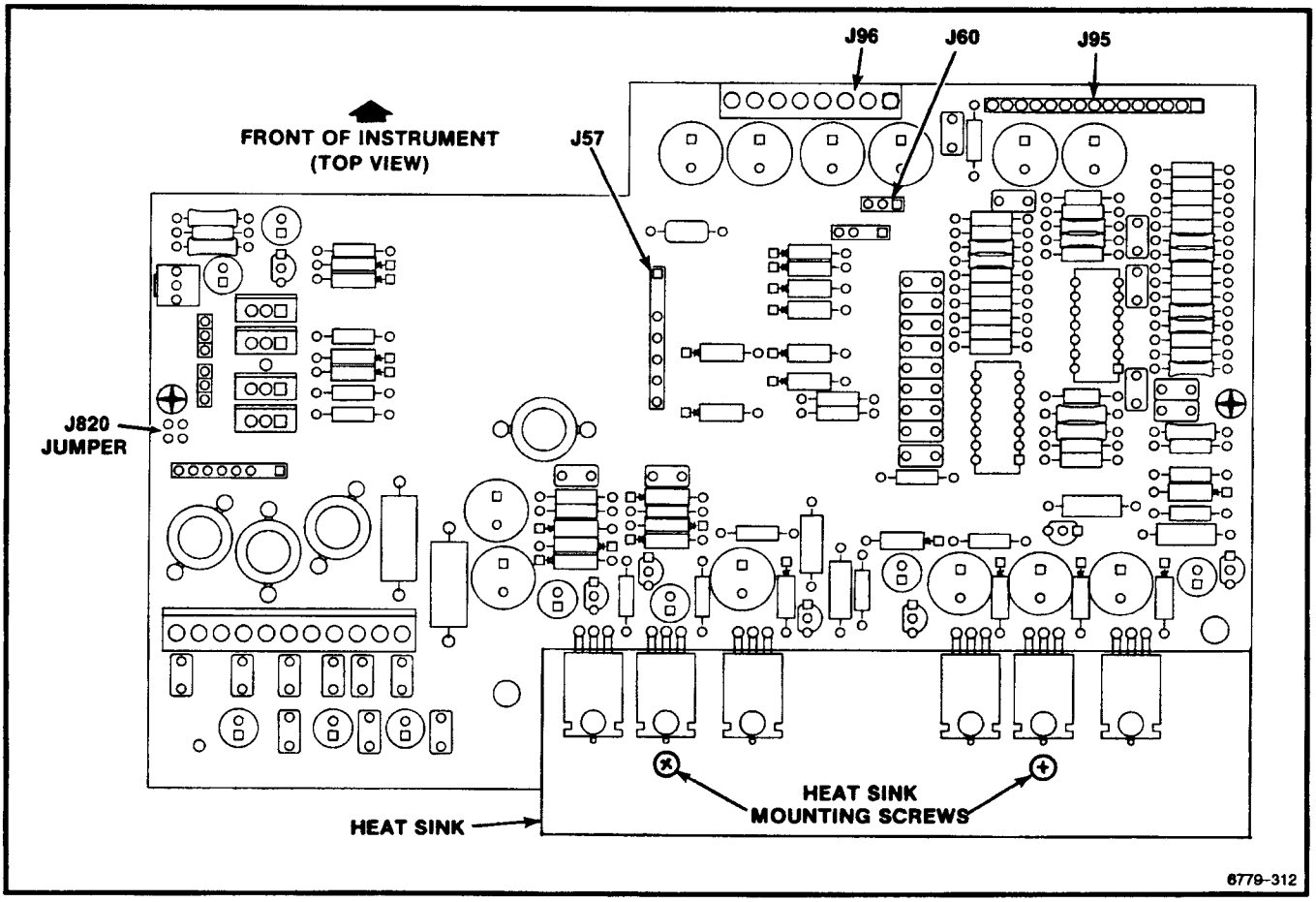


Figure 3–7. Connector locations for removal of the A4 Regulator board.

5. Carefully disconnect the J95 and J96 pins from the A1 Plug-In Interface board by pulling the A4 Regulator board toward the rear.

6. Remove the A4 Regulator board.

7. To replace the A4 Regulator board, follow the removal procedure in reverse order.

CAUTION

Use care when reconnecting the J95 and J96 pins to the A1 Plug-In Interface board. (Should it become necessary, the A5 Acquisition board may be removed to view these pins through the mainframe chassis. See the following A5 Acquisition board procedure.)

NOTE

Match the index triangle on the pin connectors with the corresponding square pad on the circuit board. Correct locations of the pin connectors are shown in the circuit board illustrations.

A5 Acquisition Board

Remove and replace the A5 Acquisition board as follows:

1. Turn the instrument on its right side (as viewed facing the front). The board is located beneath the card cage and the power supply compartments and beside the A6 Time Base board.
2. Remove the six Torx screws from the board.
   - Remove the long Torx screws from the support pivots at the front edges of the board.
3. Move the rear side of the board outward. Position the board so that its outside edge is about perpendicular to the bottom of the oscilloscope. Do not stress the wire bundles.

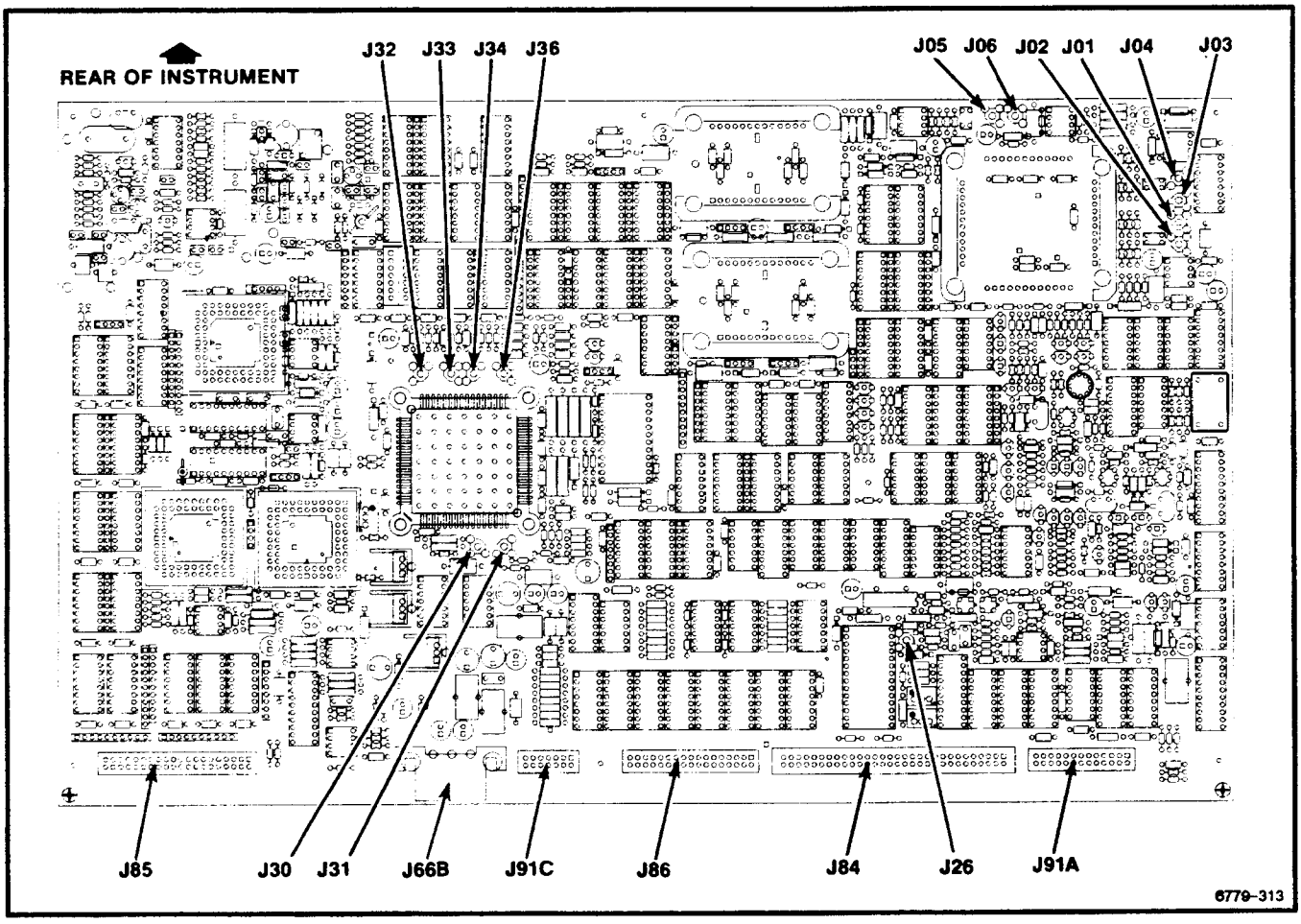


Figure 3-8. Connector locations for removal of the A5 Acquisition board.

NOTE

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

4. Disconnect the Peltola connectors from the center and board edge areas. (See Fig. 3–8.)
5. Disconnect connectors J85, J66B, J91C, J86, J84, and J91A from along the inside edge of the board.
6. Remove the A5 Acquisition board.
7. To replace the A5 Acquisition board, follow the removal procedure in reverse order.

CAUTION

Don't pinch any interconnecting wires underneath the board. Arrange the wires away from the posts to which the Torx screws will be fastened.

A6 Time Base Board

Remove and replace the A6 Time Base board as follows:

1. Turn the instrument on its right side (as viewed facing the front). The board is located next to the crt bottom and beside the A5 Acquisition board.
   - The A5 Acquisition board overlaps the rear edge of the A6 Time Base board. Remove the board-retaining screws from the A5 Acquisition board. (See the preceding "Circuit Board Removal" procedure.) **Do not remove its connectors**. Move the A5 Acquisition board away from its location to remove the A6 Time Base board.
2. Record the positions of each connector to aid in their correct replacement.
3. Remove connectors J85, J66A, J83, J86, J84, and J91.
4. Remove the spacer post and five Torx screws from the board.
5. Remove the A6 Time Base board.
6. To replace the A6 Time Base board, follow the removal instructions in reverse order.

CAUTION

Do not pinch any interconnecting wires.

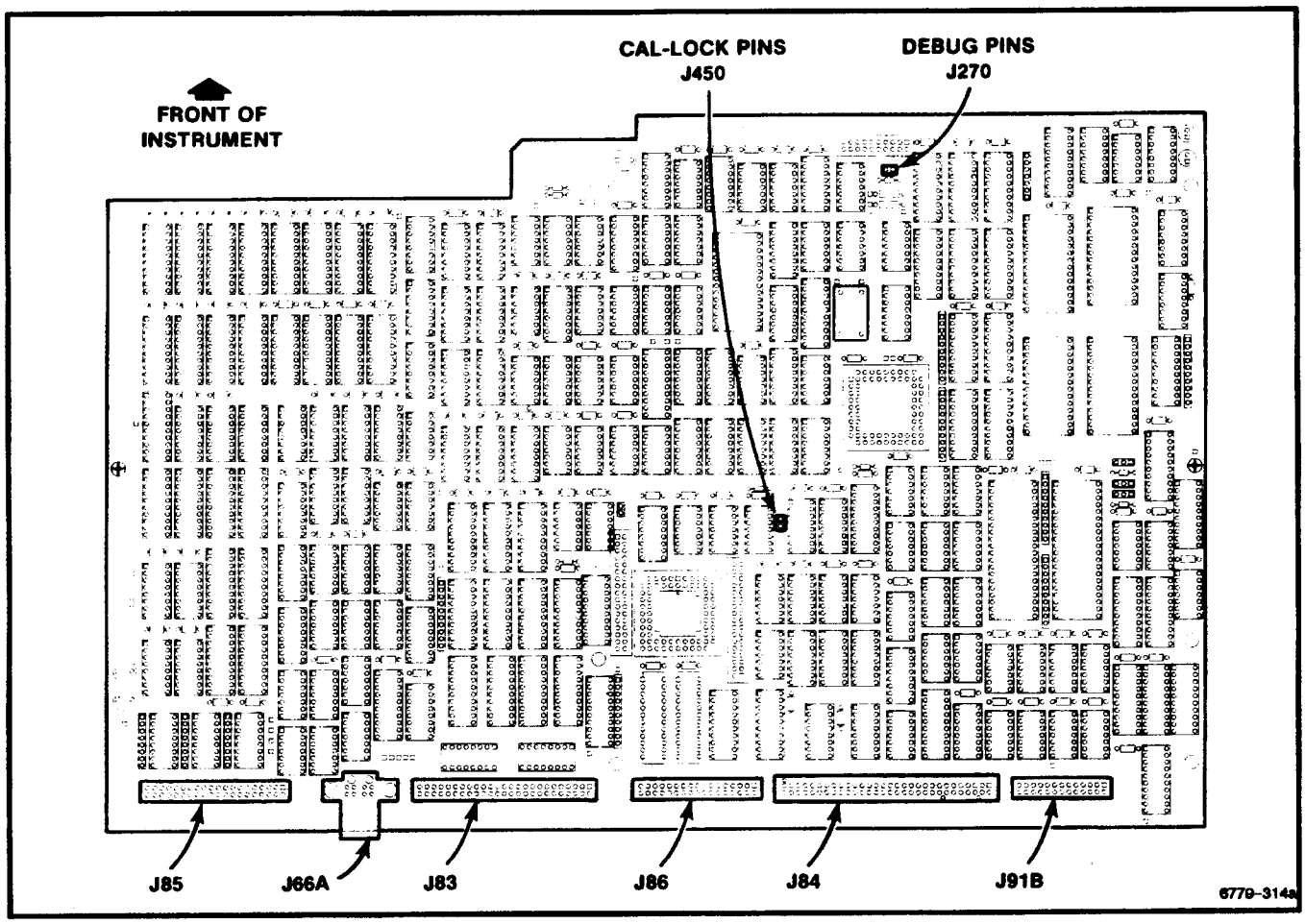


Figure 3–9. Connector locations for removal of the A6 Time Base board.

A7 Display Controller Board

Remove and Replace the A7 Display Controller board as follows:

1. Remove connectors J57, J53, J52, and J63C from the board (see Fig. 3–10). Note the index triangles on each connector so they can be replaced correctly.
2. Remove the six Torx screws.
3. Remove the A7 Display Controller board. Lift and extract the board toward the right side of the 11401/11402 (as viewed facing the front).

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) the board.

4. To replace the A7 Display Controller board, follow the removal procedure in reverse order.

CAUTION

Observe the routing of wires underneath the board. Do not pinch any interconnecting wires when replacing the board.

NOTE

Insert the inner edge of the 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).

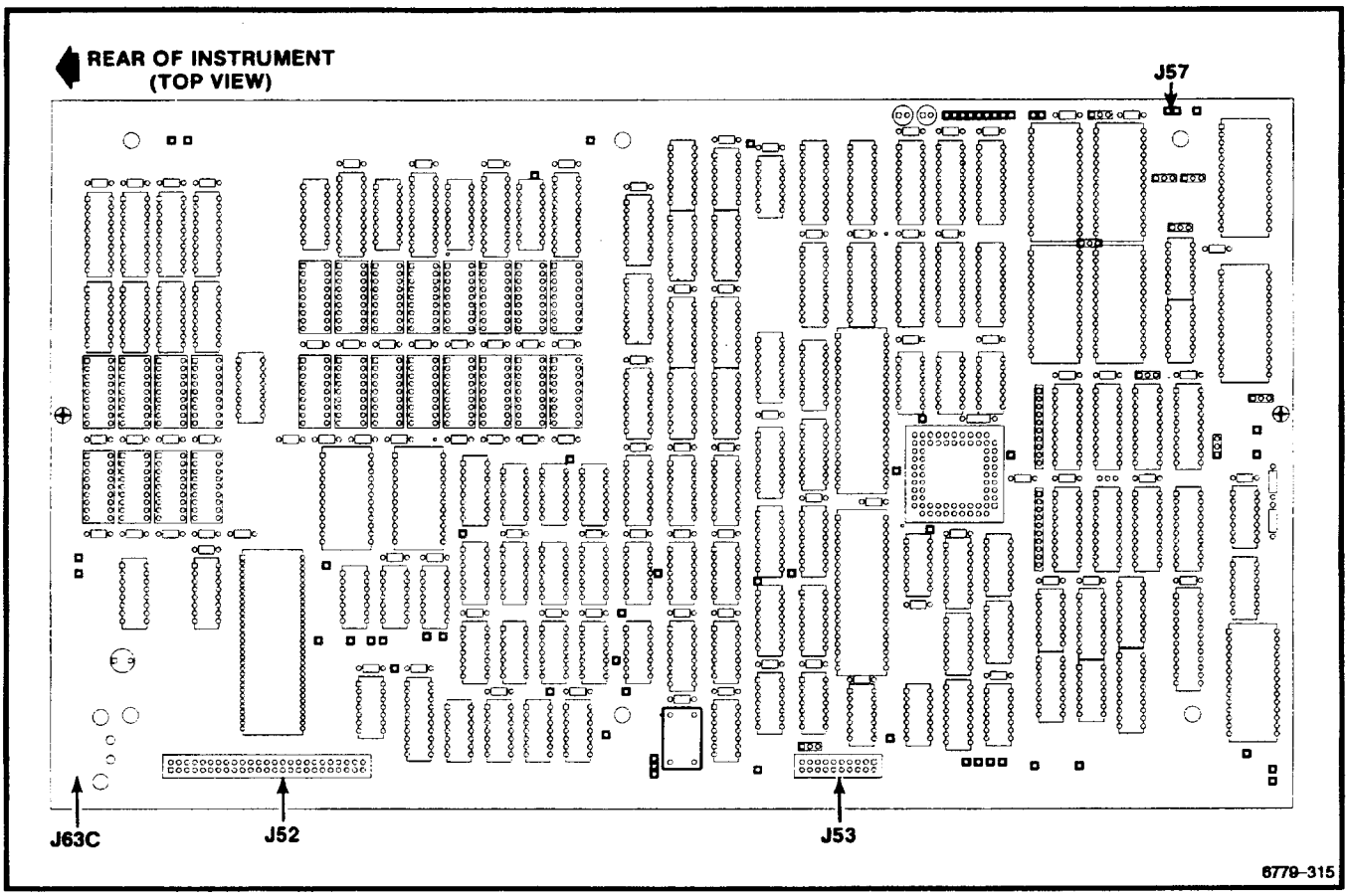


Figure 3-10. Connector locations for removal of the A7 Display Controller board.

A8 CRT Driver Board

Remove and replace the A8 CRT Driver board as follows:

1. Remove the crt shield. (See the "Cathode Ray Tube Removal," in this section.)
2. Remove all connectors from the A8 CRT Driver board (see Fig. 3–11). Note the position of connectors' index triangles so the connectors can be correctly replaced.

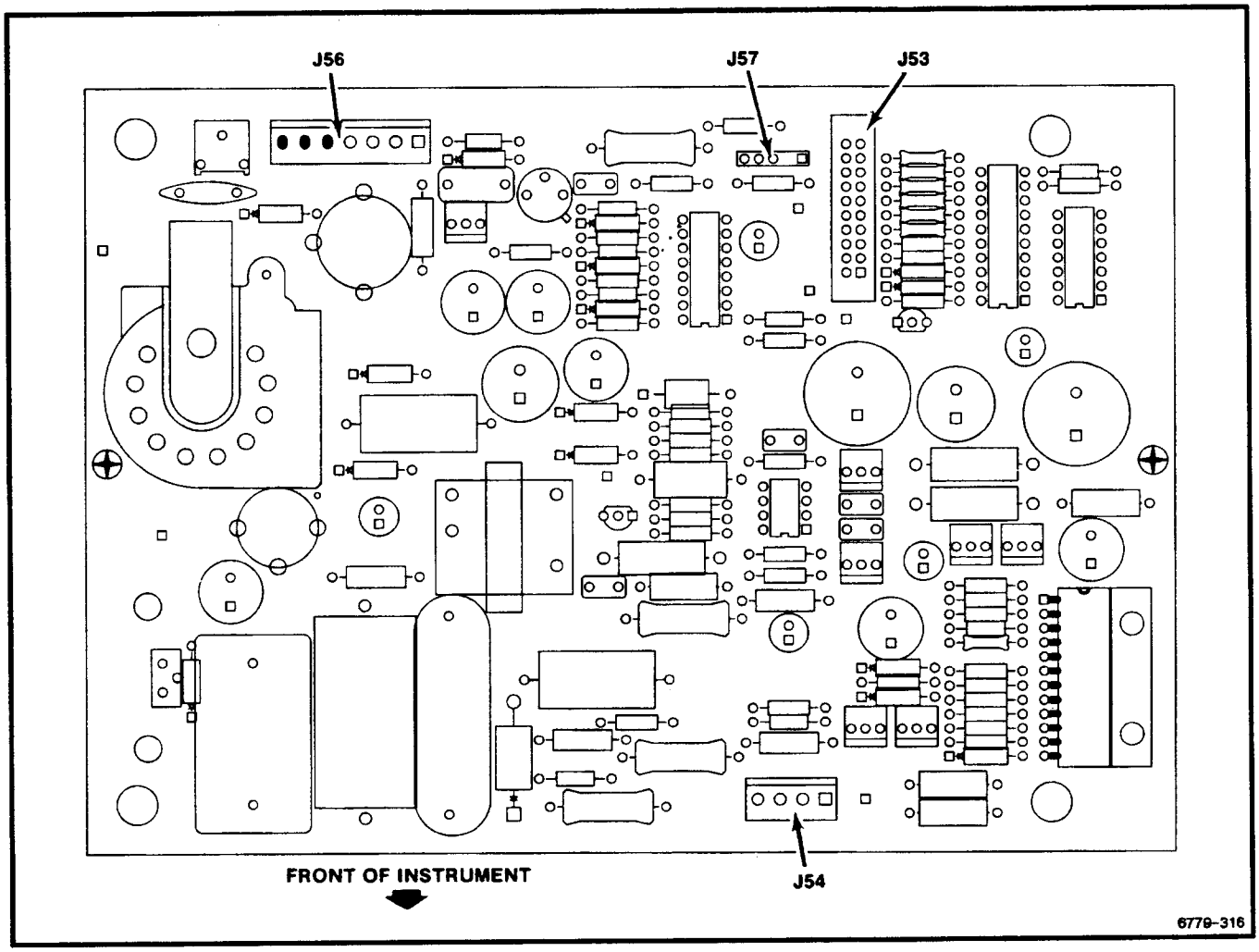


Figure 3–11. Connector locations for removal of the A8 CRT Driver board.

3. Remove the Torx screws from the (left side) front and rear decorative trim covers. See Figure 3–12. Do NOT attempt to remove the trim covers until after reading the following CAUTION.

CAUTION

Do not lift the trim covers to remove them. They will break. There is a clip on the inside of the trim cover which slides over the end of the side frame section.

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

4. Remove the trim covers.
5. Remove the single Torx screw from the center of the (left side) frame section.
   - Remove the two screws from the ends of the frame section.
   - Remove the frame section.
6. Remove the Torx screws from each corner of the board.
7. Remove the A8 CRT Driver board by sliding it under the neck of the crt and out of the left side of the instrument.
8. To replace the A8 CRT Driver board, follow the removal procedure in reverse order.

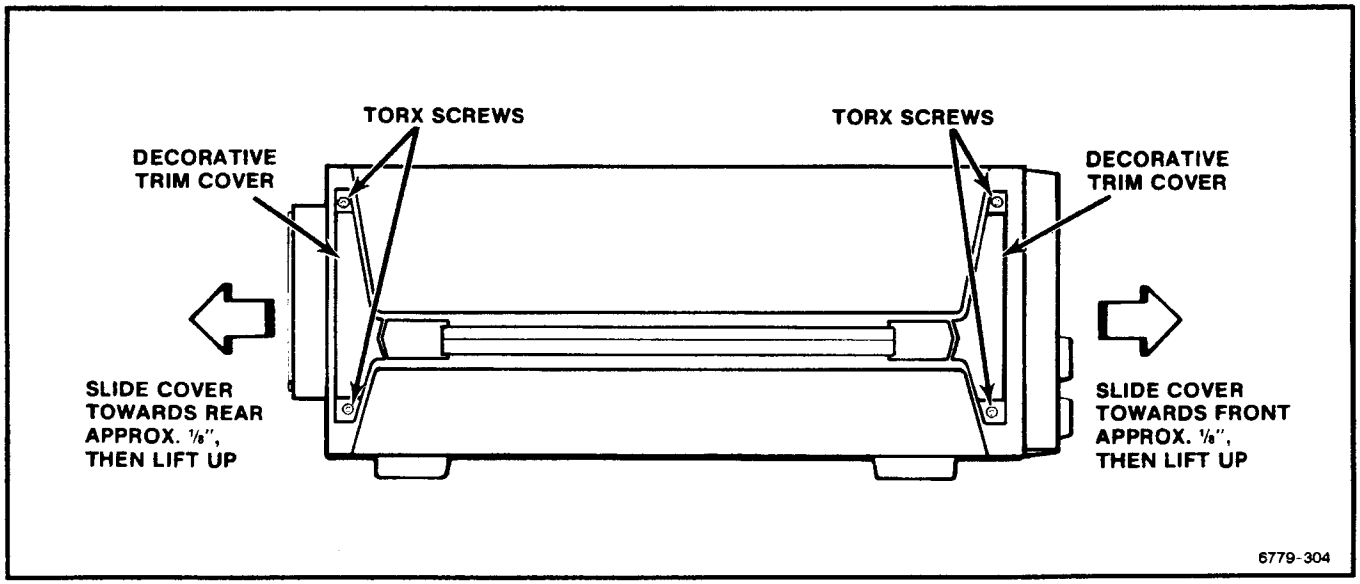


Figure 3–12. Removal of left side decorative trim covers.

A9 Touch Panel Subassembly

Remove and replace the A9 Touch Panel subassembly as follows:

1. Remove the front-panel bezel. (Refer to "Cathode-Ray Tube Removal," in this section.) Begin with step 6 and proceed through step 9.

NOTE

The wire cable from P73 on the A10 Front Panel Control board is removed with the A9 Touch Panel subassembly. *(See Fig. 3–13.) Disconnect connector P73 from the A10 Front Panel Control board. Note the position of connector index triangles in order to correctly replace the connector. 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.

2. To replace the A9 Touch Panel subassembly, route the P73 wire cable back through the slot in the chassis. Attach the connector to the board after checking the index triangles for correct orientation.

3. Replace the bezel. (Refer to "Cathode-Ray Tube Replacement," in this section.) Use steps 4 through 7.

NOTE

Feed any slack cable from P73 to inside the chassis (near the A10 Front Panel Control board). Be careful not to pinch the interconnecting cable when the bezel is replaced.

A10 Front Panel Control Board

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

1. Remove the crt shield. (See "Cathode-Ray Tube Removal," in this section.) Follow steps 1 and 2.
2. Remove connector J53 from the A7 Display Controller board. (See Fig. 3–10.)
3. Remove connectors P72, P75, P73 and P74. (See Fig. 3–13.) Note the position of their index triangles for correct replacement.
4. Remove the two Torx screws at the upper edge of the board. (See Fig. 3–13.)
5. Lift the board away from the guides at its bottom and remove it.
6. To replace the A10 Front Panel Control board, follow the removal procedure in reverse order.

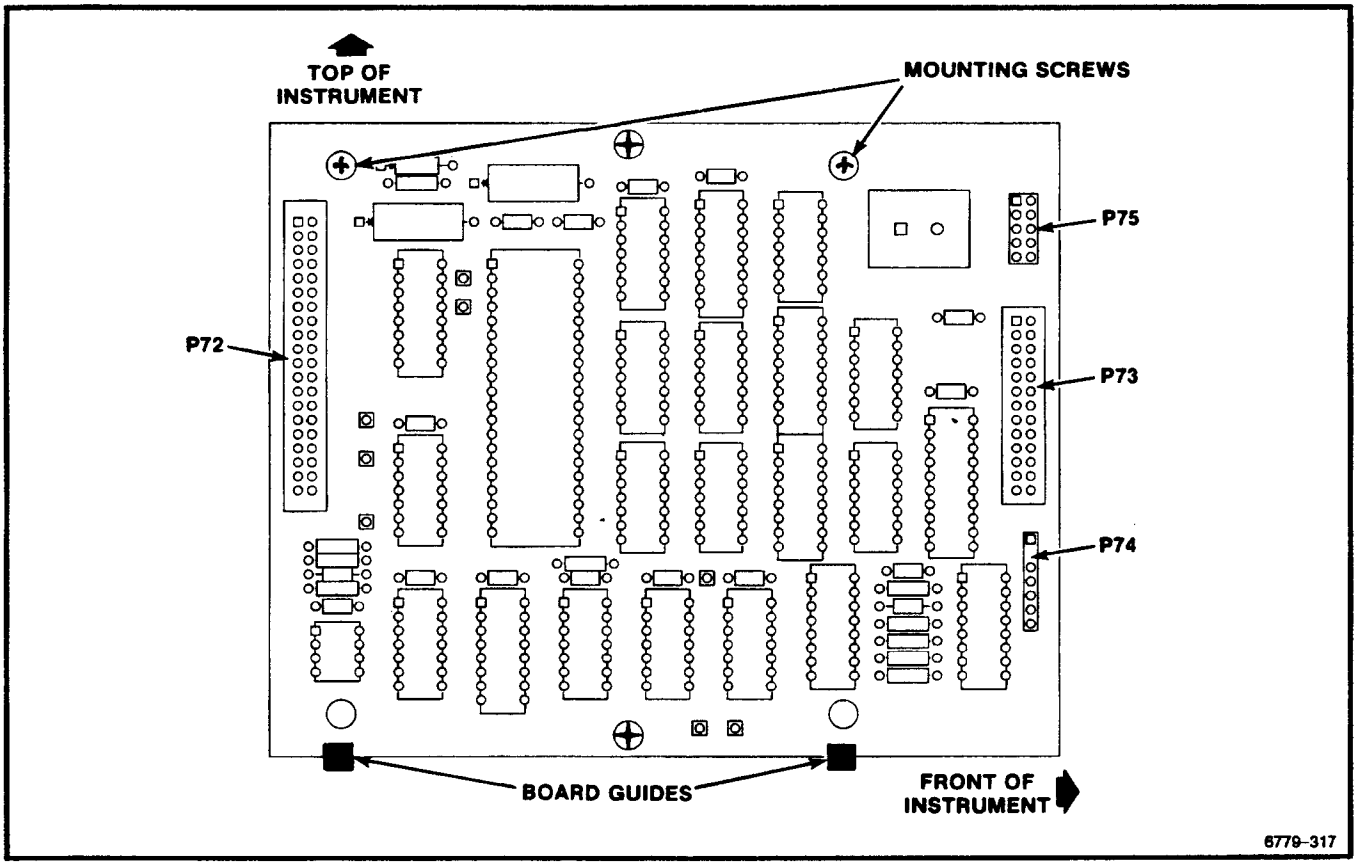


Figure 3–13. Connector locations for removal of the A10 Front Panel Control board.

A11 Front Panel Button Board

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

1. Remove the A7 Display Controller board. (See "A7 Display Controller Board," in this section.)
2. Remove the crt shield. (See "Cathode-Ray Tube Removal," in this section.) Follow steps 1 and 2.
3. Remove connector P75 from the A10 Front Panel Control board (see Fig. 3–13). Note the position of connector index triangles for correct replacement.
4. Remove the two Torx screws from the A11 Front Panel Button board, which is located at the top and near the inside center of the front casting.
5. Remove the A11 Front Panel Button board.
6. To replace the A11 Front Panel Button board, follow the removal procedure in reverse order.

A12 Rear Panel Board

Remove and replace the A12 Rear Panel board as follows:

1. Remove the connectors from the RS-232-C, the GPIB, and the PRINTER connector holders. (See Fig. 3-14.) Remove the eight Torx screws from the outer edges of the rear panel plate. (See Fig. 3-2.)

2. Tilt the plate back from the mainframe. Remove connector J78 from the top of the A12 Rear Panel board. Note the position of the connector index triangles for correct replacement.

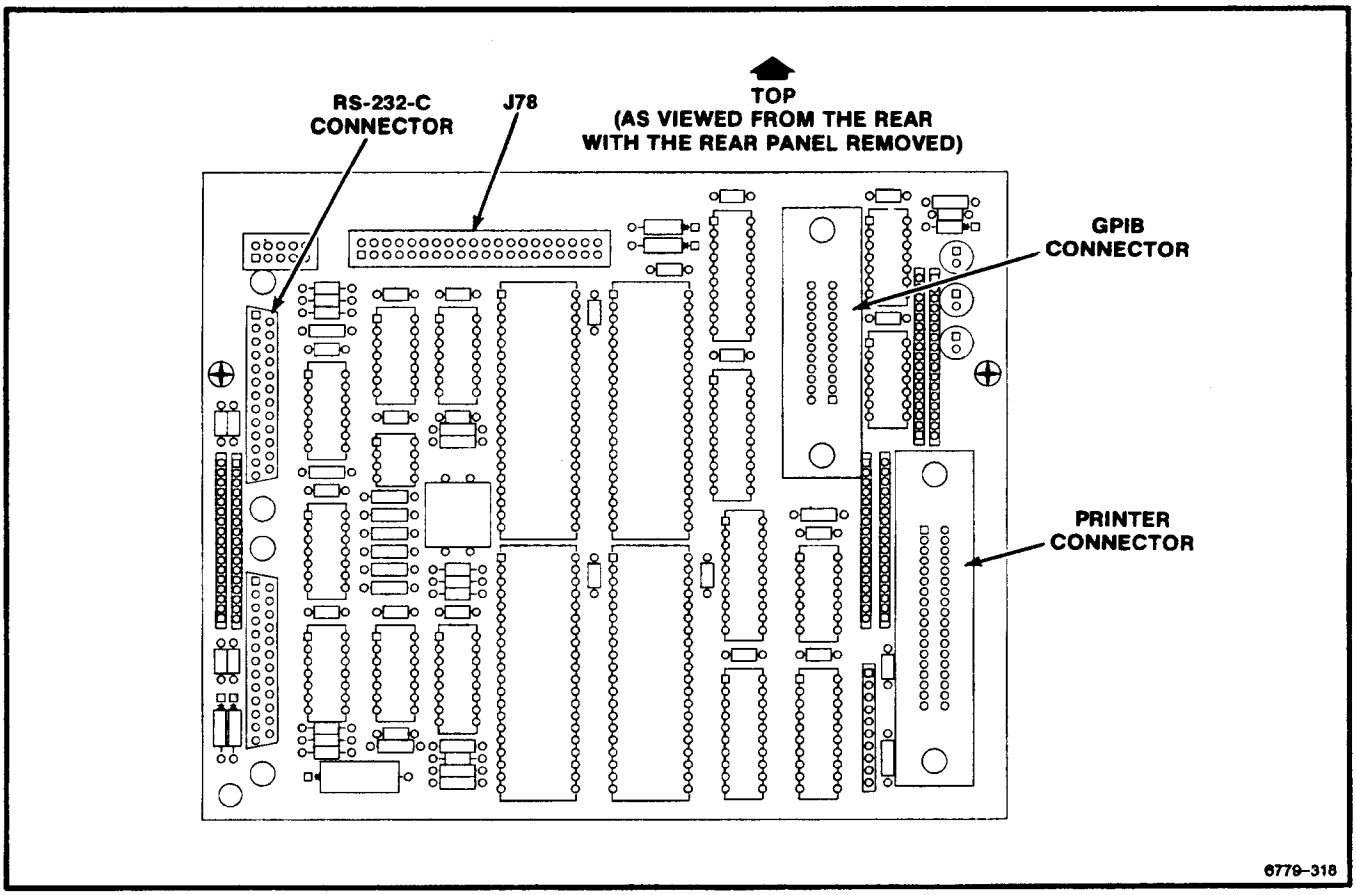


Figure 3-14. Connector locations for removal of the A12 Rear Panel board.

3. Remove the rear panel plate and its attached A12 Rear Panel board.
4. 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 screw and washer (at lower left, if present).
5. Remove the A12 Rear Panel board from the plate.

CAUTION

The metal covers on the PRINTER and on the GPIB connectors are loose. If the board is inverted, they will fall off.

6. To replace the A12 Rear Panel board, follow the removal procedure in reverse order.

NOTE

Replacement of connector J78 will be easier if the connector is replaced before the plate is reinstalled on rear of chassis.

A13 Mother Board

Remove and replace the A13 Mother board as follows:

1. Remove the card cage retainer from the top front of the card cage by removing its two screws. Remove both circuit board guides from atop 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.
2. Remove the A14 I/O, A15 MMU, A16 Waveform Compressor, A17 Main Processor, and A18 Memory Circuit boards. (See "Plug-On Boards," in this section.)

NOTE

Tag the interconnecting plugs and mark the board locations so that they can be replaced correctly.

3. Remove connector J63B from the A13 Mother board.
4. Remove the six Torx screws.
5. Remove the A13 Mother board.
6. To replace the A13 Mother board, follow the removal procedure in reverse order.

NOTE

Don't pinch the wires along the inside edge of the board when replacing it.

Plug-On Boards

All circuit boards inside the card cage plug onto the A13 Mother board. Feed-through connectors join the plug-on boards to the Mother board. Figure 3-15 shows the location of each board within the card cage.

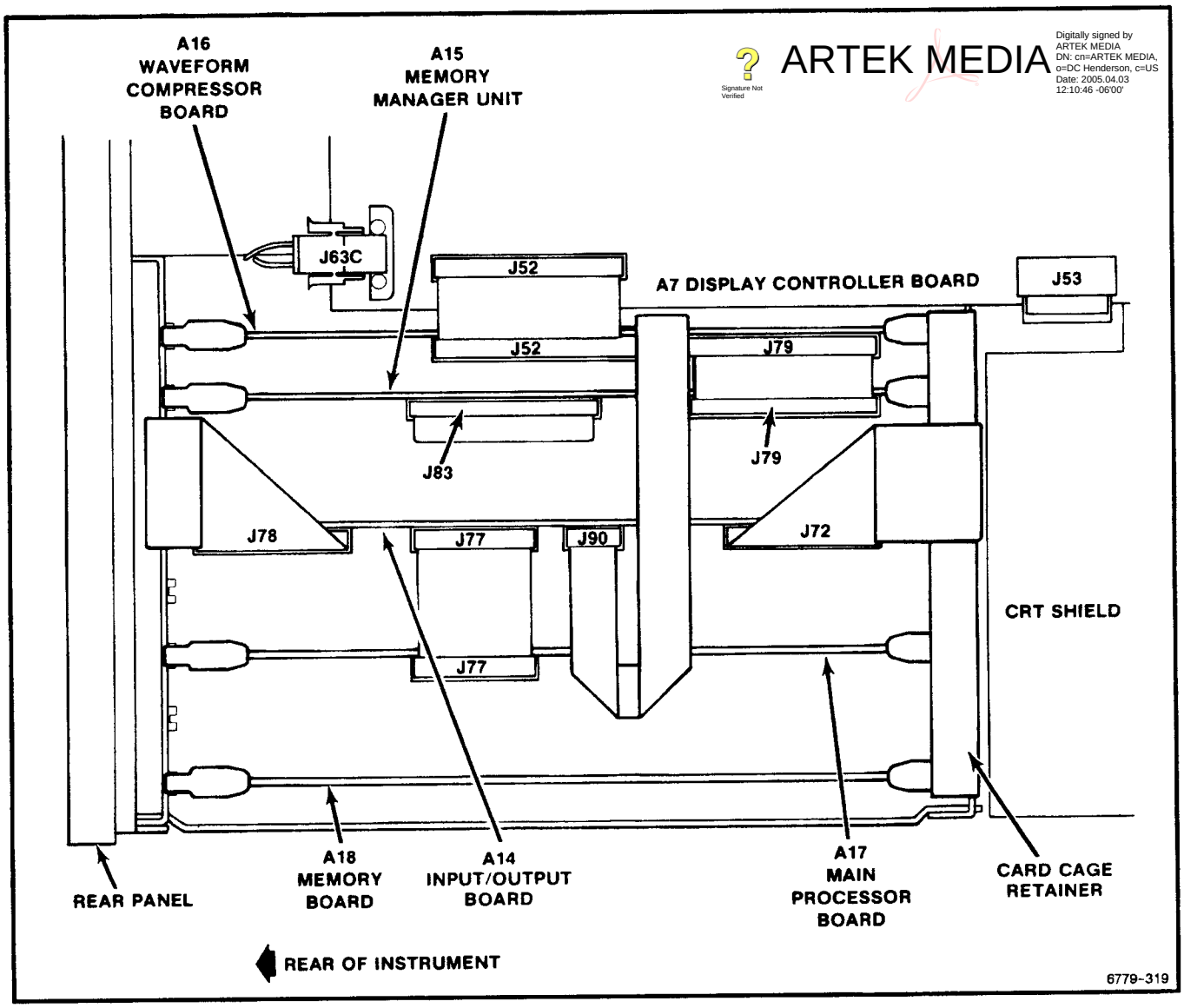


Figure 3-15. Top view of the card cage showing circuit board locations.

A14 Input/Output (I/O) Board

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

1. Remove the card cage retainer from the top of front of the card cage by removing its two screws. Remove both circuit board guides from atop 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.

2. Remove connectors J78, J77, J90 and J72. Note the position of connector triangles for correct replacement. (See Fig. 3–15 for the location of the A14 Input/Output board in the card cage and Fig. 3–16 for connector locations.)

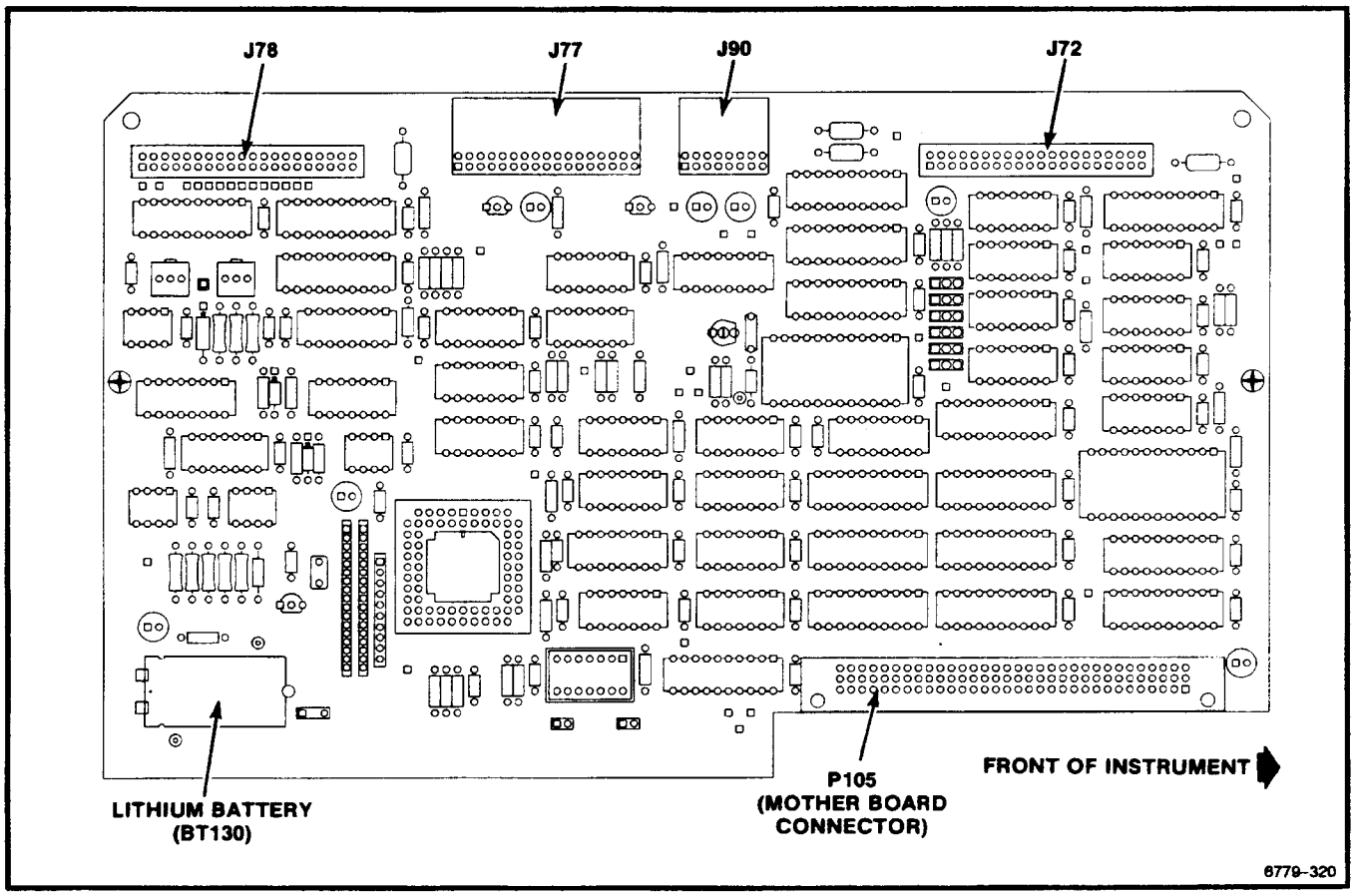


Figure 3–16. Connector locations for removal of the A14 Input/Output board.

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.

4. Remove 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.)*

5. Replace the A14 I/O board by following the removal procedure 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 P105 is seated on the A13 Mother board connector (see Fig. 3–16). Push down firmly on the A14 I/O board to connect it.

A15 Memory Manager Unit (MMU) Board

Remove and replace the A15 MMU board as follows:

1. Remove the card cage retainer from the top front of the card cage by removing its two screws. Remove both circuit board guides from atop 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.

2. Remove connectors J83 and J79. (See Figs. 3–15 and 3–17). Note the position of connector index triangles for correct replacement.

3. Remove J90 from the A14 I/O board.

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

5. Remove the A15 MMU board.

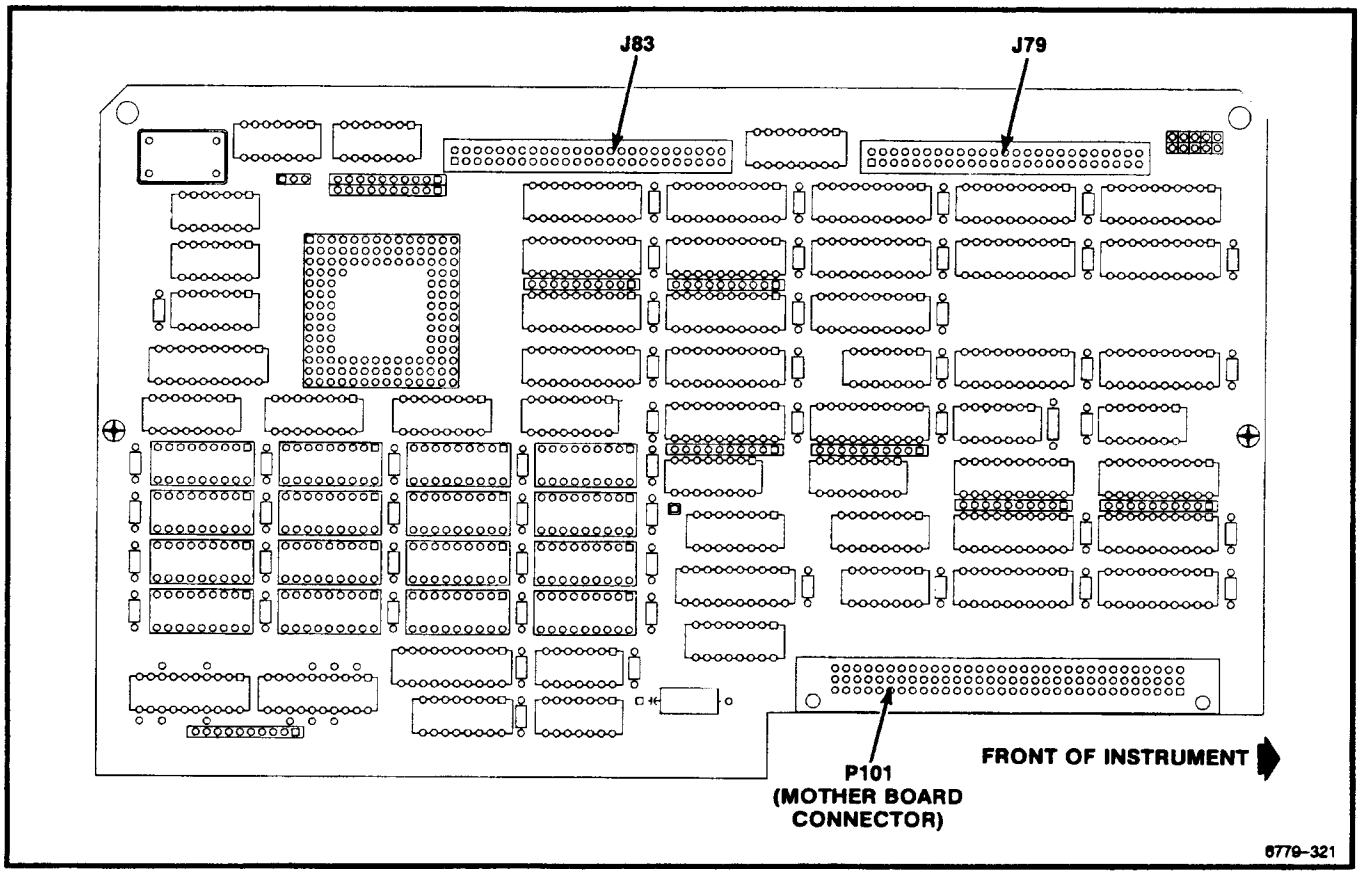


Figure 3–17. Connector locations for removal of the A15 Memory Manager Unit board.

6. Replace the A15 MMU board by following the removal procedure 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 P101 is seated onto the A13 Mother board connector. Push down firmly on the A14 MMU board to connect it.

A16 Waveform Compressor Board

Remove and replace the A16 Waveform Compressor board as follows:

1. Remove the card cage retainer from the top front of the card cage by removing its two screws. Remove both circuit board guides from atop 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.

2. Remove connectors J52 and J79. (See Figs. 3-15 and 3-18). Note the position of connector index triangles for correct connector replacement.

3. Remove J90 from the A14 I/O board. (See Fig. 3-16.)

4. Lift the white, hinged tabs at the front and rear edges of the board. Pull the tabs upward until the A16 Waveform Compressor board separates from the A13 Mother board.

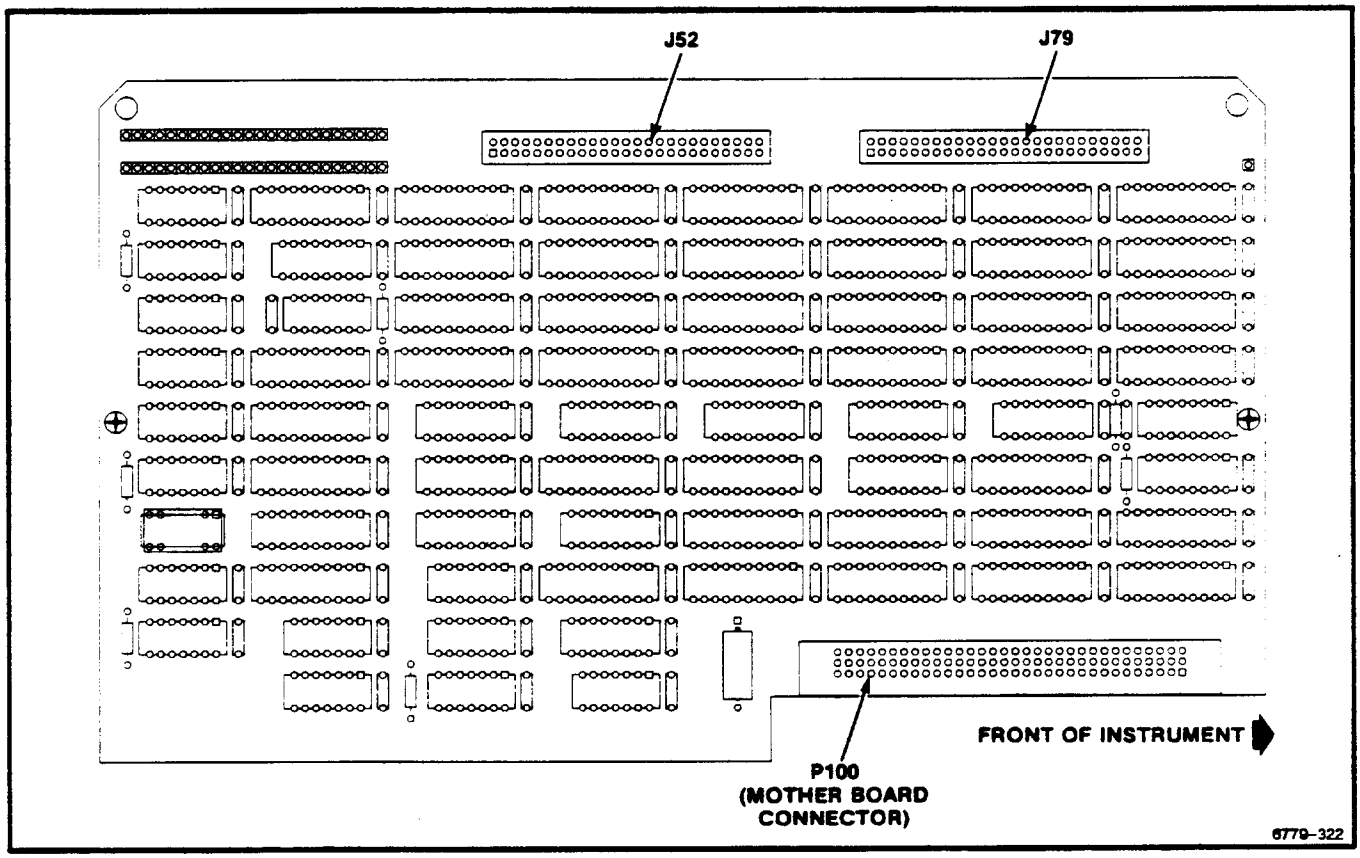


Figure 3-18. Connector locations for removal of the A16 Waveform Compressor board.

5. Remove the A16 Waveform Compressor board.
6. Replace the A16 Waveform Compressor board by following the removal procedure 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 Waveform Compressor board to connect it.

A17 Main Processor Board

Remove and replace the A17 Main Processor board as follows:

1. Remove the card cage retainer from the top front of the card cage by removing its two screws. Remove both circuit board guides from atop 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.
2. Remove connector J77. (See Figs. 3–15 and 3–19).
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.
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 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.)*

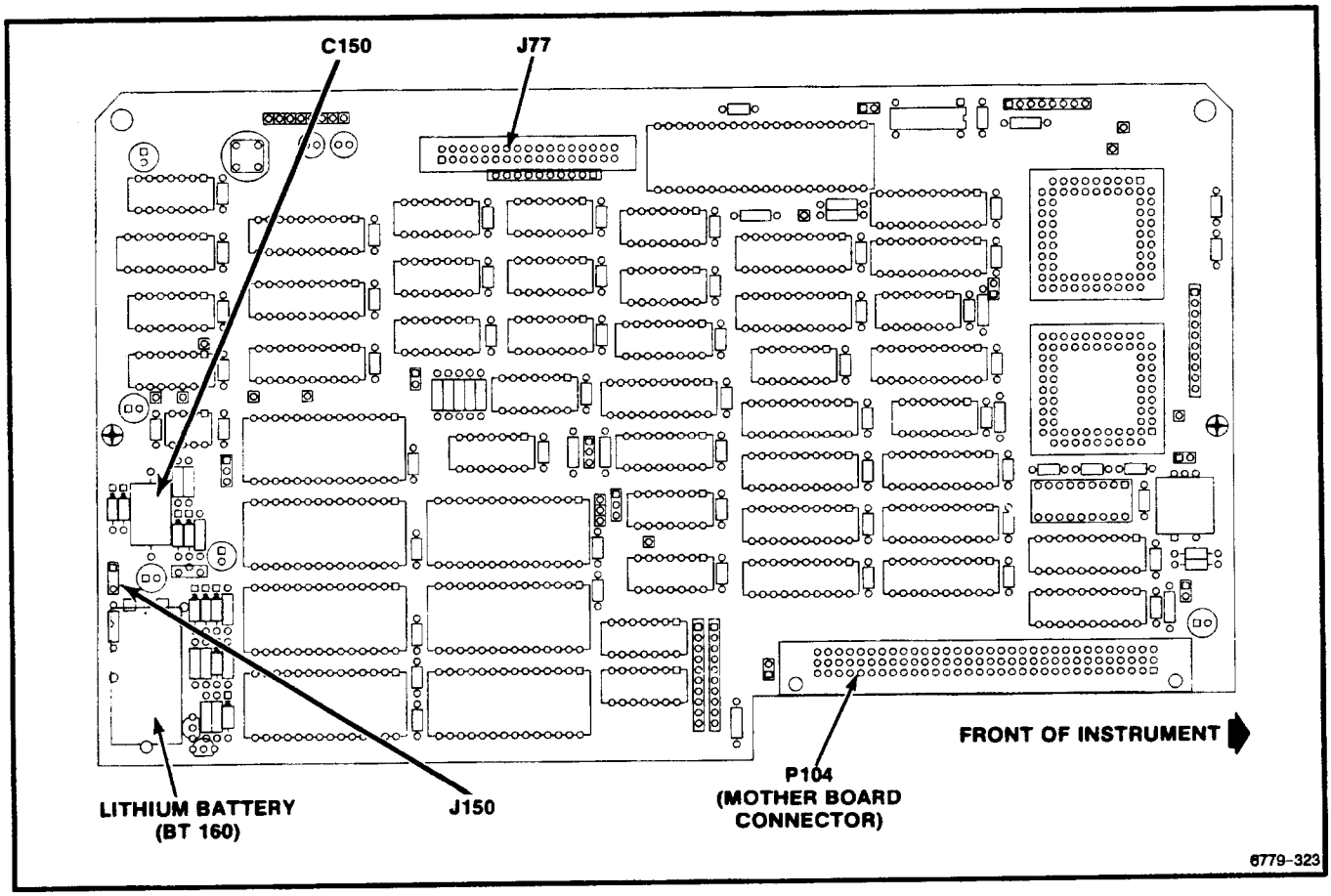


Figure 3-19. Connector locations for removal of the A17 Main Processor board.

5. Replace the A17 Main Processor board by following the removal procedure 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 is seated onto the A13 Mother board connector. Push down firmly on the A17 Main Processor board to connect it.

A18 Memory Board

Remove and replace the A18 Memory board as follows:

1. Remove the card cage retainer from the top front of the card cage by removing its two screws. Remove both circuit board guides from atop 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.
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. (See Fig. 3–15 for the location of A18 within the card cage).
3. Remove the A18 Memory board.
4. Replace the A18 Memory board by following the removal procedure 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 it.

FRU IC Removal

Destination Address Generator Integrated Circuits (DAG ICs)

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

To remove a DAG IC, proceed as follows:

1. See Figure 3-1 for the locations of the A6 Time Base board and of the DAG IC.
2. Remove the IC with special extraction pliers (such as General Tool's Part Number 821566-1). For an illustration of these extraction pliers, see Figure 3-20.

CAUTION

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

3. Insert the hook-shaped, plier tips into the slots in opposite corners of the IC socket.
4. Squeeze the handles of the pliers to lift the IC from the socket.
5. Carefully remove the loosened IC. Do not damage any IC pins.

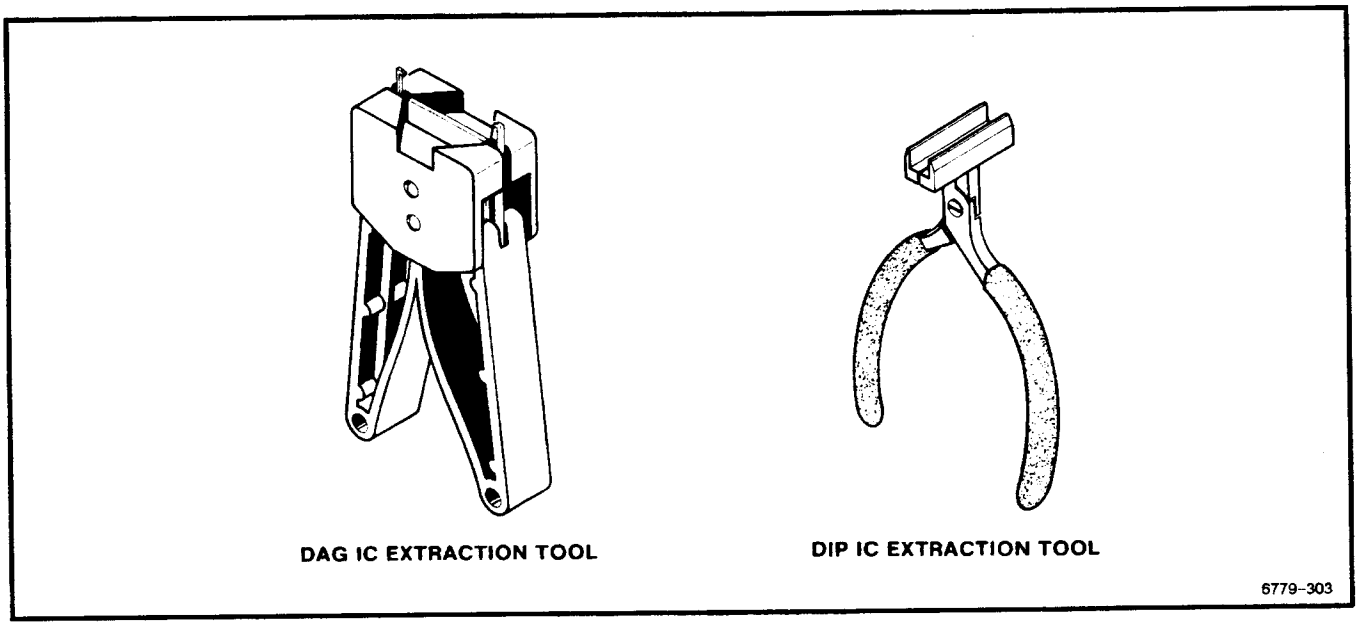


Figure 3-20. IC extraction tools.

CAUTION

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

Replace the DAG IC as follows:

NOTE

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

1. Align the beveled side of the IC (with the dot) to the side of the socket to which the arrow points.
2. Check that the beveled IC corner also aligns with the outer beveled corner of the socket.
3. Make certain that the IC lies flat against the socket.
4. Check that all IC pins align correctly with their respective socket contacts.
5. Push down carefully on the IC to seat it.

Serial Data Interface Integrated Circuits ("Slam-Pack" ICs)

The Serial Data Interface IC (U330) is mounted on the A14 Input/Output board. 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 3–21.

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

1. Remove the A14 Input/Output board by following the removal instructions listed under "Circuit Board Removal, Plug-On Boards."
2. Hold the heat sink cover in place and unfasten the retaining clip by moving it across the tabs. It may help to push down slightly on the cover.

CAUTION

Observe all the special precautions mentioned under the heading "Static-Sensitive Device Classification," in this section.

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

NOTE

Observe the index of the IC before removing it.

4. Remove the IC with tweezers.

CAUTION

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

Replace the Serial Data Interface IC as follows:

1. Using tweezers, place the beveled corner of the replacement IC against the index spring.

CAUTION

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

2. Arrange the other corners, with the tweezers, to fit evenly at the edges of the socket.
3. Set the cover flat on the IC with its end tabs properly aligned with, but not in, the mating recesses in the socket.
4. 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.
5. Check that the cover is secure by lightly tugging on it.
6. Replace the A14 Input/Output board by following its removal instructions in reverse order.

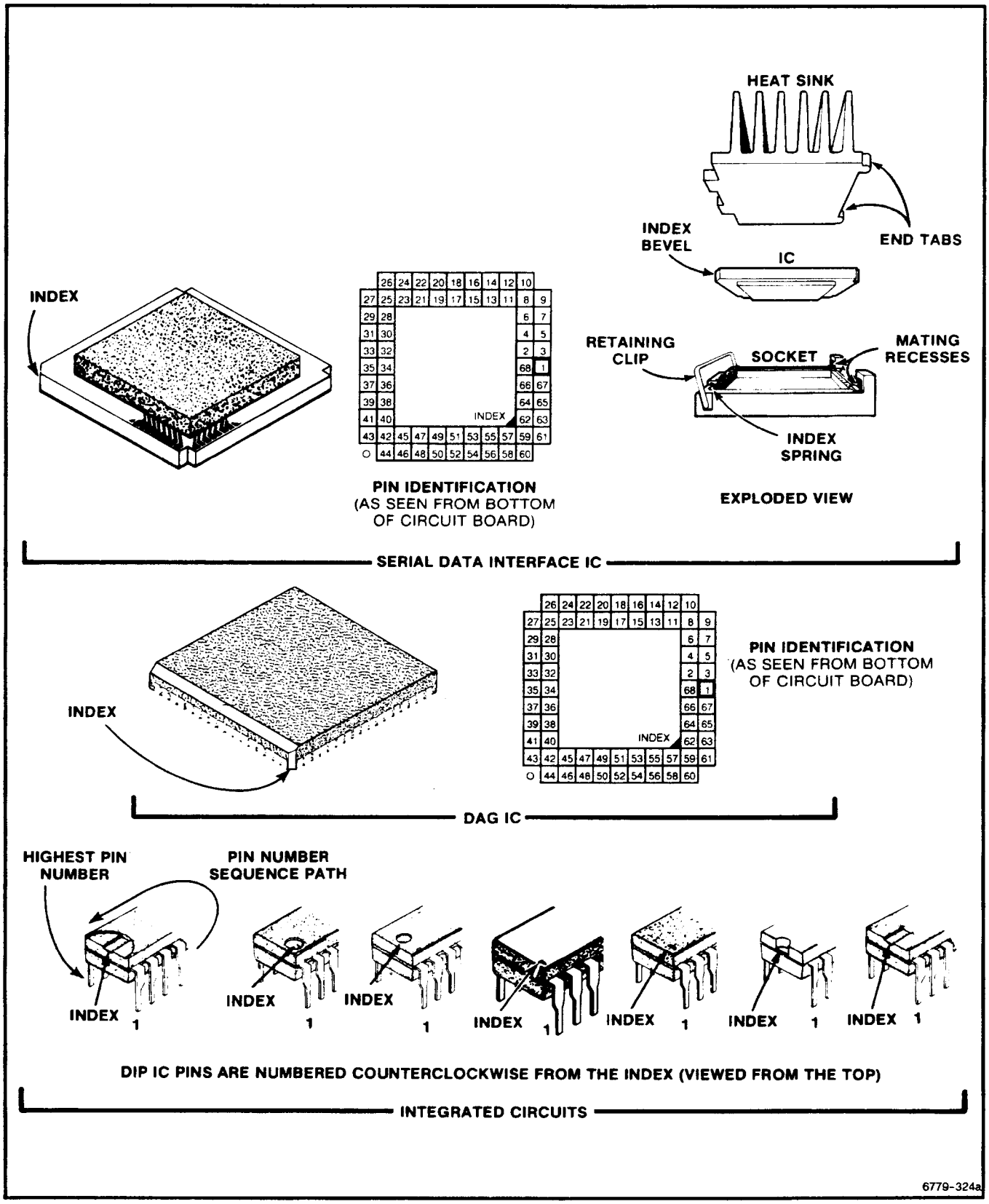


Figure 3-21. Semiconductor indexing diagram.

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

The firmware ICs are located on four separate circuit boards (see Fig. 3–1 for the IC locations on each circuit board). The boards and their respective firmware (FW) are:

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

All of the ICs listed above are ordered by a single Tektronix Part Number. **(Each IC cannot be ordered separately.)** For the 11401, the total firmware kit number is 020–1576–XX and for the 11402, the kit number is 020–1583–XX.

To remove and replace the firmware ICs, proceed as follows:

WARNING

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

CAUTION

Observe all the special precautions mentioned under the heading "Static-Sensitive Device Classification," in this section.

Preliminary Verification Procedure

1. Preparing the Instrument

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

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

2. Checking the Cal Constant Tag

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

mcalconst 134

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

3. Checking the Cal Constant

a. Connect a power cord to the instrument.

b. Connect a terminal or controller as described in the User's Reference Manual.

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

d. Set the necessary communication parameters such as baud rate, etc.

e. When the instrument has powered up, establish communication from the terminal or controller by entering the following commands (<CR> is the return key):

e<CR>
v<CR>

f. Enter the query:

mcalconst? 134<CR>

NOTE

If the four-digit value returned after the query does not match the value on the A5 Acquisition board tag, DO NOT PROCEED WITH THE FIRMWARE UPGRADE. Contact the Tektronix, Inc. Field Office or representative for assistance.

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

4. Preparing the Instrument for the Firmware Upgrade Procedure

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

b. Leave the instrument on its right side to provide access to circuit boards involved in the Firmware Upgrade Procedure.

Firmware Upgrade Procedure

1. Upgrading the A7 Display Controller board Firmware

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

b. Remove the instrument top panel cover.

c. Locate the A7 Display Controller board (see Fig. 3–1 in this section). The A7 Display Controller board is horizontally positioned above the plug-in compartment.

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

CAUTION

Be certain pin 1 is positioned correctly when replacing components.

NOTE

Use IC Insertion–Extraction Pliers for removing and replacing the ICs. (Refer to Table 2–1 in section 2 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. 3–21, the Semiconductor indexing diagram.)

e. Remove U602 and replace it with the upgrade IC. The last two-digit portion of the part number on the replacement IC should be the same as, or higher than, that on the removed IC.

f. Similarly replace U612 with an upgrade IC.

2. Accessing Boards Within the Card Cage

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

b. Remove the screws that secure the card cage retainer, an angle bar that prevents removal of the boards in the card cage. (Refer to Fig. 3–15 in this section.)

3. Upgrading the A18 Memory board Firmware

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

b. On the A18 Memory board, replace the following ICs (see Fig. 3–1 in this section):

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, higher than, that on the removed IC. Again, be certain that pin 1 is oriented correctly.

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

4. Upgrading the A17 Main Processor board Firmware

a. 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 instrument. (Refer to the A17 Main Processor board removal instructions listed under "Circuit Board Removal, Plug–On Boards" in this section.)

b. On the A17 Main Processor board, replace U240 and U250 (see Fig. 3–1.) 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. Be certain to orient pin 1 correctly when inserting the new parts.

5. Replacing the Card Cage and Circuit Board Retainers

a. Replace the card cage retainer with the two screws and replace the two nylon circuit board guides.

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

c. Replace the top cover of the instrument.

6. Upgrading the A6 Time Base board Firmware

a. Locate U281 and U283 on the A6 Time Base board (see Fig. 3–1 in this section). These components are found near the bottom front of the instrument as it resets on its right side.

b. Replace U281 and U283.

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. Be certain pin 1 is oriented correctly.

7. Setting the Cal Constant

a. Locate the CAL–LOCK pins, J450, on the A6 Time Base board (see Fig. 3–9) and add the terminal connector link. (Refer to the Shorting Jumper in Table 2–1 of Section 2.)

b. Connect a power cord to the instrument.

c. Connect a terminal or controller as described in the User's Reference Manual.

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

e. Set necessary communication parameters such as baud rate, etc.

f. After the instrument has powered up, establish communication from the terminal or controller by entering the following commands (<CR> is the return key):

e<CR>
v<CR>

g. Enter the command:

mcalconst 134:XXXX<CR>

where XXXX is the 4–digit value noted on the A5 Acquisition board Cal Constant tag. (See step 4 of the Preliminary Verification Procedure.)

8. Verifying the Cal Constant

a. Press the ENHANCED ACCURACY button to begin an Enhanced Accuracy cycle.

b. Check that the instrument successfully completes the Enhanced Accuracy cycle.

NOTE

The Enhanced Accuracy cycle must be performed for the instrument to recognize the new Cal Constant value.

c. If desired, the stored Cal Constant can be verified with the query:

mcalconst? 134 < CR >

d. Verify that the value returned is the same as written on the Cal Constant tag.

9. Verifying the Instrument Serial Number

a. Verify that the serial number on the instrument front panel matches the instrument identification number found via the Utilities menu and Instrument Options pop-up menu.

b. If the numbers do not match, enter the command:

uid main:"BXXXXXX" < CR >

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

c. Verify that the proper ID is now displayed in the Instrument Options pop-up menu.

10. Removing the Procedure Setup

a. Set the PRINCIPAL POWER SWITCH to OFF.

b. Remove the J450 CAL-LOCK jumper on the A6 Time Base board.

c. Replace the bottom instrument cover and set the instrument upright.

11. Performing Final Power-Up and Verification

NOTE

The power-up sequence must be performed for the instrument to recognize the new CAL-LOCK strap configuration and Cal Constant value.

a. Install a plug-in in each plug-in compartment. (If enough plug-ins are not available to fill all compartments, repeat the following steps enough times to ensure that each compartment is tested with a plug-in installed.)

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

c. Verify that the instrument powers up and successfully completes the self-diagnostic sequence.

d. Press the ENHANCED ACCURACY button and verify that the instrument successfully completes the sequence.

NOTE

If problems are encountered, check for the following:

- *Proper orientation of components in the sockets*
- *All component pins are properly seated*
- *Components are installed in the correct location*

Cables and Connectors

A cabling diagram (see Fig. 3-22) is provided to show the interconnecting cables between the various circuit boards, modules, and assemblies. Use this diagram for a reference when you are removing and/or replacing cables on these units.

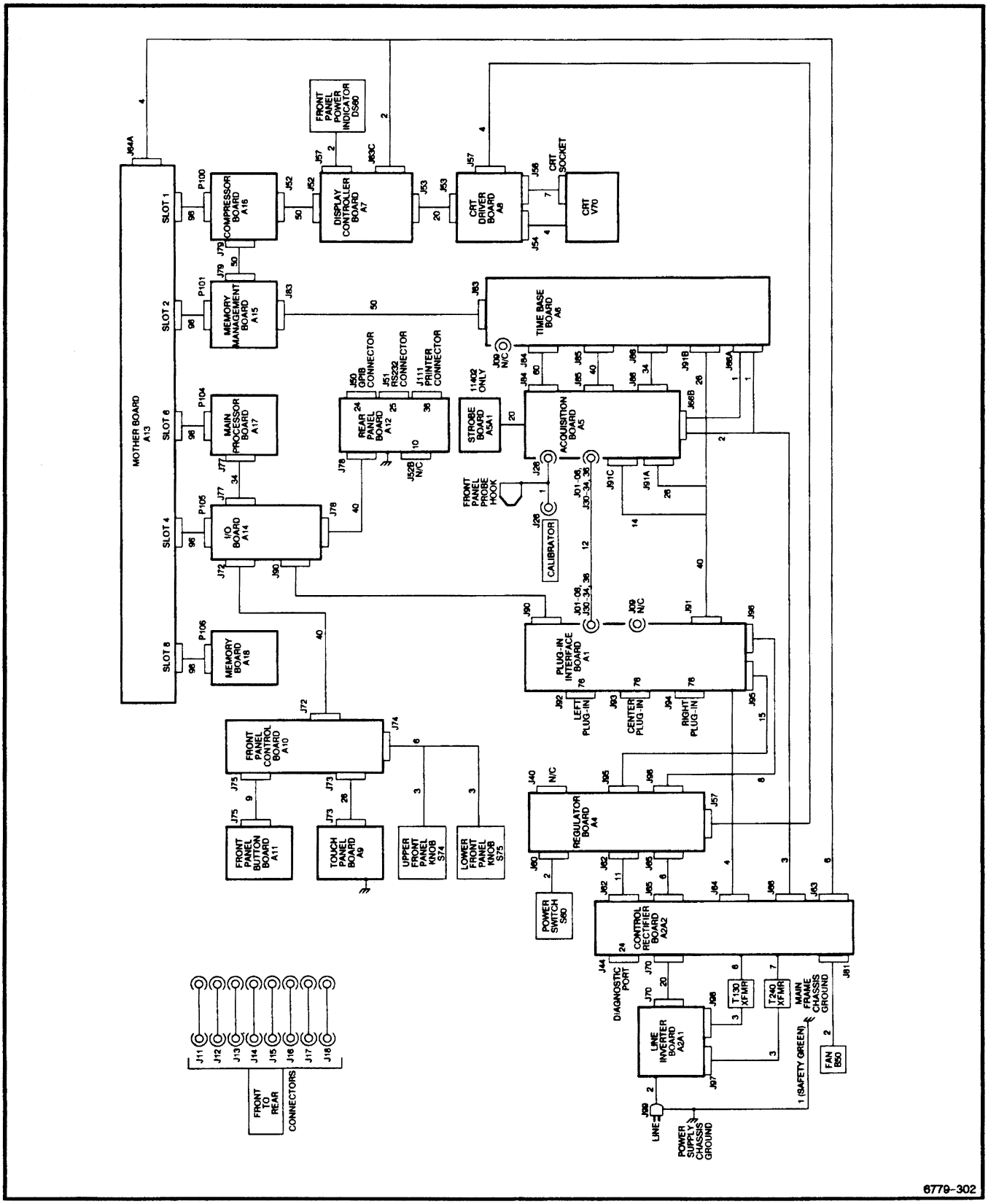


Figure 3-22. 11401/11402 Cabling Diagram.

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)

Color coding of wires 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

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.

Arrangement of Pins in Multi-Pin Connectors

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 orientation of the triangle on the multi-pin holder is determined by the index (triangle, dot or square) printed on the circuit board. Most circuit-board, mounted connectors have a square pad for pin 1.

NOTE

Some multi-pin connectors are keyed by a gap between the pin 1 and 3 positions in the holder. *(A small plastic plug covers the pin 2 position on the end of the holder.) There is a corresponding gap between pins 1 and 3 on the 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 two functions. The first is to provide a strain release for the wire connections. The wire ribbon is wrapped around a bar in between the wire connections and the top of the connector. 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.

The second function on most of the ribbon connectors is to provide a pull-tab to ease disconnection. The pull-tab is attached inside the connector. When the tab is pulled, even pressure is applied across the connector. The connector separates from its holder easily.

NOTE

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

If there isn't a pull-tab present in the connector, grasp the ends of the connector instead. Pull it straight out from the connector socket.

Line Fuse

The Line fuse used in the 11401/11402 is located on the rear panel of the power supply. Replace the line fuse (F99) with one of proper type and rating.

NOTE

Line voltage fuse F99 is used for both 115 and 230 V operation. No change in the fuse is necessary when switching the LINE VOLTAGE SELECTOR switch between 115 V and 230 V.

Checks After FRU Replacement

After any FRU has been replaced, that particular unit should be checked. (Table 3–2 lists the required checks.)

TABLE 3–2
Checks Required After FRU Replacement

FRU Replaced	Checks Required
A1 Plug-In Interface board	Part 3—Enhanced Accuracy (with a plug-in installed in each compartment)
A4 Regulator board	Part 1—Power-Up Diagnostics Part 2—Extended Diagnostics Part 3—Enhanced Accuracy Part 4—Power Supply Part 6—Calibrator Output Accuracy Part 7—Probe Compensation & Resistance Part 8—Acquisition Part 9—Vertical Input Offset Part 10—Sampler & Digitizer Part 11—Equivalent Time Step Response Part 12—Mainframe Bandwidth Part 13—A/D Converter Linearity Part 14—A/D Converter RMS Noise Part 16—Time Base
A5 Acquisition board	Part 1—Power-Up Diagnostics Part 2—Extended Diagnostics Part 3—Enhanced Accuracy Part 6—Calibrator Output Accuracy Part 7—Probe Compensation & Resistance Part 8—Acquisition Part 9—Vertical Input Offset Part 10—Sampler & Digitizer Part 11—Equivalent Time Step Response Part 12—Mainframe Bandwidth Part 13—A/D Converter Linearity Part 14—A/D Converter RMS Noise Part 15—Trigger Sensitivity Part 16—Time Base Part 19—Triggering
A6 Time Base board	Part 16—Time Base
A7 Display Controller board	Part 1—Power-Up Diagnostics Part 2—Extended Diagnostics Part 3—Enhanced Accuracy
A8 CRT Driver board	Part 5—Display

TABLE 3–2 (cont)
Checks Required After FRU Replacement

FRU Replaced	Checks Required
A9 Touch Panel board	Part 1—Power–Up Diagnostics Part 2—Extended Diagnostics Part 3—Enhanced Accuracy
A10 Front Panel Control board	Part 1—Power–Up Diagnostics Part 2—Extended Diagnostics Part 3—Enhanced Accuracy
A12 Rear Panel board	Part 1—Power–Up Diagnostics Part 2—Extended Diagnostics Part 3—Enhanced Accuracy
A13 Mother board	Part 1—Power–Up Diagnostics Part 2—Extended Diagnostics Part 3—Enhanced Accuracy
A14 Input/Output board	Part 1—Power–Up Diagnostics Part 2—Extended Diagnostics Part 3—Enhanced Accuracy Part 18—Input/Output
A15 Memory Management Unit board	Part 1—Power–Up Diagnostics Part 2—Extended Diagnostics Part 3—Enhanced Accuracy
A16 Waveform Compressor board	Part 1—Power–Up Diagnostics Part 2—Extended Diagnostics Part 3—Enhanced Accuracy
A17 Main Processor board	Part 1—Power–Up Diagnostics Part 2—Extended Diagnostics Part 3—Enhanced Accuracy
A18 Memory board	Part 1—Power–Up Diagnostics Part 2—Extended Diagnostics Part 3—Enhanced Accuracy
SDI (Serial Data Interface) IC	Part 1—Power–Up Diagnostics Part 2—Extended Diagnostics Part 3—Enhanced Accuracy (with a plug–in installed in each compartment)
DAG (Destination Address Generator) IC	Part 1—Power–Up Diagnostics Part 2—Extended Diagnostics Part 3—Enhanced Accuracy (with a plug–in installed in each compartment)

TABLE 3–2 (cont)
Checks Required After FRU Replacement

FRU Replaced	Checks Required
Firmware ICs	Part 1—Power-Up Diagnostics Part 2—Extended Diagnostics Part 3—Enhanced Accuracy (with a plug-in installed in each compartment)
CRT (Cathode Ray Tube)	Part 5—Display
Power Module	Part 1—Power-Up Diagnostics Part 2—Extended Diagnostics Part 3—Enhanced Accuracy Part 4—Power Supply Part 6—Calibrator Output Accuracy Part 7—Probe Compensation & Resistance Part 8—Acquisition Part 9—Vertical Input Offset Part 10—Sampler & Digitizer Part 11—Equivalent Time Step Response Part 12—Mainframe Bandwidth Part 13—A/D Converter Linearity Part 14—A/D Converter RMS Noise Part 16—Time Base

Diagnostic Troubleshooting

This section provides the information necessary to troubleshoot a faulty instrument to the Field Replaceable Unit (FRU) level. In most cases a FRU is a circuit board. Two FRUs are an exception; the Cathode Ray Tube (CRT)/CRT Driver board and the Power Supply Module. The primary means for troubleshooting is to use the error index code output from the Kernel Diagnostics or Self-Tests and cross-reference them to the suspect circuit boards in the FRU Guide tables below. After the faulty FRU is replaced, some recalibration of the instrument is normally required (this is discussed further below). In addition, conventional troubleshooting techniques are described at the end of this section to help identify a faulty CRT, CRT Driver, Power Supply Module, Mother board, or Regulator board.

Diagnostics Overview

Each subsystem (Executive, Display, and Digitizer) processor runs a set of Kernel Diagnostics prior to the Self-Tests. After the Display and Digitizer processors verify their support circuitry they try to establish communication with the Executive Processor. If this is successful, then the Self-Tests run to verify the functionality of each of the subsystems. After all the Self-Tests are executed, any failures cause the instrument to enter Extended Diagnostics and to display the error index codes in a diagnostic menu. Extended Diagnostics tests are a superset of the Self-Tests.

The Kernel Diagnostics (low-level Self-Tests) 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 run automatically during the Self-Tests (that is, some errors codes are only generated by manually selecting tests or Extended Diagnostics).

The next two subsections provide a quick overview of Kernel and Extended Diagnostics.

Kernel Diagnostics

Each time the front-panel ON/STANDBY switch is set to ON, the 11401/11402 performs Power-Up Diagnostics on its microprocessor subsystems and Self Test Diagnostics on all of its major circuits.

CAUTION

To avoid instrument damage, set the mainframe ON/STANDBY switch to STANDBY before installing or removing plug-ins.

Turning the instrument power off during probe calibration, enhanced accuracy, or Extended Diagnostics may result in some internal data being corrupted. If corruption occurs, refer to Restoring Data in Section 3.

When Power-Up Diagnostics begins, "**Diagnostics in Progress**" and "**Comm Test in Progress**" are displayed on the screen. Diagnostic routines are then performed on each of the instrument's microprocessor subsystems, followed by testing of the communication between these subsystems. If the instrument is being powered-up from a "cold" condition, the diagnostics may complete before the crt warms up enough to display these messages.

The starting of the Self-Test Diagnostics indicates successful completion of the Power-Up Diagnostics between the Executive and Display Subsystem. If the Digitizer Processor Kernel Diagnostics fail, then the instrument automatically enters Extended Diagnostics at the end of the Self-Tests. Upon successful completion, the graticule is displayed and the front-panel settings in effect at the last power-down are restored as well. The message, "**Dsy Kernel Failure**," or an audio beep and illuminated menu buttons indicates the failure of the Power-Up Diagnostics.

Using the Kernel Diagnostics

The Kernel Diagnostic tests run concurrently in all three subsystem processor circuits at power up. Address, data, and control lines to local ROM (containing the Diagnostic test code), RAM, and the interrupt controllers are all verified. For the Executive/Main Processor, this means checking basic operation for most boards in the Executive card cage (that is, those plugged in to the motherboard). The last test for the Display and Digitizer processors is to verify communication with the Executive processor. In a processor, all Kernel tests must run without failures before the subsystem's Self-Tests can execute.

Since the condition of the instrument is unknown at power up, the low-level Kernel Diagnostics in the Executive and Digitizer processors do not attempt to display error index codes. Instead, the low-level Kernel Diagnostics generate two-digit hex numbers that are read as a series of binary bits, such as XXX1 0101 (the upper bits are not used). This binary number is converted into a hex error index code (in this case, 15*hex*). Refer to the text under Tables 3-3, 3-6, and 3-9 for more information and examples of these two-digit hex numbers.

The Display Kernel Diagnostics display an error message on the screen giving the name of the test that failed. For example, the message

Dsy Kernel Failure
Timer 2

indicates that the Timer 2 test failed. If the display is disabled, the error index code is read from status pins (refer to Figures 3-23, 3-24, and 3-25) on the Display Controller board.

Self Test/ Extended Diagnostics

To indicate that the Self Test diagnostics have begun, "**Self Test in Progress**" is displayed. Flashing and pattern changes on the display make test progress obvious. Return to normal operation or entry into the New Configuration, as discussed below, indicates successful completion of Self Test Diagnostics. Any failures cause the instrument to run the remaining tests, then display the Extended Diagnostics menu. Record the displayed error codes for the failed circuit block(s) and refer the instrument to a qualified service person.

The format of the error index codes is based on the Extended Diagnostics menu structure. The Extended Diagnostics menus are in a three level hierarchy with the Block menu at the highest level. Each circuit block name in the Block menu is individually selectable and testable. A selected circuit block is broken into a number of parts or circuit areas in the Area menu, the second level. Touching the Area label at the bottom of the menu displays the Area Menu for the selected block. Each circuit area has a Routine menu, the third level, associated with it that has one or more selectable routines. Routines are the smallest test units that are selectable and runable. This Block, Area, and Routine menu hierarchy generates the error index codes.

Extended Diagnostics error index codes are five digit codes whose first character indicates the subsystem or plug-in tested. The last four digits are hexadecimal (hex) numbers that indicate the block, area, routine and specific failure mode. For example, E2321 is decoded as follows:

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

The subsystem character of an error index code is one of the following:

E	-Executive
D	-Display
G	-Digitizer
L	-Left
C	-Center
R	-Right

Front-panel controls are active during the Self Test sequence and any disturbance causes a test failure. If such a failure occurs, the instrument automatically enters the Extended Diagnostics mode and displays the Extended Diagnostics menu. Touching the (E) Exit label removes the menu and resumes normal operation. However, if the Diagnostics detect a fatal Digitizer Processor Kernel Diagnostics fault, exiting the menu to normal operation is not possible.

Self Test Diagnostics test the following circuits:

- Executive Control
- Front Panel
- Internal I/O
- External I/O
- Subsystem Communication
- Display Control
- Video Generator
- Digitizer
- Timebases
- Points Acquisition
- Triggers
- Points/Address Generator
- Left Compartment Plug-in
- Center Compartment Plug-in
- Right Compartment Plug-in

Using the Self Tests/Extended Diagnostics

After all Extended Diagnostic/Self-Tests have run, any resultant error index codes appear on the display next to the associated circuit block names in the Extended Diagnostics menu. Each circuit block that had a failure gives the first error encountered and the number of failures in the block. Select the label of a failed block then select the Area label to get a more complete list of the error index codes in a block. Selecting the Routine label shows the lowest level test routines in the selected Area. The currently selected Block, Area, and Routine are shown below their labels at the bottom of the menu. Several operating mode selectors are also available at the bottom of the screen. When certain test routines are selected some of these operating modes are unselectable. The mode operators are:

(E)Exit—Extended Diagnostics is terminated and the instrument enters the normal operating mode.

(p)Loop—Toggles On and Off. When On, the selected test(s) is run continuously with the number of iterations displayed.

(t)Terse—Toggles On and Off. When On, tests in the loop mode run at the fastest rate but the iteration 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 run when started.

(s)Stop on Err—Toggles On and Off. When On, testing stops after the first failed test completes.

(r)Run/(q)Quit—Starts or stops the currently selected tests.

NOTE

Touching any place on the screen (or any front-panel button) while a test is running stops the test when the current routine ends.

New Configuration

When a plug-in is first installed in a mainframe or when one is moved to a different compartment in the mainframe, the instrument is in a new configuration mode. After the instrument runs the Power-Up Diagnostics, it Self-Tests for the new configuration. During this Self-Test, the message **"New configuration—partial enhanced accuracy occurring"** appears at the top of the display. If the operation is successful (as indicated by a message), the instrument enters the normal operating mode.

Restoring Data

If the instrument power is turned off during probe calibration, self-calibration or Extended Diagnostics, some internal data may be corrupted. The display of the Extended Diagnostics menu when the power is turned on, indicates that this corruption has occurred.

If the Extended Diagnostics menu displays a plug-in Cksm Probe error (this error indicates that power was turned off during probe calibration), then using the following procedure usually restores normal operation:

1. Note from the Extended Diagnostics menu which plug-in is at fault.
2. Exit the Extended Diagnostics menu.
3. Remove and re-install the probes on the plug-in that is at fault.
4. Repeat the calibration of these probes.
5. Run the Self-Tests and confirm that the tests pass.

If the Extended Diagnostics menu displays a plug-in Cksm Plug or any other new error, then using the following procedure usually restores normal operation:

1. Exit the Extended Diagnostic menu.
2. Wait for the self-calibration to complete and pass.
3. Run the Self-Tests and confirm that the tests pass.

Usually these procedures restore normal operation. If these procedures do not restore normal operation, then your mainframe or plug-in requires servicing.

Battery Testing

The 11401/11402 holds two lithium batteries to provide power when the instrument is turned off. One powers the Real Time Clock (V614) on the A14 I/O board. The other battery provides power to the static RAM (NV RAM) on the A17 Main Processor board.

The Real Time Clock on the A14 I/O board will typically run for five years on one battery. If the clock begins to lose time rapidly when the instrument is turned off or the diagnostics report that the Real Time Clock has failed, the most likely source of the problem is the battery. If the battery drops below 2.7 V (at 20° C), follow the instructions for replacement earlier in this section.

The NV RAM will typically hold its contents for five years on one battery. If the diagnostics consistently report that the battery for the NV RAM is dead, the battery should be tested. If it measures less than 2.45 V (at 20° C), follow the instructions for replacement earlier in this section.

NOTE

If the diagnostics report an NV RAM battery failure, then exit the diagnostics. This will rewrite the confidence words into the NV RAM. Turn off the instrument for at least one hour. Turn the instrument back on. If the diagnostics still indicate an NV RAM battery failure, then the battery should be tested.

Turning the instrument off while the Extended Diagnostics are running the NV RAM Memory Test usually causes a single failure of the NV RAM battery test.

Field Replacable Unit (FRU) Guide

This section correlates error index codes resulting from Diagnostic tests with the hybrid/integrated circuit (IC) and the board FRU(s) suspected of causing each error. The FRU(s) in the board FRU category are listed in most-to-least probable cause order (assuming only one error is indicated). If any diagnostic errors occur, inspect the suspect FRU for loose connections and components. 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. In addition, refer to Table 3-2, Checks Required After FRU Replacement, under Adjustment after Repair in Section 3, Maintenance, for any necessary adjustments and precautions.

The error index codes and tests are divided into three groups based on the three mainframe subsystems: Executive/Main Processor, Display, and Digitizer. The prefix letters on the error index codes, E, D, and G refer to these processors, respectively. Error index codes prefaced with an L, C or R refer to the Left, Center and Right plug-in units. Plug-in unit error index codes are covered in the appropriate plug-in unit service manual. Each subsystem group has a table of Kernel Diagnostic error index codes, a table of Self Test/Extended Diagnostic error index codes, and a table of Manual Test error index codes.

Kernel error index codes for the Digitizer and Display are read as TTL logic levels on circuit board pins using a logic probe. Refer to Table 2-1 for a complete description of the logic probe recommended.

Abbreviations of FRU Names

All active mainframe boards are listed here with the abbreviation used in the FRU tables below.

PIINT	Plug–In Interface board	(A1)
REG	Regulator board	(A4)
ACQ	Acquisition board	(A5)
STROBEDRV	Strobe Driver board	(A5A1)
TB	Time Base board	(A6)
DSY	Display Controller board	(A7)
CRT	Cathode Ray Tube	
CRTDR	CRT Driver board	(A8)
TOUCH	Touch Panel board	(A9)
FPCTRL	Front Panel Control board	(A10)
FPBUT	Front Panel Button board	(A11)
REAR	Rear Panel board	(A12)
MOTHER	Mother board	(A13)
IO	Input/Output board	(A14)
MMU	Memory Management Unit board	(A15)
CMPR	Compressor board	(A16)
MPU	Main Processor board	(A17)
MEM	Memory board	(A18)

Abbreviations of Component and Module Names

All active components and modules are listed here with the abbreviation used in the FRU tables below.

FW	Main Processor Firmware
FW	Display Processor Firmware
FW	Digitizer Processor Firmware
SDI	Serial Data Interface IC
DAG	DAG IC
PS	Power Supply Module

The Main, Display, and Digitizer Processor Firmware are not separate components. These three components are packaged in firmware (FW) kits; a kit exists for the 11401, and another kit exists for the 11402.

Executive Subsystem Error Index Codes

TABLE 3–3
Executive Processor Kernel Error Index Codes

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

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

For example: Error index code 12*hex* causes the UTILITY and TRIGGER LEDs to light.

Reading the Executive/Main Processor Subsystem error bits from the A17 Main Processor Board test points TP201 (MSB) to TP205 (LSB) is also possible (refer to Figure 3–23 for the location of these status pins). The bits are high (+ 5 V) true.

The LEDs will flash while the kernel tests are running. If a kernel failure is detected, one or both LEDs will be lit.

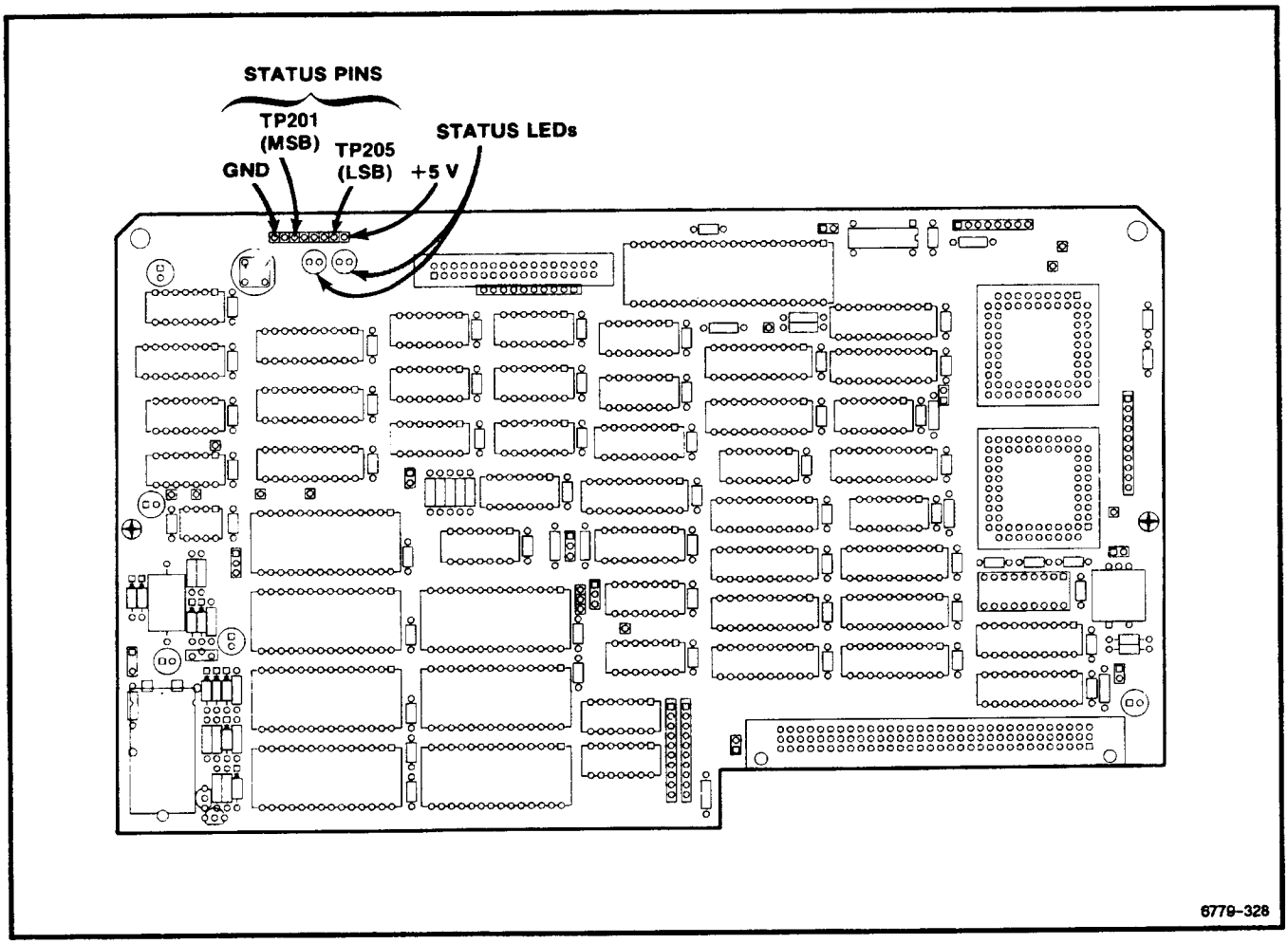


Figure 3-23. Main Processor board status pins.

TABLE 3-4
Executive Processor Self-Tests/Extended Error Index Codes

Error Index	Suspect Hybrid /IC FRUs	Suspect Board FRUs
E111X - E112X	FW	MPU
E113X - E11AX	FW	MEM, MPU
E121X - E122X	FW	MPU
E123X - E12AX	FW	MEM, MPU
E13XX		MEM, MPU
E14XX		MEM, MPU
E15XX		MPU

TABLE 3–4 (cont)
Executive Processor Self–Tests/Extended Error Index Codes

Error Index	Suspect Hybrid /IC FRUs	Suspect Board FRUs
E16XX		MPU
E17XX		IO, MPU
E18XX		IO, MPU
E19XX		MPU, IO
E1AXX		MEM, IO, MPU
E1BXX		MPU
E1CXX		MPU, MEM
E21XX		FPCTRL, IO, MPU
E22XX		FPBUT, TOUCH, FPCTRL, IO,MPU
E23XX		TOUCH, FPCTRL, IO, MPU
E24XX		IO, FPCTRL, MPU
E3XXX		IO, MPU
E4XXX		REAR, IO, MPU
E51XX		MMU, MPU
E52XX		MMU, MPU
E531X		CMPR, MPU
E532X – E53BX		CMPR, MMU, MPU
E54XX		CMPR, MMU, MPU
E55XX		CMPR, MMU, MPU
E561X		DSY, CMPR, MMU, MPU
E562X		TB, MMU, MPU
E57XX	SDI	IO, MPU
E581X (with plug–in)		LEFT, IO, PIINT, MPU
E582X (with plug–in)		CENTER, IO, PIINT, MPU
E583X (with plug–in)		RIGHT, IO, PIINT, MPU

Table 3–5 lists the Executive Processor Manual Tests, the verification procedures, and the suspect board FRUs. If the conditions specified in the verification procedure listed are not met, then the board FRUs listed are suspect.

These tests are performed manually and produce no error index code displays. They are included to help you locate faulty boards that possibly the Kernel or Self–Tests Diagnostics did not locate. Interconnections, such as mother boards and cables, and the power supply boards are not listed but are considered as possible problem sources.

TABLE 3–5
Executive Processor Manual Tests

Test	Verification Procedure	Verification Procedure Failure: Suspect Board FRUs
Front Panel		
Verify		
Hard Keys	This test allows the user 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 is only executable in the Routine menu with the All and Loop modes set to Off. Once this test is invoked, the operator can press any of the hard keys in the instrument and verify that the corresponding image of the key on the screen is highlighted, that the associated LED is turned on, and that an audio click is generated.	FPBUT, TOUCH, FPCTRL, IO, MPU
Soft Keys	This test allows the user to interactively touch any of the soft keys and verify their operation. This test verifies the operation of a key with both visual and audio feedback. This test requires operator interaction and is only executable in the Routine menu with the All and Loop modes set to Off. Once this test is invoked, the operator can touch any of the soft keys in the instrument and verify that a touch box is drawn around the soft key on the screen and that an audio click is generated.	TOUCH, FPCTRL, IO, MPU

TABLE 3–5 (cont)
Executive Processor Manual Tests

Test	Verification Procedure	Verification Procedure Failure: Suspect Board FRUs
Front Panel (cont)		
Verify (cont)		
Knobs	This test allows the user to interactively turn either of the knobs and verify their operation. This test verifies knob movement with visual feedback. This test requires operator interaction and is only executable in the Routine menu with the All and Loop modes set to Off. Once this test is invoked, the operator can turn either of the knobs on the instrument and verify that the corresponding knob pointer on the screen rotates and that its associated counter value changes.	IO, FPCTRL, MPU
Internal I/O		
Tone Gen		
Ramp Tone	This test verifies the capability of the instrument to generate tones through its internal speaker. This test requires operator interaction and is only executable in the Routine menu with the The Loop mode set to On and the Terse and All mode set to Off. After invoking this test, the operator should verify that a high speed clicking sound occurs.	IO, FPCTRL, MPU

TABLE 3–5 (cont)
Executive Processor Manual Tests

Test	Verification Procedure	Verification Procedure Failure: Suspect Board FRUs
Internal I/O		
RealTime Clk		
Calibrate	This test allows the user to check and adjust the Real Time Clock period. This test requires operator interaction and is only executable in the Routine menu with the All and Loop modes set to Off. Once this test is invoked, the operator can check/adjust the Real Time Clock period following the procedure outlined in the Checks and Adjustments Section.	IO, MPU
External I/O		
Printer		
Pattern	This test prints a set of of patterns (all printable ASCII characters) to help the operator verify the external printer interface. This test requires operator interaction and is only executable in the Routine menu with the All mode set to Off. Before executing this test, the operator should connect a Centronics–compatible printer to the printer connector on the rear panel of the instrument	REAR, IO, MPU

TABLE 3–5 (cont)
Executive Processor Manual Tests

Test	Verification Procedure	Verification Procedure Failure: Suspect Board FRUs
External I/O		
RS–232		
Extern Loop	This test verifies parts of the external RS–232 interface This test requires operator interaction and is only executable in the Routine menu with the All mode set to Off. Before executing this test, the operator should connect an external loopback connector (Tektronix part number 013–0198–00) to the RS–232 connector on the rear panel of the instrument.	REAR, IO, MPU
GPIB		
Intrpt Reset Reset Status Data Lines Interrupt	These tests verify the Executive processor interface to the internal GPIB circuitry. The major external GPIB functions are not tested. This test requires operator interaction and is only executable in the Routine menu with the All and Loop modes set to Off. Before executing this test, the operator should disconnect the instrument from the GPIB bus.	REAR, IO, MPU

Display Subsystem Error Index Codes

TABLE 3–6
Display Processor Kernel Error Index Codes

Error Index*hex*	Suspect Hybrid/ IC FRUs	Suspect Board FRUs
FF – FE		DSY
FD – FA	FW	DSY
F9 – F5		DSY
F4		DSY, CMPR

The name of the first Display Kernel test that fails is displayed on the screen. The Display Processor error index code are read from the Display Controller board (A7) test points TPH (LSB) to TPA (MSB) next to the STATUS 0 and STATUS 1 LEDs (refer to Figure 3–24 for the location of these status pins). The bits are high (+5 V) true.

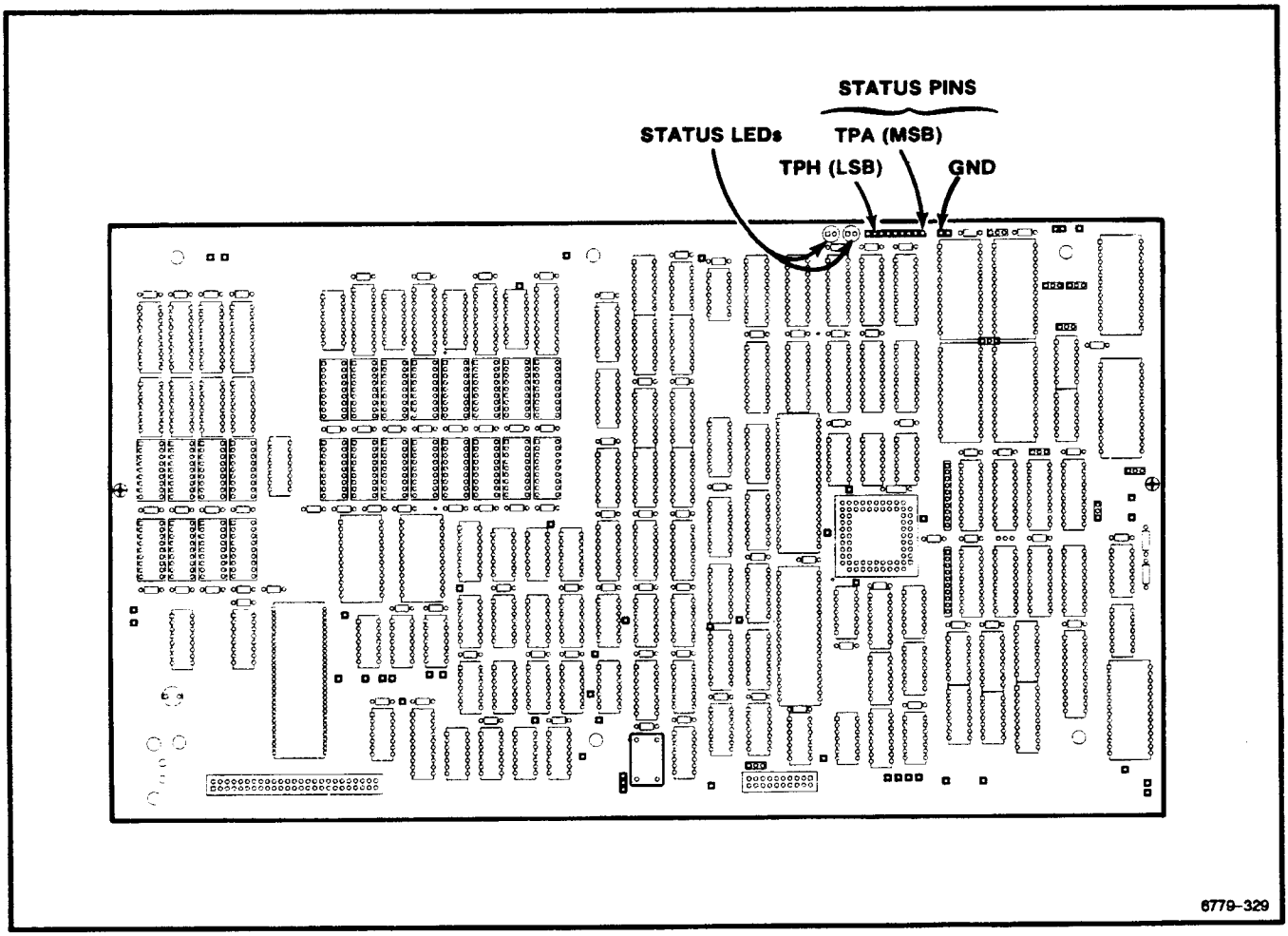


Figure 3–24. A7 Display Controller board status pins.

TABLE 3–7
Display Processor Self Test/Extended Error Index Codes

Error Index	Suspect Hybrid/ IC FRUs	Suspect Board FRUs
D11XX - D12XX	FW	DSY
D13XX		DSY
D14XX - D15XX		DSY
D161X		DSY, CMPR
D162X		DSY, CMPR
D163X		DSY, CMPR
D164X		DSY, CMPR
D21XX		DSY
D22XX - D26XX		DSY

Table 3–8 lists the Display Processor Manual Tests, the verification procedures, and the suspect board FRUs. If the condition specified in the verification procedure listed is not met, then the board FRUs listed are suspect.

These tests are performed manually and produce no error index code displays. They are included to help you locate faulty boards that possibly the Kernel or Self–Tests Diagnostics did not locate. Interconnections, such as mother boards and cables, and the power supply boards are not listed but are considered as possible problem sources.

TABLE 3–8
Display Processor Self Test/Extended

Error Index	Verification Procedure	Verification Procedure Failure: Suspect Board FRUs
Video Gen CRT Driver Stimulus	This test verifies the capability of the CRT Driver board to change the intensity of the crt display screen. This test requires operator interaction and is only executable in the Routine menu with the All mode set to Off. Once this test is invoked, the operator is required to verify that the intensity of the display crt screen changes through four different intensity levels.	CRTDR, DSY, CRT

Digitizer Subsystem Error Index Codes

TABLE 3-9
Digitizer Processor Kernel Tests Error Index Codes

Error Index	Suspect Hybrid/ IC FRUs	Suspect Board FRUs
1F - 1E		TB
1D - 1A	FW	TB
19 - 17		TB
16		TB, MMU

The error index code bits of the first Digitizer Kernel test that fails are read from the A6 Time Base board test connector J290, pins 2 (LSB) to 6 (MSB) (refer to Figure 3-25 for the location of these status pins). The bits are high (+5 V) true.

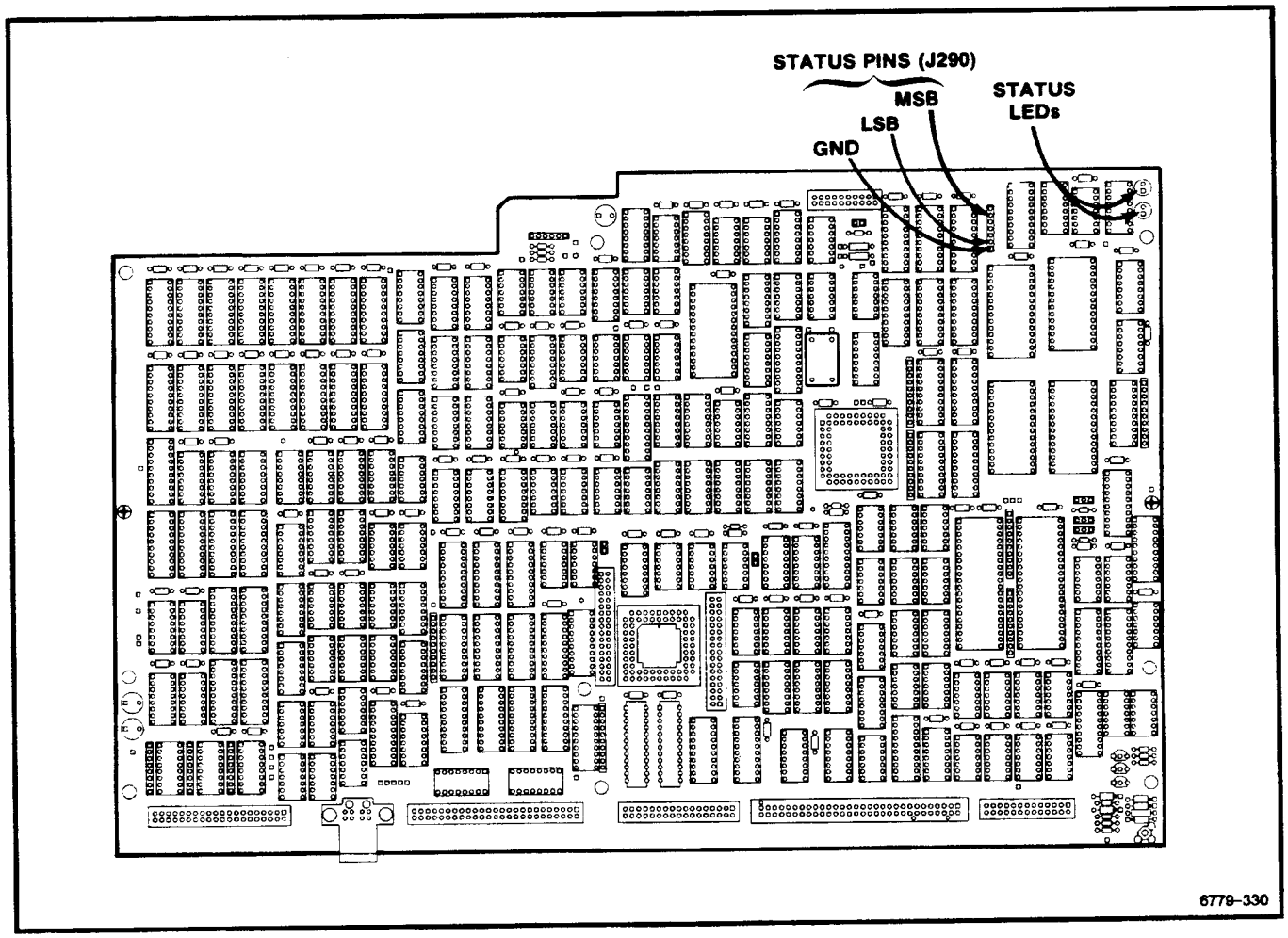


Figure 3-25. A6 Time Base board status pins.

TABLE 3-10
Digitizer Processor Self Test/Extended Error Index Codes

Error Index	Suspect Hybrid/ IC FRUs	Suspect Board FRUs
G11XX - G12XX	FW	TB
G13XX		TB
G14XX - G15XX		TB
G16XX		TB, MMU
G21XX		ACQ, TB
G221X		TB
G222X - G223X		TB
G231X		TB
G232X		TB
G233X		TB
G234X		TB
G235X		TB
G236X		TB, ACQ
G31XX - G32XX		TB
G33XX		TB, ACQ
G351X - G352X		ACQ, TB
G353X		ACQ, TB
G35XX		ACQ, TB
G411X - G412X		TB, ACQ
G413X		TB, ACQ
G421X		TB, ACQ
G511X		TB
G52XX	DAG	TB
G53XX		TB, MMU

Table 3-11 lists the Digitizer Processor Manual Test, the verification procedures, and the suspect board FRUs. If the conditions specified in the verification procedure listed are not met, then the board FRUs listed are suspect.

These tests are performed manually by selecting them individually and may produce no error index code displays. They are included to help you locate faulty boards that possibly the Kernel or Self-Tests Diagnostics did not locate. Interconnections, such as mother boards and cables, and the power supply boards are not listed but are considered as possible problem sources.

- F200 supplies + 5 V to the A12 Rear Panel board. If diagnostics report failure of all three panel ports (RS-232, GPIB, Centronics, and printer), then this fuse is the likely suspect (assuming that the ribbon cable to the A12 Rear Panel board is powered on). Test F200 with an ohmmeter or voltmeter. It should measure less than 1.5 V.

- F800 supplies + 5 V to the A10 Front Panel Control board and the A11 Front Panel board. If the diagnostics report both an A9 Touch Panel board failure and knob failures, then this fuse is one source of this problem. When tested with an ohmmeter, this fuse should measure less than 1 Ω.

- F600 supplies + 15 V to the A14 I/O board Temperature Sensor and Tone Generator, the lights of the A11 Front Panel Button board, the A9 Touch Panel board, the A12 Rear Panel board's RS-232 output line drivers, the Card Cage, and the A17 Main Processor board's NV RAM. If the NV RAM battery test and the RS-232 External Loop Back test fail (but the Internal Loop Back test passes), and the A11 Front Panel Button board's lights, Temperature Sensor, and Tone Generator are all off, then this fuse is the likely suspect. When tested with an ohmmeter, this fuse should measure less than 1 Ω.

- F602 supplies -15 V to the A14 I/O board Temperature Sensor and Tone Generator, A12 Rear Panel board's RS-232 output line drivers, the A9 Touch Panel board, and the Card Cage. If the Temperature Sensor and Tone Generator, and the RS-232 External Loop Back test fail (but the Internal Loop Back test passes), then this fuse is the likely suspect. When tested with an ohmmeter, it should measure less than 1Ω.

TABLE 3-11
Digitizer Processor Manual Tests

Error Index	Verification Procedure	Verification Procedure Failure: Suspect Board FRUs
Points Acq		
Cal Refs		
FP 1 KHz	This test verifies that the front panel CALIBRATOR is capable of generating a 6 V peak-peak, 1 kHz square wave, centered around 0 V. Once this test is invoked, the operator can use a Test Oscilloscope to verify the waveform present on the front panel CALIBRATOR bnc. Refer to Table 2-1 for a complete description of the Test Oscilloscope required.	ACQ, TB
FP 1 MHz	This test verifies that the front panel CALIBRATOR is capable of generating a 6 V peak-peak, 1 MHz square wave, centered around 0 V. Once this test is invoked, the operator can use a Test Oscilloscope to verify the waveform present on the front panel CALIBRATOR bnc. Refer to Table 2-1 for a complete description of the Test Oscilloscope required.	ACQ, TB

TABLE 3–11 (cont)
Digitizer Processor Manual Tests

Error Index	Verification Procedure	Verification Procedure Failure: Suspect Board FRUs
Points Acq (cont)		
Cal Refs		
FP –10.000 V FP –5.000 V FP –2.5000 V FP –1.000 V FP –100.00mV FP +99.951mV FP +999.51mV FP +2.4988 V FP +4.9976 V FP +9.9951 V	This test verifies that the front panel CALIBRATOR is capable of generating –10.000 V dc, respectively. Once this test is invoked, the operator can use a Digital Voltmeter to verify the voltage present on the front panel CALIBRATOR bnc. Refer to Table 2–1 for a complete description of the Digital Voltmeter required.	ACQ, TB

NOTE

In Table 3–11, Points Acq denotes points acquired, Cal Refs denotes calibrator references, and FP denotes the Front Panel.

Enhanced Accuracy Mode Troubleshooting

Table 3–12 lists the error messages that are possible in the Enhanced Accuracy mode and the troubleshooting technique to use. Enhanced accuracy is available after the system has a 20–minute warmup period.

TABLE 3–12
Enhanced Accuracy Mode Error Messages and Troubleshooting

Error Message	Suggested Troubleshooting
"A/D Out of Specification"	Replace Acquisition board
"A/D Quantizer 1"	Replace Acquisiton board
"A/D D/A Converter"	Replace Acquisition board
"A/D Quantizer 2 Positive"	Replace Acquisition board
"A/D Quantizer 2 Negative"	Replace Acquisition board
"Main Time Interpolator"	Replace Acquisition board.
"Window Time Interpolator"	Replace Acquisition board.
"Main Fine Holdoff"	Reset the Digitizer Cal Constants as shown in the procedure on page 3–89. If the error message does not disappear, replace the Acquisition board.
"Window Fine Holdoff"	Reset the Digitizer Cal Constants as shown in the procedure on page 3–89. If the error message does not disappear, replace the Acquisition board.
"Main Trigger Level"	Replace the Acquisition board and/or the Plug–In Interface board.

NOTE

In Table 3–12, A/D denotes an analog to digital converter and D/A denotes a digital to analog converter.

Reset Digitizer Cal Constants

When an error message indicates the need to reset the digitizer cal constants (see Table 3–12) you should complete the following steps. You will need a CAL–LOCK strap, debug strap, and a Diagnostic Terminal.

1. Set the mainframe to standby (power should be off).
2. Remove the bottom cover from the instrument.
3. Connect the J450 CAL–LOCK strap as shown in Figure 3–9.
4. Connect the debug strap as shown in Figure 3–9.
5. Connect the terminal to the instrument.
6. Turn the power on.
7. Ignore the diagnostic error message and exit diagnostics.
8. Remove the debug strap.
9. Using the Diagnostic Terminal, set Cal Constant 134 to the value written on the sticker attached to the A5 Acquisition board.

(mcalconst to 134:XXXX <CR>)

10. To verify the cal constant use the Diagnostic Terminal to enter the query:

mcalconst? 134 <CR>

11. Perform Enhanced Accuracy with plug–ins in one or more compartments. (See Note below.)
12. Turn off the power and remove the CAL–LOCK strap and terminal. Replace the bottom cover.

NOTE

The trace centering adjustment will not be made on empty plug–in compartments. Power up with an 11k plug–in in each compartment and wait for Partial Cal to do this adjustment.

Other Troubleshooting

CRT or CRT Driver Board

This procedure requires a Test Terminal and a compatible RS-232-C serial interface cable. Refer to Table 2-1 for a complete description of the equipment required.

Module Troubleshooting

If the instrument powers up (ON/STANDBY light on) but the display gives scrambled information or none at all, then the CRT and 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.

1. With the power off, remove the top cover, then turn the power on. Observe the two LEDs on the Display Driver 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 Display Driver board and the CRT Driver board are also suspect. (These chips generate the analog signals for the CRT Driver board, but the Diagnostics do not check these chips.)

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-up cycle to force a Diagnostic error so the instrument 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 CRT Driver board is at fault. Note, any other errors and use the FRU Guide earlier in this section to identify a suspect board.

Power Supply Module

This procedure requires an Extended Diagnostics Power Supplies Troubleshooting Fixture. Refer to Table 2-1 for a complete description of the equipment required.

Module Troubleshooting

Power supply problems show up when the front-panel ON/STANDBY switch is pressed ON. If the green light beside the ON label fails to light then check the following:

1. The PRINCIPAL POWER SWITCH located on the back panel is in the ON position.

2. The line cord is connected to a functional power source with the same output voltage set with the Line Voltage Selector on the back panel.

3. Check that the fuse is good. If it is blown, replace the fuse then check out the power supply, as described at the end of this list.

4. Check that the fan is exhausting air from the instrument when the ON/STANDBY switch is ON. A defective fan causes an over-temperature shutdown in the power supply.

If these checks fail to correct the problem, connect the Extended Diagnostics 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 up again. This procedure is only effective for externally shorted power supplies. Once again, refer to documentation accompaning the Test Fixture for more troubleshooting hints.

A13 Mother Board

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

A4 Regulator Board

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

Fuse Testing

The A14 I/O board has four fuses. F200 supplies +5V to the A12 Rear Panel board. F800 supplies +5V to the A10 Front Panel Control board and the A9 Touch Panel board. F600 supplies +15V to the A14 I/O board, Card Cage, A10 Front Panel control board, A9 Touch Panel board, A11 Front Panel Button board, and A12 Rear Panel board (reduced to +12V). F602 supplies -15V to the A14 I/O board, Card Cage, A10 Front Panel Control board (reduced to -5V), and A12 Rear Panel board (reduced to -12V).

The A14 I/O board uses the +15V and -15V supplies on board to run the Temperature Sensor and the Tone Generator. Of the other Card Cage boards, the A17 Main Processor board uses the +15V supply to run the NVRAM circuitry. The information above and Table 3-13 will help you to identify a failure of one of these fuses. If a test fails, then check the fuses.

CAUTION

Using a replacement fuse with an incorrect current rating may cause 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.) Check Section 5, Replaceable Parts for the correct value and part number for each fuse.

TABLE 3–13
A14 I/O Board Fuse Failures

Fuse	Kernel Test Failure J715——J710	Test Failure J715——J710
F200 open	OB hex (GPIB Interrupt)	
F800 open	OE hex (Front Panel Inter) Note: Front Panel lights do not work. The code must be read from the Error Status test points (TP200–TP205) on the A17 Main Processor board.	
F600 open	Passes the Kernel Test, but the Front Panel lights are off.	Exec Control E1511 2 NVRAM E1511 2 Battery E1511 1 Data Lines E1521 1 *Addr/Data E1531 1 Internal I/O E3111 1 Temp Sensor E3111 1 Comparator E3111 1 *Tone Gen —— *Ramp Tone (works) Note: The Front Panel lights, soft keys, and hard keys do not work.
F602 open	OE hex (Front Panel Inter) Note: The Tone Generator has a very different tone.	

***indicates a Manual Test forced by the operator.**
It is not automatically run by Self-Test.

Section 4
Theory of Operation

This section describes and illustrates the 11401/11402 block diagram (refer to Fig. 4–1) including individual boards, signal flow, control flow, and the power section of the system.

Block Diagram Description

A1 Plug–in Interface Board

The obvious purpose of the A1 Plug–in Interface Board is to interface plug–ins to the mainframe. Signals and voltages are routed within the instrument through the A1 Plug–in Interface Board. Another function of this board is to bus power supply voltages from the Power Supply Assembly that plugs into the back of the A1 Plug–in Interface Board. There are no active components on this board.

A4 Regulator Board

The A4 Regulator Board converts semi–regulated voltages into stabilized, low–voltage operating power for use throughout the instrument. When over–voltage, under–voltage, or unusual startup behavior of any regulated supply in the instrument is detected by this board, a signal is latched into an LED indicator and an immediate shutdown of the entire power supply is initiated.

A5 Acquisition Board

The circuitry on the A5 Acquisition board samples waveform signals from each plug–in compartment. These signals are then output to the A/D converter on this board. The sampled waveform signal is converted to a digital value for output to the A6 Time Base board and the A17 Main Processor board.

Circuitry for the main and delayed triggers is also located on the A5 Acquisition board.

A6 Time Base Board

The basic function of the A6 Time Base board is to use the signals from the A5 Acquisition board to produce waveform records of a desired length and resolution at a specified position. The circuitry for the two user–defined window records is also held on the A6 Time Base board. These window trigger circuits are connected to the main trigger on the A5 Acquisition board.

A7 Display Controller Board

Waveform data is sent to the A7 Display Controller board from the A16 Waveform Compressor board. Once it is processed, this data is usually sent directly to the A8 CRT Driver board.

The Video Memory and the Display System Timing Generator are located on the A7 Display Controller board. The Display Driver is also held on this board. It provides the control and video signal interface to the A8 CRT Driver board.

The Executive Processor Parallel Interface Port is located on the A7 Display Controller board. It has two separate functions: 1) a bidirectional 16–bit interface for commands and 2) an interface for transferring incoming 16–bit waveform information to the CRT.

There are two EPROMs that comprise the standard firmware for this board and two optional EPROMs can be configured for the use by three different types of EPROMs depending on the amount of storage needed.

The Multi-function Universal Asynchronous Receiver Transmitter (MUART) on the A7 Display Controller board provides 16 lines of parallel I/O, a serial port, a baud rate generator, various timers, and an interrupt controller. The A7 Display Controller board uses the parallel I/O to provide software control of various portions of the display hardware.

A8 CRT Driver Board

The 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 decoded by the A8 CRT Driver board to generate the z-axis, sweep signals, and grid bias voltages for the CRT.

A9, A10, A11 Front Panel Boards

The A9 Touch Panel board, the A11 Front Panel Button board, and the A10 Front Panel Control board contain a Touch panel for selecting menu options, major menu keys (hard keys), and a Menu Status LED panel. The three boards interface to the Executive Processor on the A17 Main Processor board. A general purpose programmable keyboard and display controller on the A10 Front Panel Control board notifies the A17 Main Processor when the touch panel or hard keys have been touched.

A12 Rear Panel Board

The A12 Rear Panel board is the instrument's link to the outside world. This board contains connectors for a GPIB port, RS-232 port, and a PRINTER port. The RS-232 port is for connecting a terminal or a Personal Computer (such as an IBM PC) to the instrument. The GPIB port allows the instrument to be controlled by a GPIB controller. The remaining port is for connecting a printer to the instrument. The A14 I/O board drives the A12 Rear Panel board.

A14 Input/Output Board

The A14 I/O board is an interface between the A17 Main Processor board and the A12 Rear Panel board (which contains the GPIB, RS-232, and Centronics printer ports), the Front Panel boards, and the plug-ins. The A14 I/O board also contains:

- the system Timer—gives diagnostics the ability to analyze pulse trains. It is also used as a timer for the operating system.
- the Real Time Clock—keeps track of the current time of day, date, and year which the A17 Main Processor board sets and reads. A lithium battery powers this clock.
- the Serial Data Interface device—provides communication between the A17 Main Processor board and the three plug-ins as well as both front panel knobs.
- the Temperature Sensor—the A17 Main Processor board uses the Temperature Sensor to get a digital reading of the temperature in the instrument. When the temperature changes, the instrument can automatically recalibrate itself.
- the Tone Generator—generates a range of tones that are used to indicate touches on the front panel as well as error conditions during diagnostics.

A15 Memory Management Board

The A15 Memory Management board coordinates communications among the A7 Display board, A5 Acquisition board, A6 Time Base board, and the A17 Main Processor board. The A15 Memory Management board also holds either 128K or 256K bytes of Waveform memory.

A16 Waveform Compressor/Adder

Each waveform displayed by the 11401/11402 is made of 512 horizontal points (short vertical lines made of a pair of points at the same horizontal position). No matter what size of waveform is being acquired, it will always be displayed as 512 horizontal points. The A15 Memory Management Unit board provides the A16 Waveform Compressor/Adder board with a variable number of data points which the A16 Waveform Compressor/Adder board compresses to 512 pairs of data points which are then transferred to the display. The Adder part of the A16 Waveform Compressor/Adder provides vertical display offset control for the user.

The A16 Waveform Compressor/Adder board operates in two separate modes:

- Transparent—the A16 Waveform Compressor/Adder transfers data (that is, text or waveform headers) directly from the waveform RAM (which is located on the A15 Memory Management Unit board) to the A7 Display Controller board without altering the data.
- Compressed—the A16 Waveform Compressor board compresses the waveform data points down to a number that the displays requires (512 pairs).

A17 Main Processor Board

The A17 Main Processor board directs the instrument in performing all operations. Another primary function of the board is to run diagnostic self-tests on the instrument when powering-up or when the user requests. These routines are stored in EPROMs on the A17 Main Processor board and the A18 Memory Board. The A17 Main Processor board does all data processing not directly related to generating the display or digitizing the waveform since these functions takes place on the A7 Display board or the A5 Acquisition board. The A17 Main Processor board does, however, run the Measurement and Calculated Waveforms systems.

Option 4D is a Direct Memory Access (DMA) Controller which can be installed on the A17 Main Processor board. The DMA device increases the data transfer rate for the GPIB external interface.

The CPU is located on the A17 Main Processor board. The CPU controls all the boards in the card cage (EXP), Rear Panel, and Front Panel. The CPU processes acquired and stored waveform data and makes measurements on the waveforms. The CPU is run from software stored in EPROMs on the A17 Main Processor board and the A18 Memory board.

The Reset Generator on the A17 Main Processor board provides a positive power-up reset for the entire instrument.

A18 Memory Board

The A18 Memory board provides both dynamic RAM and EPROM for most CPU operations. Support circuitry for the memories and diagnostic circuitry are located on the A18 Memory board. The A17 Main Processor board initiates all access to DRAM, DMA, or EPROMs.

The EPROMs on this board contain most of the operating system code and diagnostics code for the CPU on the A17 Main Processor board.

Signal Flow

The main signal flow begins at the plug-ins located in the A1 Plug-in Interface Board and proceeds left to right along the top of the block diagram as follows:

A1 Plug-In Interface Board → A5 Acquisition Board → A6 Time Base Board
→ A15 Memory Management Unit Board → A16 Waveform Compressor Board
→ A7 Display Controller Board → A8 CRT Driver Board → CRT

The A17 Main Processor Board intercepts a signal from the A15 Memory Management Unit Board to perform additional processing on the signal if necessary. Then the A17 Main Processor Board returns the signal to the A15 Memory Management Unit Board.

Control Flow

The A17 Main Processor Board controls the signal flow for the oscilloscope. Signal control is distributed in a star configuration to the other boards, either directly or indirectly (that is, the A17 Main Processor Board controls some boards through another board or boards). (Refer to Introducing the 11401 and 11402 Digitizing Oscilloscopes Manual for an example of the star configuration.) Control signals are carried on either a parallel bus, a serial bus, or shared with the signal bus.

The A17 Main Processor Board controls the plug-ins through the A14 Input/Output Board. The A14 Input/Output Board converts the parallel data to serial data and distributes the serial data to the plug-ins through the A1 Plug-in Interface Board.

The system is controlled manually as follows:

manual input → A9 Touch Panel Board → A10 Front Panel Control Board
→ A14 Input/Output Board → A17 Main Processor Board

and/or

manual input → A11 Front Panel Button Board → A10 Front Panel Control Board
→ A14 Input/Output Board → A17 Main Processor Board

The RS-232-C Port and the General Purpose Interface Bus (GPIB) Port on the A12 Rear Panel Board provide remote control capability from a personal computer, minicomputer, mainframe computer, or automated test-equipment (ATE) controller (refer to Introducing the 11401 and 11402 Digitizing Oscilloscopes Manual for more information on these ports).

The A17 Main Processor Board directly controls the A15 Memory Management Board and the A16 Waveform Compressor Board.

The A17 Main Processor Board controls the Acquisition System (the A5 Acquisition Board and the A6 Time Base Board) as follows:

A17 Main Processor Board ⟺ A15 Memory Management Unit Board

⟺ A6 Time Base Board ⟺ A5 Acquisition Board

20-bit
⟺
Interface

The A17 Main Processor Board controls the A7 Display Controller Board as follows:

A17 Main Processor Board ⟺ A15 Memory Management Unit Board

16-bit
⟺ A16 Waveform Compressor Board
Interface

16-bit
⟺ A7 Display Controller Board
Interface

Power

The Power Supply Module receives line power as input (refer to Section 1—General Information, for more information on the operating power) and distributes digital power to the system. The A4 Regulator Board receives input from the Power Supply Module and distributes power to the system.

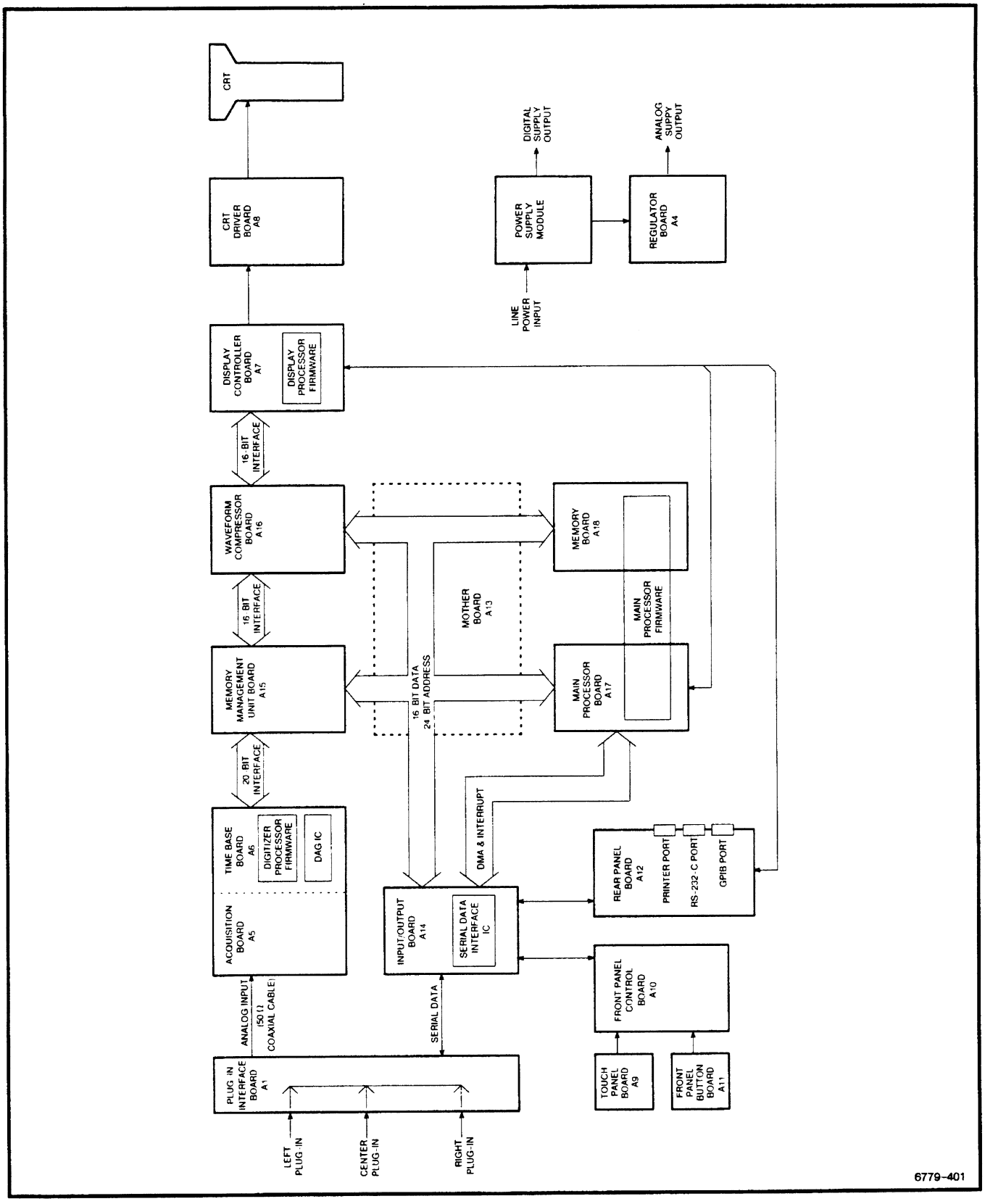


Figure 4–1. 11401/11402 System Block Diagram.

REPLACEABLE PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

ITEM NAME

In the 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, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example 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 indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
01536	TEXTRON INC CAMCAR DIV SEMS PRODUCTS UNIT	1818 CHRISTINA ST	ROCKFORD IL 61108
04348	LAWRENCE ENGINEERING AND SUPPLY INC	500 S FLOWER ST P O BOX 30	BURBANK CA 91503
06383	PANDUIT CORP	17301 RIDGELAND	TINLEY PARK IL 07094-2917
09772	WEST COAST LOCKWASHER CO INC	16730 E JOHNSON DRIVE P O BOX 3588	CITY OF INDUSTRY CA 91744
11897	PLASTIGLIDE MFG CORP	2701 W EL SEGUNDO BLVD	HAWTHORNE CA 90250-3318
12327	FREEWAY CORP	9301 ALLEN DR	CLEVELAND OH 44125-4632
16428	COOPER BELDEN ELECTRONIC WIRE AND CA SUB OF COOPER INDUSTRIES INC	NW N ST	RICHMOND IN 47374
28520	HEYCO MOLDED PRODUCTS	750 BOULEVARD P O BOX 160	KENILWORTH NJ 07033-1721
30010	BICC-VERO ELECTRONICS INC	40 LINDEMAN DR	TRUMBULL CT 06611-4739
53387	MINNESOTA MINING MFG CO 3M ELECTRONIC PRODUCTS DIV	3M CENTER	ST PAUL MN 55101-1428
61058	MATSUSHITA ELECTRIC CORP OF AMERICA PANASONIC INDUSTRIAL CO DIV	ONE PANASONIC WAY PO BOX 1502	SECAUCUS NJ 07094-2917
70903	COOPER BELDEN ELECTRONICS WIRE AND C SUB OF COOPER INDUSTRIES INC	2000 S BATAVIA AVE	GENEVA IL 60134-3325
71400	BUSSMANN DIV OF COOPER INDUSTRIES INC	114 OLD STATE RD PO BOX 14460	ST LOUIS MO 63178
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076-9749
74445	HOLO-KROME CO	31 BROOK ST	ELMWOOD CT 06110-2350
75915	LITTELFUSE INC SUB TRACOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016-3049
77900	ILLINOIS TOOL WORKS SHAKEPROOF DIV	ST CHARLES RD	ELGIN IL 60120
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
81041	HOWARD INDUSTRIES DIV OF MSL INDUSTRIES INC	1 NORTH DIXIE HWY PO BOX 287	MILFORD IL 60953
83486	ELCO INDUSTRIES INC	1101 SAMUELSON RD	ROCKFORD IL 61101
83553	ASSOCIATED SPRING BARNES GROUP INC	15001 S BROADWAY P O BOX 231	GARDENA CA 90248-1819
85480	BRADY W H CO CORP H Q INDUSTRIAL PRODUCTS DIV	2221 W CAMDEN RD PO BOX 2131	MILWAUKEE WI 53209
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61108-5181
98335	WEATHERFORD ENGINEERING AND MFG. COM PANY		WEATHERFORD, TX 76086
S3109	FELLER	ASA ADOLF AG STOTZWEID CH8810	HORGEN SWITZERLAND
S3629	SCHURTER AG H C/O PANEL COMPONENTS CORP	2015 SECOND STREET	BERKELEY CA 94170
TK0435	LEWIS SCREW CO	4300 S RACINE AVE	CHICAGO IL 60609-3320
TK0510	PANASONIC COMPANY DIV OF MATSUSHITA ELECTRIC CORP	ONE PANASONIC WAY	SECAUCUS NJ 07094
TK0861	H SCHURTER AG DIST PANEL COMPONENTS	2015 SECOND STREET	BERKELEY CA 94170
TK1262	MURPHY ELECTRONICS INC (DIST)	14933 NE 40TH ST	REDMOND WA 98052-5326
TK1373	PATELEC-CEM (ITALY)	10156 TORINO	VAICENTALLO 62/45S ITALY
TK1456	PAPST MECHATRONIC CORP	AQUIDNECK INDUSTRIAL PK	NEWPORT RI 02840
TK1543	CAMCAR/TEXTRON	600 18TH AVE	ROCKFORD IL 61108-5181
TK1546	DTM PRODUCTS INC	4725 NAUTILUS COURT S	BOULDER CO 80301
TK1869	ALPS	100 N CNTRE AVE	ROCKVILLE CENTRE NY 11570
TK6020	DAINICHI-NIPPON CABLES	NEW KOKUSAI BLDG 4-1 MARUNOUCHI 3-CHOME CHIYODA-KU	TOKYO 100 JAPAN

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-1	200-3126-00			1	COVER,CABINET:LIFT OFF,UPPER	80009	200-3126-00
-2	214-0603-02			4	.PIN ASSY,SECRG:W/SPRING WASHER	80009	214-0603-02
-3	386-1151-00			4	.CLAMP,RIM CLENC:SPG STL CD PL	83553	ORDER BY DESCR
-4	386-0227-00			4	.STOP,CLP,RIM CL:	80009	386-0227-00
-5	200-3127-00			1	COVER,CABINET:LIFT OFF,LOWER	80009	200-3127-00
-6	214-0603-02			4	.PIN ASSY,SECRG:W/SPRING WASHER	80009	214-0603-02
-7	386-1151-00			4	.CLAMP,RIM CLENC:SPG STL CD PL	83553	ORDER BY DESCR
-8	386-0227-00			4	.STOP,CLP,RIM CL:	80009	386-0227-00
-9	348-0596-00			4	PAD,CAB.FOOT:0.69 X 0.255 X 0.06,PU	80009	348-0596-00
-10	348-0879-00			4	FOOT,CABINET:BOTTOM,BLUE,POLYCARBONATE (ATTACHING PARTS)	80009	348-0879-00
-11	211-0711-00			4	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-12	348-0875-00			1	FLIPSTAND,CAB.:	80009	348-0875-00

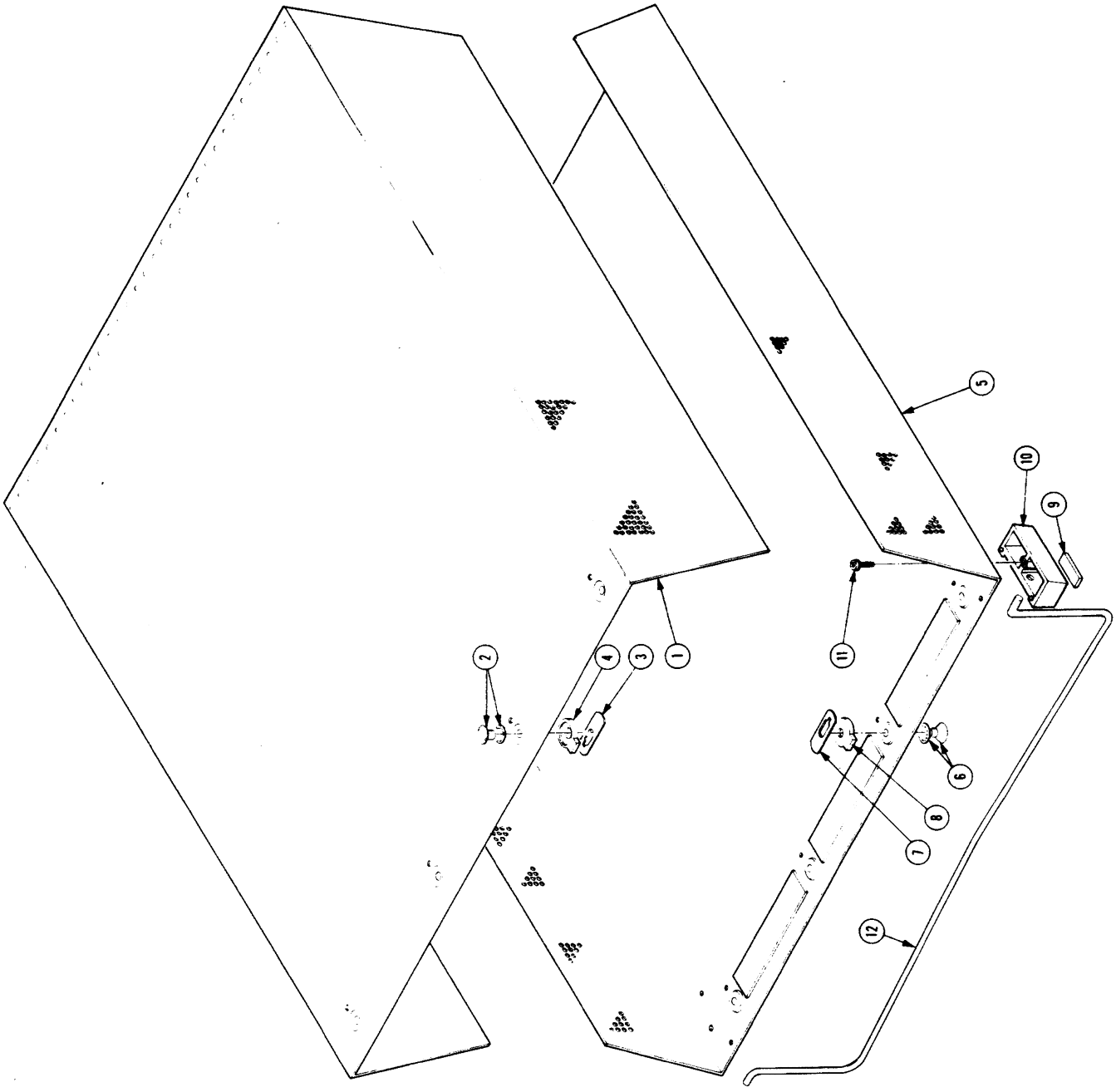


FIG. 1 CABINET
Replaceable Parts - 11401 Service

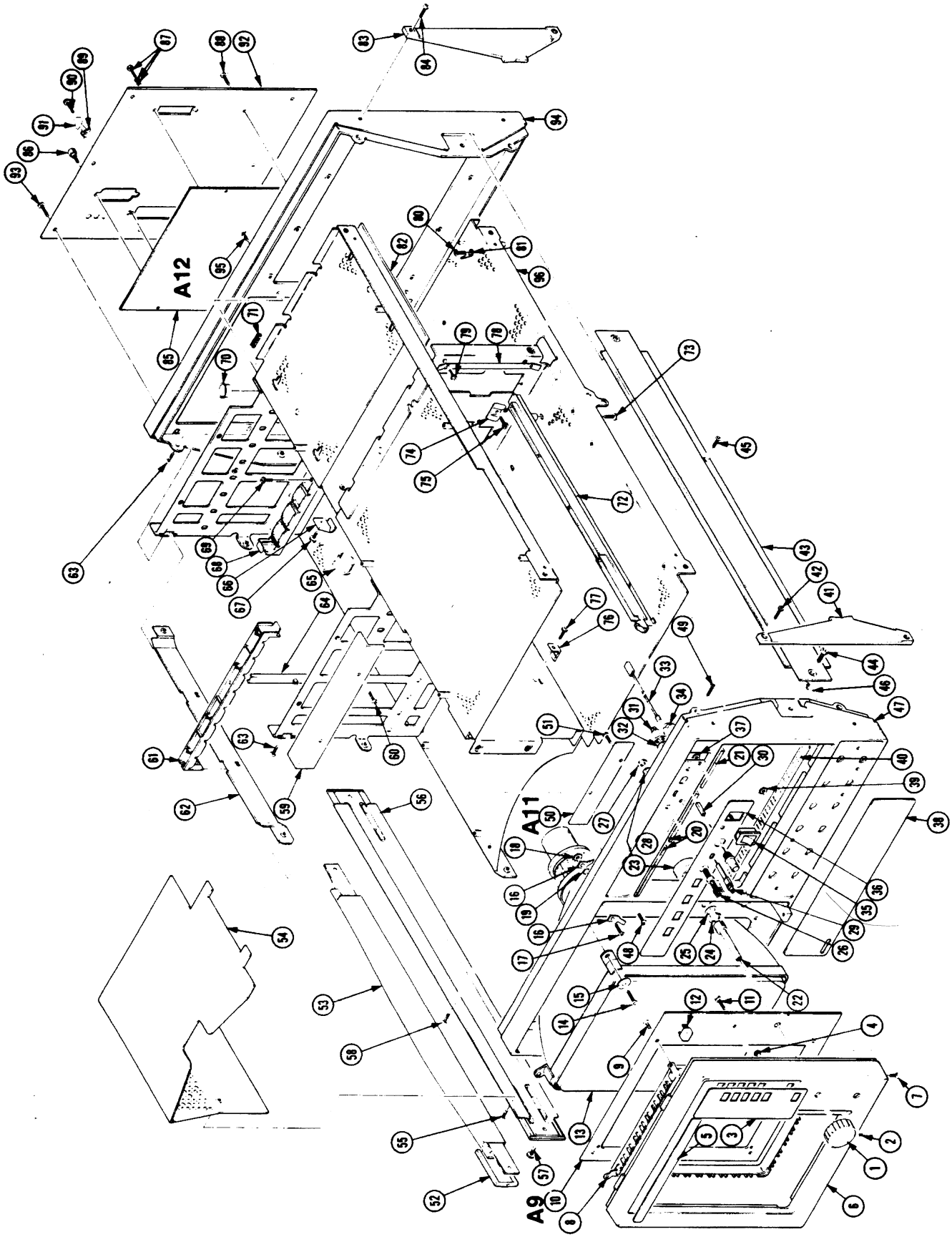


FIG. 2 FRONT, CHASSIS, REAR
Replaceable Parts - 11401 Service

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
					(ATTACHING PARTS)		
-2	213-0022-00			2	SETSCREW:4-40 X 0.188,STL	74445	ORDER BY DESCR
					(END ATTACHING PARTS)		
-3	333-3214-00	B010100	B010818	1	PANEL,FRONT:LOWER,NON FEED THRU	80009	333-3214-00
	333-3214-01	B010819		1	PANEL,FRONT:	80009	333-3214-01
					(ATTACHING PARTS)		
-4	210-0586-00	B010100	B010818	1	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
	210-0586-00	B010819		4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
					(END ATTACHING PARTS)		
-5	334-6507-00	B010100	B010818	1	MARKER,IDENT:MKD TEKTRONIX 11401	80009	334-6507-00
-6	200-3143-00	B010100	B010818	1	COVER,CRT SCALE:	80009	200-3143-00
	200-3143-01	B010819		1	COVER,CRT SCALE:BEZEL	80009	200-3143-01
					(ATTACHING PARTS)		
-7	211-0392-00			2	SCREW,MACHINE:4-40 X 0.25,FLH,82 DEG,STL	80009	211-0392-00
					(END ATTACHING PARTS)		
-8	386-5282-00	B010100	B010312	1	DIFFUSER,LIGHT:PLASTIC	80009	386-5282-00
	386-5282-01	B010313		1	DIFFUSER,LIGHT:PLASTIC	80009	386-5282-01
					(ATTACHING PARTS)		
-9	211-0372-00			4	SCREW,MACHINE:4-40 X 0.312,PNH,STL	TK1543	B80-00020-003
					(END ATTACHING PARTS)		
-10	614-0727-00	B010100	B010818	1	PANEL SUBASSY:TOUCH	80009	614-0727-00
	614-0727-01	B010819		1	FRONT PNL ASSY:	80009	614-0727-01
					(SEE A9)		
					(ATTACHING PARTS)		
-11	211-0372-00	B010100	B010818	1	SCREW,MACHINE:4-40 X 0.312,PNH,STL	TK1543	B80-00020-003
	211-0378-00	B010819		1	SCR,ASSEM WSHR:4-40 X 0.375.PNH,STL,CD PL	80009	211-0378-00
					(END ATTACHING PARTS)		
-12	366-0600-00			10	PUSH BUTTON:0.269 X 0.409,ABS	80009	366-0600-00
-13	154-0898-00			1	ELECTRON TUBE:CRT W/DEFLECTION YOKE	61058	M22JPT3GH/M-ITC
					(ATTACHING PARTS)		
-14	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
-15	210-0949-00			4	WASHER,FLAT:0.141 ID X 0.5 OD X 0.062,BRS	12327	ORDER BY DESCR
					(END ATTACHING PARTS)		
-16	131-1688-00			2	TERM,QIK DISC.:MALE,0.032 X 0.25 BL	00779	42577-4
					(ATTACHING PARTS)		
-17	211-0721-00			1	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
-18	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	78189	511-061800-00
-19	210-0006-00			1	WASHER,LOCK:#6 INTL,0.018 THK,STL	77900	1206-00-00-0541C
					(END ATTACHING PARTS)		
-20	348-0876-00			2	SHLD GSKT,ELEK:SOLID TYPE,2.480 L	80009	348-0876-00
-21	348-0877-00			1	SHLD GSKT,ELEK:SOLID TYPE,1.860 L	80009	348-0877-00
-22	384-1682-00			2	EXTENSION SHAFT:2.375 L,POLYCARBONATE	80009	384-1682-00
-23	311-2320-00			2	ENCODER,DIGITAL:INCREMENTAL,50PPR,50 DETENT	TK1869	LA22661
					,QUAD OUTPUT,LOC LUG AT 9 O'CLOCK		
					(ATTACHING PARTS)		
-24	220-0052-00			2	NUT,PLAIN,HEX:M9 X 0.75	73743	ORDER BY DESCR
-25	210-0012-00			2	WASHER,LOCK:0.384 ID,INTL,0.022 THK,STL	09772	ORDER BY DESCR
					(END ATTACHING PARTS)		
-26	129-0103-00			1	POST,BDG,ELEC:ASSEMBLY	80009	129-0103-00
					(ATTACHING PARTS)		
-27	210-0455-00			1	NUT,PLAIN,HEX:0.25-28 X 0.375,BRS NP	73743	3089-402
-28	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,STL	77900	1214-05-00-0541C
					(END ATTACHING PARTS)		
-29	131-3768-00			1	TERMINAL ASSY:CALIBRATOR	80009	131-3768-00
-30	131-3767-00			1	CONN ASSY,ELEC:CAL TERMINAL	80009	131-3767-00
					(ATTACHING PARTS)		
-31	103-0268-00	B010100	B021086	1	ADAPTER,CONN:PELTOLA TO BNC	80009	103-0268-00
	103-0268-01	B021087		1	ADPTR COAX CONN:0.438 HEX,SST	80009	103-0268-01
-32	210-0012-00			1	WASHER,LOCK:0.384 ID,INTL,0.022 THK,STL	09772	ORDER BY DESCR
					(END ATTACHING PARTS)		
-33	150-0121-05			1	LAMP,CARTRIDGE:5V,0.06A,GREEN LENS	80009	150-0121-05
-34	352-0169-00			2	HLDR,TERM CONN:2 WIRE,BLACK	80009	352-0169-00
-35	260-2275-00			1	SWITCH,ROCKER:SPST,30MA,12V	TK1262	ME010-D
-36	333-3213-00			1	PANEL,FRONT:UPPER	80009	333-3213-00
					(ATTACHING PARTS)		
-37	210-0586-00			4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
					(END ATTACHING PARTS)		

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-	174-0178-00	B010100	B021153	1	CABLE ASSY,RF:(4) 50 OHM COAX,30.5 L,W/CONN	80009	174-0178-00
	174-0178-01	B021154		1	CABLE ASSY,RF:4,50 OHM COAX,31.25 L (FROM FRONT BNC'S TO REAR BNC'S) (OPTION 1C ONLY)	80009	174-0178-01
	174-0252-00	B010100	B010936	1	CABLE ASSY,RF:(4),50 OHM COAX,30.5 L	80009	174-0252-00
	174-0252-01	B010937		1	CABLE ASSY,RF:4,50 OHM COAX,31.25 L (FROM FRONT BNC'S TO REAR BNC'S) (OPTION 1C ONLY)	80009	174-0252-01
-38	333-3231-00			1	PANEL,FRONT:LOWER(STANDARD)	80009	333-3231-00
	333-3215-00			1	PANEL,FRONT:LOWER,(OPTION) (OPTION 1C ONLY) (ATTACHING PARTS)	80009	333-3215-00
-39	210-0586-00			4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL (END ATTACHING PARTS)	78189	211-041800-00
-40	348-0878-00			1	SHLD GSKT,ELEK:SOLID TYPE,7.646 L	80009	348-0878-00
-41	101-0107-00			2	TRIM,DECORATIVE:RIGHT SIDE,FRONT CASTING (ATTACHING PARTS)	80009	101-0107-00
-42	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PNH,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-43	426-2099-00	B010100	B021211	1	FRAME SECT,CAB.:RIGHT SIDE	80009	426-2099-00
	426-2099-01	B021212		1	FRAME SECT,CAB.:RIGHT SIDE (ATTACHING PARTS)	80009	426-2099-01
-44	212-0685-00	B010100	B010989	2	SCREW,MACHINE:10-32 X 0.281,PNH,STL	93907	ORDER BY DESCR
	212-0681-00	B010990		2	SCREW,MACHINE:10-32 X 0.25,PNH,STL	83486	ORDER BY DESCR
-45	211-0718-00			1	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-46	348-0886-00			4	SHLD GSKT,ELEK:FINGER TYPE,18.310 L	80009	348-0886-00
-47	386-5268-02			1	SUBPANEL,FRONT:PLATED (ATTACHING PARTS)	80009	386-5268-02
-48	211-0721-00			2	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
-49	211-0718-00			3	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-50	670-9367-00			1	CIRCUIT BD ASSY:FRONT PANEL BUTTON (SEE A11) (ATTACHING PARTS)	80009	670-9367-00
-51	211-0410-00			2	SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL (END ATTACHING PARTS)	93907	ORDER BY DESCR
-52	200-2191-00			2	CAP,RETAINER:PLASTIC	80009	200-2191-00
-53	367-0248-01			1	HANDLE,CARRYING:16.341 L,W/CLIP	80009	367-0248-01
-54	200-3142-00			1	COVER,CRT:GUARD (ATTACHING PARTS)	80009	200-3142-00
-55	211-0718-00			2	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-56	426-2098-00	B010100	B021211	1	FRAME SECT,CAB.:LEFT SIDE	80009	426-2098-00
	426-2098-01	B021212		1	FRAME SECT,CAB.:LEFT SIDE (ATTACHING PARTS)	80009	426-2098-01
-57	212-0685-00	B010100	B010989	2	SCREW,MACHINE:10-32 X 0.281,PNH,STL	93907	ORDER BY DESCR
	212-0681-00	B010990		2	SCREW,MACHINE:10-32 X 0.25,PNH,STL	83486	ORDER BY DESCR
-58	211-0718-00			1	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL (END ATTACHING PARTS) FRAME SECTION INCLUDES:	83486	ORDER BY DESCR
-59	343-1267-00	B010100	B021135	1	RTNR,CARD CAGE:0.7 X 6.53,ALUMINUM	80009	343-1267-00
	343-1267-01	B021136		1	RTNR,CARD CAGE:ALUMINUM (ATTACHING PARTS)	80009	343-1267-01
-60	211-0711-00			2	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-61	351-0746-00			2	GUIDE,CKT BOARD:NYLON 6.803 L	80009	351-0746-00
-62	407-3438-00	B010100	B021135	1	BRACKET,CHASSIS:AL	80009	407-3438-00
	407-3438-01	B021136		1	BRACKET,CHASSIS:ALUMINUM (ATTACHING PARTS)	80009	407-3438-01
-63	211-0718-00	B010100	B021135	5	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
	211-0718-00	B021136		6	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-64	351-0765-00			16	GUIDE,CKT BOARD:NYLON	30010	29-0124D
-65	348-0532-00			1	GROMMET,PLASTIC:BLACK,ROUND,0.625 ID	28520	SB-750-10
-66	343-0081-00			1	STRAP,RETAINING:0.125 DIA,NYLON (ATTACHING PARTS)	85480	CPNY-172BK

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-67	211-0711-00			1	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-68	351-0746-00			1	GUIDE,CKT BOARD:NYLON 6.803 L (ATTACHING PARTS)	80009	351-0746-00
-69	211-0711-00			1	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-70	342-0313-00			1	GROMMET,PLASTIC:0.437 ID X 0.562 OD,NYLON	28520	2066
-71	255-0334-00			2	PLASTIC CHANNEL:12.75 X 0.175 X 0.155,NYLON	11897	122-37-2500
-72	351-0744-00			3	GUIDE,PLUG-IN:POLYAMIDE (ATTACHING PARTS)	80009	351-0744-00
-73	211-0711-00			3	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-74	131-0799-00			4	CONTACT,ELEC:PLUG-IN GND,BE NI CD PL (ATTACHING PARTS)	80009	131-0799-00
-75	211-0408-00			4	SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX (END ATTACHING PARTS)	93907	ORDER BY DESCR
-76	344-0133-00			2	CLIP,SPR TNSN:CKT BOARD MT,WHITE (ATTACHING PARTS)	80009	344-0133-00
-77	211-0408-00			2	SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX (END ATTACHING PARTS)	93907	ORDER BY DESCR
-78	131-0800-03			2	CONTACT,ELEC:PLUG-IN GND,BE NI HT TR (ATTACHING PARTS)	80009	131-0800-03
-79	211-0408-00			4	SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX (END ATTACHING PARTS)	93907	ORDER BY DESCR
-80	211-0722-00			1	SCREW,MACHINE:6-32 X 0.25,PNH,STL	80009	211-0722-00
-81	210-0006-00			1	WASHER,LOCK:#6 INTL,0.018 THK,STL (SCREW AND WASHER ARE ATTACHING PARTS FOR POWER SUPPLY)	77900	1206-00-00-0541C
-82	386-5283-00			2	SUPPORT,CHASSIS:POWER SUPPLY,POLYCARBONATE	80009	386-5283-00
-83	101-0106-00			2	TRIM,DECORATIVE:LEFT SIDE,FRONT CASTING (ATTACHING PARTS)	80009	101-0106-00
-84	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PNH,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-85	670-8853-00			1	CIRCUIT BD ASSY:REAR PANEL (SEE A12) (ATTACHING PARTS)	80009	670-8853-00
-86	129-0774-00			2	SPCR,POST:0.25,4-40 EXT END,BRS,0.25 HEX	80009	129-0774-00
-87	214-3106-00			2	HARDWARE KIT:JACK SOCKET	53387	3341-1S
-88	211-0372-00			1	SCREW,MACHINE:4-40 X 0.312,PNH,STL (END ATTACHING PARTS)	TK1543	B80-00020-003
-89	407-3446-00	B010100	B021211	2	BRKT,BAIL MTG:STEEL,0.35 X 0.289	00779	552101-1
	214-2476-01	B021212		2	HDW ASSY KIT:BAIL LOCK,ELEC CONN RCPT MTG (ATTACHING PARTS)	80009	214-2476-01
-90	211-0410-00			2	SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL (END ATTACHING PARTS)	93907	ORDER BY DESCR
-91	344-0387-00	B010100	B021211	2	CLIP,BAIL:STAINLESS STEEL	80009	344-0387-00
-92	386-5369-00			1	PLATE,CONNECTOR:8.388 X 7.852,AL	80009	386-5369-00
	386-5336-00			1	PLATE,CONNECTOR:ALUMINUM (OPTION 1C ONLY)	80009	386-5336-00
	334-6776-00			1	MARKER,IDENT:MKD GPIB (ATTACHING PARTS)	80009	334-6776-00
-93	211-0721-00			8	SCREW,MACHINE:6-32 X 0.375,PNH,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-94	386-5269-02			1	SUBPANEL,REAR:PLATED (ATTACHING PARTS)	80009	386-5269-02
-95	211-0718-00			2	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-96	610-0751-00	B010100	B021135	1	CHASSIS ASSY:	80009	610-0751-00
	610-0751-03	B021136		1	CHASSIS ASSY:	80009	610-0751-03

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-1	670-8849-01	B010100	B010624	1	CIRCUIT BD ASSY:TIMEBASE	80009	670-8849-01
	670-8849-02	B010625	B021020	1	CIRCUIT BD ASSY:TIME BASE	80009	670-8849-02
	670-8849-03	B021021		1	CIRCUIT BD ASSY:TIME BASE	80009	670-8849-03
					(SEE A6)		
					(ATTACHING PARTS)		
-2	211-0711-00			5	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-3	129-0591-00			1	SPACER,POST:0.937 L,6-32 INT-EXT,STL	80009	129-0591-00
-4	670-8847-00	B010100	B011173	1	CIRCUIT BD ASSY:FRONT PANEL CONTROL	80009	670-8847-00
	670-8847-01	B011174		1	CIRCUIT BD ASSY:FRONT PANEL CONTROL	80009	670-8847-01
					(SEE A10)		
					(ATTACHING PARTS)		
-5	211-0711-00			2	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-6	670-8846-00	B010100	B010412	1	CIRCUIT BD ASSY:CRT DRIVER	80009	670-8846-00
	670-8846-01	B010413	B010670	1	CIRCUIT BD ASSY:CRT DRIVER	80009	670-8846-01
	670-8846-02	B010671	B021020	1	CIRCUIT BD ASSY:CRT DRIVER	80009	670-8846-02
	670-8846-03	B021021		1	CIRCUIT BD ASSY:CRT DRIVER	80009	670-8846-03
					(SEE A8 REPL)		
					(ATTACHING PARTS)		
-7	211-0711-00			4	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
					CRT DRIVER BOARD ASSEMBLY INCLUDES:		
-8	159-0279-00			1	.FUSE,WIRE LEAD:0.375A,250V,SLOW	75915	230.375
-9	159-0103-00	B010193		1	.FUSE,CARTRIDGE:0.4A,125V,0.25SEC	75915	279.400
-10	670-8856-00	B010100	B021020	1	CIRCUIT BD ASSY:MEMORY	80009	670-8856-00
	670-8856-01	B021021		1	CIRCUIT BD ASSY:MEMORY	80009	670-8856-01
					(SEE A18)		
-11	670-8855-00	B010100	B010921	1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	670-8855-00
	670-8855-01	B010922	B021020	1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	670-8855-01
	670-8855-02	B021021		1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	670-8855-02
					(SEE A17)		
	670-8855-50	B010100	B010921	1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	670-8855-50
	670-8855-51	B010922	B021020	1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	670-8855-51
	670-8855-52	B021021		1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	670-8855-52
					(OPTION 4D ONLY)		
-12	146-0055-00			1	.BATTERY,DRY:3.0V,1200 MAH,LITHIUM	TK0510	BR-2/3A-E2P
-13	670-8854-00	B010100	B011007	1	CIRCUIT BD ASSY:INPUT/OUTPUT	80009	670-8854-00
	670-8854-01	B011008		1	CIRCUIT BD ASSY:INPUT/OUTPUT	80009	670-8854-01
					(SEE A14)		
-14	146-0055-00			1	.BATTERY,DRY:3.0V,1200 MAH,LITHIUM	TK0510	BR-2/3A-E2P
-15	159-0245-00			4	.FUSE,WIRE LEAD:1A,125V,FAST	75915	R251001T1
-16	670-8858-00	B010100	B010894	1	CIRCUIT BD ASSY:MEMORY MGT UNIT	80009	670-8858-00
	670-8858-01	B010895		1	CIRCUIT BD ASSY:MEMORY MGT UNIT	80009	670-8858-01
					(SEE A15)		
	670-8858-50	B010100	B010844	1	CIRCUIT BD ASSY:MEMORY MGT UNIT	80009	670-8858-50
	670-8858-51	B010845		1	CIRCUIT BD ASSY:MEM MGT UNIT	80009	670-8858-51
					(OPTION 2D ONLY)		
-17	670-8859-00			1	CIRCUIT BD ASSY:COMPRESSOR	80009	670-8859-00
					(SEE A16)		
-18	670-8851-00			1	CIRCUIT BD ASSY:MOTHER	80009	670-8851-00
					(SEE A13)		
					(ATTACHING PARTS)		
-19	211-0711-00			6	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-20	670-8848-00	B010100	B021020	1	CIRCUIT BD ASSY:DISPLAY CONTROLLER	80009	670-8848-00
	670-8848-01	B021021		1	CIRCUIT BD ASSY:DISPLAY CONTROLLER	80009	670-8848-01
					(SEE A7)		
					(ATTACHING PARTS)		
-21	211-0711-00			6	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-22	670-8852-00			1	CIRCUIT BD ASSY:PL-IN INTERFACE	80009	670-8852-00
					(SEE A1)		
					(ATTACHING PARTS)		
-23	211-0408-00	B010100	B010688	9	SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX	93907	ORDER BY DESCR
	211-0410-00	B010689		9	SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-24	346-0154-00			3	STRAP,TIEDOWN,E:6.125 L,PLASTIC,LATCH	06383	PLP1.5I INTERMED

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-25	670-8840-00	B010100	B010977	1	CIRCUIT BD ASSY:REGULATOR	80009	670-8840-00
	670-8840-01	B010978		1	CIRCUIT BD ASSY:REGULATOR	80009	670-8840-01
					(SEE A4)		
					(ATTACHING PARTS)		
-26	211-0721-00			2	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
					REGULATOR BOARD ASSEMBLY INCLUDES:		
-27	159-0220-00			1	.FUSE,WIRE LEAD:3A,125V,FAST	71400	TRA3
-28	670-8850-01	B010397	B010490	1	CIRCUIT BD ASSY:ACQUISITION	80009	670-8850-01
	670-8850-02	B010491	B010907	1	CIRCUIT BD ASSY:ACQUISITION	80009	670-8850-02
	670-8850-03	B010908	B021020	1	CIRCUIT BD ASSY:ACQUISITION	80009	670-8850-03
	670-8850-04	B021021		1	CIRCUIT BD ASSY:ACQUISITION	80009	670-8850-04
					(SEE A5)		
					(ATTACHING PARTS)		
-29	211-0711-00			4	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
					ACQUISITION BOARD ASSEMBLY INCLUDES:		
-30	671-0828-00	B021021		1	.CIRCUIT BD ASSY:TRIGGER ENHANCEMENT	80009	671-0828-00
					.(SEE A5A19)		
					(ATTACHING PARTS)		
-31	210-0551-00	B021021		3	.NUT,PLAIN,HEX:4-40 X 0.25,ST CD PL	TK0435	ORDER BY DESCR
					(END ATTACHING PARTS)		
					.TRIGGER ENHANCEMENT BOARD INCLUDES:		
-32	210-0227-00	B021021		3	..TERMINAL,LUG:0.141 ID,LOCKING,BRZ TINNED	98335	GC7462M
					(ATTACHING PARTS)		
-33	211-0180-00	B021021		3	..SCR,ASSEM WSHR:2-56 X 0.25,PNH,BRS,NP,POZ	TK0435	ORDER BY DESCR
-34	210-0405-00	B021021		3	..NUT,PLAIN,HEX:2-56 X 0.188,BRS CD PL	73743	12157-50
-35	210-0053-00	B021021		3	..WASHER,LOCK:#2 SPLIT,0.02 THK STL	78189	ORDER BY DESCR
					(END ATTACHING PARTS)		
-36	386-5429-00			1	SUPPORT,PIVOT:CKT,RIGHT	80009	386-5429-00
					(ATTACHING PARTS)		
-37	213-0992-00			1	SCREW,TPG,TF:4-24 X 0.375,PNH,STL	93907	B80-70000-003
					(END ATTACHING PARTS)		
-38	386-5428-00			1	SUPPORT,PIVOT:CKT,LEFT	80009	386-5428-00
					(ATTACHING PARTS)		
-39	213-0992-00			1	SCREW,TPG,TF:4-24 X 0.375,PNH,STL	93907	B80-70000-003
					(END ATTACHING PARTS)		
	020-1576-00	B010100	B010657	1	MATERIAL KIT:11401,VER 1.2,1.6	80009	020-1576-00
	020-1576-01	B010658	B010852	1	COMPONENT KIT:	80009	020-1576-01
	020-1576-02	B010853	B021020	1	COMPONENT KIT:	80009	020-1576-02
	020-1576-03	B021021	B021088	1	COMPONENT KIT:11401 CODE 18	80009	020-1576-03
	020-1576-04	B021089	B021225	1	COMPONENT KIT:EXP VER 3.8,DSP VER 3.3,DIG VER 3.9	80009	020-1576-04
	020-1576-05	B021226		1	COMPONENT KIT:EXP VER 4.1,DSP VER 4.0,DIG VER 4.2	80009	020-1576-05
					WIRE ASSEMBLIES		
	175-9873-00			1	CA ASSY,SP,ELEC:2,14,2,16 AWG,18 L	80009	175-9873-00
					(FROM A3J63 TO A7J63,A13J63)		
	175-9912-00			1	CABLE ASSY,RF:50 OHM COAX,48.0 L,6-2,6-3	80009	175-9912-00
					(FROM A1J32,J33 TO A5J32,J33)		
	175-9913-00			1	CABLE ASSY,RF:50 OHM COAX,48.0 L,6-4,6-N	80009	175-9913-00
					(FROM A1J34,J36 TO A5J34,J36)		
	175-9914-00			1	CABLE ASSY,RF:50 OHM COAX,48.0 L,6-0,6-1	80009	175-9914-00
					(FROM A1J30,J31 TO A5J30,J31)		
	175-9905-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-1	80009	175-9905-00
					(FROM A1J01 TO A5J01)		
	175-9906-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-2	80009	175-9906-00
					(FROM A1J02 TO A5J02)		
	175-9907-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-3	80009	175-9907-00
					(FROM A1J03 TO A5J03)		
	175-9908-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-4	80009	175-9908-00
					(FROM A1J04 TO A5J04)		
	175-9909-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-5	80009	175-9909-00
					(FROM A1J05 TO A5J05)		
	175-9910-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-6	80009	175-9910-00
					(FROM A1J06 TO A5J06)		

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-	131-1315-01			8	CONN,RCPT,ELEC:BNC,FEMALE (J11 THRU J18,QUANTITY OF 2. FRONT AND BACK. OPTION 1C ONLY)	80009	131-1315-01
	174-0287-00			1	CABLE ASSY,RF:50 OHM COAX,29.0 L,W/PELTALAS (FROM A5J26 TO J26)	80009	174-0287-00
	175-9810-00			1	CA ASSY,SP,ELEC:50,4.0 L (FROM A7J52 TO A16J52)	80009	175-9810-00
	175-9811-00			1	CA ASSY,SP,ELEC:20,6.0 L (FROM A7J53 TO A8J53)	80009	175-9811-00
	175-9855-00			1	CA ASSY,SP,ELEC:7 PIN CONN W/CRT SKT,4.5 L (FROM A8J56 TO CRT SOCKET)	80009	175-9855-00
	175-9799-00			1	CA ASSY,SP,ELEC:16.5 L (FROM A7J57 TO DS60)	80009	175-9799-00
	175-9857-00			1	CA ASSY,SP,ELEC:11,18 AWG,7.25 L,RIBBON (FROM A2A2J63 TO A7J63 AND A13J64)	80009	175-9857-00
	175-9803-00			1	CA ASSY,SP,ELEC:7,26 AWG,7.5 L,RIBBON (FROM A2A2J65 TO A4J65)	80009	175-9803-00
	175-9798-00			1	CA ASSY,SP,ELEC:18.0 L (FROM A2A2J66 TO A5J66 AND A6J66)	80009	175-9798-00
	175-9854-00			1	CA ASSY,SP,ELEC:36,28 AWG,7.0 L (FROM A10J72 TO A14J72)	80009	175-9854-00
	175-9807-00			1	CA,ASSY,SP,ELEC: (FROM A10J74 TO S74 AND S75)	80009	175-9807-00
	175-9814-00			1	CA ASSY,SP,ELEC:34,3.0 L (FROM A14J77 TO A17J77)	80009	175-9814-00
	175-9815-00			1	CA ASSY,SP,ELEC:34,12.0 L (FROM A12J78 TO A14J78)	80009	175-9815-00
	175-9809-00			1	CA ASSY,SP,ELEC:50,3.0 L (FROM A15J79 TO A16J79)	80009	175-9809-00
	175-9808-00			1	CA ASSY,SP,ELEC:50,18.0 L (FROM A6J83 TO A15J83)	80009	175-9808-00
	175-9806-00			1	CA ASSY,SP,ELEC:60,4.0 L (FROM A5J84 TO A6J84)	80009	175-9806-00
	175-9805-00			1	CA ASSY,SP,ELEC:40,4.0 L (FROM A5J85 TO A6J85)	80009	175-9805-00
	175-9804-00			1	CA ASSY,SP,ELEC:34,4.0 L (FROM A5J86 TO A6J86)	80009	175-9804-00
	175-9812-00			1	CA ASSY,SP,ELEC:26,7.0 L (FROM A1J91 TO A5J91 AND A6J91)	80009	175-9812-00

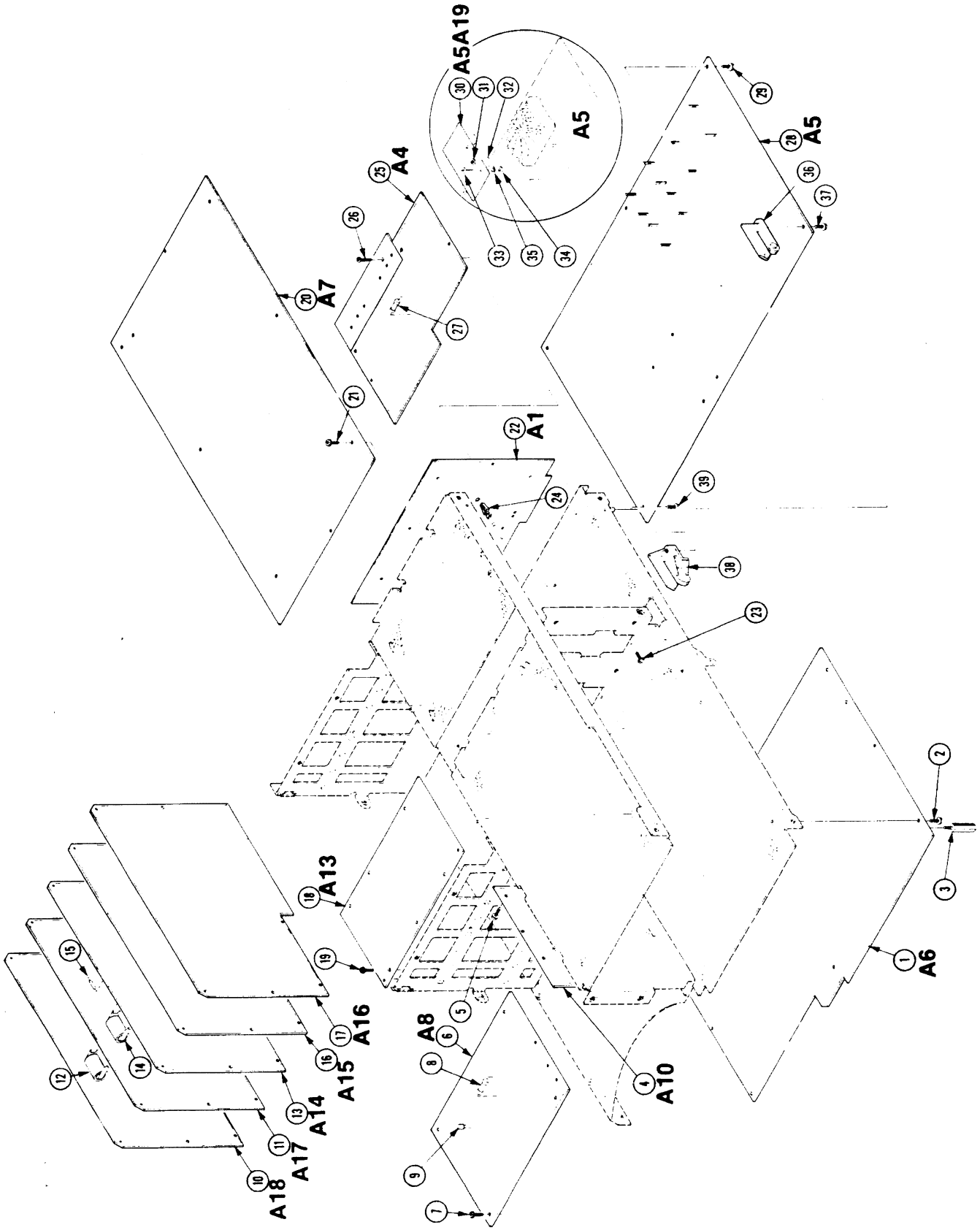


FIG. 3 CIRCUIT BOARDS
Replaceable Parts - 11401 Service

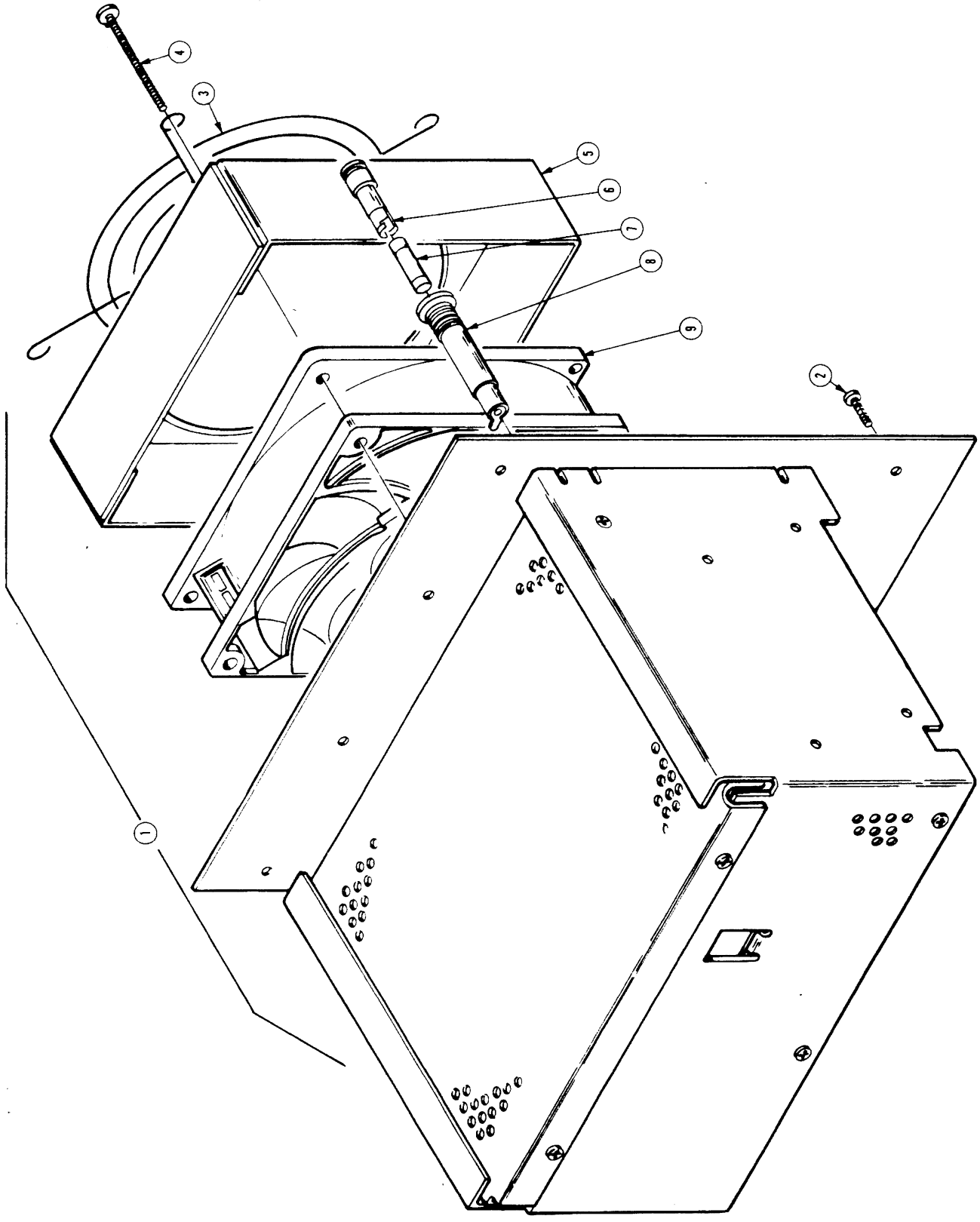


FIG. 4 POWER SUPPLY
Replaceable Parts - 11401 Service

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
4-1	620-0022-00	B010100	B010957	1	POWER SUPPLY:ET MAINFRAME	80009	620-0022-00
	620-0022-01	B010958	B021217	1	POWER SUPPLY:ET,RT,HIRES MAIN FRAMES	80009	620-0022-01
	620-0022-02	B021218		1	POWER SUPPLY:ET,RT,HIRES MAIN FRAME	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	71400	MTH-CW-6
					.(FUSE USED IN FUSE HOLDER)		
	159-0021-00			1	.FUSE,CARTRIDGE:3AG,2A,250V,FAST BLOW	71400	AGC-CW-2
					.(FUSE USED ON LINE INVERTER BOARD)		
-8	204-0832-00			1	.BODY,FUSEHOLDER:3AG & 5 X 20MM FUSES	TK0861	031 1673
-9	119-1725-01			1	.FAN,TUBEAXIAL:8 14.5VDC,6W,3200RPM,106CFM	TK1456	4112 KX

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
5-							
					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
	012-0208-00			8	CABLE,INTCON:10.0 L (OPTION 1C ONLY)	80009	012-0208-00
	070-5791-01			1	MANUAL,TECH:USERS,11401/11402	80009	070-5791-01
	070-6103-01			1	MANUAL,TECH:INTRODUCTION,11401/11402	80009	070-6103-01
	070-6255-00			1	MANUAL,TECH:OPERATORS,11401/11402	80009	070-6255-00
	070-6274-00			1	MANUAL,TECH:INSTR,11000 SERIES (OPTION 1R ONLY)	80009	070-6274-00
	070-6694-00			1	PROCEDURE:INCOMING INSPECTION,11401/2	80009	070-6694-00
					OPTIONAL ACCESSORIES		
	012-0555-00			1	CABLE,INTCON:3 METERS	80009	012-0555-00
	012-0911-00			1	CABLE,INTCON:144.0 L, RS 232	TK6020	ESF-85249
	012-0991-00			1	CABLE,GPIB:LOW EMI,2 METER	00779	553577-3
	016-0829-00			1	PANEL,BLANK:PLUG-IN HOUSING,11K SERIES	80009	016-0829-00
	067-1264-00			1	FIXTURE,CAL:POWER SPLY EXTENDED DIAGNOSTICS	80009	067-1264-00
	067-1267-00			1	FIXTURE,CAL:TROUBLE SHOOTING AID EXTENDER CARD W/CABLES	80009	067-1267-00
	070-6779-03			1	MANUAL,TECH:SERVICE REF,11401/11402	80009	070-6779-03

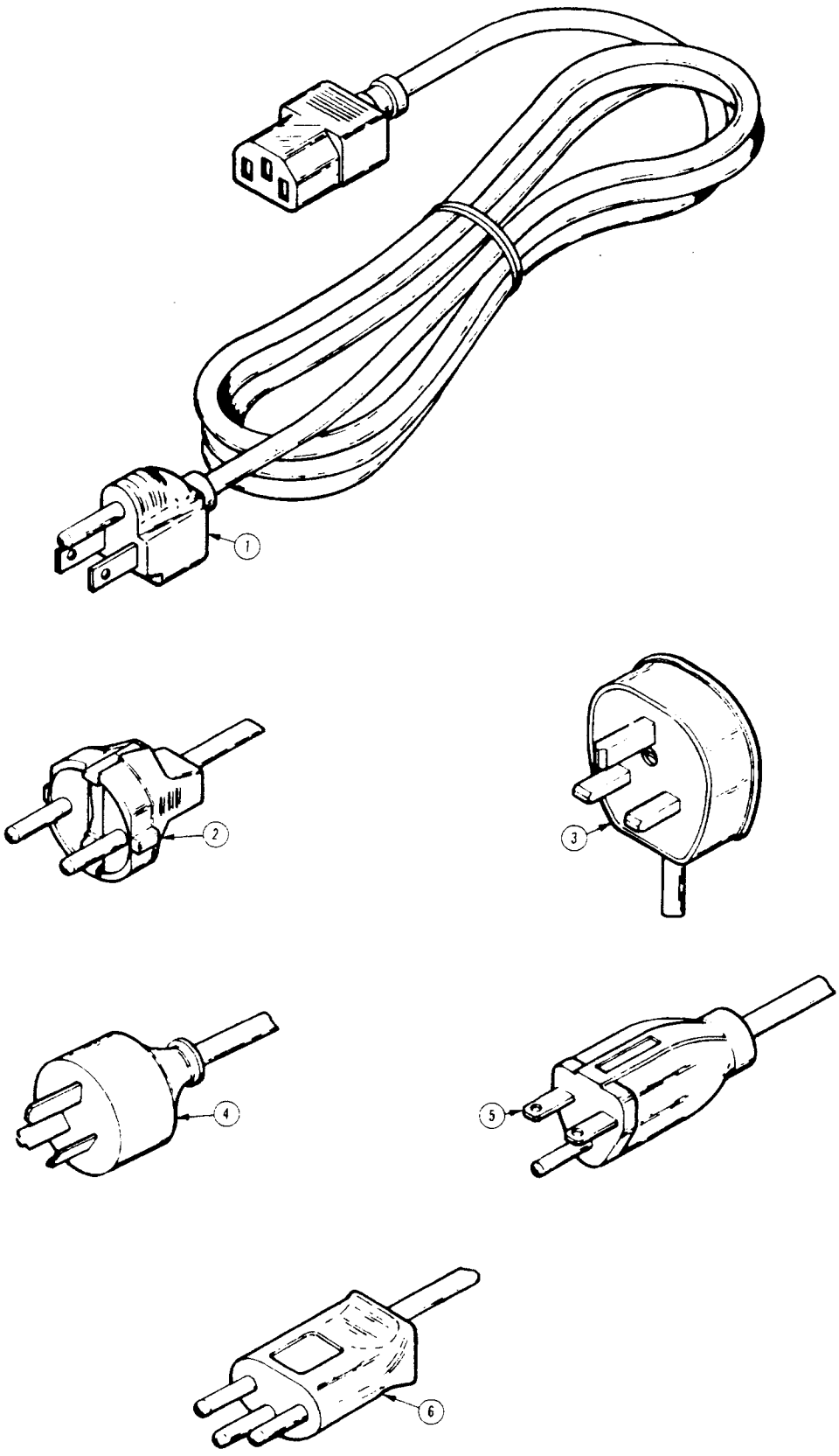


FIG. 5 ACCESSORIES
Replaceable Parts - 11401 Service

REPLACEABLE PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

ITEM NAME

In the 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, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example 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 indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
01536	TEXTRON INC CAMCAR DIV SEMS PRODUCTS UNIT	1818 CHRISTINA ST	ROCKFORD IL 61108
04348	LAWRENCE ENGINEERING AND SUPPLY INC	500 S FLOWER ST P O BOX 30	BURBANK CA 91503
06383	PANDUIT CORP	17301 RIDGELAND	TINLEY PARK IL 07094-2917
09772	WEST COAST LOCKWASHER CO INC	16730 E JOHNSON DRIVE P O BOX 3588	CITY OF INDUSTRY CA 91744
11897	PLASTIGLIDE MFG CORP	2701 W EL SEGUNDO BLVD	HAWTHORNE CA 90250-3318
12327	FREEWAY CORP	9301 ALLEN DR	CLEVELAND OH 44125-4632
16428	COOPER BELDEN ELECTRONIC WIRE AND CA SUB OF COOPER INDUSTRIES INC	NW N ST	RICHMOND IN 47374
28520	HEYCO MOLDED PRODUCTS	750 BOULEVARD P O BOX 160	KENILWORTH NJ 07033-1721
30010	BICC-VERO ELECTRONICS INC	40 LINDEMAN DR	TRUMBULL CT 06611-4739
53387	MINNESOTA MINING MFG CO 3M ELECTRONIC PRODUCTS DIV	3M CENTER	ST PAUL MN 55101-1428
61058	MATSUSHITA ELECTRIC CORP OF AMERICA PANASONIC INDUSTRIAL CO DIV	ONE PANASONIC WAY PO BOX 1502	SECAUCUS NJ 07094-2917
70903	COOPER BELDEN ELECTRONICS WIRE AND C SUB OF COOPER INDUSTRIES INC	2000 S BATAVIA AVE	GENEVA IL 60134-3325
71400	BUSSMANN DIV OF COOPER INDUSTRIES INC	114 OLD STATE RD PO BOX 14460	ST LOUIS MO 63178
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076-9749
74445	HOLO-KROME CO	31 BROOK ST	ELMWOOD CT 06110-2350
75915	LITTELFUSE INC SUB TRACOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016-3049
77900	ILLINOIS TOOL WORKS SHAKEPROOF DIV	ST CHARLES RD	ELGIN IL 60120
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
81041	HOWARD INDUSTRIES DIV OF MSL INDUSTRIES INC	1 NORTH DIXIE HWY PO BOX 287	MILFORD IL 60953
83486	ELCO INDUSTRIES INC	1101 SAMUELSON RD	ROCKFORD IL 61101
83553	ASSOCIATED SPRING BARNES GROUP INC	15001 S BROADWAY P O BOX 231	GARDENA CA 90248-1819
85480	BRADY W H CO CORP H Q INDUSTRIAL PRODUCTS DIV	2221 W CAMDEN RD PO BOX 2131	MILWAUKEE WI 53209
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61108-5181
98335	WEATHERFORD ENGINEERING AND MFG. COM PANY		WEATHERFORD, TX 76086
S3109	FELLER	ASA ADOLF AG STOTZWEID CH8810	HORGEN SWITZERLAND
S3629	SCHURTER AG H C/O PANEL COMPONENTS CORP	2015 SECOND STREET	BERKELEY CA 94170
TK0435	LEWIS SCREW CO	4300 S RACINE AVE	CHICAGO IL 60609-3320
TK0510	PANASONIC COMPANY DIV OF MATSUSHITA ELECTRIC CORP	ONE PANASONIC WAY	SECAUCUS NJ 07094
TK0861	H SCHURTER AG DIST PANEL COMPONENTS	2015 SECOND STREET	BERKELEY CA 94170
TK1262	MURPHY ELECTRONICS INC (DIST)	14933 NE 40TH ST	REDMOND WA 98052-5326
TK1373	PATELEC-CEM (ITALY)	10156 TORINO	VAICENTALLO 62/45S ITALY
TK1456	PAPST MECHATRONIC CORP	AQUIDNECK INDUSTRIAL PK	NEWPORT RI 02840
TK1543	CAMCAR/TEXTRON	600 18TH AVE	ROCKFORD IL 61108-5181
TK1546	DTM PRODUCTS INC	4725 NAUTILUS COURT S	BOULDER CO 80301
TK1869	ALPS	100 N CNTRE AVE	ROCKVILLE CENTRE NY 11570
TK6020	DAINICHI-NIPPON CABLES	NEW KOKUSAI BLDG 4-1 MARUNOUCHI 3-CHOME CHIYODA-KU	TOKYO 100 JAPAN

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-1	200-3126-00			1	COVER,CABINET:LIFT OFF,UPPER	80009	200-3126-00
-2	214-0603-02			4	.PIN ASSY,SECRG:W/SPRING WASHER	80009	214-0603-02
-3	386-1151-00			4	.CLAMP,RIM CLENC:SPG STL CD PL	83553	ORDER BY DESCR
-4	386-0227-00			4	.STOP,CLP,RIM CL:	80009	386-0227-00
-5	200-3127-00			1	COVER,CABINET:LIFT OFF,LOWER	80009	200-3127-00
-6	214-0603-02			4	.PIN ASSY,SECRG:W/SPRING WASHER	80009	214-0603-02
-7	386-1151-00			4	.CLAMP,RIM CLENC:SPG STL CD PL	83553	ORDER BY DESCR
-8	386-0227-00			4	.STOP,CLP,RIM CL:	80009	386-0227-00
-9	348-0596-00			4	PAD,CAB.FOOT:0.69 X 0.255 X 0.06,PU	80009	348-0596-00
-10	348-0879-00			4	FOOT,CABINET:BOTTOM,BLUE,POLYCARBONATE (ATTACHING PARTS)	80009	348-0879-00
-11	211-0711-00			4	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-12	348-0875-00			1	FLIPSTAND,CAB.:	80009	348-0875-00

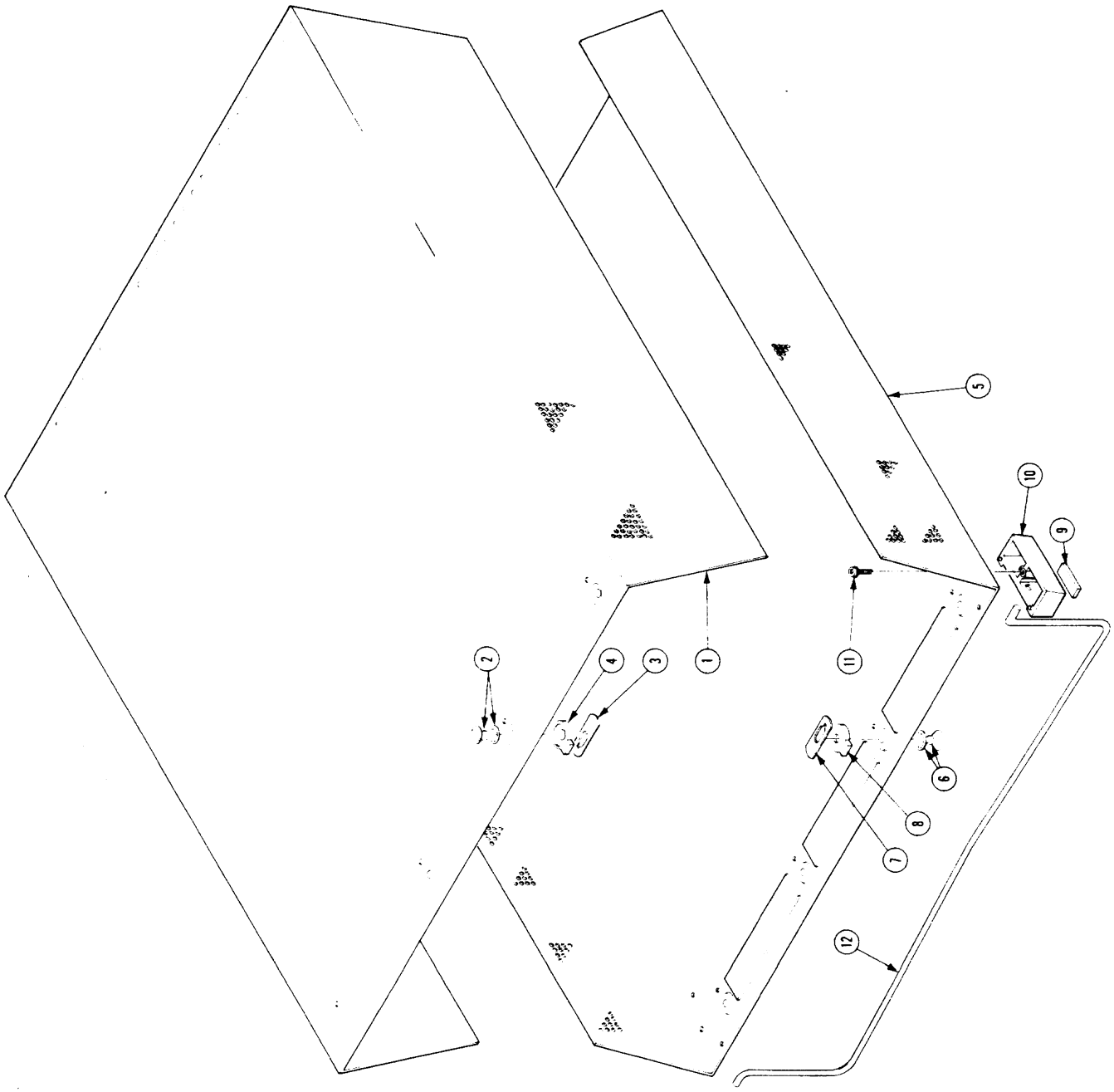


FIG. 1 CABINET
Replaceable Parts - 11402 Service

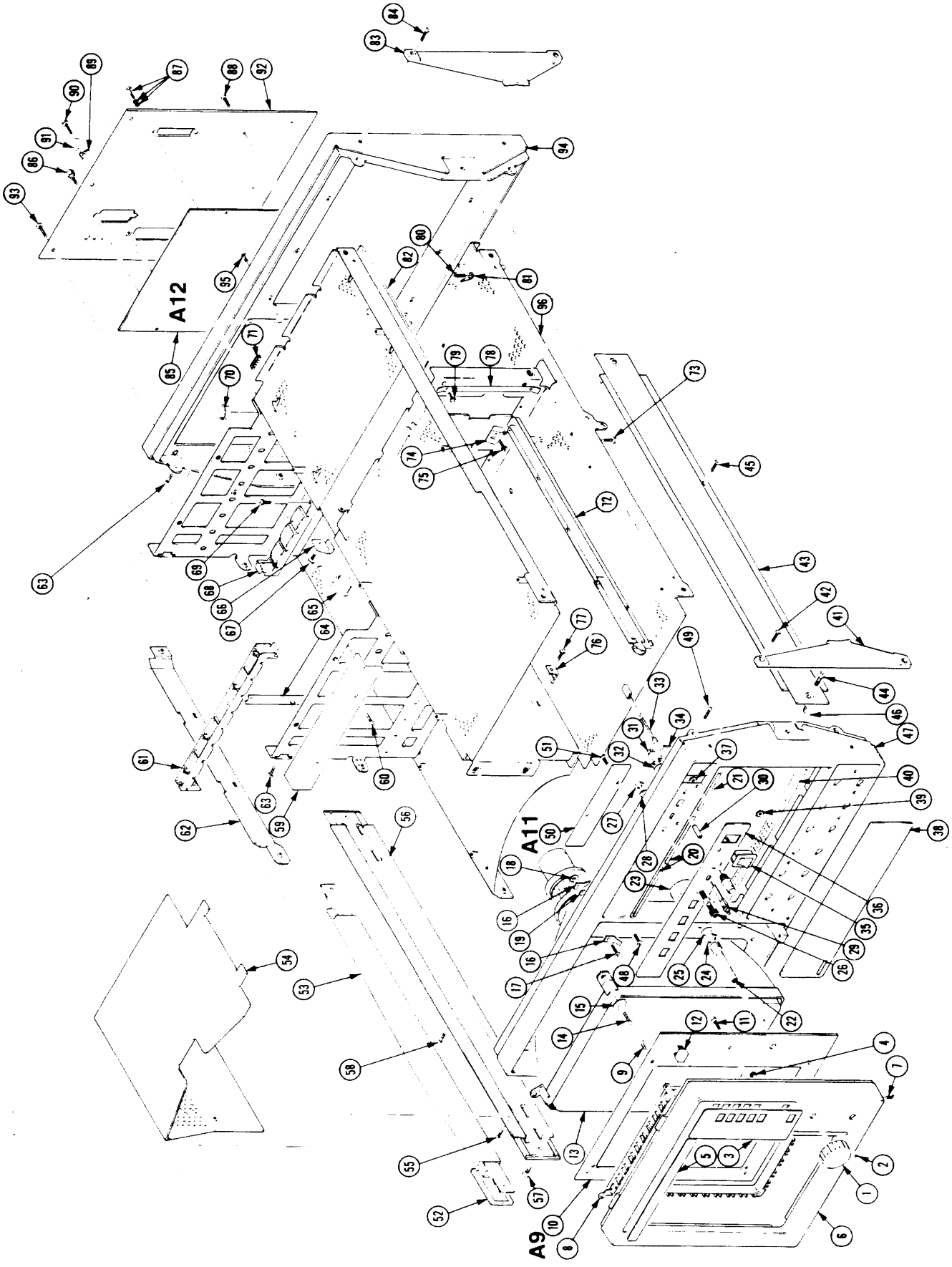


FIG. 2 FRONT, CHASSIS, REAR
Replaceable Parts - 11402 Service

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 (ATTACHING PARTS)	TK1546	ORDER BY DESCR
-2	213-0022-00			2	SETSCREW:4-40 X 0.188,STL (END ATTACHING PARTS)	74445	ORDER BY DESCR
-3	333-3214-00	B010100	B010920	1	PANEL,FRONT:LOWER,NON FEED THRU	80009	333-3214-00
	333-3214-02	B010921		1	PANEL,FRONT: (ATTACHING PARTS)	80009	333-3214-02
-4	210-0586-00	B010100	B010920	1	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
	210-0586-00	B010921		4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL (END ATTACHING PARTS)	78189	211-041800-00
-5	334-6790-00	B010100	B010920	1	MARKER,IDENT:MKD TEKTRONIX 11402 DIGITIZING OSCILLOSCOPE	80009	334-6790-00
-6	200-3143-00	B010100	B010920	1	COVER,CRT SCALE:	80009	200-3143-00
	200-3143-01	B010921		1	COVER,CRT SCALE:BEZEL (ATTACHING PARTS)	80009	200-3143-01
-7	211-0392-00			2	SCREW,MACHINE:4-40 X 0.25,FLH,82 DEG,STL (END ATTACHING PARTS)	80009	211-0392-00
-8	386-5282-00	B010100	B010312	1	DIFFUSER,LIGHT:PLASTIC	80009	386-5282-00
	386-5282-01	B010313		1	DIFFUSER,LIGHT:PLASTIC (ATTACHING PARTS)	80009	386-5282-01
-9	211-0372-00			4	SCREW,MACHINE:4-40 X 0.312,PNH,STL (END ATTACHING PARTS)	TK1543	B80-00020-003
-10	614-0785-00	B010100	B010920	1	FRONT PNL ASSY:	80009	614-0785-00
	614-0785-01	B010921		1	FRONT PNL ASSY: (SEE A9) (ATTACHING PARTS)	80009	614-0785-01
-11	211-0372-00	B010100	B010920	1	SCREW,MACHINE:4-40 X 0.312,PNH,STL	TK1543	B80-00020-003
	211-0378-00	B010921		1	SCR,ASSEM WSHR:4-40 X 0.375.PNH,STL,CD PL (END ATTACHING PARTS)	80009	211-0378-00
-12	366-0600-00			10	PUSH BUTTON:0.269 X 0.409,ABS	80009	366-0600-00
-13	154-0898-00			1	ELECTRON TUBE:CRT W/DEFLECTION YOKE (ATTACHING PARTS)	61058	M22JPT3GH/M-ITC
-14	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
-15	210-0949-00			4	WASHER,FLAT:0.141 ID X 0.5 OD X 0.062,BRS (END ATTACHING PARTS)	12327	ORDER BY DESCR
-16	131-1688-00			2	TERM,QIK DISC.:MALE,0.032 X 0.25 BL (ATTACHING PARTS)	00779	42577-4
-17	211-0721-00			1	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
-18	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	78189	511-061800-00
-19	210-0006-00			1	WASHER,LOCK:#6 INTL,0.018 THK,STL (END ATTACHING PARTS)	77900	1206-00-00-0541C
-20	348-0876-00			2	SHLD GSKT,ELEK:SOLID TYPE,2.480 L	80009	348-0876-00
-21	348-0877-00			1	SHLD GSKT,ELEK:SOLID TYPE,1.860 L	80009	348-0877-00
-22	384-1682-00			2	EXTENSION SHAFT:2.375 L,POLYCARBONATE	80009	384-1682-00
-23	311-2320-00			2	ENCODER,DIGITAL:INCREMENTAL,50PPR,50 DETENT ,QUAD OUTPUT,LOC LUG AT 9 O'CLOCK (ATTACHING PARTS)	TK1869	LA22661
-24	220-0052-00			2	NUT,PLAIN,HEX:M9 X 0.75	73743	ORDER BY DESCR
-25	210-0012-00			2	WASHER,LOCK:0.384 ID,INTL,0.022 THK,STL (END ATTACHING PARTS)	09772	ORDER BY DESCR
-26	129-0103-00			1	POST,BDG,ELEC:ASSEMBLY (ATTACHING PARTS)	80009	129-0103-00
-27	210-0455-00			1	NUT,PLAIN,HEX:0.25-28 X 0.375,BRS NP	73743	3089-402
-28	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,STL (END ATTACHING PARTS)	77900	1214-05-00-0541C
-29	131-3768-00			1	TERMINAL ASSY:CALIBRATOR	80009	131-3768-00
-30	131-3767-00			1	CONN ASSY,ELEC:CAL TERMINAL (ATTACHING PARTS)	80009	131-3767-00
-31	103-0268-00	B010100	B021247	1	ADAPTER,CONN:PELTOLA TO BNC	80009	103-0268-00
	103-0268-01	B021248		1	ADPTR COAX CONN:0.438 HEX,SST	80009	103-0268-01
-32	210-0012-00			1	WASHER,LOCK:0.384 ID,INTL,0.022 THK,STL (END ATTACHING PARTS)	09772	ORDER BY DESCR
-33	150-0121-05			1	LAMP,CARTRIDGE:5V,0.06A,GREEN LENS	80009	150-0121-05
-34	352-0169-00			2	HLDR,TERM CONN:2 WIRE,BLACK	80009	352-0169-00
-35	260-2275-00			1	SWITCH,ROCKER:SPST,30MA,12V	TK1262	ME010-D
-36	333-3213-00			1	PANEL,FRONT:UPPER (ATTACHING PARTS)	80009	333-3213-00
-37	210-0586-00			4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-					(END ATTACHING PARTS)		
	174-0178-00	B010100	B021331	1	CABLE ASSY,RF:(4) 50 OHM COAX,30.5 L,W/CONN	80009	174-0178-00
	174-0178-01	B021332		1	CABLE ASSY,RF:4,50 OHM COAX,31.25 L (FROM FRONT BNC'S TO REAR BNC'S) (OPTION 1C ONLY)	80009	174-0178-01
	174-0252-00	B010100	B011003	1	CABLE ASSY,RF:(4),50 OHM COAX,30.5 L	80009	174-0252-00
	174-0252-01	B011004		1	CABLE ASSY,RF:4,50 OHM COAX,31.25 L (FROM FRONT BNC'S TO REAR BNC'S) (OPTION 1C ONLY)	80009	174-0252-01
-38	333-3231-00			1	PANEL,FRONT:LOWER(STANDARD)	80009	333-3231-00
	333-3215-00			1	PANEL,FRONT:LOWER,(OPTION) (OPTION 1C ONLY) (ATTACHING PARTS)	80009	333-3215-00
-39	210-0586-00			4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL (END ATTACHING PARTS)	78189	211-041800-00
-40	348-0878-00			1	SHLD GSKT,ELEK:SOLID TYPE,7.646 L	80009	348-0878-00
-41	101-0107-00			2	TRIM,DECORATIVE:RIGHT SIDE,FRONT CASTING (ATTACHING PARTS)	80009	101-0107-00
-42	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PNH,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-43	426-2099-00	B010100	B021402	1	FRAME SECT,CAB.:RIGHT SIDE	80009	426-2099-00
	426-2099-01	B021403		1	FRAME SECT,CAB.:RIGHT SIDE (ATTACHING PARTS)	80009	426-2099-01
-44	212-0685-00	B010100	B011050	2	SCREW,MACHINE:10-32 X 0.281,PNH,STL	93907	ORDER BY DESCR
	212-0681-00	B011051		2	SCREW,MACHINE:10-32 X 0.25,PNH,STL	83486	ORDER BY DESCR
-45	211-0718-00			1	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-46	348-0886-00			4	SHLD GSKT,ELEK:FINGER TYPE,18.310 L	80009	348-0886-00
-47	386-5268-02			1	SUBPANEL,FRONT:PLATED (ATTACHING PARTS)	80009	386-5268-02
-48	211-0721-00			2	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
-49	211-0718-00			3	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-50	670-9367-00			1	CIRCUIT BD ASSY:FRONT PANEL BUTTON (SEE A11) (ATTACHING PARTS)	80009	670-9367-00
-51	211-0410-00			2	SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL (END ATTACHING PARTS)	93907	ORDER BY DESCR
-52	200-2191-00			2	CAP,RETAINER:PLASTIC	80009	200-2191-00
-53	367-0248-01			1	HANDLE,CARRYING:16.341 L,W/CLIP	80009	367-0248-01
-54	200-3142-00			1	COVER,CRT:GUARD (ATTACHING PARTS)	80009	200-3142-00
-55	211-0718-00			2	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-56	426-2098-00	B010100	B021402	1	FRAME SECT,CAB.:LEFT SIDE	80009	426-2098-00
	426-2098-01	B021403		1	FRAME SECT,CAB.:LEFT SIDE (ATTACHING PARTS)	80009	426-2098-01
-57	212-0685-00	B010100	B011050	2	SCREW,MACHINE:10-32 X 0.281,PNH,STL	93907	ORDER BY DESCR
	212-0681-00	B011051		2	SCREW,MACHINE:10-32 X 0.25,PNH,STL	83486	ORDER BY DESCR
-58	211-0718-00			1	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL (END ATTACHING PARTS) FRAME SECTION INCLUDES:	83486	ORDER BY DESCR
-59	343-1267-00	B010100	B021310	1	RTNR,CARD CAGE:0.7 X 6.53,ALUMINUM	80009	343-1267-00
	343-1267-01	B021311		1	RTNR,CARD CAGE:ALUMINUM (ATTACHING PARTS)	80009	343-1267-01
-60	211-0711-00			2	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-61	351-0746-00			2	GUIDE,CKT BOARD:NYLON 6.803 L	80009	351-0746-00
-62	407-3438-00	B010100	B021310	1	BRACKET,CHASSIS:AL	80009	407-3438-00
	407-3438-01	B021311		1	BRACKET,CHASSIS:ALUMINUM (ATTACHING PARTS)	80009	407-3438-01
-63	211-0718-00	B010100	B021310	5	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	83486	ORDER BY DESCR
	211-0718-00	B021311		6	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-64	351-0765-00			16	GUIDE,CKT BOARD:NYLON	30010	29-0124D
-65	348-0532-00			1	GROMMET,PLASTIC:BLACK,ROUND,0.625 ID	28520	SB-750-10
-66	343-0081-00			1	STRAP,RETAINING:0.125 DIA,NYLON (ATTACHING PARTS)	85480	CPNY-172BK

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-67	211-0711-00			1	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-68	351-0746-00			1	GUIDE,CKT BOARD:NYLON 6.803 L (ATTACHING PARTS)	80009	351-0746-00
-69	211-0711-00			1	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-70	342-0313-00			1	GROMMET,PLASTIC:0.437 ID X 0.562 OD,NYLON	28520	2066
-71	255-0334-00			2	PLASTIC CHANNEL:12.75 X 0.175 X 0.155,NYLON	11897	122-37-2500
-72	351-0744-00			3	GUIDE,PLUG-IN:POLYAMIDE (ATTACHING PARTS)	80009	351-0744-00
-73	211-0711-00			3	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15 (END ATTACHING PARTS)	01536	ORDER BY DESCR
-74	131-0799-00			4	CONTACT,ELEC:PLUG-IN GND,BE NI CD PL (ATTACHING PARTS)	80009	131-0799-00
-75	211-0408-00			4	SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX (END ATTACHING PARTS)	93907	ORDER BY DESCR
-76	344-0133-00			2	CLIP,SPR TNSN:CKT BOARD MT,WHITE (ATTACHING PARTS)	80009	344-0133-00
-77	211-0408-00			2	SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX (END ATTACHING PARTS)	93907	ORDER BY DESCR
-78	131-0800-03			2	CONTACT,ELEC:PLUG-IN GND,BE NI HT TR (ATTACHING PARTS)	80009	131-0800-03
-79	211-0408-00			4	SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX (END ATTACHING PARTS)	93907	ORDER BY DESCR
-80	211-0722-00			1	SCREW,MACHINE:6-32 X 0.25,PNH,STL	80009	211-0722-00
-81	210-0006-00			1	WASHER,LOCK:#6 INTL,0.018 THK,STL (SCREW AND WASHER ARE ATTACHING PARTS FOR POWER SUPPLY)	77900	1206-00-00-0541C
-82	386-5283-00			2	SUPPORT,CHASSIS:POWER SUPPLY,POLYCARBONATE	80009	386-5283-00
-83	101-0106-00			2	TRIM,DECORATIVE:LEFT SIDE,FRONT CASTING (ATTACHING PARTS)	80009	101-0106-00
-84	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PNH,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-85	670-8853-00			1	CIRCUIT BD ASSY:REAR PANEL (SEE A12) (ATTACHING PARTS)	80009	670-8853-00
-86	129-0774-00			2	SPCR,POST:0.25,4-40 EXT END,BRS,0.25 HEX	80009	129-0774-00
-87	214-3106-00			2	HARDWARE KIT:JACK SOCKET	53387	3341-1S
-88	211-0372-00			1	SCREW,MACHINE:4-40 X 0.312,PNH,STL (END ATTACHING PARTS)	TK1543	B80-00020-003
-89	407-3446-00	B010100	B021402	2	BRKT,BAIL MTG:STEEL,0.35 X 0.289	00779	552101-1
	214-2476-01	B021403		2	HDW ASSY KIT:BAIL LOCK,ELEC CONN RCPT MTG (ATTACHING PARTS)	80009	214-2476-01
-90	211-0410-00			2	SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL (END ATTACHING PARTS)	93907	ORDER BY DESCR
-91	344-0387-00	B010100	B021402	2	CLIP,BAIL:STAINLESS STEEL	80009	344-0387-00
-92	386-5369-00			1	PLATE,CONNECTOR:8.388 X 7.852,AL	80009	386-5369-00
	386-5336-00			1	PLATE,CONNECTOR:ALUMINUM (OPTION 1C ONLY)	80009	386-5336-00
	334-6776-00			1	MARKER,IDENT:MKD GPIB (ATTACHING PARTS)	80009	334-6776-00
-93	211-0721-00			8	SCREW,MACHINE:6-32 X 0.375,PNH,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-94	386-5269-02			1	SUBPANEL,REAR:PLATED (ATTACHING PARTS)	80009	386-5269-02
-95	211-0718-00			2	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL (END ATTACHING PARTS)	83486	ORDER BY DESCR
-96	610-0751-00	B010100	B021310	1	CHASSIS ASSY:	80009	610-0751-00
	610-0751-03	B021311		1	CHASSIS ASSY:	80009	610-0751-03

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-1	670-8849-01	B010100	B010649	1	CIRCUIT BD ASSY:TIMEBASE	80009	670-8849-01
	670-8849-02	B010650	B021081	1	CIRCUIT BD ASSY:TIME BASE	80009	670-8849-02
	670-8849-03	B021082		1	CIRCUIT BD ASSY:TIME BASE	80009	670-8849-03
					(SEE A6)		
					(ATTACHING PARTS)		
-2	211-0711-00			5	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-3	129-0591-00			1	SPACER,POST:0.937 L,6-32 INT-EXT,STL	80009	129-0591-00
-4	670-8847-00	B010100	B011358	1	CIRCUIT BD ASSY:FRONT PANEL CONTROL	80009	670-8847-00
	670-8847-01	B011359		1	CIRCUIT BD ASSY:FRONT PANEL CONTROL	80009	670-8847-01
					(SEE A10)		
					(ATTACHING PARTS)		
-5	211-0711-00			2	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-6	670-8846-00	B010100	B010412	1	CIRCUIT BD ASSY:CRT DRIVER	80009	670-8846-00
	670-8846-01	B010413	B010677	1	CIRCUIT BD ASSY:CRT DRIVER	80009	670-8846-01
	670-8846-02	B010678	B021081	1	CIRCUIT BD ASSY:CRT DRIVER	80009	670-8846-02
	670-8846-03	B021082		1	CIRCUIT BD ASSY:CRT DRIVER	80009	670-8846-03
					(SEE A8 REPL)		
					(ATTACHING PARTS)		
-7	211-0711-00			4	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
					CRT DRIVER BOARD ASSEMBLY INCLUDES:		
-8	159-0279-00			1	.FUSE,WIRE LEAD:0.375A,250V,SLOW	75915	230.375
-9	159-0103-00	B010193		1	.FUSE,CARTRIDGE:0.4A,125V,0.25SEC	75915	279.400
-10	670-8856-00	B010100	B021081	1	CIRCUIT BD ASSY:MEMORY	80009	670-8856-00
	670-8856-01	B021082		1	CIRCUIT BD ASSY:MEMORY	80009	670-8856-01
					(SEE A18)		
-11	671-0068-00	B010100	B010998	1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	671-0068-00
	671-0068-01	B010999	B021081	1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	671-0068-01
	671-0068-02	B021082		1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	671-0068-02
					(SEE A17)		
	671-0068-50	B010100	B010998	1	CIRCUIT BD ASSY:MAIN PROCESSOR(DMA OPT)	80009	671-0068-50
	671-0068-51	B010999	B021081	1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	671-0068-51
	671-0068-52	B021082		1	CIRCUIT BD ASSY:MAIN PROCESSOR	80009	671-0068-52
					(OPTION 4D ONLY)		
-12	146-0055-00			1	.BATTERY,DRY:3.0V,1200 MAH,LITHIUM	TK0510	BR-2/3A-E2P
-13	670-8854-00	B010100	B011068	1	CIRCUIT BD ASSY:INPUT/OUTPUT	80009	670-8854-00
	670-8854-01	B011069		1	CIRCUIT BD ASSY:INPUT/OUTPUT	80009	670-8854-01
					(SEE A14)		
-14	146-0055-00			1	.BATTERY,DRY:3.0V,1200 MAH,LITHIUM	TK0510	BR-2/3A-E2P
-15	159-0245-00			4	.FUSE,WIRE LEAD:1A,125V,FAST	75915	R251001T1
-16	670-8858-00	B010100	B010978	1	CIRCUIT BD ASSY:MEMORY MGT UNIT	80009	670-8858-00
	670-8858-01	B010979		1	CIRCUIT BD ASSY:MEMORY MGT UNIT	80009	670-8858-01
					(SEE A15)		
	670-8858-50	B010100	B010944	1	CIRCUIT BD ASSY:MEMORY MGT UNIT	80009	670-8858-50
	670-8858-51	B010945		1	CIRCUIT BD ASSY:MEM MGT UNIT	80009	670-8858-51
					(OPTION 2D ONLY)		
-17	670-8859-00			1	CIRCUIT BD ASSY:COMPRESSOR	80009	670-8859-00
					(SEE A16)		
-18	670-8851-00			1	CIRCUIT BD ASSY:MOTHER	80009	670-8851-00
					(SEE A13)		
					(ATTACHING PARTS)		
-19	211-0711-00			6	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-20	670-8848-00	B010100	B021081	1	CIRCUIT BD ASSY:DISPLAY CONTROLLER	80009	670-8848-00
	670-8848-01	B021082		1	CIRCUIT BD ASSY:DISPLAY CONTROLLER	80009	670-8848-01
					(SEE A7)		
					(ATTACHING PARTS)		
-21	211-0711-00			6	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-22	670-8852-00			1	CIRCUIT BD ASSY:PL-IN INTERFACE	80009	670-8852-00
					(SEE A1)		
					(ATTACHING PARTS)		
-23	211-0408-00	B010100	B010725	9	SCR,ASSEM WSHR:4-40 X 0.250,PNH,STL TORX	93907	ORDER BY DESCR
	211-0410-00	B010726		9	SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-24	346-0154-00			3	STRAP,TIEDOWN,E:6.125 L,PLASTIC,LATCH	06383	PLP1.5I INTERMED

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-25	670-8840-00	B010100	B011038	1	CIRCUIT BD ASSY:REGULATOR	80009	670-8840-00
	670-8840-01	B011039		1	CIRCUIT BD ASSY:REGULATOR	80009	670-8840-01
					(SEE A4)		
					(ATTACHING PARTS)		
-26	211-0721-00			2	SCREW,MACHINE:6-32 X 0.375,PNH,STL	83486	ORDER BY DESCR
					(END ATTACHING PARTS)		
					REGULATOR BOARD ASSEMBLY INCLUDES:		
-27	159-0220-00			1	.FUSE,WIRE LEAD:3A,125V,FAST	71400	TRA3
-28	671-0024-00	B010100	B010266	1	CIRCUIT BD ASSY:ACQUISITION	80009	671-0024-00
	671-0024-01	B010267	B010361	1	CIRCUIT BD ASSY:ACQUISITION	80009	671-0024-01
	671-0024-02	B010362	B010989	1	CIRCUIT BD ASSY:ACQUISITION	80009	671-0024-02
	671-0024-03	B010990	B021081	1	CIRCUIT BD ASSY:ACQUISITION	80009	671-0024-03
	671-0024-04	B021082		1	CIRCUIT BD ASSY:ACQUISITION	80009	671-0024-04
					(SEE A5)		
					(ATTACHING PARTS)		
-29	211-0711-00			4	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
					ACQUISITION BOARD ASSY INCLUDES:		
-30	671-0828-00	B021082		1	.CIRCUIT BD ASSY:TRIGGER ENHANCEMENT	80009	671-0828-00
					.(SEE A5A19)		
					(ATTACHING PARTS)		
-31	210-0551-00	B021082		3	.NUT,PLAIN,HEX:4-40 X 0.25,ST CD PL	TK0435	ORDER BY DESCR
					(END ATTACHING PARTS)		
					.TRIGGER ENHANCEMENT BOARD ASSY INCLUDES:		
-32	210-0227-00	B021082		3	..TERMINAL,LUG:0.141 ID,LOCKING,BRZ TINNED	98335	GC7462M
					(ATTACHING PARTS)		
-33	211-0180-00	B021082		3	..SCR,ASSEM WSHR:2-56 X 0.25,PNH,BRS,NP,POZ	TK0435	ORDER BY DESCR
-34	210-0405-00	B021082		3	..NUT,PLAIN,HEX:2-56 X 0.188,BRS CD PL	73743	12157-50
-35	210-0053-00	B021082		3	..WASHER,LOCK:#2 SPLIT,0.02 THK STL	78189	ORDER BY DESCR
					(END ATTACHING PARTS)		
-36	386-5429-00			1	SUPPORT,PIVOT:CKT,RIGHT	80009	386-5429-00
					(ATTACHING PARTS)		
-37	213-0992-00			1	SCREW,TPG,TF:4-24 X 0.375,PNH,STL	93907	B80-70000-003
					(END ATTACHING PARTS)		
-38	386-5428-00			1	SUPPORT,PIVOT:CKT,LEFT	80009	386-5428-00
					(ATTACHING PARTS)		
-39	213-0992-00			1	SCREW,TPG,TF:4-24 X 0.375,PNH,STL	93907	B80-70000-003
					(END ATTACHING PARTS)		
	020-1583-00	B010100	B010653	1	MATERIAL KIT:11402 VER 1.2,1.6	80009	020-1583-00
	020-1583-01	B010654	B010956	1	COMPONENT KIT:	80009	020-1583-01
	020-1583-02	B010957	B021081	1	COMPONENT KIT:	80009	020-1583-02
	020-1583-03	B021082	B021239	1	COMPONENT KIT:11402 CODE 18	80009	020-1583-03
	020-1583-04	B021240	B021434	1	COMPONENT KIT:EXP VER 3.8,DSP VER 3.3,DIG VER 3.9	80009	020-1583-04
	020-1583-05	B021435		1	COMPONENT KIT:EXP VER 4.1,DSP VER 4.0,DIG VER 4.2	80009	020-1583-05
					WIRE ASSEMBLIES		
	175-9873-00			1	CA ASSY,SP,ELEC:2,14,2,16 AWG,18 L	80009	175-9873-00
					(FROM A3J63 TO A7J63,A13J63)		
	175-9912-00			1	CABLE ASSY,RF:50 OHM COAX,48.0 L,6-2,6-3	80009	175-9912-00
					(FROM A1J32,J33 TO A5J32,J33)		
	175-9913-00			1	CABLE ASSY,RF:50 OHM COAX,48.0 L,6-4,6-N	80009	175-9913-00
					(FROM A1J34,J36 TO A5J34,J36)		
	175-9914-00			1	CABLE ASSY,RF:50 OHM COAX,48.0 L,6-0,6-1	80009	175-9914-00
					(FROM A1J30,J31 TO A5J30,J31)		
	175-9905-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-1	80009	175-9905-00
					(FROM A1J01 TO A5J01)		
	175-9906-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-2	80009	175-9906-00
					(FROM A1J02 TO A5J02)		
	175-9907-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-3	80009	175-9907-00
					(FROM A1J03 TO A5J03)		
	175-9908-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-4	80009	175-9908-00
					(FROM A1J04 TO A5J04)		
	175-9909-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-5	80009	175-9909-00
					(FROM A1J05 TO A5J05)		
	175-9910-00			1	CABLE ASSY,RF:50 OHM COAX,18.0 L,9-6	80009	175-9910-00

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-					(FROM A1J06 TO A5J06)		
	131-1315-01			8	CONN,RCPT,ELEC:BNC,FEMALE (J11 THRU J18,QUANTITY OF 2. FRONT AND BACK. OPTION 1C ONLY)	80009	131-1315-01
	174-0287-00			1	CABLE ASSY,RF:50 OHM COAX,29.0 L,W/PELTALAS (FROM A5J26 TO J26)	80009	174-0287-00
	175-9810-00			1	CA ASSY,SP,ELEC:50,4.0 L (FROM A7J52 TO A16J52)	80009	175-9810-00
	175-9811-00			1	CA ASSY,SP,ELEC:20,6.0 L (FROM A7J53 TO A8J53)	80009	175-9811-00
	175-9855-00			1	CA ASSY,SP,ELEC:7 PIN CONN W/CRT SKT,4.5 L (FROM A8J56 TO CRT SOCKET)	80009	175-9855-00
	175-9799-00			1	CA ASSY,SP,ELEC:16.5 L (FROM A7J57 TO DS60)	80009	175-9799-00
	175-9857-00			1	CA ASSY,SP,ELEC:11,18 AWG,7.25 L,RIBBON (FROM A2A2J63 TO A7J63 AND A13J64)	80009	175-9857-00
	175-9803-00			1	CA ASSY,SP,ELEC:7,26 AWG,7.5 L,RIBBON (FROM A2A2J65 TO A4J65)	80009	175-9803-00
	175-9798-00			1	CA ASSY,SP,ELEC:18.0 L (FROM A2A2J66 TO A5J66 AND A6J66)	80009	175-9798-00
	175-9854-00			1	CA ASSY,SP,ELEC:36,28 AWG,7.0 L (FROM A10J72 TO A14J72)	80009	175-9854-00
	175-9807-00			1	CA,ASSY,SP,ELEC: (FROM A10J74 TO S74 AND S75)	80009	175-9807-00
	175-9814-00			1	CA ASSY,SP,ELEC:34,3.0 L (FROM A14J77 TO A17J77)	80009	175-9814-00
	175-9815-00			1	CA ASSY,SP,ELEC:34,12.0 L (FROM A12J78 TO A14J78)	80009	175-9815-00
	175-9809-00			1	CA ASSY,SP,ELEC:50,3.0 L (FROM A15J79 TO A16J79)	80009	175-9809-00
	175-9808-00			1	CA ASSY,SP,ELEC:50,18.0 L (FROM A6J83 TO A15J83)	80009	175-9808-00
	175-9806-00			1	CA ASSY,SP,ELEC:60,4.0 L (FROM A5J84 TO A6J84)	80009	175-9806-00
	175-9805-00			1	CA ASSY,SP,ELEC:40,4.0 L (FROM A5J85 TO A6J85)	80009	175-9805-00
	175-9804-00			1	CA ASSY,SP,ELEC:34,4.0 L (FROM A5J86 TO A6J86)	80009	175-9804-00
	175-9812-00			1	CA ASSY,SP,ELEC:26,7.0 L (FROM A1J91 TO A5J91 AND A6J91)	80009	175-9812-00

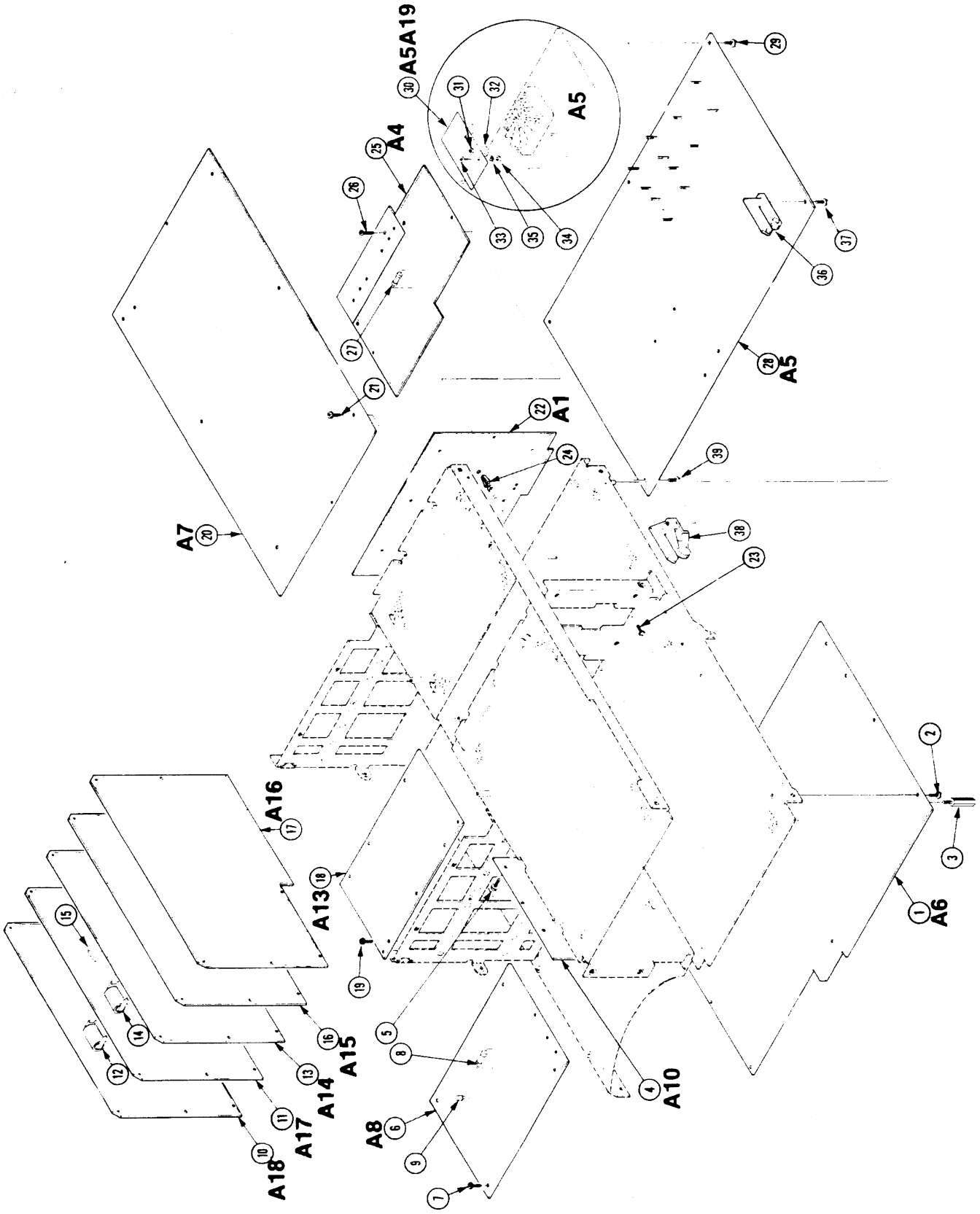


FIG. 3 CIRCUIT BOARDS
Replaceable Parts - 11402 Service

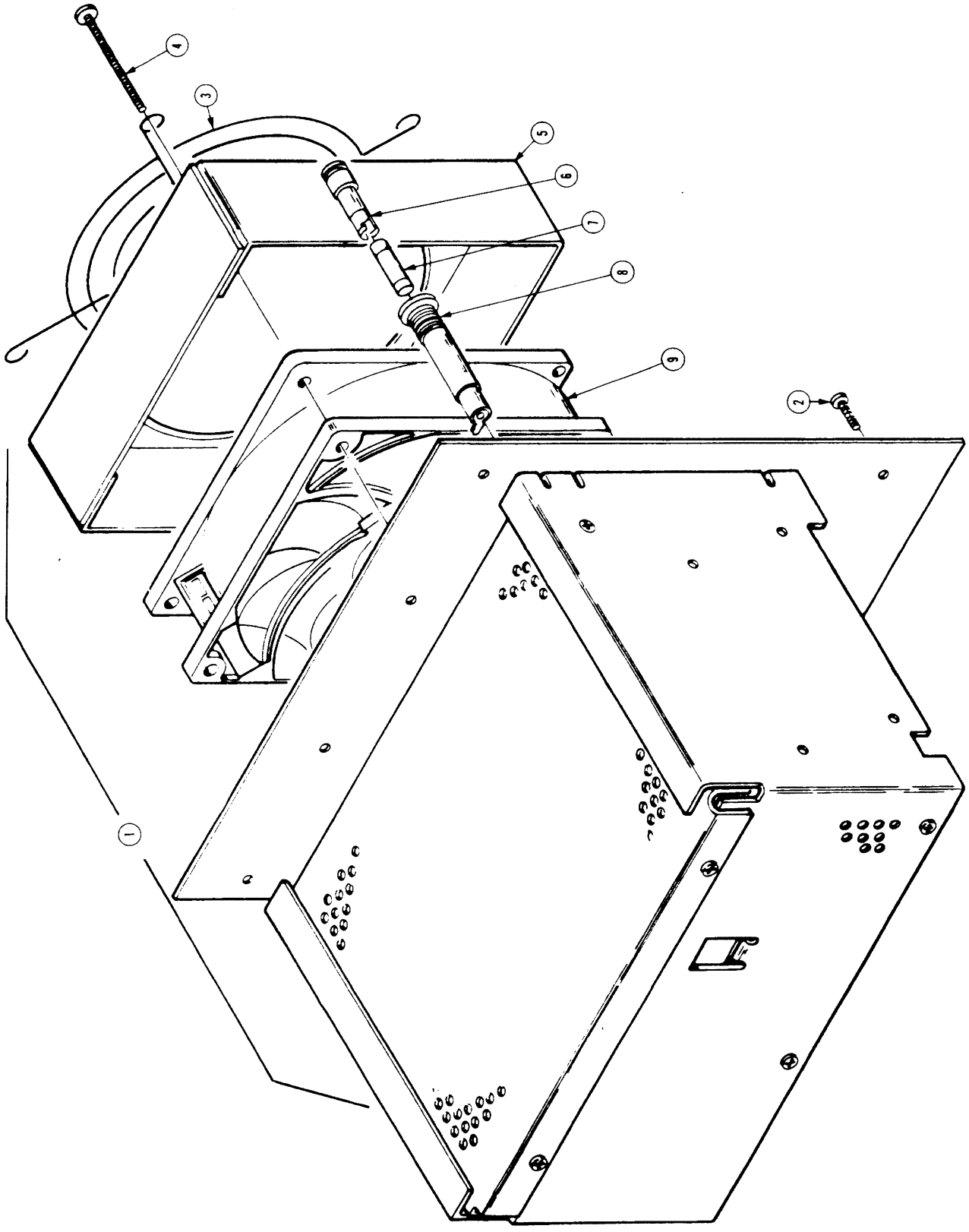


FIG. 4 POWER SUPPLY
Replaceable Parts - 11402 Service

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
4-1	620-0022-00	B010100	B011024	1	POWER SUPPLY:ET MAINFRAME	80009	620-0022-00
	620-0022-01	B011025	B021419	1	POWER SUPPLY:ET,RT,HIRES MAIN FRAMES	80009	620-0022-01
	620-0022-02	B021420		1	POWER SUPPLY:ET,RT,HIRES MAIN FRAME	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	71400	MTH-CW-6
					.(FUSE USED IN FUSE HOLDER)		
	159-0021-00			1	.FUSE,CARTRIDGE:3AG,2A,250V,FAST BLOW	71400	AGC-CW-2
					.(FUSE USED ON LINE INVERTER BOARD)		
-8	204-0832-00			1	.BODY,FUSEHOLDER:3AG & 5 X 20MM FUSES	TK0861	031 1673
-9	119-1725-01			1	.FAN,TUBEAXIAL:8 14.5VDC,6W,3200RPM,106CFM	TK1456	4112 KX

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
5-								
						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
	012-0208-00			8		CABLE,INTCON:10.0 L (OPTION 1C ONLY)	80009	012-0208-00
	070-5791-01			1		MANUAL,TECH:USERS,11401/11402	80009	070-5791-01
	070-6103-01			1		MANUAL,TECH:INTRODUCTION,11401/11402	80009	070-6103-01
	070-6255-00			1		MANUAL,TECH:OPERATORS,11401/11402	80009	070-6255-00
	070-6274-00			1		MANUAL,TECH:INSTR,11000 SERIES (OPTION 1R ONLY)	80009	070-6274-00
	070-6694-00			1		PROCEDURE:INCOMING INSPECTION,11401/2	80009	070-6694-00
						OPTIONAL ACCESSORIES		
	012-0555-00			1		CABLE,INTCON:3 METERS	80009	012-0555-00
	012-0911-00			1		CABLE,INTCON:144.0 L, RS 232	TK6020	ESF-85249
	012-0991-00			1		CABLE,GPIB:LOW EMI,2 METER	00779	553577-3
	016-0829-00			1		PANEL,BLANK:PLUG-IN HOUSING,11K SERIES	80009	016-0829-00
	067-1264-00			1		FIXTURE,CAL:POWER SPLY EXTENDED DIAGNOSTICS	80009	067-1264-00
	067-1267-00			1		FIXTURE,CAL:TROUBLE SHOOTING AID EXTENDER CARD W/CABLES	80009	067-1267-00
	070-6779-03			1		MANUAL,TECH:SERVICE REF,11401/11402	80009	070-6779-03

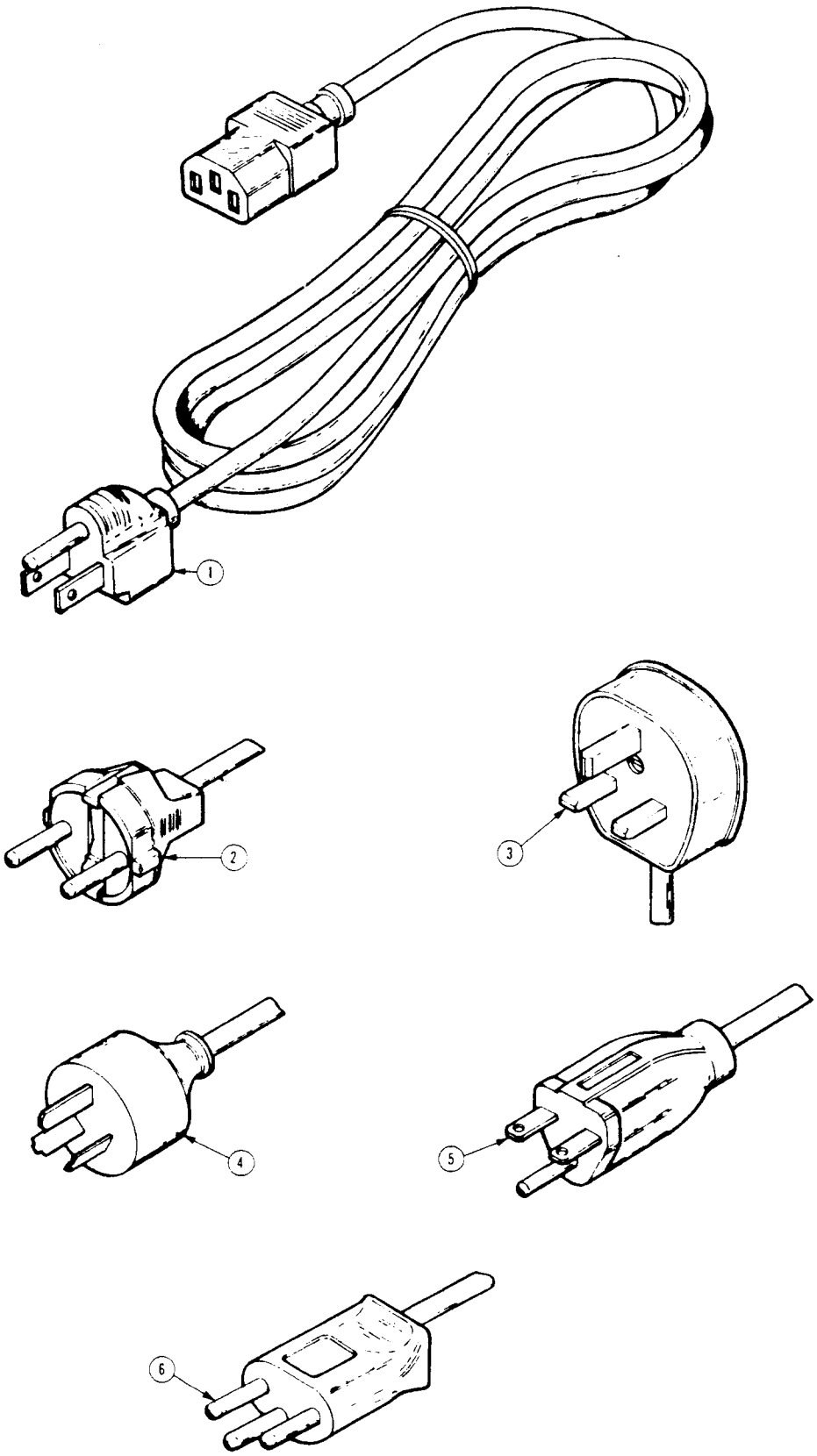


FIG. 5 ACCESSORIES
Replaceable Parts - 11402 Service