Part No. 070-6784-00
Product Group 47

11A33
Differential Comparator

Service Reference

WARNING

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

Please check for CHANGE INFORMATION at the rear of this manual.

First Printing NOV 1987

Tektronix®
COMMITTED TO EXCELLENCE

INSTRUMENT SERIAL NUMBERS

Each instrument has a serial number on a panel insert, tag, or stamped on the chassis. The first number or letter 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:

B000000	Tektronix, Inc. Beaverton, Oregon, USA
1000000	Tektronix Guernsey, Ltd., Channel Islands
2000000	Tektronix United Kingdom, Ltd., London
3000000	Sony/Tektronix, Japan
7000000	Tektronix Holland, NV, Heerenveen, The Netherlands

Printed in U.S.A.

Contents

Section 3—Maintenance

Section 4—Theory of Operation

Section 5—Replaceable Parts

Change Information

Related Documentation

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

Manuals (Standard Accessories)

11A33 User's Reference Supplement
11A33 Incoming Inspection Procedure

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 ot 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 in a mainframe connected to 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 mainframe 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 mainframe power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective-ground connection, by way of the grounding conductor in the mainframe 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, or replacing components.

Section 1
General Information

This section gives all the information needed to apply power to the 11A33 Differential Comparator.

Information on installing and removing the plug-in, instrument options, packaging for shipment, as well as environmental conditions such as operating temperature is included here.

Introduction

This manual is designed for use by qualified service personnel. It contains information necessary to check, troubleshoot, and maintain the 11A33 Differential Comparator. Troubleshooting is primarily based upon internal Power-up Diagnostics. These diagnostics identify suspect Field Replaceable Unit(s) (FRUs). Once the faulty FRU is identified, use the instructions provided in this manual to remove and replace it. Section 5, Replaceable Parts gives a complete list of the FRUs in this instrument.

The 11A33 is a differential comparator plug-in amplifier that plugs into any of the 11000-series plug-in mainframes. Commands from the mainframe control all the plug-in functions. The plug-in front panel has a momentary pushbutton and a back-lighted "display on" indicator. Other controls and status indicators are located on the mainframe.

The impedance of each input can be set to 1 GΩ, 1 MΩ, or 50 Ω. Bandwidth can be limited to 20 MHz or 100 MHz. The plug-in provides a display, a trigger, and an auxiliary output to the mainframe. Display and trigger signals can be independently inverted.

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

Plug-in to Mainframe Compatibility

Details about bandwidth are included in Part 4, Specification, of the User's Reference Supplement, and in the Tektronix Corporate Catalog. Refer to the Tektronix Corporate Catalog for complete compatibility information.

Initial Inspection

This instrument was inspected mechanically and electrically before shipment. Therefore, this instrument should not have any mars or scratches and should meet all electrical specifications.

Inspect the plug-in for possible physical damage incurred in transit. Use the Incoming Inspection Procedure shipped with the instrument to verify instrument performance. If you find damage or deficiency, contact your local Tektronix Field Office or representative.

Installing and Removing the Plug-In

To install the plug-in in any 11000-series oscilloscope mainframe:

1. Set the mainframe ON/STANDBY switch to STANDBY to prevent damage to the instrument.

CAUTION

If the green indicator light remains ON when the STANDBY position is selected, then the switch has been left internally disabled after the servicing of the Power Supply. To enable the ON/STANDBY switch, refer to the Maintenance section of the mainframe Service Manual.

2. Align the grooves in the top and bottom of the plug-in with the guides in the mainframe plug-in compartment.

3. Insert the plug-in into the mainframe until its front panel is flush with the front panel of the mainframe.

To remove the plug-in from a mainframe.

1. Set the mainframe ON/STANDBY switch to STANDBY to prevent damage to the instrument.

2. Pull the release latch (refer to Fig. 1-1) to disengage the plug-in from the mainframe.

3. Pull the plug-in straight out of the plug-in compartment.

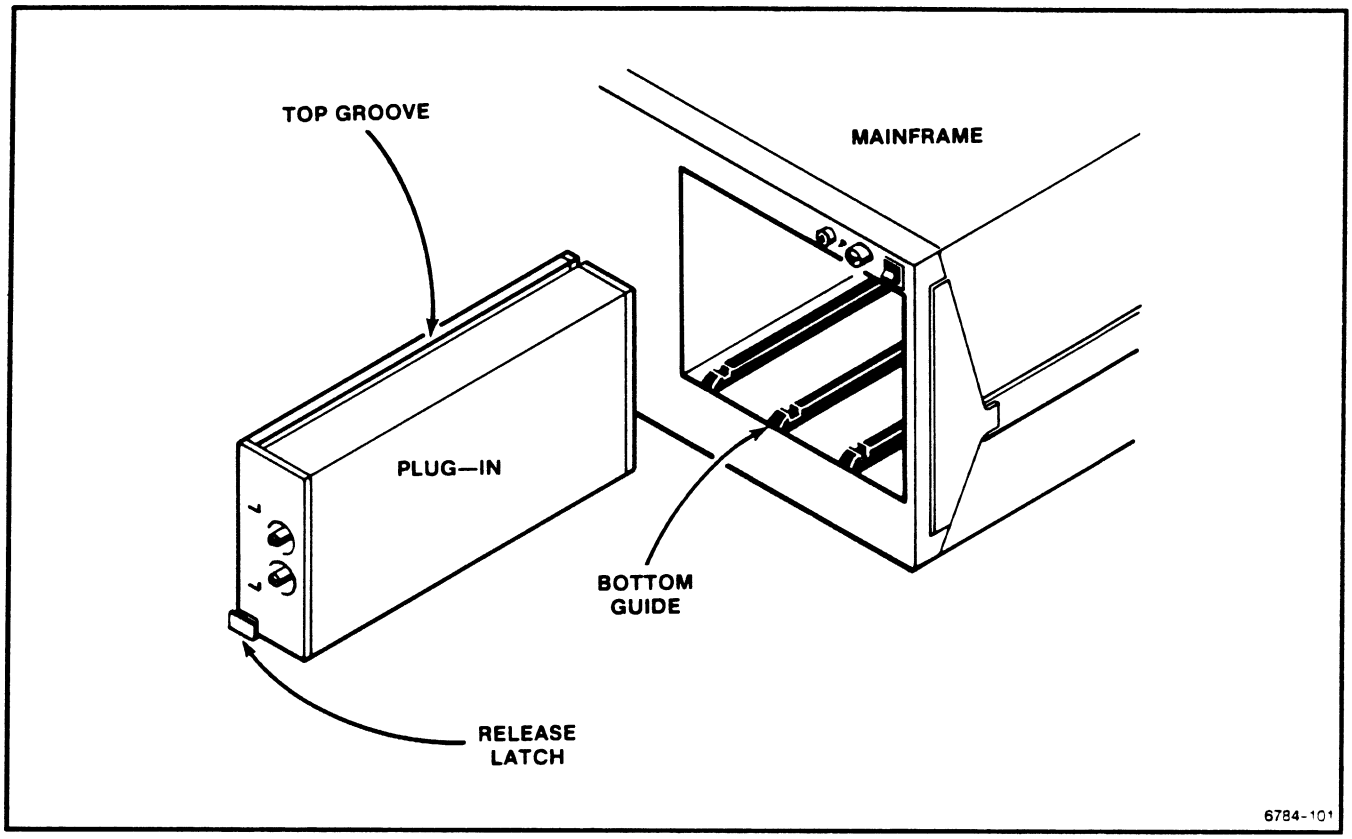


Figure 1-1. Installing a plug-in in a mainframe oscilloscope.

Instrument Options

The customer can order Option 24, which includes one set of P6135 probes.

Packaging for Shipment

If possible, save and reuse the original carton and packaging to package the instrument when shipping it by commercial transportation. Package and ship the plug-ins and mainframes separately.

Attach a tag to the plug-in if it is shipped to a Tektronix Service Center for service or repair. Include the following information on the tag:

- Name and address of the instrument owner
- Name of a person at your firm who can be contacted about the instrument
- Complete instrument type and serial number
- A description of the service required

Package the plug-in as follows, if the original package is not available or is not fit for use:

1. Obtain a corrugated cardboard carton with inside dimensions at least six inches (15 cm) greater than the instrument dimensions. Use a carton with a bursting test strength of at least 200 pounds per square inch.
2. Fully wrap the plug-in with anti-static sheeting, or its equivalent, to protect the finish.
3. Tightly pack dunnage or urethane foam between the carton and the instrument to cushion the plug-in on all sides. Allow three inches of packing on each side.
4. Seal the carton with shipping tape or with industrial staples.
5. Mark the address of the Tektronix Service Center and your return address on the carton in one or more prominent places.

Operating Environment

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

Operating Temperature

Operate the plug-in where the ambient air temperature is between 0° and +50° C. Store the plug-in in ambient temperatures from -40° to +75° C. After storing the plug-in 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 reverts to non-enhanced accuracy if the internal mainframe temperature changes more than 5° C.

Section 2
Checks and Adjustments

This section contains procedures to check electrical specifications and to manually set all internal adjustments. This procedure provides a logical sequence of check and adjustment steps for either returning the instrument to specified operation following repair or for performing a part of a routine maintenance program. Consult the User's Reference manual for more information about advertised specifications and instrument operation. Consult the test equipment manuals for information concerning test equipment setup or interconnection. The Specifications or Measurement Limits are given at the beginning of each procedure.

Using this Procedure

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.

The mainframe tutorial manual is strongly recommended to familiarize the first-time user with the mainframe controls and features.

Plug-In Installation and Removal

CAUTION

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

Turning the instrument power off during probe calibration, self-calibration, Extended Diagnostics or other intense system activity may result in some internal data being corrupted. If corruption occurs, refer to Restoring Calibration Data in Section 3.

Initialized Setting

At the beginning of most steps, the user is instructed to **Initialize** the instrument as part of the setup. The **Initialize** feature, available through the UTILITY menu, presets all instrument controls and functions to known values. Initializing the instrument at the beginning of a step eliminates the possibility of settings from previous steps causing erroneous or confusing results. For more information on initialization, refer to the mainframe User's Reference manual.

Test Equipment

Table 2-1 contains suggested test equipment used with the Checks and Adjustment Procedure. The procedures are based on the test equipment examples shown in the Setups, but other equipment with similar specifications may be substituted. However, using other equipment could alter the test results, the Setup information, or the related connectors and adapters required.

Procedure Parts

The procedure is divided into the following parts which should be performed sequentially:

1. Initial Setup
2. Check/Adjust CMRR
3. Check/Adjust Bandwidth
4. Check Enhanced Accuracy
5. Check DC Balance
6. Check ΔV DC Accuracy
7. Check Offset Accuracy
8. Check/Adjust VC Accuracy
9. Check Overdrive Recovery

TABLE 2-1
Test Equipment

Description	Minimum Specification	Examples of Applicable Test Equipment
11000-series plug-in mainframe.	Tektronix plug-in mainframe.	TEKTRONIX 11301 11302 11401 11402
Power Module	Tektronix five- or six-compartment power module.	TEKTRONIX TM 506 or TM 515 Power Module.
Leveled Sine Wave Generator	250 kHz to 250 MHz, Leveled variable amplitude, 50 kHz reference.	TEKTRONIX SG 503 Leveled Sine Wave Generator with a TM 500-series Power Module.
Function Generator	Frequency: 10 Hz to 20 MHz; Amplitude: 30 V p-p.	TEKTRONIX FG 504 40 MHz Function Generator with a TM 500-series Power Module.
Sine Wave Calibrator	Frequency: 40 Hz to 250 kHz, 100 V p-p.	Fluke 5200A AC Calibrator.
Power Supply	Continuously variable from 0-40 V; current limit, adjustable from 0-400 mA.	TEKTRONIX PS 503A Dual Power Supply with a TM 500-series Power Module.
DC Voltage Calibrator (optional)	Output, 0-40 V	Data Precision 8200.
Overdrive Recovery Tester		TEKTRONIX 067-0608-00 Overdrive Recovery Calibration Fixture.
Accessory Power Supply	±15 V; probe power outlet.	TEKTRONIX 1101A.
Risetime Limiter		TEKTRONIX 067-1341-00 Rise Time Limiter Calibration Fixture.
Digital Multimeter (w/test leads)	Accuracy, ≤0.01%.	Fluke 8842A Digital Multimeter.
Calibration Generator	Period, 0.1 ms, Amplitude, -60 V. Period 1 µs; Amplitude, 500 mV; Risetime < 1 ns.	TEKTRONIX PG 506 Calibration Generator with a TM 500-series Power Module.

TABLE 2-1 (cont)
Test Equipment

Description	Minimum Specification	Examples of Applicable Test Equipment
Calibration Fixture Flexible Extender		TEKTRONIX 067-1261-00 Flexible Extender Calibration Fixture.
Signal Standardizer	Tektronix Calibration Fixture with interface connector modified for 11000-series use.	TEKTRONIX 067-0587-02 Signal Standardizer.
Any Plug-in Amplifier:		TEKTRONIX 11A32 Two Channel Amplifier 11A33 Differential Comparator 11A34 Four Channel Amplifier 11A52 Two Channel Amplifier 11A71 Amplifier
Blank Panel	Blank Panel or any 11000-series Amplifier plug-in.	TEKTRONIX 016-0829-00 Blank Panel or any Amplifier plug-in listed above.
Coaxial Cable (2 required)	50 Ω, 36-inch, male BNC connectors.	Tektronix Part 012-0482-00.
Adapter, BNC to Alligator Clips	BNC Female to Clip leads.	Tektronix Part 013-0076-00.
Attenuator, 10X	Impedance: 50 Ω, one male and one female BNC connector.	Tektronix Part 011-0059-02.
Adapter, BNC to Banana (2 required)	BNC Female to Dual Banana	Tektronix Part 103-0090-00.
Connector, T	BNC, T: Two female and one male BNC connector.	Tektronix Part 103-0030-00.
Dual Input Coupler	Two male and one female BNC connector.	Tektronix Part 067-0525-02.
Termination	Impedance: 50 Ω; Accuracy, within 2%; Connectors, BNC.	Tektronix Part 011-0049-01.
Resistor	430 Ω; Tolerance, 10% ; Power rating, 1 W.	Tektronix Part 303-0431-00.
Alignment Tool (insulated slot)	Insulated slot.	Tektronix Part 003-0675-01.
Magnetic Screwdriver	Holder for Torx tips.	Tektronix Part 003-0293-00.

TABLE 2-1 (cont)
Test Equipment

Description	Minimum Specification	Examples of Applicable Test Equipment
Torx Screwdriver Tips	#6 tip #7 tip #8 tip #10 tip #10 tip (narrow shank) #15 tip	Tektronix Part 003-1415-00. Tektronix Part 003-1293-00. Tektronix Part 003-0964-00. Tektronix Part 003-0814-00. Tektronix Part 003-0815-00. Tektronix Part 003-0966-00.
Square Tip Driver		Tektronix Part 003-1400-00.
Allen Wrench		Tektronix Part 003-0105-00.
Nonmetallic Screwdriver		Tektronix Part 003-1364-00.
Integrated Circuit Extracting Tools	IC Insertion-Extraction Pliers 28-pin type	General Tool P/N U505BG or equiv.
Patch Cord, BNC to Banana	One BNC, one banana connector.	Tektronix Part 012-0091-00.
24-pin Socket		Tektronix Part 136-0751-00.
Needle-nose pliers		
Tweezers		
Static Control Mat		Tektronix Part 006-3414-00.
Wrist Strap		Tektronix Part 006-3415-00.

Part 1 – Initial Setup

Description

Perform the Checks and Adjustments procedure 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 the plug-ins.

Turning the instrument power off during probe calibration, self-calibration, Extended Diagnostics or other intense system activity may result in some internal data being corrupted. If corruption occurs, refer to Restoring Calibration Data in Section 3.

Procedure

a. Power on the following test equipment so that it is warmed up with the instrument to be tested:

Power Supply
Calibration Generator
Leveled Sine Wave Generator
Digital Multimeter
Function Generator
Sine Wave Calibrator

b. With the ON/STANDBY switch set to STANDBY, connect the mainframe to a suitable power source.

c. Remove both the left and right side shields from the 11A33.

Part 2a – Check/Adjust CMRR: Standard Procedure

Description

A signal is applied to both the + and - input connectors, and the difference (or residue) is displayed. The ratio of the residue to the signal amplitude is the Common Mode Rejection Ratio (CMRR). This part examines Test Groups 1 through 6 using the Standard Procedure.

If a Sine Wave Calibrator is not available, then use the Alternative Procedure later in this part with the 60 V high amplitude output of the Calibration Generator to check and adjust Test Groups 5 and 6.

CAUTION

Severe damage occurs unless the proper procedure is used in adjusting C1, C2, C3, and C4.

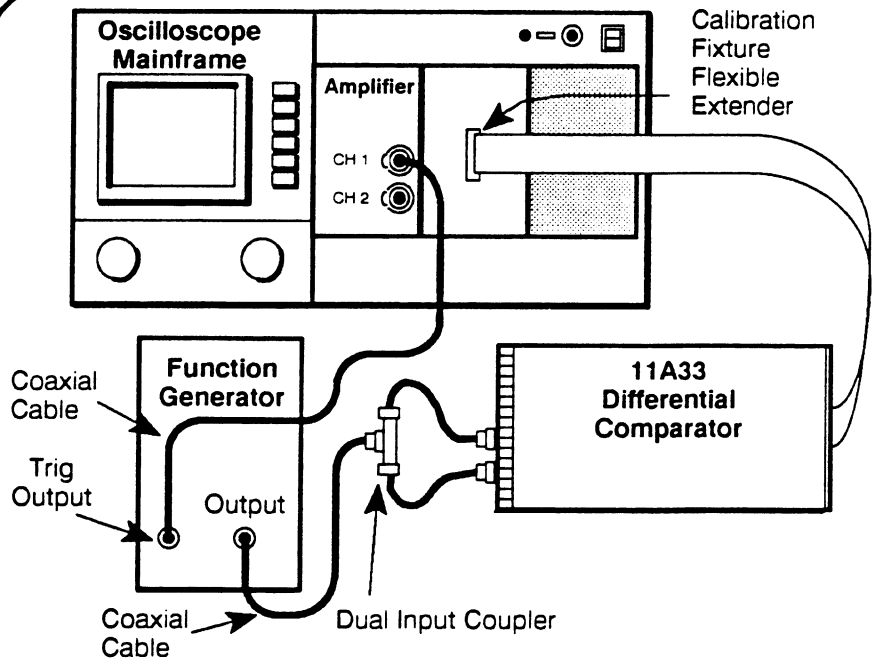
Each of these capacitors is composed of a grounded setscrew and a conductive area on the attenuator ceramic substrate directly below the screw tip. To change the capacitance, turn the screw, which changes the distance between the conductive area and the screw tip.

Turning the screw too far clockwise causes the tip to touch the conductive area and short out the signal path. Continued turning of the screw causes breakage of the ceramic substrate.

Specifications

Refer to Table 2-2.

Setup: Test Groups 1–4



Perform the following settings in the order listed:

Oscilloscope Mainframe
- ON/STANDBY ..... ON
- Wait for calibration complete.
- UTILITY menu ..... **Initialize**

Left Plug-in
- CH 1 Display on/off ..... on

Center Plug-In
- CH 1 Display on/off ..... on

Oscilloscope Mainframe
- **Main Size** ..... **5 ms/div**
- **BW Limit** or **HF Limit** ..... **100 MHz**

Function Generator
- Waveform ..... sinewave
- Frequency ..... 40 Hz
- Amplitude ..... 8 V p-p

6784-212

Procedure

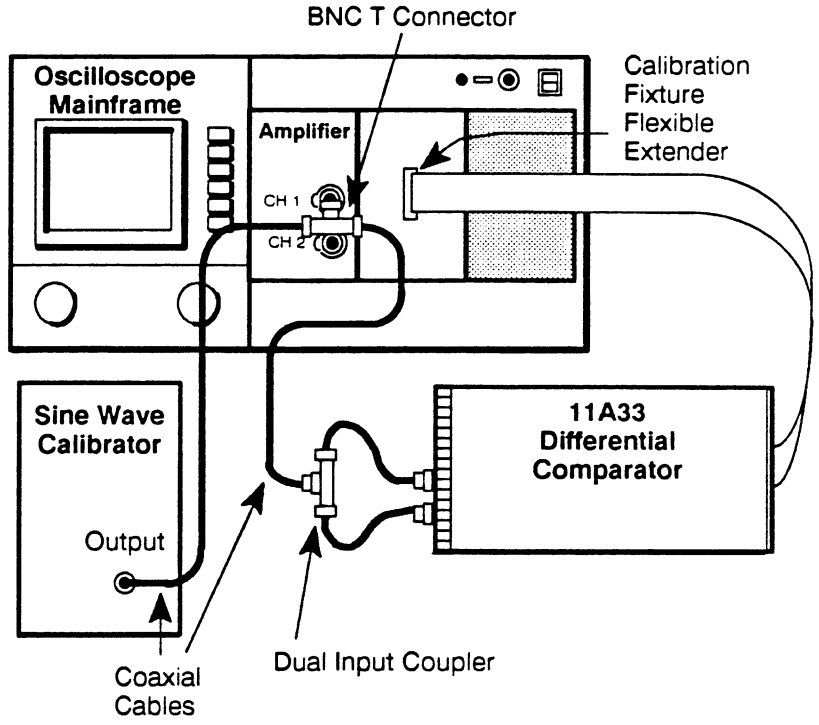
a. *CHECK* – that each Test Frequency and Amplitude in Table 2-2 for Test Groups 1 through 4 produces a Displayed Amplitude that is less than the Residual Specification Limit shown. Table 2-2 can be copied and used as a data sheet and test record.

STOP DO NOT attempt to reduce the Displayed Amplitude if it is within the stated limits. Proceed to step c.

b. *ADJUST* – if necessary, the components identified for the Test Group, to reduce the Displayed Amplitude within the Residual Specification Limit. Refer to Figure 2-1 for adjustment locations.

c. If C2 or C4 is adjusted, repeat step a for Test Group 2.

Setup: Test Groups 5–6



Perform the following settings in the order listed:

Sine Wave Calibrator

Frequency ..... 40 Hz
Amplitude ..... 100 V p-p

Left Plug-in

Settings are unchanged.

Center Plug-in

Settings are unchanged.

Oscilloscope Mainframe

Settings are unchanged.

6784-211

Procedure

d. *CHECK* – that each Test Frequency and Amplitude in Table 2-2 for Test Groups 5 and 6 produces a Displayed Amplitude that is less than the Residual Specification Limit shown. Table 2-2 can be copied and used as a data sheet and test record.

STOP DO NOT attempt to reduce the Displayed Amplitude if it is within the stated limits. Proceed to step f.

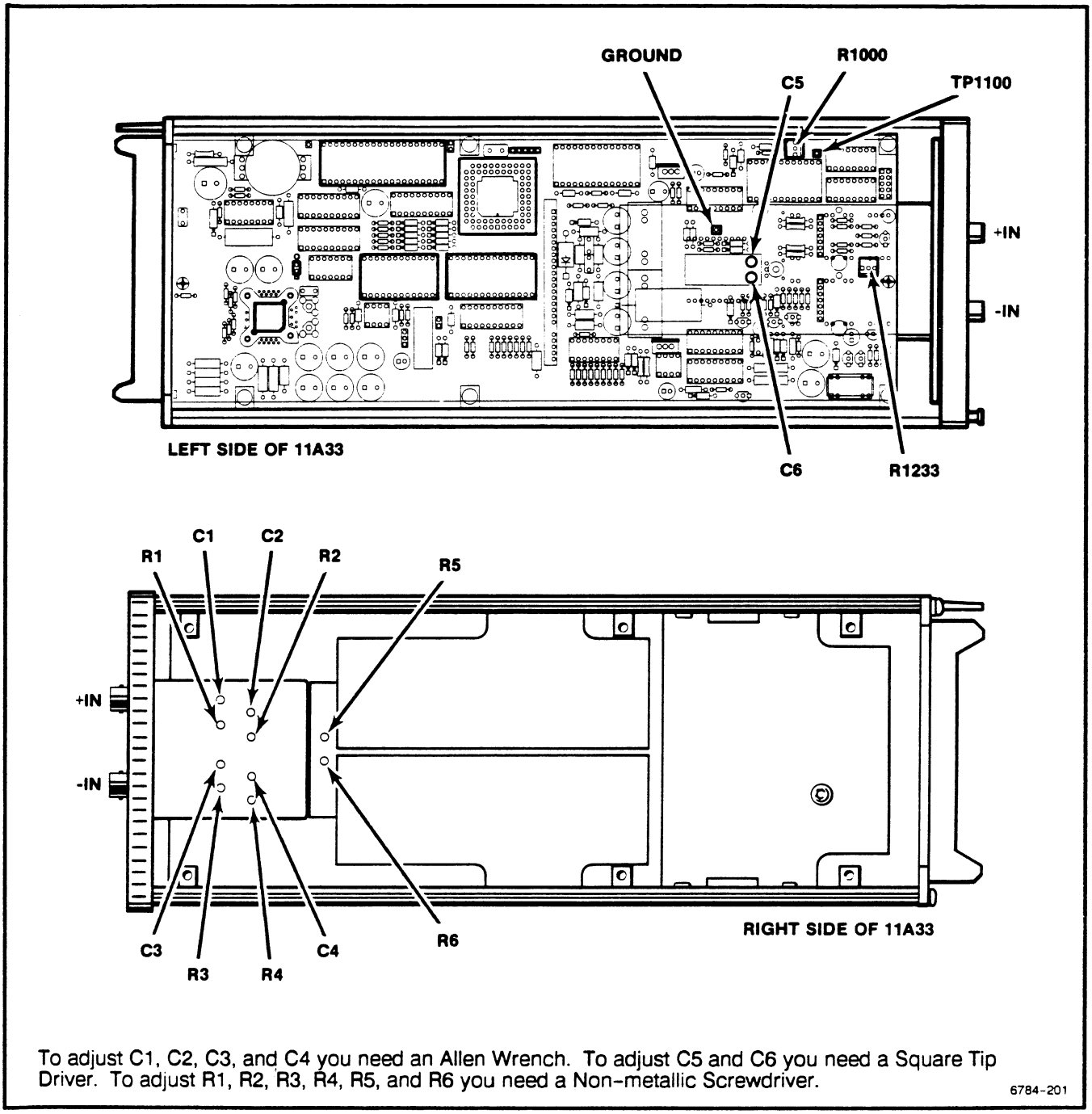
e. *ADJUST* – if necessary, the components identified for the Test Group, to reduce the Displayed Amplitude within the Residual Specification Limit. Refer to Figure 2-1 for adjustment locations.

f. If C1 or C3 is adjusted, repeat step a for Test Groups 2 and 4.

NOTE

These adjustments have been properly set at the factory and normally require only slight adjustment during the life of the Attenuator-Preamplifier Module. Only if these adjustments were radically disturbed is it helpful to return to the Initial Settings described in Part 2c – Adjust CMRR: Initial Settings.

Refer to Figure 2-1 for the locations of the eight adjustments on the Attenuator-Preamplifier Module. Six are accessible from the right-hand side of the instrument, and two are accessible from the left-hand side of the instrument, through an access hole in the A1 Main board (C5, C6, R5, and R6 are not labeled on the actual instrument).



To adjust C1, C2, C3, and C4 you need an Allen Wrench. To adjust C5 and C6 you need a Square Tip Driver. To adjust R1, R2, R3, R4, R5, and R6 you need a Non-metallic Screwdriver.

6784-201

Figure 2-1. Adjustment locations.

TABLE 2-2
11A33 CMRR

Size	Test Frequency	CMRR Specification	Test Amplitude	Residual Specification Limit	Displayed Amplitude
Test Group 1: Adjust R5, R6:					
1 mV/div	40 Hz	10,000:1	8 V p-p	0.8 mV p-p	____
1 mV/div	40 Hz	5,000:1	16 V p-p	3.2 mV p-p	____
(After adjusting R5 or R6, press ENHANCED ACCURACY on the mainframe before proceeding to Group 2.)					
Test Group 2: Adjust C5, C6:					
1 mV/div	20 MHz	500:1	1 V p-p	2 mV p-p	____
1 mV/div	10 MHz	1,000:1	1 V p-p	1 mV p-p	____
1 mV/div	1 MHz	10,000:1	8 V p-p	0.8 mV p-p	____
1 mV/div	1 MHz	5,000:1	16 V p-p	3.2 mV p-p	____
1 mV/div	2 MHz	2,500:1	16 V p-p	6.4 mV p-p	____
1 mV/div	5 MHz	2,000:1	8 V p-p	4 mV p-p	____
Test Group 3: Adjust R2, R4:					
0.1 V/div	40 Hz	1,000:1	30 V p-p	30 mV p-p	____
Test Group 4: Adjust C2, C4:					
0.1 V/div	1 MHz	1,000:1	30 V p-p	30 mV p-p	____
0.1 V/div	10 MHz	100:1	30 V p-p	300 mV p-p	____
0.1 V/div	20 MHz	100:1	30 V p-p	300 mV p-p	____
Test Group 5: Adjust R1, R3:					
1 V/div	40 Hz	500:1	100 V p-p	200 mV p-p	____
Test Group 6: Adjust C1, C3:					
1 V/div	250 kHz	500:1	100 V p-p	200 mV p-p	____

Part 2b—Check/Adjust CMRR: Alternative Procedure

Description

This part examines Test Groups 5 and 6 using the Alternative Procedure.

CAUTION

Severe damage occurs unless the proper procedure is used in adjusting C1, C2, C3, and C4.

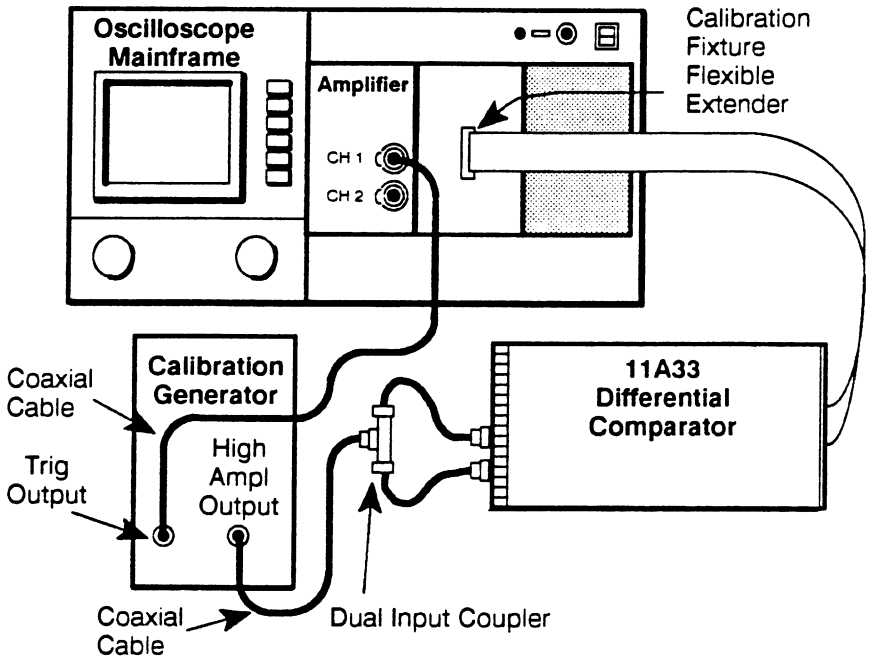
Each of these capacitors is composed of a grounded setscrew and a conductive area on the attenuator ceramic substrate directly below the screw tip. To change the capacitance, turn the screw, which changes the distance between the conductive area and the screw tip.

Turning the screw too far clockwise causes the tip to touch the conductive area and short out the signal path. Continued turning of the screw causes breakage of the ceramic substrate.

Measurement Limits

Since the pulse amplitude used in this procedure is approximately 60 V, the residual signal is too small to measure accurately. However, you can use this procedure to set the adjustments and to provide good confidence that the instrument is performing properly; but formal proof of performance requires the Sine Wave Calibrator to allow sufficient measurement accuracy.

Setup



Perform the following settings in the order listed:

Calibration Generator

Period ..... 0.1 ms
Amplitude ..... 60 V
Function ..... High Ampl

Oscilloscope Mainframe

Settings are unchanged.

Left Plug-in

Settings are unchanged.

Center Plug-In

Settings are unchanged.

6784-210

Procedure

a. *ADJUST* – R1 and R3 to minimize the vertical difference between the trailing portions of successive half cycles of the square wave residual signal. Ignore the spikes and tilt at the leading portion of each half cycle.

b. *ADJUST* – C1 and C3 to minimize the amplitude of the tilting at the leading portion of each half cycle of the residual signal. Ignore spikes at the leading edge of each half cycle.

Part 2c – Adjust CMRR: Initial Settings

Description

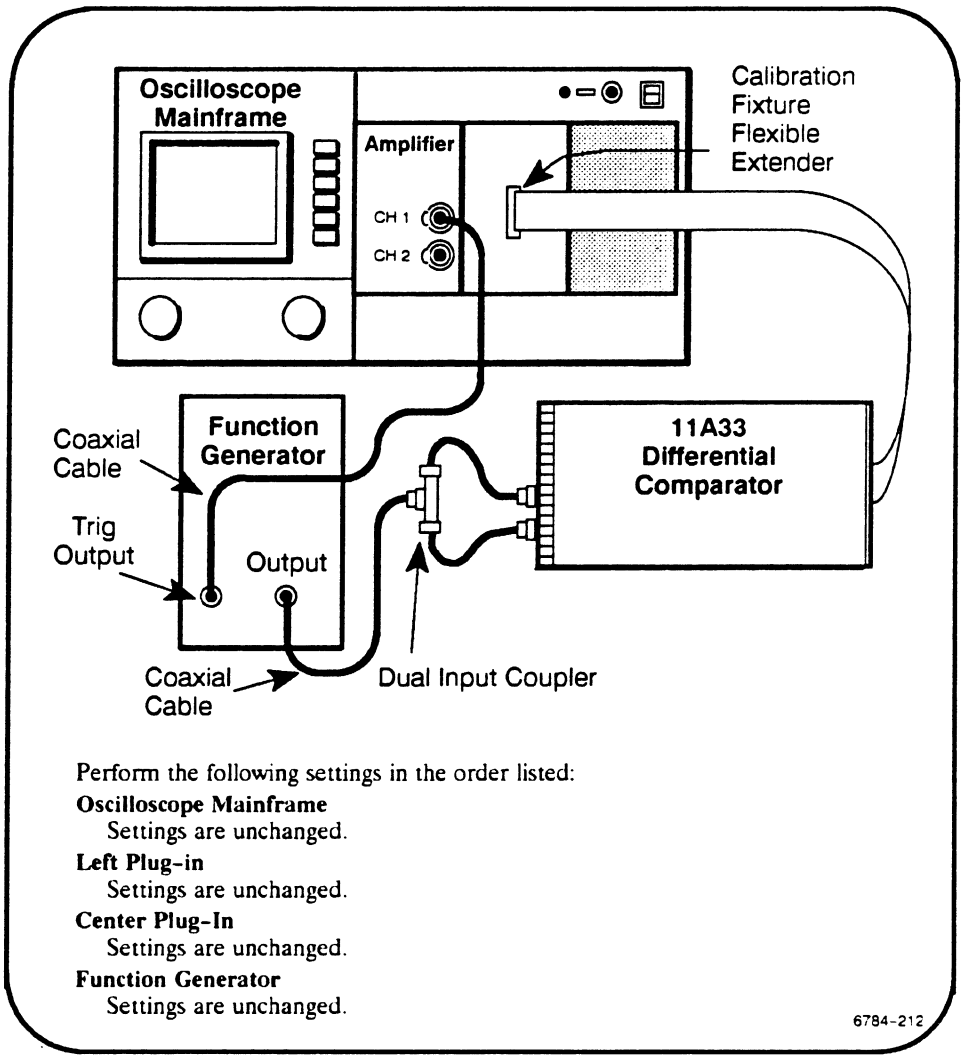
DO NOT attempt to use the procedure in this part if only minor adjustments are not sufficient to achieve the specified performance, or if the previous settings are not severely disturbed. Proceed to the Standard or Alternative Procedures in most cases.

Severe damage occurs unless the proper procedure is used in adjusting C1, C2, C3, and C4.

Each of these capacitors is composed of a grounded setscrew and a conductive area on the attenuator ceramic substrate directly below the screw tip. To change the capacitance, turn the screw, which changes the distance between the conductive area and the screw tip.

Turning the screw too far clockwise causes the tip to touch the conductive area and short out the signal path. Continued turning of the screw causes ***breakage of the ceramic substrate.***

Setup



Perform the following settings in the order listed:

Oscilloscope Mainframe
Settings are unchanged.

Left Plug-in
Settings are unchanged.

Center Plug-In
Settings are unchanged.

Function Generator
Settings are unchanged.

Procedure

a. For R2: Connect a signal, frequency approximately 40 Hz and amplitude approximately 30 V p-p, through the dual input coupler to the + and - input connectors of the instrument. Set **Vert Size** to 100 mV/div, + coupling to DC, and - coupling to DC. Observe the displayed residual signal, which is the result of imperfect common mode rejection.

R2 is a continuous rotation device with no stops. Rotate R2 up to one full turn to locate the point at which resistance changes abruptly from minimum to maximum. A radical change in the residual signal amplitude or phase indicates this point.

Rotate the screwdriver one-half turn. This is the proper initial position (midrange resistance).

b. For R4: Repeat the R2 setting process.

c. For R1: Repeat the R2 setting process, with the signal amplitude approximately 100 V p-p and **Vert Size** set to 1 V/div.

d. For R3: Repeat the R1 setting process.

e. For R5: Rotate fully counterclockwise.

f. For R6: Rotate fully clockwise.

g. For C2: Connect a signal, with a frequency of approximately 250 kHz and an amplitude of approximately 30 V p-p through the dual input coupler to the + and - input connectors of the instrument. Set **Vert Size** to 100 mV/div, + coupling to DC, and - coupling to DC. Observe the displayed residual signal, which is the result of imperfect common mode rejection.

Slowly, carefully, and with as little torque as possible rotate C2 clockwise. The residual signal amplitude increases as the common mode rejection is degraded. As the screw tip approaches the substrate and increases the capacitance, the residual signal amplitude increases radically. When the screw tip touches the substrate, the residual signal amplitude increases to the input signal amplitude, since one amplifier input is shorted out.

CAUTION

DO NOT turn the screw any farther clockwise or the substrate will break.

Rotate the screw 1.6 turns counterclockwise. This is the proper initial position.

h. For C4: Repeat the C2 setting process.

i. For C1: Repeat the C2 setting process with the signal amplitude approximately 100 V p-p and **Vert Size** set to 1 V/div.

j. For C3: Repeat the C1 setting process.

k. For C5: Connect a Fast Rise pulse to the + input connector of the instrument and observe the fastest rise time to determine the adjustment needed to produce minimum capacitance. (C5 is also a continuous rotation device with no stops.)

l. For C6: Repeat the C5 setting process, except connect the fast rise pulse to the - input connector of the instrument.

Part 3—Check Bandwidth

Description

First, amplitude is measured at the specification frequencies using the Signal Standardizer, to characterize the mainframe.

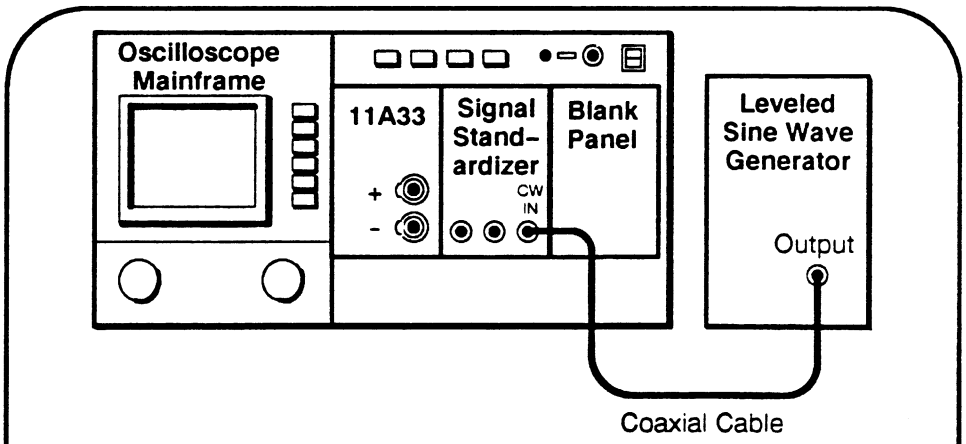
Then, the displayed amplitude is checked at the specification frequencies to determine the plug-in's contribution to the bandwidth.

Specifications

Refer to Table 2-3.

Examine Mainframe Bandwidth

Setup



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

Oscilloscope Mainframe
- Waveform ..... **C** (center)
- Trigger Source ..... **C** (center)
- **Main Size** ..... **10 µs/div**

Left Plug-in
- Not used in this procedure.

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

Leveled Sine Wave Generator
- Frequency ..... reference

6784-216

Procedure

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

a. Set the Leveled Sine Wave Generator output amplitude so that the Signal Standardizer CW Leveled light is on.

b. *CHECK*—that this light remains on throughout the following steps.

c. Set the Signal Standardizer Position and Amplitude for a 6-division display amplitude, centered on the screen.

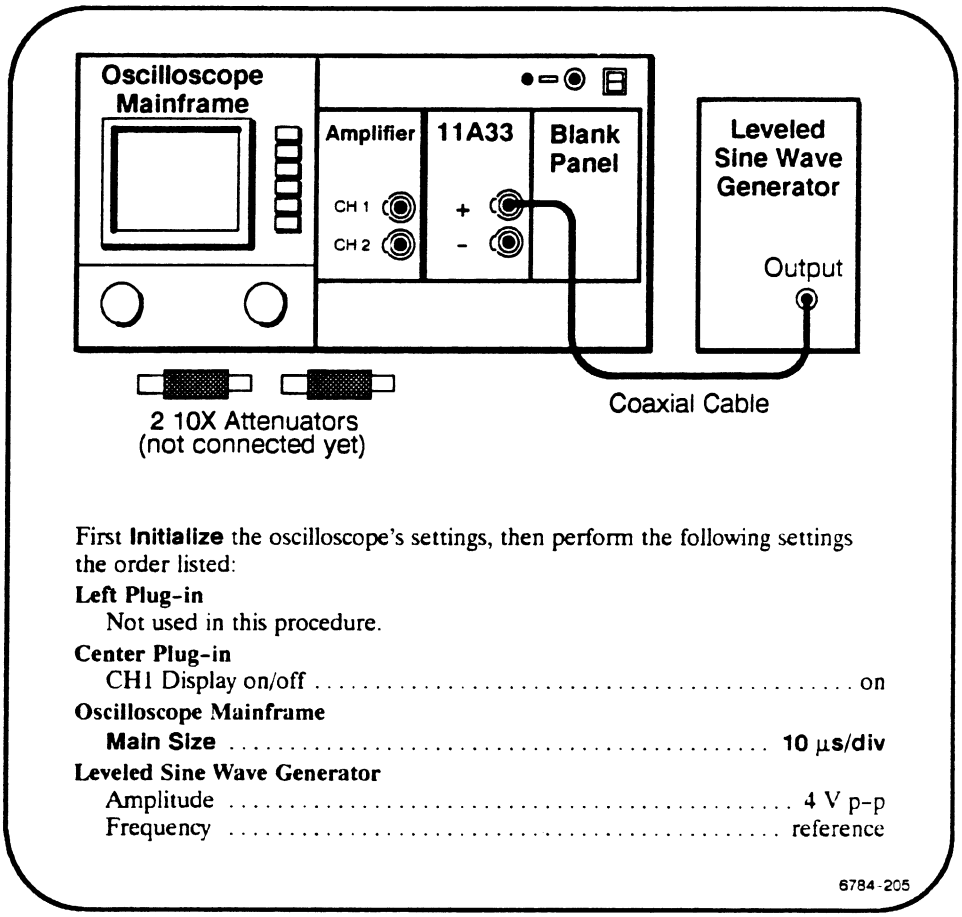
d. Set the Leveled Sine Wave Generator frequency to each Test Frequency in column (1) of Table 2-3, and record the displayed amplitude in the Displayed Amplitude column (2) on a copy of Table 2-3. This data is used in the Check Plug-in Bandwidth procedure for calculating the plug-in bandwidth.

e. Set the mainframe ON/STANDBY switch to STANDBY.

f. Remove the Signal Standardizer from the Center plug-in compartment. Remove the 11A33 from the Left plug-in compartment and reinstall it in the Center plug-in compartment.

Check Plug-in Bandwidth

Setup



First **Initialize** the oscilloscope's settings, then perform the following settings the order listed:

Left Plug-in
Not used in this procedure.

Center Plug-in
CH1 Display on/off ..... on

Oscilloscope Mainframe
Main Size ..... **10 µs/div**

Leveled Sine Wave Generator
Amplitude ..... 4 V p-p
Frequency ..... reference

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

Procedure

Perform this procedure for each Vertical Size and input listed in column (3) of Table 2-3.

To measure the amplitude, either count the divisions, use the ΔV cursors, or use the peak-to-peak measurement function with averaging (for the 11401 or 11402 only).

a. Set the Leveled Sine Wave Generator amplitude as shown in the Reference Amplitude column (4).

b. Set the Leveled Sine Wave Generator frequency as shown in the Frequency column (1).

c. Record the Displayed Amplitude in column (5).

d. *CHECK*—that the plug-in amplitude, computed by dividing column (5) by column (2), is at least the value shown in column (6).

DO NOT attempt to attempt to adjust HF ADJ if it is within the stated limits. Proceed to step f.

e. ADJUST—R1233 HF ADJ. You should set it enough counterclockwise to provide adequate bandwidth at all check points. Setting the adjustment any farther counterclockwise only increases display noise and provides no useful increase in bandwidth.

f. Set the Leveled Sine Wave Generator to the reference frequency.

TABLE 2-3
11A33 Bandwidth

(1)	(2) Mainframe with Standardizer	(3)	(4) Mainframe with Plug-in	(5)	(6) Plug-in only
Test Frequency MHz	**Displayed Amplitude: div**	**Vertical Size**	**Reference Amplitude: div**	**Displayed Amplitude: div**	**Calculated Amplitude: col (5) ÷ col (2)**
		+ Input			
150	____	1 V/div	4	____	____ ≥0.567
150	____	500 mV/div	6	____	____ ≥0.850
150	____	50 mV/div	6	____	____ ≥0.850
150	____	20 mV/div	6	____	____ ≥0.850
150	____	10 mV/div	6	____	____ ≥0.850
150	____	5 mV/div	6	____	____ ≥0.850
150	____	2 mV/div	6	____	____ ≥0.850
120	____	1 mV/div	6	____	____ ≥0.850
		- Input			
150	____	1 V/div	4	____	____ ≥0.567
150	____	500 mV/div	6	____	____ ≥0.850
150	____	50 mV/div	6	____	____ ≥0.850

Part 4—Check Enhanced Accuracy

Description

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

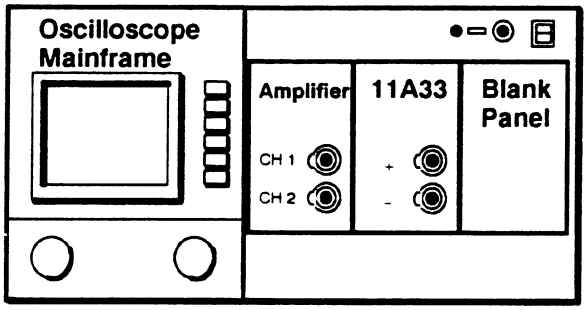
For more information about the Enhanced Accuracy state, refer to Enhanced Measurement Accuracy Indicator in the mainframe User's Reference manual.

While Enhanced Accuracy is in effect, to verify the DC measurement accuracy of the plug-in and mainframe system, apply and monitor test voltages, and compare these test voltages with the measurements made on the screen.

Specifications

When invoked, the self-calibration activity executes successfully.

Setup



Initialize the oscilloscope's settings.

Left Plug-in
Not used in this procedure.

Center Plug-in
No setting changes.

Oscilloscope Mainframe
No setting changes.

6784-207

Procedure

a. Twenty minutes after power up, the instrument must recalibrate itself to achieve the Enhanced Accuracy state. Press the ENHANCED ACCURACY button. Another prompt then appears on the display. Press the ENHANCED ACCURACY button again. Self-calibration takes a couple of minutes.

CAUTION

Turning the instrument power off during self-calibration may result in losing some of the non-volatile RAM data. This could cause diagnostic errors at the next power-up and affect normal instrument operation in unpredictable ways. If this occurs, refer to Restoring Calibration Data in Section 3.

b. *CHECK*—for the message, "**Calibration in Progress**" or "**Enhanced Accuracy in Progress**", indicating that the instrument began self-calibration.

c. *CHECK*—for the message, "**Calibration completed and passed**" or "**Self calibration completed successfully**", indicating successful self-calibration. The **EA** indicator appears on the display when calibration is finished.

Part 5—Check DC Balance

Description

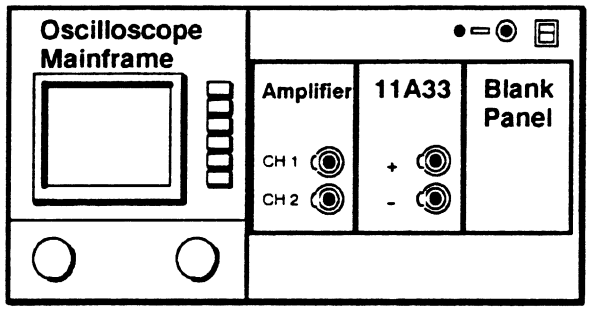
The position of the displayed trace with no input signal applied is examined.

The purpose of this procedure is to confirm that dc balance can be accomplished accurately. This procedure does not test for drift over time or temperature. Therefore, the specifications are more precise than the specifications in the User's Reference manual and this procedure must be performed immediately after Enhanced Accuracy calibration.

Specifications

Refer to Table 2-4.

Setup



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

Left Plug-in
Not used in this procedure.

Center Plug-in
CH 1 Display on/off ..... on

Oscilloscope Mainframe
Vert Size ..... **10 V/div**
BW Limit or **HF Limit** ..... **20 MHz**
Impedance ..... **50 Ω**

6784-207

Procedure

CHECK—that the displayed trace position is at the center graticule line, within the limits listed in Table 2-4 for each Vertical Size setting.

If you are using the 11301 or 11302 mainframe, then use **Vertical Cursors** to help measure the trace position.

If you are using the 11401 or 11402 mainframe, then set **Average N** to **ON** and use **Mean (whole zone)** in the MEASURE menu to help measure the trace position.

TABLE 2-4
11A33 DC Balance

Vertical Size	11401/11402 Position		11301/11302 Position (± div)
	(± div)	(± mV)	
10 V/div	0.063	630	0.093
5 V/div	0.065	330	0.095
2 V/div	0.073	146	0.103
1 V/div	0.085	85	0.115
0.5 V/div	0.065	33	0.095
0.2 V/div	0.073	14.6	0.103
0.1 V/div	0.085	8.5	0.115
50 mV/div	0.065	3.3	0.095
20 mV/div	0.073	1.46	0.103
10 mV/div	0.085	0.85	0.115
5 mV/div	0.110	0.55	0.140
2 mV/div	0.185	0.37	0.215
1 mV/div	0.310	0.31	0.340

Part 6a – Check ΔV DC Accuracy: 11401/11402 Mainframe Procedure

Description

The system ΔV DC Accuracy is checked using a precision Digital Multimeter and a Power Supply. The system must be in Enhanced Accuracy mode during this procedure.

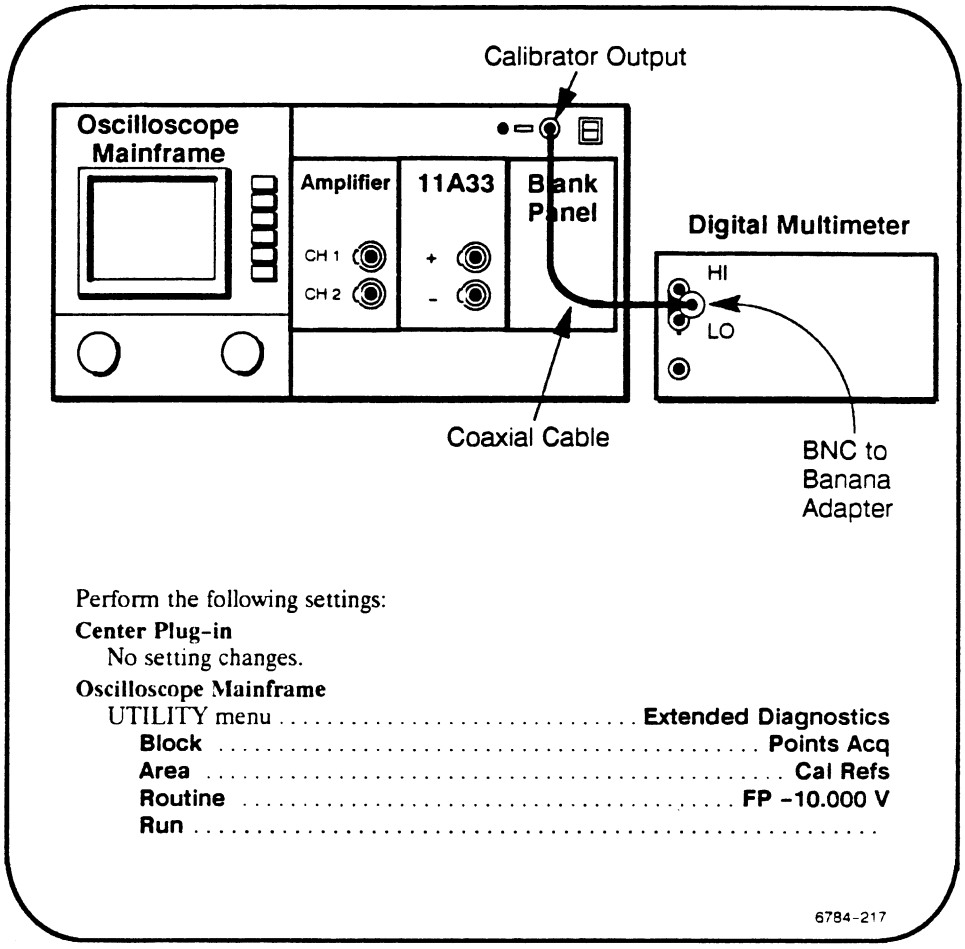
The purpose of this procedure is to confirm that the plug-in can be accurately calibrated. This procedure does not test for mainframe calibration voltage reference accuracy or long term stability. Therefore, the mainframe is characterized and tests must be performed immediately after an Enhanced Accuracy calibration. Also, the plug-in specifications are more stringent than those in the User's Reference Manual.

Specifications

ΔV DC Accuracy within ±0.63%.

Characterize 11401/11402 Mainframe

Setup



Perform the following settings:

Center Plug-in

No setting changes.

Oscilloscope Mainframe

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

6784-217

Procedure

a. Record the DMM absolute value.

b. Press **Exit.**

c. Press **FP + 9.9951 V.**

d. Press **Run.**

e. Record the DMM reading.

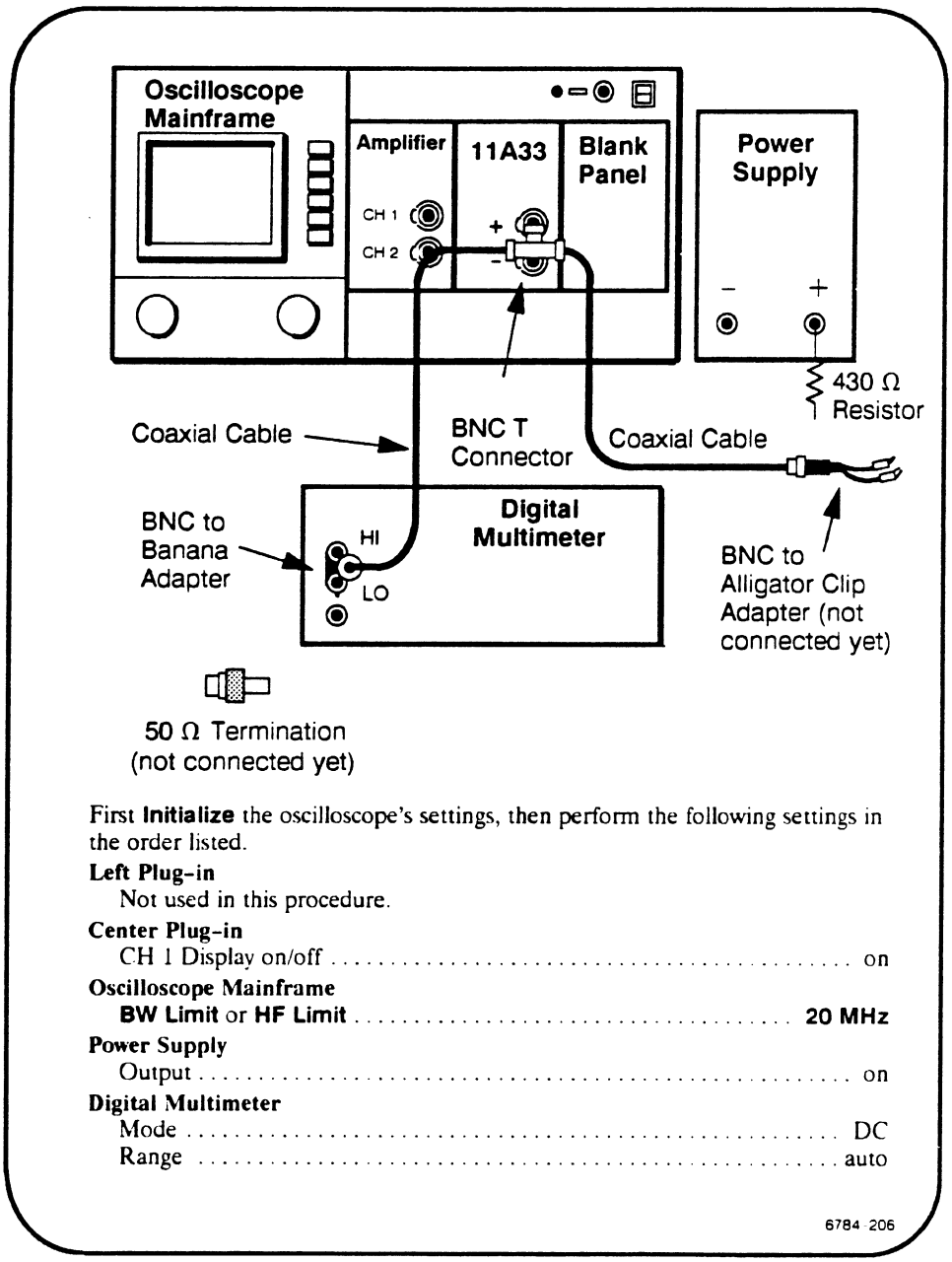
f. Press **Exit.**

g. Press **Exit Diagnostics.**

h. Add the absolute value of the DMM readings obtained in steps a and e. Divide the result by 19.9951 V to obtain the mainframe's calibration voltage reference characterization factor (which is used in the Test Plug-in procedure).

Test Plug-in

Setup



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

Left Plug-in
Not used in this procedure.

Center Plug-in
CH 1 Display on/off ..... on

Oscilloscope Mainframe
BW Limit or **HF Limit** ..... **20 MHz**

Power Supply
Output ..... on

Digital Multimeter
Mode ..... DC
Range ..... auto

6784-206

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

Procedure

Press the Enhanced Accuracy button twice. Immediately after self-calibration has completed and passed, perform this procedure.

It is helpful if you use a pocket calculator to do the calculations required for evaluating the data in this part. If your Digital Multimeter is equipped with a comparison or relative reference feature, use this feature for the readings and calculations required in steps b and d.

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

a. Set **Average N** to **ON** select **Mean (whole zone)** in the MEASURE menu, and set **Compare** to **ON**.

b. Connect the alligator clips to the Power Supply and set the voltage so that the trace is within ±0.2 divisions of the first graticule line above the bottom of the screen. Read the Digital Multimeter and record the absolute value (that is, ignore the polarity).

c. Select **Save Current Meas Value as References** in the Compare and Reference popup menu of the MEASURE menu.

d. Connect the alligator clips to the Power Supply and set the voltage so that the trace is within ±0.2 divisions of the first graticule line below the top of the screen. Read the Multimeter and add the absolute value (that is, ignore the polarity) to the reading obtained in step b.

e. Read the ΔMean value in the MEASURE menu.

f. Divide the sum obtained in step d by the Δ readout obtained in step e. Then, divide this result by the mainframe characterization factor (obtained in step h of the Characterize 11401/11402 Mainframe procedure).

g. ***CHECK*** – that the result obtained in step f is ≥0.9937 but ≤1.0063.

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

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

Part 6b – Check ΔV DC Accuracy: 11301/11302 Mainframe Procedure

Description

The system ΔV DC Accuracy is checked using a precision Digital Multimeter and a Power Supply. The system must be in Enhanced Accuracy mode during this procedure.

The purpose of this procedure is to confirm that the plug-in can be accurately calibrated. This procedure does not test for mainframe calibration voltage reference accuracy or long term stability. Therefore, the mainframe is characterized and tests must be performed immediately after an Enhanced Accuracy calibration. Also, the plug-in specifications are more stringent than those in the User's Reference Manual.

Specifications

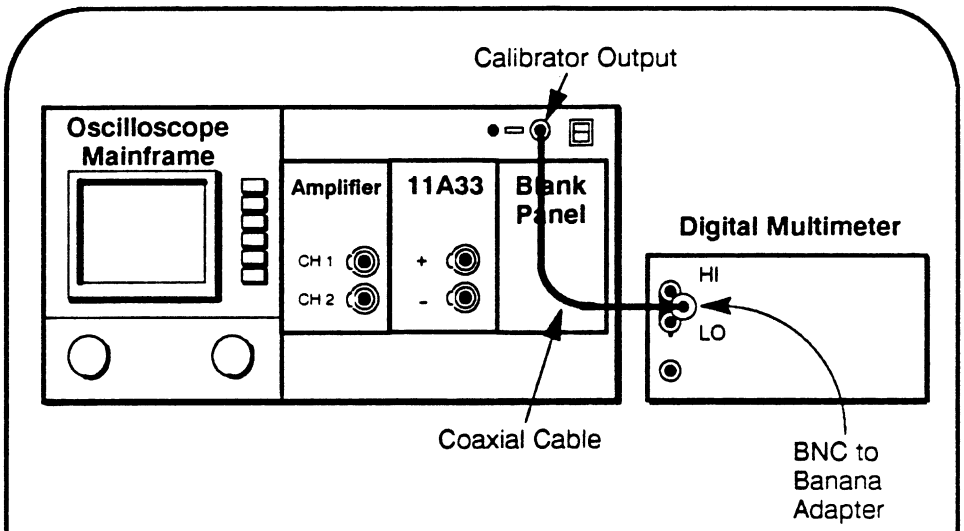
ΔV DC Accuracy within ±1.2%.

Characterize 11301/11302 Mainframe

NOTE

After entering Extended Test, verify that your mainframe's firmware is Version V2.4 or higher. If your mainframe's firmware version is lower than V2.4, then you cannot perform this procedure.

Setup



Perform the following settings:

Center Plug-in

No setting changes.

Oscilloscope Mainframe

UTILITY menu ..... **Ext Test**
Block ..... **Front Panel**
Area ..... **FP Calibrator**
Routine ..... **-9.9988 V**
Loop ..... **cnt ( )**
Run .....

6784-217

Procedure

a. Record the DMM reading.

b. Select **Exit.**

c. Select **Routine** and set to **+9.9939V.**

d. Select **Run.**

e. Record the DMM reading.

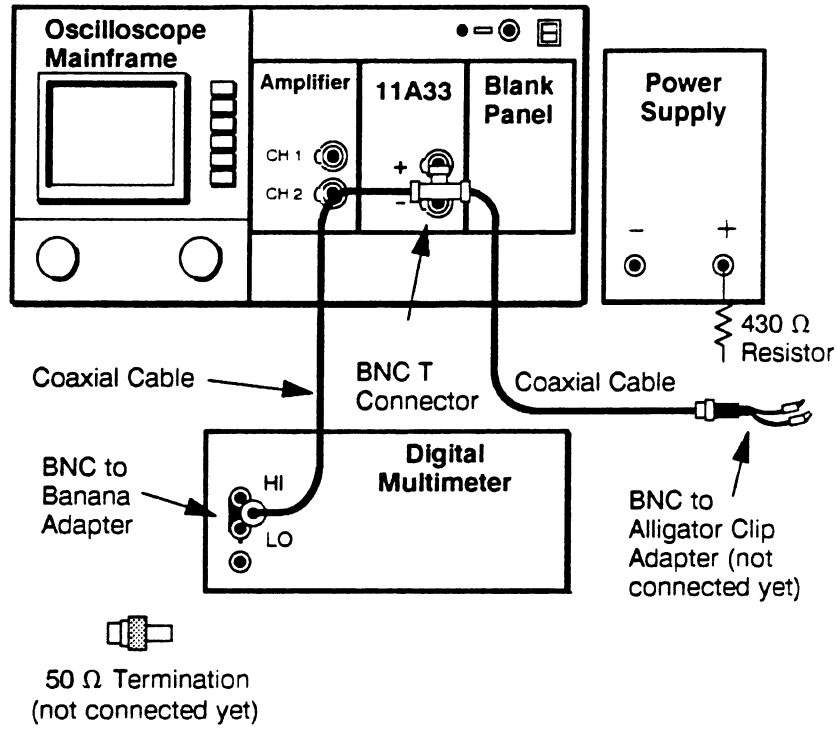
f. Select **Exit.**

g. Select **Exit Diagnostic.**

h. Add the absolute values of the DMM readings obtained in steps a and e. Divide the result by 19.9927 to obtain the mainframe's calibration voltage reference characterization factor (which is used in the Test Plug-in procedure).

Test Plug-in

Setup



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

Left Plug-in
Not used in this procedure.

Center Plug-in
CH 1 Display on/off ..... on

Oscilloscope Mainframe
BW Limit or **HF Limit** ..... **20 MHz**
Vert Size ..... **10 V/div**

Power Supply
Output ..... on

Digital Multimeter
Mode ..... DC
Range ..... auto

6784-206

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

Procedure

Press the Enhanced Accuracy button twice. Immediately after self-calibration has completed and passed, perform this procedure.

It is helpful if you use a pocket calculator to do the calculations required for evaluating the data in this part. If your Digital Multimeter is equipped with a comparison or relative reference feature, use this feature for the readings and calculation required in steps b and d.

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

a. Select **Vertical Cursors.**

b. Connect the alligator clips to the Power Supply and set the voltage so that the trace is within ±0.2 divisions of the first graticule line above the bottom of the screen. Read the Digital Multimeter and record the absolute value (that is, ignore the polarity).

c. Set the Vert Ref cursor on the trace, using the left function control knob with FINE resolution.

d. Connect the alligator clips to the Power Supply and set the voltage so that the trace is within ±0.2 divisions of the first graticule line below the top of the screen. Read the Multimeter and add the absolute value to the reading obtained in step b.

e. Set the ΔVert cursor on the trace using the right function control knob with FINE resolution. Read the ΔVert readout.

f. Divide the sum obtained in step d by the Δ readout obtained in step e. Then divide this result by the mainframe characterization factor obtained in step h of the Characterize 11301/11302 Mainframe procedure.

g. ***CHECK*** – that the result obtained in step f is ≥0.988 but ≤1.012.

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

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

Part 7—Check DC Offset Accuracy

Description

The system DC Offset is checked using a precision Digital Multimeter and a Power Supply.

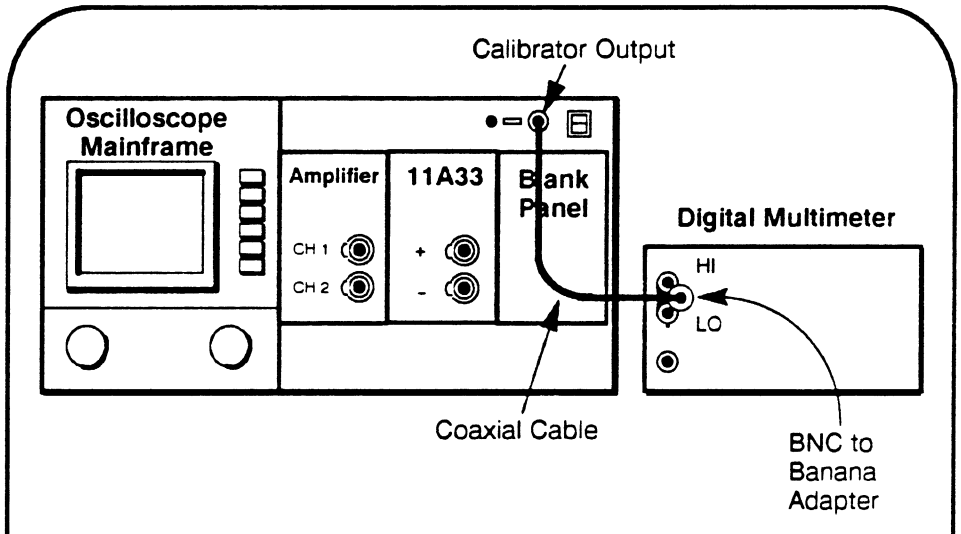
The purpose of this procedure is to confirm that the plug-in can be accurately calibrated. This procedure does not test for mainframe calibration voltage reference accuracy or long term stability. Therefore, the mainframe is characterized and tests must be performed immediately after an Enhanced Accuracy calibration. Also, the plug-in specifications are more stringent than those in the User's Reference Manual.

Specifications

Refer to Table 2-5.

Characterize 11401/11402 Mainframe

Setup



Perform the following settings:

Center Plug-in

No setting changes.

Oscilloscope Mainframe

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

6784-217

Procedure

a. Record the DMM absolute value.

b. Press **Exit**.

c. Press **FP + 9.9951 V**.

d. Press **Run**.

e. Record the DMM reading.

f. Press **Exit**.

g. Press **Exit Diagnostics**.

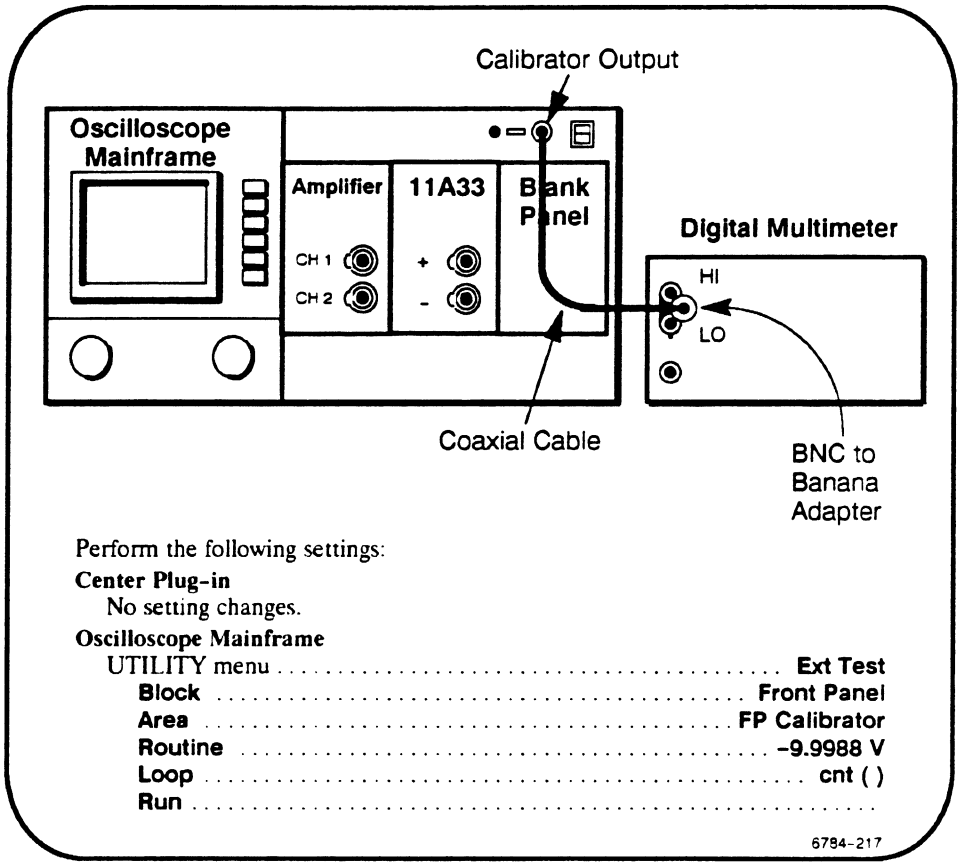
h. Add the absolute value of the DMM readings obtained in steps a and e. Divide the result by 19.9951 V to obtain the mainframe's calibration voltage reference characterization factor (which is used in the Test Plug-in procedure).

Characterize 11301/11302 Mainframe

NOTE

After entering Extended Test, verify that your mainframe's firmware is Version V2.4 or higher. If your mainframe's firmware version is lower than V2.4, then you cannot perform this procedure.

Setup



Perform the following settings:

Center Plug-in

No setting changes.

Oscilloscope Mainframe

UTILITY menu ..... **Ext Test**
Block ..... **Front Panel**
Area ..... **FP Calibrator**
Routine ..... **-9.9988 V**
Loop ..... **cnt ( )**
Run .....

6784-217

Procedure

a. Record the DMM reading.

b. Select **Exit.**

c. Select **Routine** and set to **+9.9939V**.

d. Select **Run**.

e. Record the DMM reading.

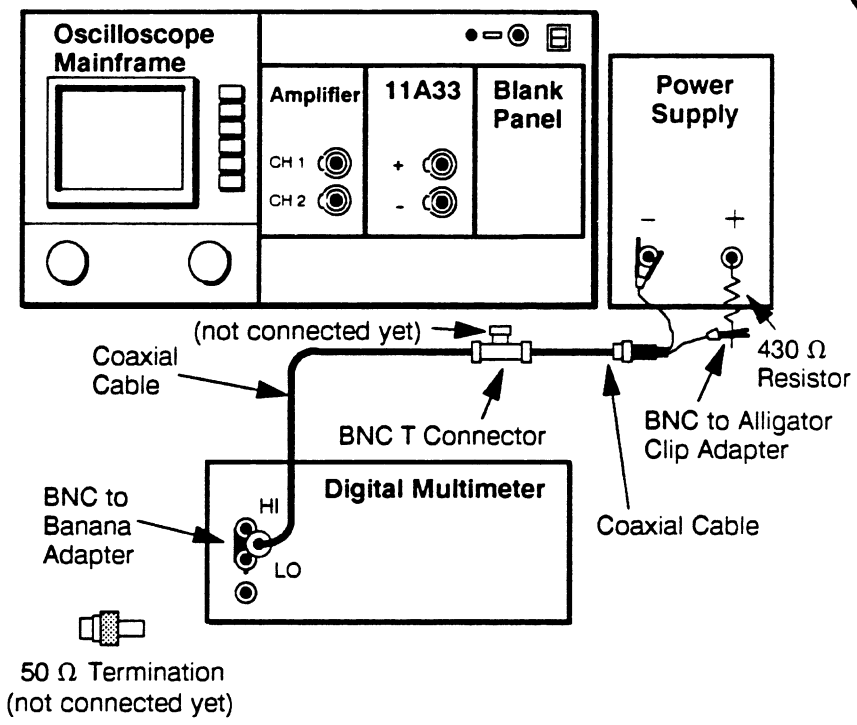
f. Select **Exit**.

g. Select **Exit Diagnostic.**

h. Add the absolute values of the DMM readings obtained in steps a and e. Divide the result by 19.9927 to obtain the mainframe's calibration voltage reference characterization factor (which is used in the Test Plug-in procedure.)

Test Plug-in

Setup



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

Left Plug-in
Not used in this procedure.

Center Plug-in
CH 1 Display on/off ..... on

Oscilloscope Mainframe
BW Limit or **HF Limit** ..... **20 MHz**

Power Supply
Output ..... on

Digital Multimeter
Mode ..... DC
Range ..... auto

6784-208

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

Procedure

Press the Enhanced Accuracy button twice. Immediately after self-calibration has completed and passed, perform this procedure.

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

a. Note the position of the displayed trace (it should be near the center of the graticule).

   If you are using the 11301 or 11302 mainframe, then use **Vertical Cursors** to help measure and set the trace position.

   If you are using the 11401 or 11402 mainframe, then set **Average N** to **ON** and use **Mean (whole zone)** in the MEASURE menu to help measure and set the trace position.

b. Connect the BNC T Connector to the + input connector, with the DMM connected.

c. Set the **Vert Offset** to **40 V**. Set the Power Supply voltage so that the displayed trace returns to the position noted in step a. Divide the DMM reading by the mainframe characterization factor (obtained in the Characterize Mainframe procedure) and subtract the Vertical Offset.

d. *CHECK*—that the result obtained in step c is less than the Error Limit shown in Table 2-5.

e. Disconnect the BNC T connector at the + input connector and set **Vert Offset** to **0**.

f. Repeat steps a through e for each Vertical Size and Offset shown in Table 2-5. When testing with small voltages, it may help to install attenuators in series and a 50 Ω termination in parallel between the BNC to alligator clip adapter and the coaxial cable so that you can set the voltages with better resolution. You can also use a DC Voltage Calibrator to achieve better resolution (when testing with small voltages).

TABLE 2-5
11A33 DC Offset Accuracy

Vertical Size	Vertical Offset	Error Limit (± Volts)
1 V/div	40 V	170 mV
0.1 V/div	10 V	32 mV
1 mV/div	1 V	2.7 mV
1 mV/div	800 mV	2.3 mV
1 mV/div	600 mV	1.9 mV
1 mV/div	400 mV	1.5 mV
1 mV/div	200 mV	1.1 mV

Part 8—Check/Adjust VC Accuracy

Description

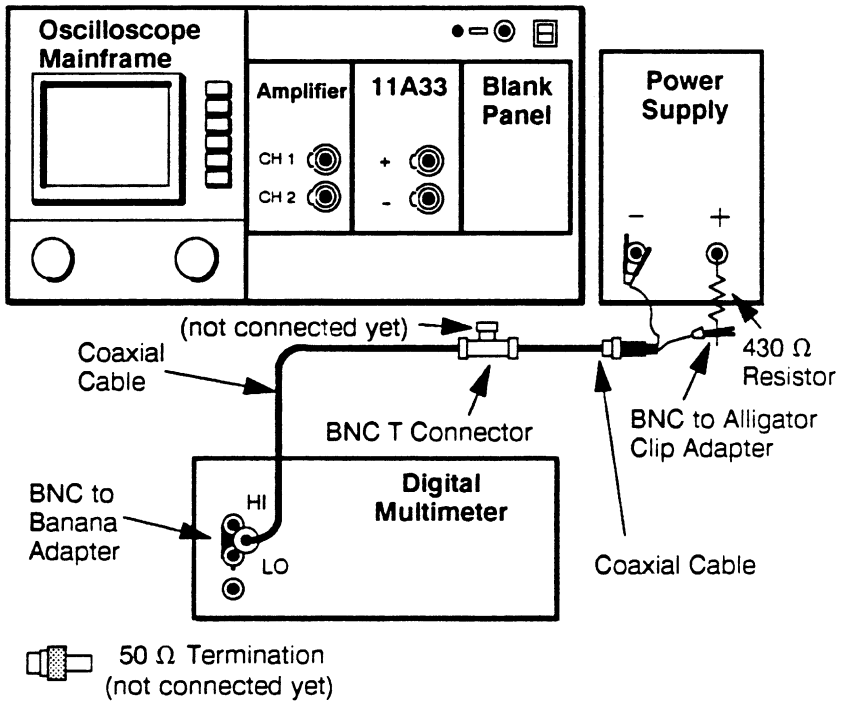
Accuracy of the comparison voltage (VC) is checked using a precision Digital Multimeter and a Power Supply.

The system must be in Enhanced Accuracy mode during this procedure

Specifications

Refer to Table 2-6.

Setup



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

Left Plug-in
Not used in this procedure.

Center Plug-in
CH 1 Display on/off ..... on

Oscilloscope Mainframe
Vert Size ..... **1 mV/div**
Coupling ..... **+DC, -Vc**
BW Limit or **HF Limit** ..... **20 MHz**

Power Supply
Output ..... on

Digital Multimeter
Mode ..... DC
Range ..... auto

6784-214

Procedure

a. Note the position of the displayed trace (it should be near the center of the graticule).

b. Connect the BNC T Connector to the + input connector, with the DMM and the Power Supply connected.

c. Set **Vert Offset** to **8 V**, and set the Power Supply so that the displayed trace returns to its original position.

d. ***CHECK***—that the difference between the Vertical Offset reading and the DMM Reading is less than that shown in Table 2-6.

e. Disconnect the BNC T Connector and set the **Vert Offset** to **0**.

f. Repeat steps a through e for each Vertical Offset shown in Table 2-6. When testing with small voltages, it may help to install attenuators in series and a 50 Ω termination in parallel between the BNC to alligator clip adapter and the coaxial cable so that you can set the voltages with better resolution. You can also use a DC Voltage Calibrator to achieve better resolution (when testing with small voltages).

TABLE 2-6
11A33 VC Accuracy Limits

Vertical Offset	(Vertical Offset - DMM Reading) Limit (± Volts)
8 V	10.0 mV
6 V	7.6 mV
4 V	5.2 mV
2 V	2.8 mV

Continue only if CHECK(s) failed. Otherwise, proceed to Part 9—Check Overdrive Recovery.

g. Set the ON/STANDBY switch to STANDBY.

h. Remove the amplifier from the Left plug-in compartment.

i. Connect the DMM to the VC test point TP1100 and Ground test point on the A1 Main board. Refer to Figure 2-1 for the adjustment and test point locations.

j. Set the ON/STANDBY switch to ON. (Note that the instrument does not need to be in the Enhanced Accuracy mode at this point.)

k. Select Extended Diagnostic/Test in the UTILITY menu.

l. Select the Center plug-in with Area set to Group II, Routine set to VC Low, and then run the diagnostics.

m. Read the DMM. Note this value.

n. Set Routine to VC high and then run the diagnostics.

o. ***ADJUST*** – VC ADJ, R1000 so that the DMM reading is equal to 10.000 V ±0.002 V plus the VC Low reading noted previously.

p. Set Routine to VC Low and then run the diagnostics.

q. Read the DMM. If the reading has changed from the value noted in step m, note this value and go to step n. Continue this loop until the VC Low reading does not change. When the reading does not change from the value noted in step m, exit the Diagnostics/Test and disconnect the DMM.

r. If you are continuing to Part 9, set the ON/STANDBY switch to STANDBY, then reinstall the amplifier in the Left plug-in compartment and set the ON/STANDBY switch to ON.

Part 9—Check Overdrive Recovery

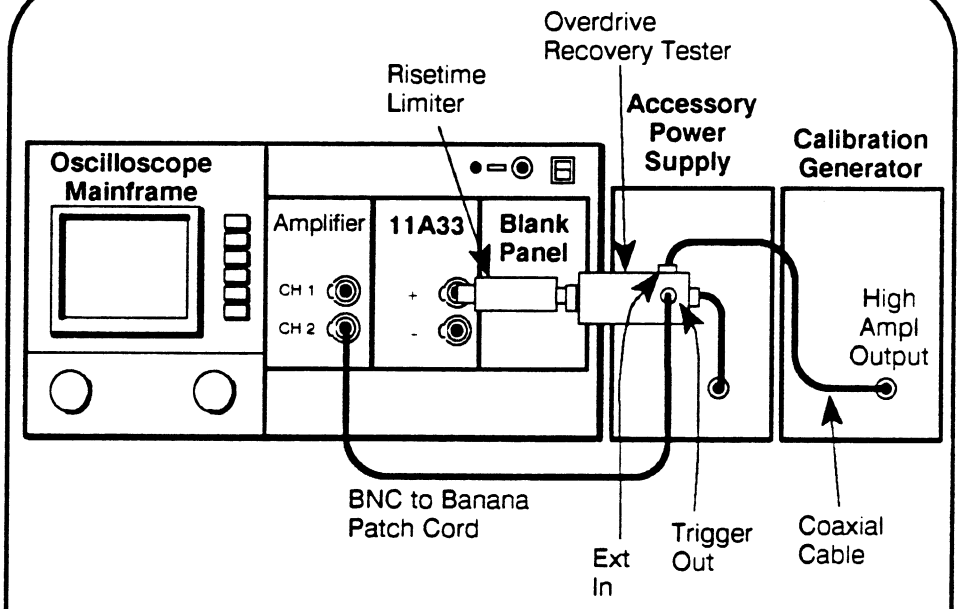
Description

The Overdrive Recovery Tester applies a pulse of 8 V amplitude to the plug-in input. The plug-in's recovery to the 0 V level is observed.

Specifications

Overdrive Recovery within ±20 mV after 40 ns.
Overdrive Recovery within ±2 mV after 100 μs.
Overdrive Recovery within ±1 mV after 300 μs.

Setup



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

Calibration Generator
- Period ..... 10 ms
- Pulse Amplitude ..... 20 V (or the level required to operate the Overdrive Recovery Tester)

Overdrive Recovery Tester
- Level Switch ..... +
- Level Control ..... midrange

Oscilloscope Mainframe
- **Main Size** ..... **10 ns/div**

Left Plug-in
- CH 1 Display on/off ..... on

Oscilloscope Mainframe
- **Vert Size** ..... **100 mV/div**
- **Impedance** ..... **50 Ω**
- Trigger Coupling ..... DC
- Trigger Mode ..... auto
- Trigger Level ..... about +300 mV (adjust for stable display)

Setup

Center Plug-in
CH 1 Display on/off ..... on
Oscilloscope Mainframe
Vert Size ..... **1 V/div**
Vert Offset ..... **+4 V**
Overdrive Recovery Tester
Manual button ..... depressed
Level control ..... +8 V (trace is 4 divisions from center of screen)
Oscilloscope Mainframe
Main Pos ..... position 50% level (+4 V at t=0) to left edge of graticule (refer to Fig. 2-2)
Vert Size ..... **5 mV/div**
Vert Offset ..... **0 mV**

6784-209

Procedure

a. *CHECK*—that the trace is within ±20 mV of the center of the screen after t=40 ns (refer to Fig. 2-3).

b. Set **Vert Size** to **1 mV/div** and **Vert Offset** to **0 mV**.

c. Set **Main Size** to **50 μs/div** and **Main Pos** so that the edge of the 11A33 displayed waveform is set to the left edge of the graticule.

d. *CHECK*—that the trace is within ±2 mV of the center of the screen after 100 μs and within ±1 mV after 300 μs (refer to Fig. 2-4).

e. Repeat the Setup procedure beginning at the third Oscilloscope Mainframe settings and proceeding through steps a, b, c, and d in this procedure for the - input.

f. Change Overdrive Recovery Tester polarity to - and Trigger Slope to - and Trigger level to -300 mV (adjust for stable display). Repeat the Setup procedure beginning at the third Oscilloscope Mainframe settings, with **Vert Offset** initially set to -4 V and -8 V overdrive, and proceeding through steps a through e in this procedure for both the + and - inputs.

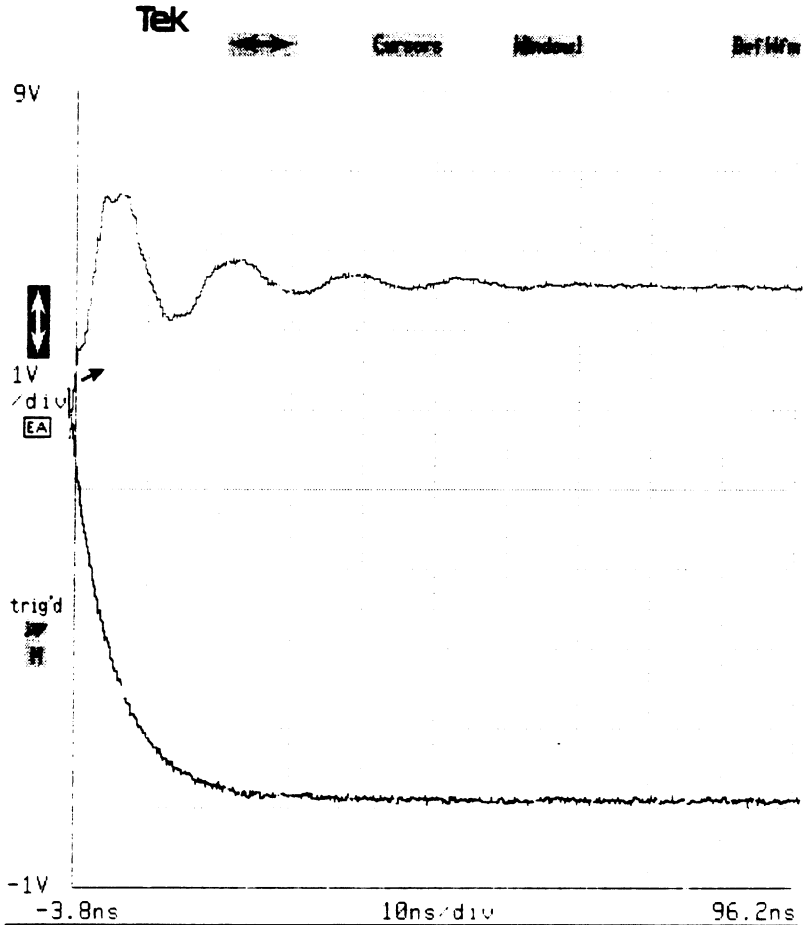


Figure 2-2. Main Pos check at t = 0.

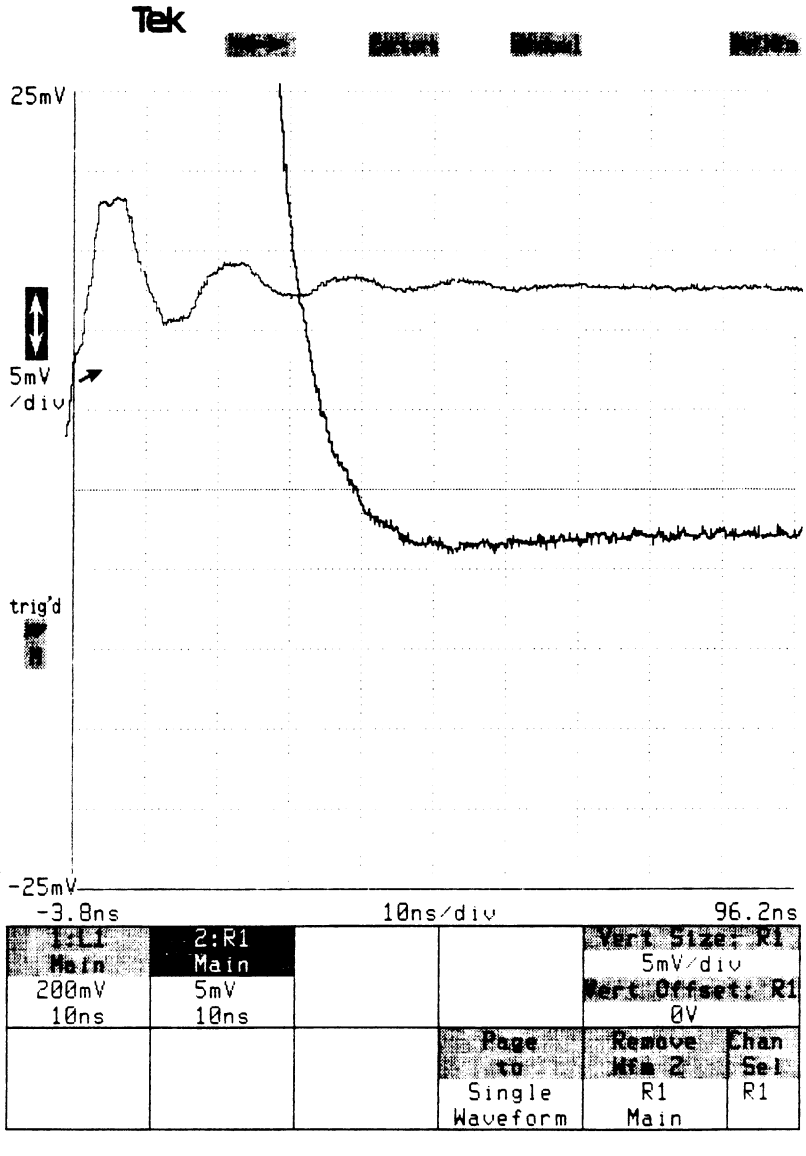


Figure 2–3. Overdrive Recovery measurement at t = 40 ns.

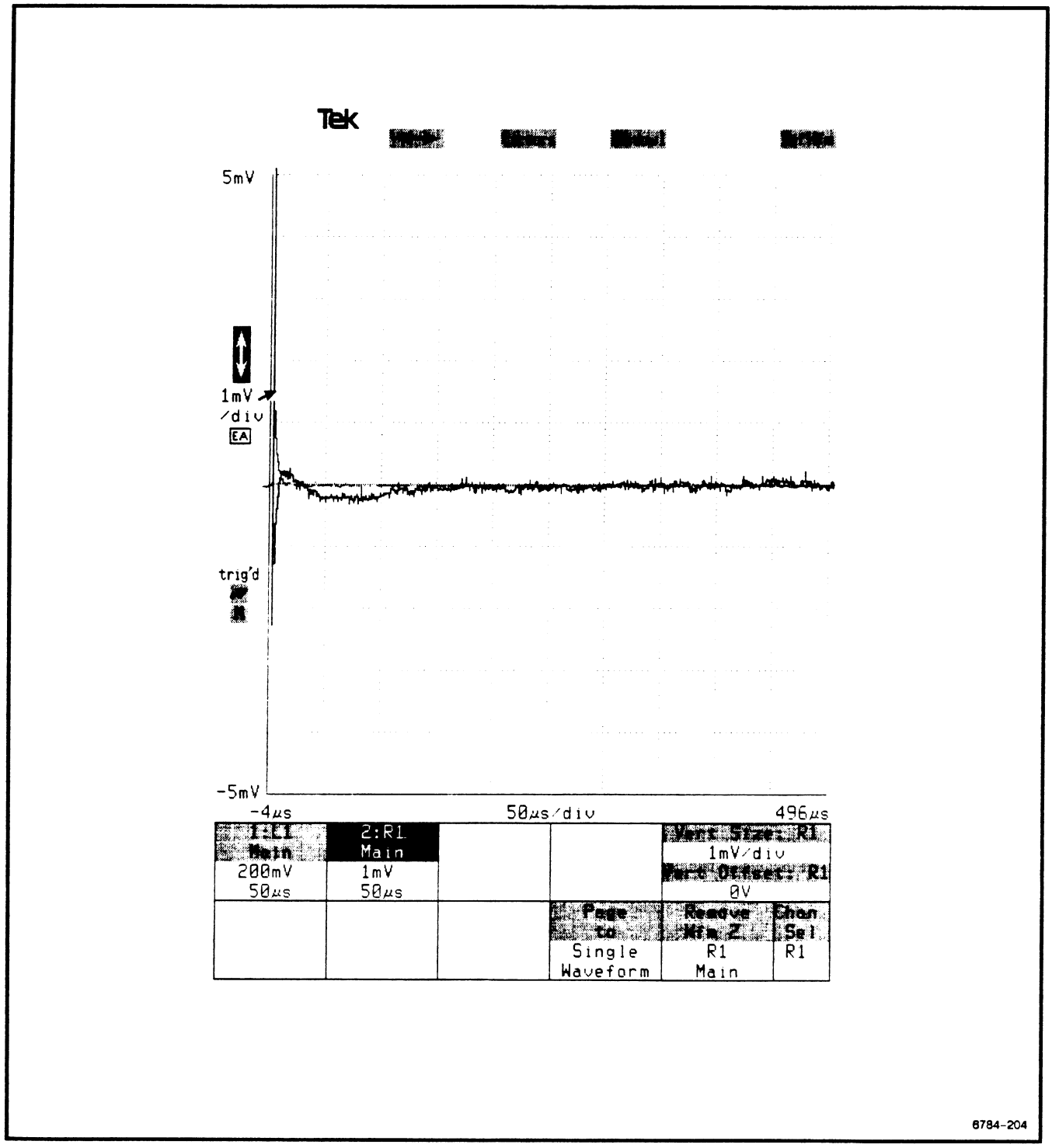


Figure 2-4. Overdrive Recovery measurement at t = 100 μs and 300 μs.

Section 3
Maintenance

This section contains information for performing preventive maintenance, corrective maintenance, testing, and diagnostics. All support-related items mentioned in this section are listed in Table 2-1.

Preventive Maintenance

Preventive maintenance performed regularly can prevent or forestall plug-in breakdown and may improve reliability. The severity of the environment to which the plug-in is subjected determines the frequency of maintenance.

Plug-in Shield Removal

The side shields, top and bottom frames, and front panel reduce radiation of electromagnetic interference (EMI) from the mainframe. The side shields are held in place by grooves in the frames.

To remove a shield, pry it out with your fingers, beginning at the rear of the appropriate side shield. To install a cover, position it over the frame grooves, then press down with your fingers until the cover snaps into place. Pressure must be applied along the full length of the frames to secure the shield.

The plug-in will not slide into the mainframe if the side shields are not fully seated in the frames.

Cleaning

The plug-in should be cleaned as often as operating conditions require. Accumulation of dirt on components acts as an insulating blanket and prevents efficient heat dissipation, which can cause overheating and component breakdown. Dirt also provides an electrical conduction path that can result in plug-in failure.

The cabinet panels of the mainframe, in which the plug-in is installed, reduce the amount of dust reaching the interior of the instrument. Keep the cabinet panels in place for safety and cooling.

CAUTION

Avoid the use of chemical cleaning agents which might damage the materials used in this plug-in. Use only 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 plug-in can be removed with a soft cloth or small brush. The brush is particularly useful for dislodging dirt in and around the side-shield ventilation holes and front-panel switches. Remove the side shields before cleaning them.

Interior

Cleaning the interior of the plug-in should seldom be necessary. The best way to clean the interior is to blow off the accumulated dust with dry, low-velocity air (such as from a vacuum cleaner). Remove any dirt that remains with a soft brush or a cloth dampened with a mild solution of detergent and water. A cotton-tipped swab is useful for cleaning in narrow spaces, or for cleaning more delicate circuit components.

CAUTION

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

Visual Inspection

The plug-in should be inspected occasionally for loosely-seated or heat-damaged components. 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 problems with the plug-in. Therefore, correcting the cause of overheating is important to prevent reoccurence of the damage.

Periodic Electrical Adjustment

To ensure accurate measurements, check the electrical adjustment of this plug-in after each 2,000 hours of operation, or every 24 months if used infrequently. Instructions are given in Section 2, Checks and Adjustments.

Corrective Maintenance

Corrective maintenance consists of module replacement and plug-in repair. Special techniques required to replace modules in the plug-in are given here.

Ordering Parts

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

- Plug-in type
- Plug-in serial number
- Description of the FRU part (if electrical, include circuit number)
- Tektronix part number

Static-Sensitive Device Classification

CAUTION

Static discharge can damage any semiconductor component in this instrument.

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

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 on either a metal surface 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.
4. Allow nothing capable of generating or holding a static charge on your work station surface.
5. Keep the component leads shorted together whenever possible.
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.

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)	1
ECL	2
Schottky signal diodes	3
Schottky TTL	4
High-frequency bipolar transistors	5
JFETs	6
Linear microcircuits	7
Low-power Schottky TTL	8
TTL (least sensitive)	9

[1]Voltage equivalent for levels.

1 = 100 to 500 V
2 = 200 to 500 V
3 = 250 V
4 = 500 V
5 = 400 to 600 V
6 = 600 to 800 V
7 = 400 to 1000 V (est.)
8 = 900 V
9 = 1200 V

(Voltage discharged from a 100 pF capacitor through a resistance of 100 ohms.)

Removing and Replacing FRUs

CAUTION

To avoid instrument damage, set the mainframe ON/STANDBY switch to STANDBY and remove the plug-in from the mainframe before removing or replacing FRUs.

To determine the location of a FRU, refer to Figure 3-1.

The side shields will have to be removed to gain access to the circuit boards and other FRUs. Refer to Plug-In Shield Removal at the beginning of this section.

The exploded-view drawing associated with the Replaceable Parts List may be helpful in the disassembly procedures that follow. This drawing is located in Section 5, at the end of this manual.

CAUTION

If the green indicator light remains lit when the STANDBY position is selected, then the switch has been left internally disabled after the servicing of the power supply. To enable the ON/STANDBY switch, refer to the Maintenance section of the mainframe Service Manual.

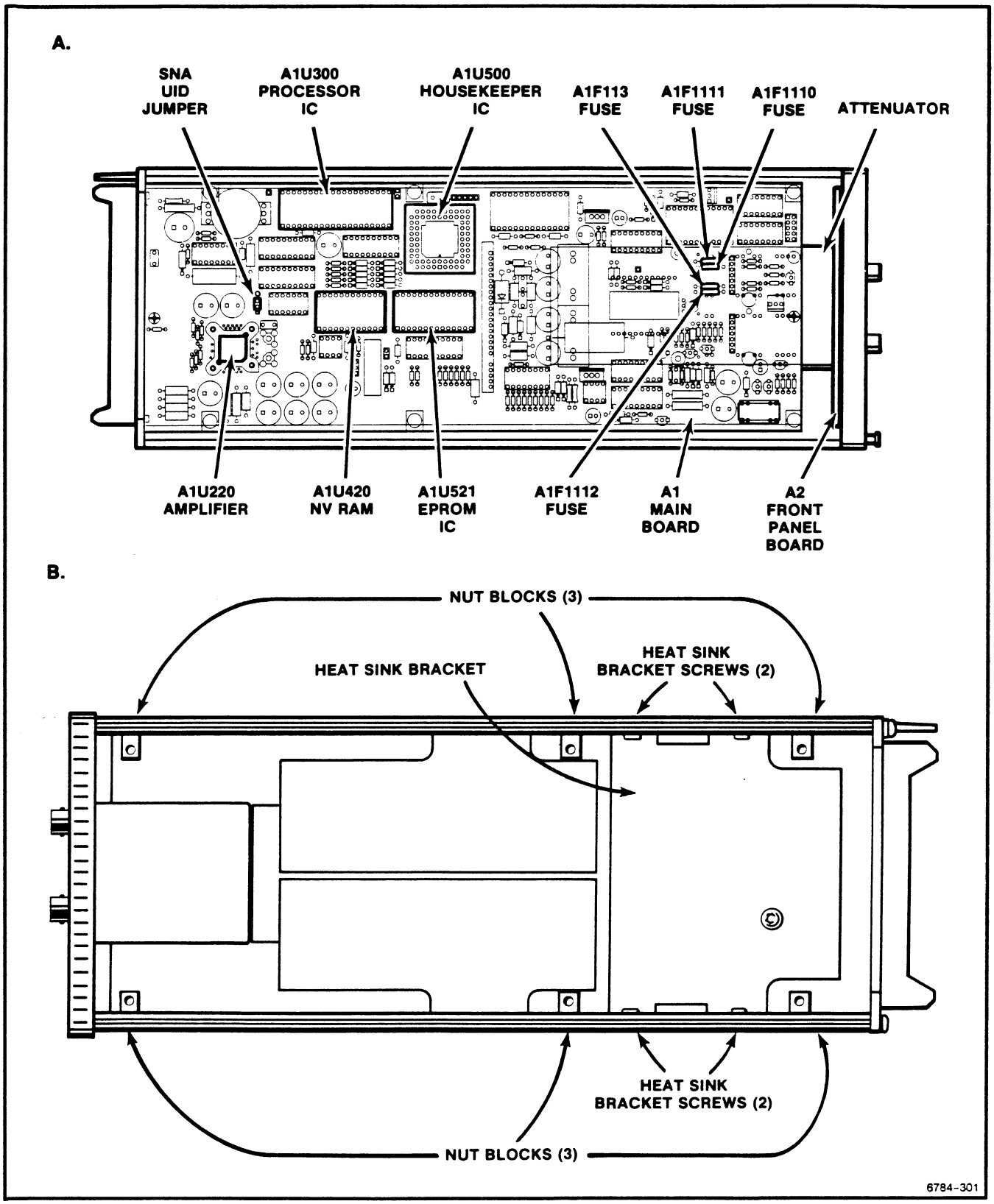


Figure 3-1. Field Replaceable Units (FRU) locater and A1 Main board securing hardware.

Semiconductor FRU Removal

CAUTION

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

Dual In-Line Package Integrated Circuits (DIP ICs)

Remove and install the Processor IC, EPROM IC, and the RAM IC by using the following instructions.

If the RAM IC is soldered into the board, then consult a Tektronix Service Center for recommended removal procedures. Do not solder the replacement RAM IC. Instead, install a 24-pin socket, and plug the RAM IC into the socket.

How To Remove the DIP ICs

1. Use insertion-extraction pliers (such as the General Tool's Insertion-Extraction Pliers, Part Number U505-Series). An illustration of these pliers is shown in Figure 3-2.
2. Position the pliers around the outside of the IC body. Squeeze the handles to grasp the IC and slowly pull it from the socket.

CAUTION

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

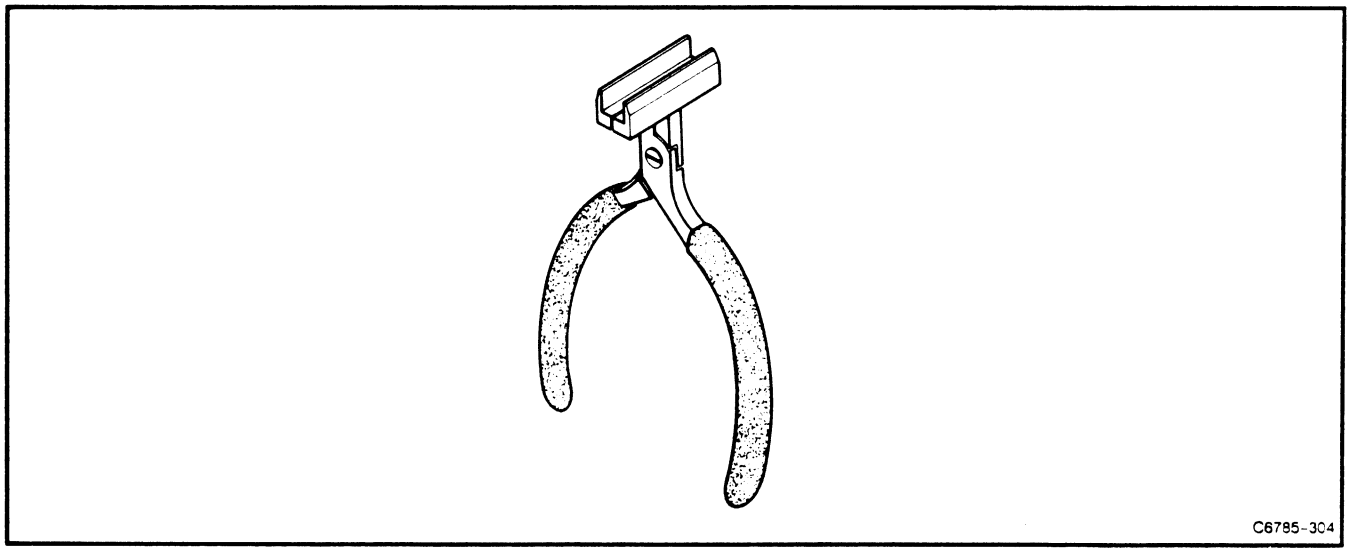


Figure 3-2. IC insertion-extraction Pliers.

How To Replace the DIP ICs

1. Grasp the replacement IC with the insertion-extraction pliers. Check that all of its pins are straight and evenly spaced. Do not use the IC label as an index. Look for the index at the end of the IC body.

2. Align the index slot on the IC with the corresponding index on its socket. (Refer to Fig. 3-3 for indexing information.)

3. Align the IC pins with their respective socket contacts. Slowly and evenly press the IC into its socket.

Housekeeper Integrated Circuit ("Slam-Pack" IC)

The Housekeeper IC (A1U500) is indexed to its socket by a beveled corner as shown in Figure 3-3. 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 as shown in Figure 3-3.

How to Remove the Housekeeper IC

1. Unfasten the retaining clip by moving it across the tabs. It may help to push down slightly on the cover.
2. Remove the cover slowly to prevent the IC from falling out. Observe the index of the IC before removing it.
3. Remove the IC with tweezers.

CAUTION

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

How to Install the Housekeeper IC

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

CAUTION

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

2. Arrange the other IC 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 the mating recesses in the socket. (The cover is not symmetrical.)
4. Push the cover down, keeping it flat on the IC, and slide it into place. Hold the cover in place while moving the retaining clip over the tabs on the other end.

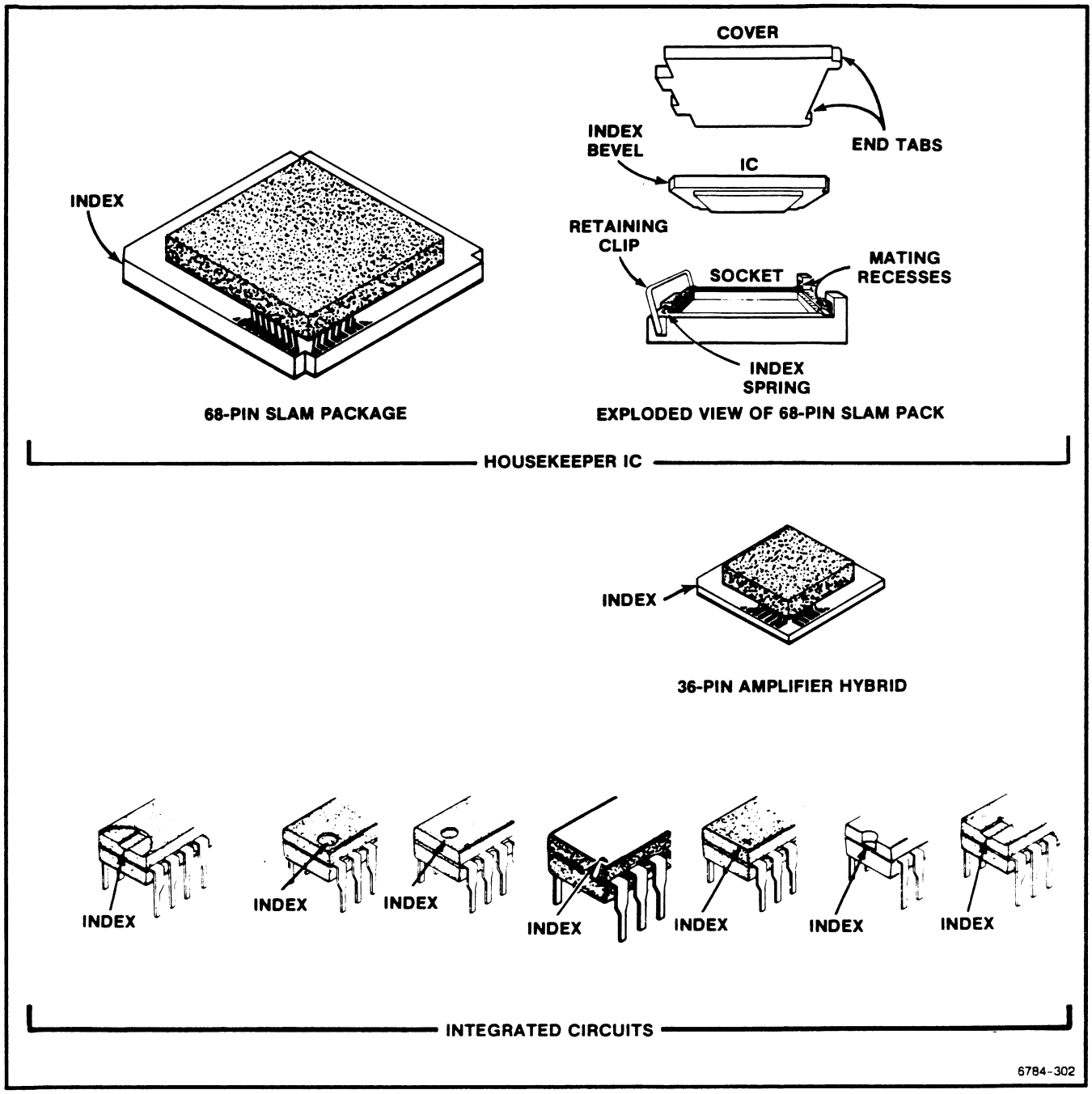


Figure 3-3. Semiconductor indexing diagram.

Amplifier Hybrid

Figure 3-4 shows an exploded view of a Hypcon (Hybrid-printed circuit connector) and gives disassembly and replacement instructions. When replacing the hybrid, do not touch the elastomer's gold-plated contacts with your fingers. Use a cleaner which will not lessen contact reliability. The Hypcon socket contacts are fragile. Use caution when removing and replacing a Hypcon to avoid damaging these contacts.

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

If the hybrid and elastomer contact holders are contaminated, clean them by flushing or spraying with alcohol and oven dry at +50° C. **Do not scrub with a cotton-tipped swab or similar device.** (Cotton fibers may adhere to the contacts.) If the contact holder is excessively contaminated, replace it with a new one.

Tighten the mounting screws with two inch-pounds of torque (2.3 kg-cm) to secure the Hypcon to the circuit board.

Make sure that the elastomer is properly seated in the contact holder before re-mounting the assembly to the circuit board. Use care when mounting the whole assembly to the circuit board to prevent misalignment between the connector and board.

CAUTION

Because of the close tolerances involved, special care must be taken to ensure correct index alignment of each Hypcon part during reassembly. (Fig. 3-4 shows the index locations.) Failure to do so can result in a cracked hybrid substrate.

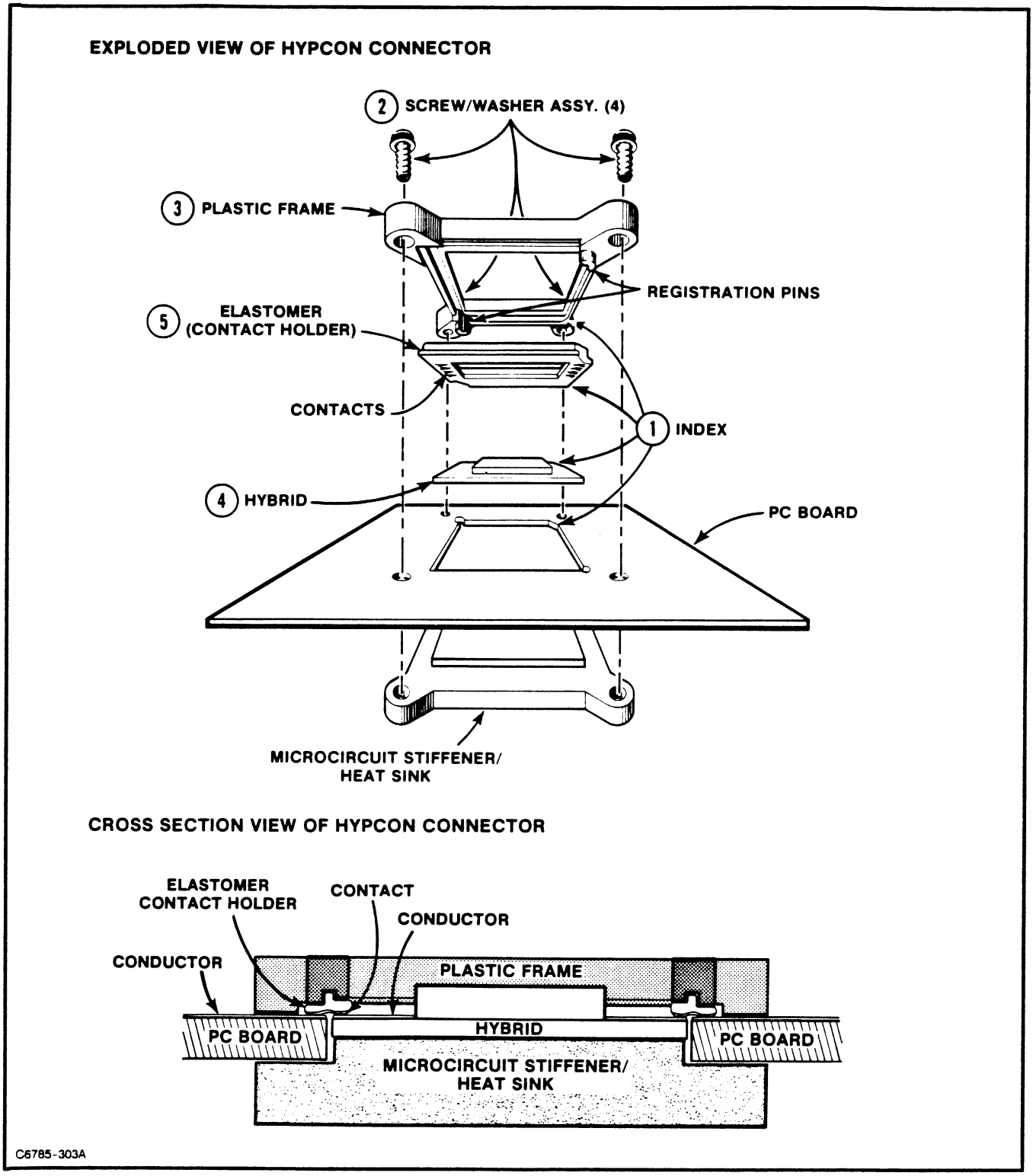


Figure 3–4. Hypcon assembly removal and replacement.

DISASSEMBLY AND REMOVAL

1. Notice the index on the circuit board (arrow) and the plastic frame (pointed tab).
2. Unscrew and remove the four screw/washer assemblies.
3. Lift the plastic frame from the board.
4. Notice the index location of the hybrid and remove the hybrid from the circuit board with the tweezers.

NOTE

Step 5 describes the removal of the elastomer from the plastic frame. This step is not necessary when replacing only the hybrid.

5. Notice the index location of the elastomer contact holder and remove the contact holder from the plastic frame by grasping the corner with the tweezers and then lifting up. Do not touch the gold-plated contacts with your fingers.

REASSEMBLY AND REPLACEMENT

a. Grasp a corner of the elastomer with the tweezers and place it into the plastic frame. Align the keyed corner of the elastomer with the keyed corner of the plastic frame. Tamp the elastomer into the plastic frame uniformly.

NOTE

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

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

c. Place the plastic frame with the elastomer installed over the hybrid such that the key (pointed tab) aligns with the corner arrow on the circuit board.

d. Insert the mounting hardware and apply two inch-pounds of torque (2.3 kg-cm) to secure the connector assembly. Do not overtighten. To do so, strips the microcircuit stiffener/heat sink mounting threads.

C6785-303B

Figure 3-4 (cont). Hypcon assembly removal and replacement.

Circuit Board and Attenuator FRU Removal

How to Remove the Front Panel

1. Unhook the return spring from the release bar and set it aside.
2. Use a Torx T-8 screwdriver to remove the four screws that fasten the front subpanel to the top and bottom frames.
3. Pull the release bar as far out of the instrument as it will come, and leave it in that position.
4. Insert a slender, sharp-pointed tool, such as a scribe, between the front panel and the subpanel at the notch around the release bar. Gently separate the front panel from the subpanel. Use care to prevent bending the front panel.

How to Install the Front Panel

1. Check that the four screws that fasten the front subpanel to the top and bottom frames are removed.
2. Check that the release bar return spring is removed.
3. Set the plug-in on its side with the front panel facing you.
4. Pull the release bar as far out of the instrument as it will come, and leave it in that position.
5. Position the front panel so that the notch in the bottom fits over the release bar rod, then carefully insert the four front-panel tabs into the slots in the front subpanel. (You may need to pull the top and bottom frames away from the subpanel to allow the front-panel tabs to fit between the casting and the frames.)
6. Gently snap the edges of the front panel into place around the input connectors and the outer edges of the panel.
7. Use a Torx T-8 screwdriver to install the four screws that fasten the front subpanel to the top and bottom frames.
8. Install the release bar return spring. Orient the spring so that its loop fits over the frame hook correctly (flat against the frame section).

How to Remove and Install the A2 Front Panel Board

1. Remove the front panel as outlined above in How to Remove the Front Panel.
2. Unplug the connector that provides electrical connection to the A1 Main board.
3. Use a Torx T-6 screwdriver to remove the screws that fasten the A2 Front Panel board to the front subpanel, and remove the A2 Front Panel board.
4. To replace an A2 Front-Panel board, follow the preceding steps in reverse order.

How to Remove the Attenuator

The attenuator is only replaceable as a unit. Components are not replaceable. Do not disassemble any screws not mentioned in this procedure.

1. Remove the front panel as outlined in "How to Remove the Front Panel," and remove the left and right side shields.
2. Loosen the two T-10 Torx screws near the front of the A1 Main board that secure the A1 Main board to the top and bottom frames.
3. Use a T-8 Torx screwdriver to remove the four screws that secure the heatsink brackets to the top and bottom frames (refer to Fig. 3-5).
4. Use a Torx T-10 screwdriver to remove the four screws that secure the heatsink brackets to the attenuator and remove the heatsink bracket.
5. Use a Torx T-8 screwdriver to remove the four screws that secure the attenuator to the A1 Main board from the component side of the A1 Main board.
6. Disconnect the coaxial cables that connect the attenuator to the A1 Main board from the component side of the A1 Main board.
7. Remove connectors J1110 and J1120 from the A1 Main board.
8. Use a Torx T-6 screwdriver to remove the six screws that secure the attenuator to the front subpanel.
9. Lift the rear of the attenuator about a quarter inch from the A1 Main board, then carefully withdraw the attenuator from the plug-in.
10. Remove the MOE strips from the MOE holders.

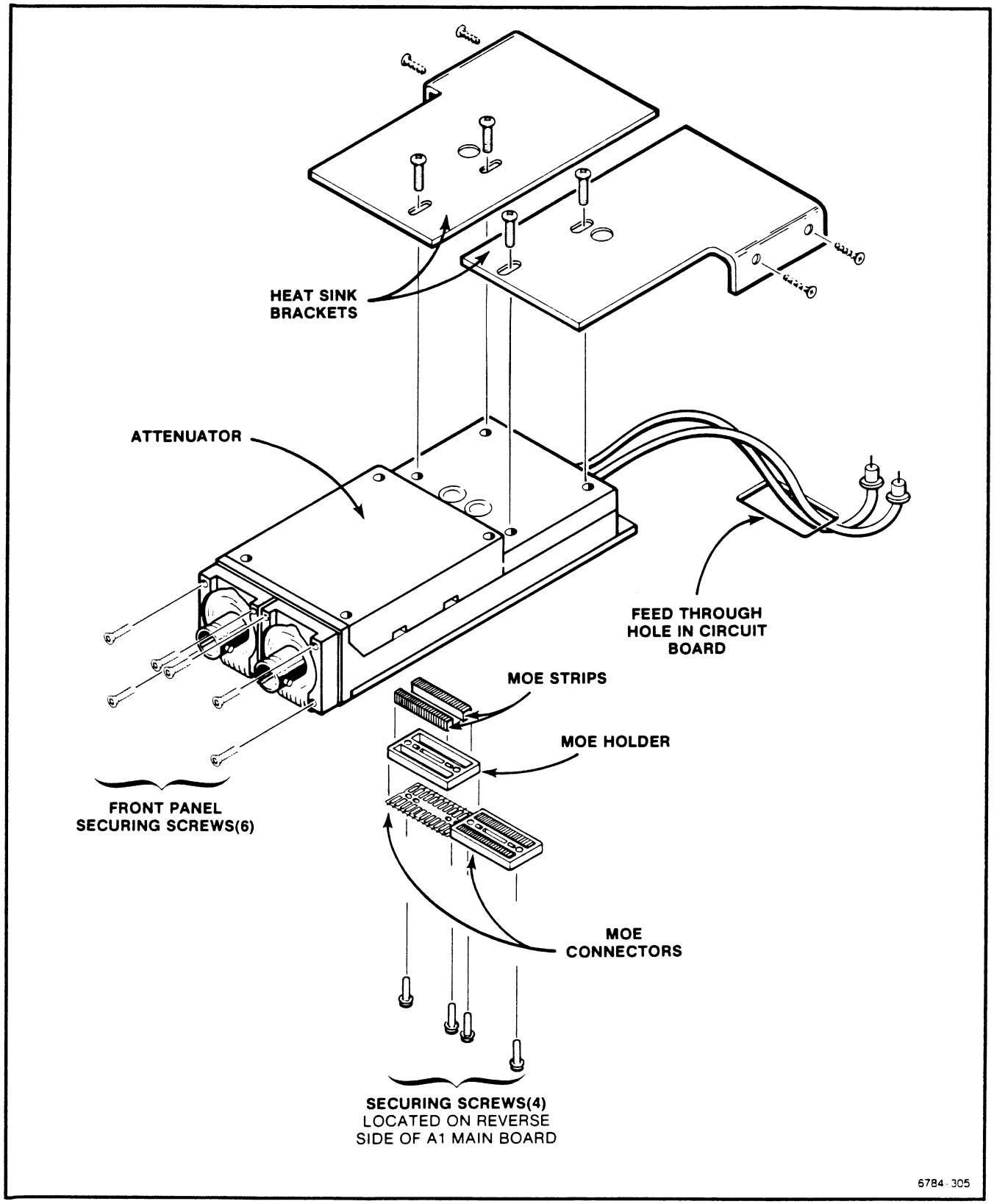


Figure 3-5. Locations of screws and parts for removal of an attenuator.

How to Install the Attenuator

1. Place the MOE strips in the MOE holders.
2. Ensure the plastic bezels are properly positioned, and insert the bnc connectors of the attenuator through the holes in the front subpanel. Feed the attenuator flex cables between the A2 Front Panel circuit board and the A1 Main board.
3. Hold the attenuator against the MOE assemblies and install the four screws that secure the attenuator to the A1 Main board. Do not tighten the screws; fasten just enough to hold the attenuator in place.
4. Install the six screws that secure the attenuator to the front subpanel.
5. Tighten the two screws that secure the A1 Main board to the top and bottom frames near the front of A1 the Main board.
6. Install the front panel.
7. Tighten the screws that hold the attenuator to the A1 Main board.
8. Attach connectors J1110 and J1120 to the A1 Main board.
9. Attach the coaxial cables to the A1 Main board. The cables are captive inside the attenuator assembly. There is approximately 0.1 inch of movement possible. To ensure that the cables are firmly seated in their connectors, grasp each cable close to where it enters the housing. Gently push each cable inward.
10. Install the heatsink brackets.
11. Install the left and right side shields.

How to Remove the A1 Main Board

1. Remove the attenuator as outlined in "How to Remove the Attenuator."
2. Remove the metal-on-elastomer (MOE) strips and holders.
3. Replace the four screws that fasten the top and bottom frames to the front subpanel.
4. Unplug the connector that connects the A1 Main board to the A2 Front Panel board.
5. Use a narrow shank, Torx T-10 screwdriver to remove the six screws and nut blocks that secure the A1 Main board to the top and bottom frames. Figures 3-1 and 3-6 show the nut blocks.
6. Use a Torx T-15 screwdriver to remove the screw that fastens the heat sink bracket to the A1 Main board. Figure 3-1 shows this screw.
7. Use a Torx T-15 screwdriver to remove the four screws that fasten the plastic rear panel to the top and bottom frames.
8. Carefully withdraw the A1 Main board from between the frames.
9. Remove the rear panel from the A1 Main board

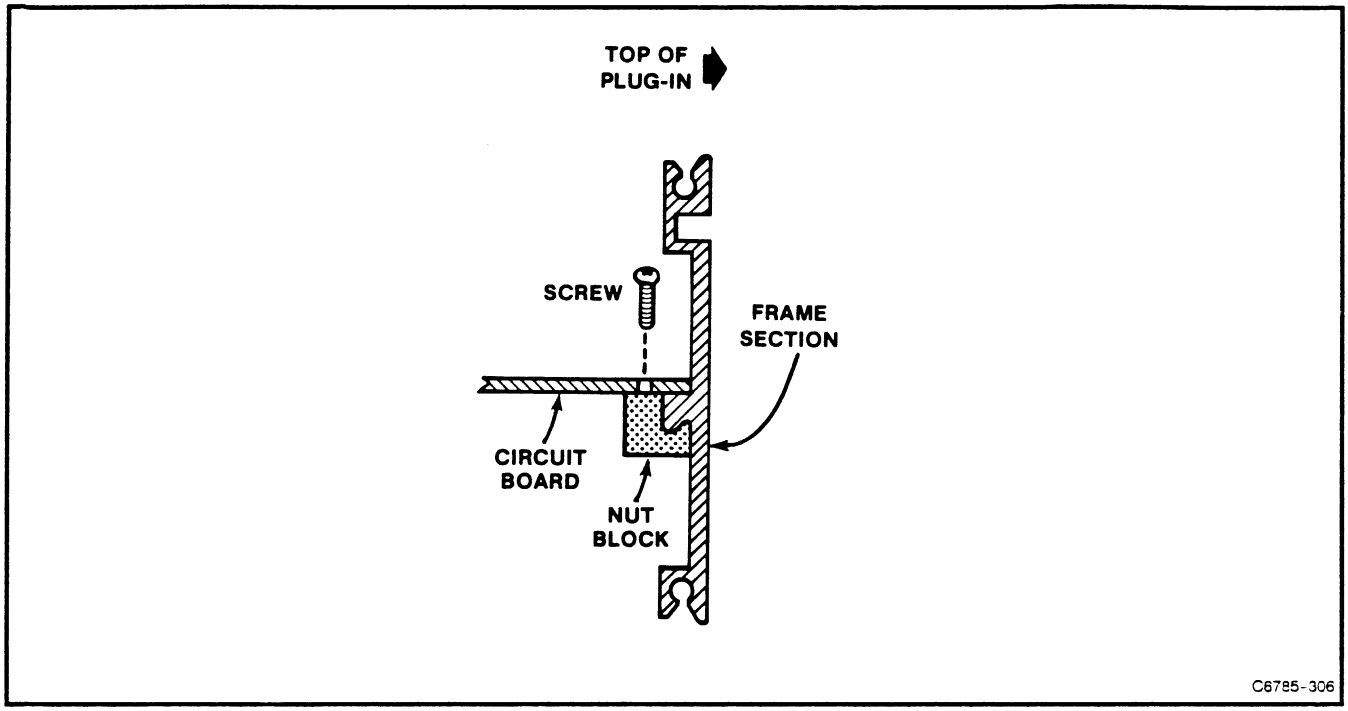


Figure 3-6. Location of a nut block securing the circuit board to the frame section.

How to Install the A1 Main Board

1. Set the plug-in on its side with the pushbuttons up. Reattach the rear panel to the A1 Main board.
2. Carefully insert the A1 Main board between the frames until the plastic rear panel contacts the top and bottom frames. The board fits on the top of the center ridges on the top and bottom frames.
3. Use a Torx T-15 screwdriver to start the four screws that fasten the rear panel to the top and bottom frames.
4. Use a Torx T-15 screwdriver to install the screw that fastens the heat sink bracket to the A1 Main board.
5. Use a narrow-shank Torx T-10 screwdriver to install the six screws and nut blocks hat clamp the A1 Main board to the top and bottom frames.
6. Replace the attenuator. See "How to Install the Attenuator."
7. Connect the cable from the A2 Front-Panel board to the connector on the A1 Main board.
8. Tighten the four screws that you started in step 3.
9. Program the UID as outlined in "Programming the Unit Identification." (Refer to the following instructions.)

Programming the Unit Identification

The Unit Identification (UID) is identical to the instrument's serial number and is stored in NVRAM. It will be necessary to enter this number if the A1 Main board is replaced or if data in NVRAM becomes corrupted.

How to enter the UID:

1. Connect the Terminal to the mainframe's RS-232-C port. (Refer to the mainframe User's Reference Manual for instructions on setting up the RS-232-C parameters.)
2. Move the UID jumper marked SNA on the A1 Main board (shown in Fig. 3-1) to the "S" position (two lower pins).
3. Install the plug-in into any compartment. Turn the power on. Wait until the Diagnostics checks are completed.
4. At the Terminal, type the command:

   UID [Left|Center|Right]:" < Serial Number > "
   - Left|Center|Right refers to the name of the compartment.
5. At the Terminal, type the query:

   UID? [Left|Center|Right]

   Observe that the correct UID is reported.
6. Move the ON/STANDBY switch to STANDBY.
7. Remove the plug-in.
8. Return the jumper on the A1 Main board to the two middle SNA pins.

Cables and Connectors

The gray-colored, multi-pin connector has a contrasting-color line along one side of its attached wire cable. This color line indicates the location of pin 1 in the connector. To remove this connector, grasp its ends and pull the connector away from the circuit board.

To replace the connector, align the colored line on the cable with the square-shaped pad of pin 1 on the circuit board. Reattach the connector to the circuit board pins.

To remove the flex circuit cable, grasp the wires close to where they make contact with the circuit board. Hold the wires between your thumb and first finger and slowly pull them out.

To replace the flex circuit cable, check that the wire contacts are even and straight. Align the contacts with the socket. Push all the contacts into the socket at the same time. Ensure that all the wires are fully inserted into the socket.

Diagnostic Troubleshooting

This section provides the information necessary to troubleshoot a faulty instrument to the Field Replaceable Unit (FRU) level. FRUs are circuit boards, attenuator modules, and integrated circuits or hybrids that are replaceable without soldering. The primary means for troubleshooting is to use the error index code output from the Diagnostics or Self-Tests and cross-reference them to the suspect FRU(s) in the FRU Guide tables. After the faulty FRU is replaced, recalibration of the instrument is normally required.

Diagnostics Overview

The processor runs a set of Kernel Tests prior to the Self-Tests. If this is successful, then the Self-Tests are run to verify the functionality of each of the subsystems. Any failure causes the instrument to enter Extended Diagnostics and to display the error index code(s) in a diagnostic menu. Extended Diagnostics tests are a superset of the Self-Tests.

The Kernel Tests, Self-Tests/Extended Diagnostics, and the Enhanced Accuracy mode produce and format error index codes differently, so they are covered separately.

Some of these tests that may indicate faulty FRUs are not run automatically during the Self-Tests (that is, some errors codes are only generated by manually selecting tests).

The next two subsections provide a quick overview of Kernel Tests and Extended Diagnostics.

For an overview of the Enhanced Accuracy mode refer to Part 4—Check Enhanced Accuracy in section 2, Checks and Adjustments.

Kernel Tests

Each time the front-panel ON/STANDBY switch is set to ON, the mainframe and plug-ins perform Power-Up Diagnostics on their microprocessor subsystems and Self-Test Diagnostics on all of their major circuits.

CAUTION

Turning the instrument power off during the execution of the Diagnostic tests may result in losing some or all of the non-volatile RAM data (such as stored settings, calibration constants, etc.). This could affect normal instrument operation in unpredictable ways. If this occurs, refer to Restoring Calibration Data later in this section.

After the plug-in is powered-up and the MPU has reset, the plug-in begins a sequence of test routines to determine if its kernel systems are operating properly. If any of these tests fail, then it is unlikely that the plug-in can communicate failure information to the mainframe. The flashing of a fault code on the front panel CH 1 LED indicates a particular failure. This fault code indicates which Kernel Test is failing.

The following description explains how to read the fault code:

If the plug-in Kernel Tests detect a fault, then the CH 1 LED is flashed eight times to display a fault code. Each time the CH 1 LED turns on, count the occurrences. If the CH 1 LED is lit twice as long (that is, during one cycle, CH 1 is lit for twice the normal pulse width), then the test corresponding to the current count accumulated is the one which failed. Refer to the timing diagram in Figure 3-7 for an example LED fault code. The timing diagram illustrates a test number 2 failure.

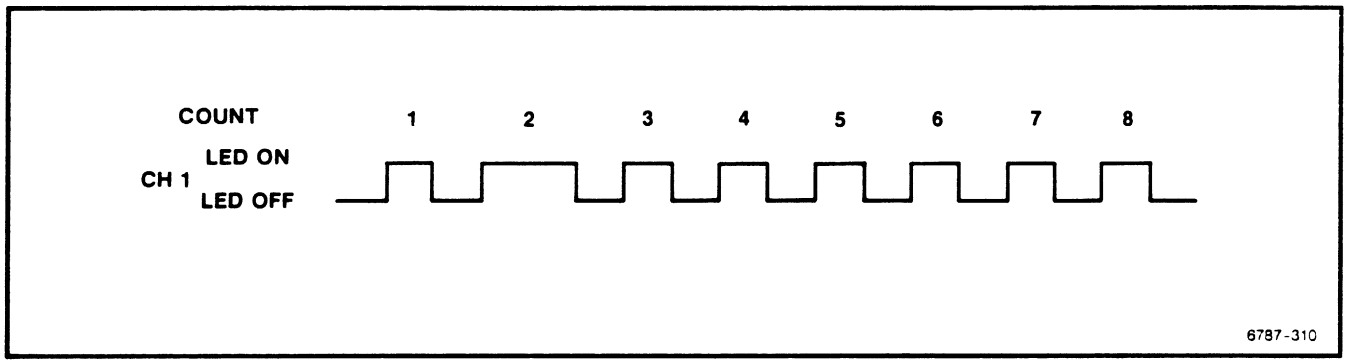


Figure 3-7. Sample LED fault code timing diagram.

The Kernel Tests are:

1. ROM Checksum Test
2. Non-volatile RAM Test
3. Housekeeper IC Test

1. The ROM Checksum Test computes a checksum of the content of the firmware ROM. This calculated checksum is then compared with a checksum stored in the ROM. If the checksums do not match, the test fails, and fault code 1 is reported. After the fault code is reported by flashing the front panel LEDs, the plug-in attempts to begin normal operation, but it is unlikely that the instrument can function properly with a bad ROM Checksum.

2. The Non-volatile RAM (NV RAM) Test verifies that the NV RAM is functioning properly. Since the NV RAM contains calibration information which must remain undamaged, this test does not alter critical data. If the testing algorithm detects a failure, then the plug-in reports a fault code of 2 and repeatedly loops the NV RAM Test. The instrument continues looping the NV RAM Test until the power is removed. Until the condition causing the NV RAM Test to fail is corrected, the mainframe does not recognize the plug-in.

   The NV RAM Test could corrupt calibration data stored in the NV RAM if the power is cycled or removed during this test. If corruption occurs, then the Calconstant Checksum is corrupted as well. Furthermore, at the next power-up, the plug-in resets the cal constants to default ROM settings and reports a Plug-in Calconstant Checksum Error during mainframe-invoked, Power-up Diagnostics. After the mainframe/plug-in system is run through an Enhanced Accuracy cycle, the plug-in is once again properly calibrated.

3. The Housekeeper IC Test verifies the functionality of the Housekeeper IC. The Housekeeper IC performs many 'housekeeping' chores of the amplifier; including channel sequencing, refreshing the analog control voltage system, latching amplifier step gain settings, and the communications with the mainframe. This test exercises this IC and records the ICs reactions using an algorithm similar to the algorithm that signature analysis uses. If the resulting signature of the Housekeeper IC does not match a known good signature, then the test fails and reports a fault code of 3. Also, the test is executed repeatedly if it fails. The instrument continues looping the Housekeeper IC Test until power is removed. Until the condition causing the Housekeeper IC Test to fail is corrected, the mainframe does not recognize the plug-in.

   After all power-on Kernel Tests have completed and successfully passed, the plug-in initializes its settings and communicates with the mainframe.

Self-Test/ Extended Diagnostics

First, the plug-in must successfully power-up, initialize its settings, and establish communication with the mainframe. Then, the mainframe requests that the plug-in execute its Self-Test routines (unless the mainframe's Self-Tests are disabled, in which case all the Self-Tests are ignored). Return to normal operation or entry into the New Configuration calibration, as discussed below, indicates successful completion of the Self-Test Diagnostics. Any failures cause the instrument to 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. You may have to step through several pages of the menu display to find all the failure codes.

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 plug-in is one Block. A 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 unit tested. The last four digits are hexadecimal (hex) numbers that indicate the Block, Area, Routine and specific failure mode. For example, R1241 is decoded as follows:

R	Right Plug-in
1	Block name - plug-in
2	Area name - Group II
4	Routine name - Checksum Probe
1	Failure Identity - specific failure mode

The subsystem character of an error index code is one of the following, and indicates the compartment in which the plug-in is installed. In the tables in this section, only the four digit failure code is listed; the prefix L, C, or R is omitted.

L	-Left
C	-Center
R	-Right

Front-panel controls are active during the Self-Test sequence and any disturbance causes a test failure.

Self-Test Diagnostics test the following circuits:

- Attenuator relay driver
- Probe coding
- Calibration (cal) constant checksums
- Calibration (cal) constant values
- A/D and D/A converters
- Probe power fuses
- 18 V power supply
- Signal path

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. Several operating mode selectors are available on the screen. When certain test routines are selected, some of these operating modes are unselectable.

Refer to the mainframe User's Reference manual for information on Extended Diagnostics or Extended Test menus and operation.

New Configuration Calibration

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 recalibrates itself for the new configuration. During this calibration, the message **"Powerup new configuration partial calibration occurring"** appears. If the calibration is successful (as indicated by a message), the instrument enters the normal operating mode.

Restoring Calibration Data

If the instrument power is turned off during probe calibration, self-calibration, Extended Diagnostics or other intense system activity, 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 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 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.

Plug-In Memory Backup Power

The non-volatile RAM (A1U420 NV RAM) within the plug-in allows retention of the data in memory when the plug-in is removed.

The NV RAM stores system-configuration data such as the plug-in, mainframe, and probe IDs as well as the cal constants. The data that the NV RAM stores, enable the plug-in to resume Enhanced Accuracy performance from a powered-down condition, without performing a full calibration (Enhanced Accuracy) operation.

The rated lifetime of the NV RAMs integral power source is ten years. If, on system power-up, the plug-in habitually loses Enhanced Accuracy status without a system configuration change (that is, the plug-in remains plugged into the same slot in the same mainframe), then the NV RAM may require replacement.

Field Replaceable Unit (FRU) Guide

This section correlates error index codes resulting from Diagnostic tests with the hybrid, integrated circuit (IC), module, or board FRU(s) suspected of causing each error. The FRU(s) in each 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(s). Verify that the new FRU is a correct replacement for the old FRU. If the old FRU contains firmware, then verify that the new firmware version is either the same version as, or an updated version of, the old firmware version.

The error index codes and tests are divided into three tables. A table of Kernel Diagnostic error codes, a table of Self-Test/Extended Diagnostic error indexes, and a table of Enhanced Accuracy error indexes.

Abbreviations of FRU Names

All boards are listed here with the abbreviation used in the Suspect Board FRU(s) column of the Error Index Code tables that follow:

Abbreviation	Name	Designator
Main	Main board	A1
Front	Front Panel board	A2

Abbreviations of Component and Module Names

All active components and modules are listed here with the abbreviation used in the Suspect Module, Hybrid, or IC FRU(s) column of the Error Index Code tables that follow.

Abbreviation	Name	Designator
MPU	Processor	A1U300
EPROM	Firmware	A1U521
RAM	Memory	A1U420
HK	Housekeeper	A1U500
Att	Attenuator	
Amp	Amplifier	A1U220
P FUSE	+ Fuses	A1F1112, A1F1113
N FUSE	-Fuses	A1F1110, A1F1111

Error Index Codes

This table lists the error codes possible in the Kernel Tests.

Error Code	Suspect Module, Hybrid, or IC FRU(s)	Suspect Board FRU(s)
1	EPROM, MPU	Main
2	RAM	Main
3	HK, MPU	Main

This table lists the error messages possible in the Self-Tests and Extended Diagnostics.

Error Index	Suspect Module, Hybrid, or IC FRU(s)	Suspect Board FRU(s)
-1111		Main
-1121	Att	Main
-1131[1]	RAM	Main
-1141[1]	RAM	Main
-1151		Main
-1211		Main
-1221	P FUSE	Main
-1231	N FUSE	Main
-1241	HK	Main
-1251	HK	Main
-1261		Main
-1271		Main
-1281		Main
-1311	HK	Main
-1321	Att	Main
-1611	Att, Amp	Main
-1621	Att, Amp	Main
-1631	Att, Amp	Main

[1]These error indexes may also result from the corruption of the calibration data (refer to Restoring Calibration Data earlier in this section.)

This table lists the error indexes resulting from Enhanced Accuracy. Enhanced Accuracy is available after the system has a 20-minute warmup period.

Error Index	Suspect Hybrid or IC FRU(s)	Suspect Board FRU(s)
-1411	Amp	
-1421	Amp	
-1431		Main
-1441	Att	Main
-1451	Amp	Main
-1461	Amp	Main
-1471	Att	Main
-1481	Amp	Main
-1491	Amp	Main
-14A1	Amp	Main
-14B1	Amp	Main
-1511	Att	Main
-1521	Att	Main
-1531	Att	Main
-1541	Att	Main
-1551	Att	Main
-1561	Att	Main

Fuse Troubleshooting

Failure codes 1221 or 1231 indicate that one or more probe power fuses are defective.

Refer to Figure 3-1 (FRU locator) for fuse locations.

To find a defective fuse, remove the plug-in from the mainframe, and use a Multimeter to check for continuity across each fuse. Replace all defective fuses. Then, install the plug-in in the mainframe and verify that the diagnostic error does not reappear.

The most likely cause of a blown fuse is a short circuit applied at the front-panel TEKPROBE® input connector. If a newly installed fuse blows with nothing connected at the TEKPROBE® input connector, then look for a short circuit on the A1 Main board or on the flexible circuit connecting the A1 Main board to the TEKPROBE® input connector.

Section 4
Theory of Operation

This section describes and illustrates (refer to Fig. 4-1) the plug-in block diagram; including signal flow and control flow. This section also discusses the power supplies for the plug-in.

Block Diagram Description

Signal Flow

The display of a signal begins with the inputting of a signal directly to either one or both of the input connectors (possibly with a probe) and proceeds as follows:

+ input connector → Attenuator →
- input connector →

→ Aux Signal
Amplifier → Trigger Signal
→ Display Signal

The input coupling mode is either AC, DC, VC, or Off. In the AC and DC coupling modes, the input signal is coupled to the Attenuator. In the Off coupling mode, the signal path is open. In the VC coupling mode, the comparison voltage is coupled to the Attenuator.

During self-calibration, the mainframe supplies the signal to the Attenuator.

The Attenuator contains resistive dividers, capacitive dividers, ac coupling capacitors, relays, and a differential amplifier. The Amplifier provides gain switching and bandwidth limit filters and separate outputs for the display, trigger, and auxiliary signal paths.

The plug-in contains a microprocessor (MPU) that communicates with the mainframe. The MPU also constantly monitors the input Overload Sense and the Probe Data communication lines. The operation of the MPU is through the internally stored program in its read only memory (ROM). The MPU stores the plug-in calibration (cal) constants in random access memory (RAM). A battery backs-up the RAM, therefore, the internal cal constants are not lost upon power-down. Also, when powering-down, the mainframe stores the oscilloscope's settings. When the system re-powers, the mainframe restores and transmits these settings to the plug-in.

The MPU communicates with the mainframe through a peripheral IC called the Housekeeper. The Housekeeper converts the 8-bit data bytes from the MPU into a serial data signal. This signal is sent to the mainframe. Conversely, the Housekeeper converts the serial data signal from the mainframe into 8-bit data bytes for the processor to read. The MPU stores the channel switching sequence in the Housekeeper. The Housekeeper also updates the analog control voltages and provides the comparison voltage through a digital-to-analog converter (DAC).

The MPU uses an analog-to-digital (A/D) converter to read the value of the Overload Sense and Probe Data lines. The A/D converter is also used in the Self-Test.

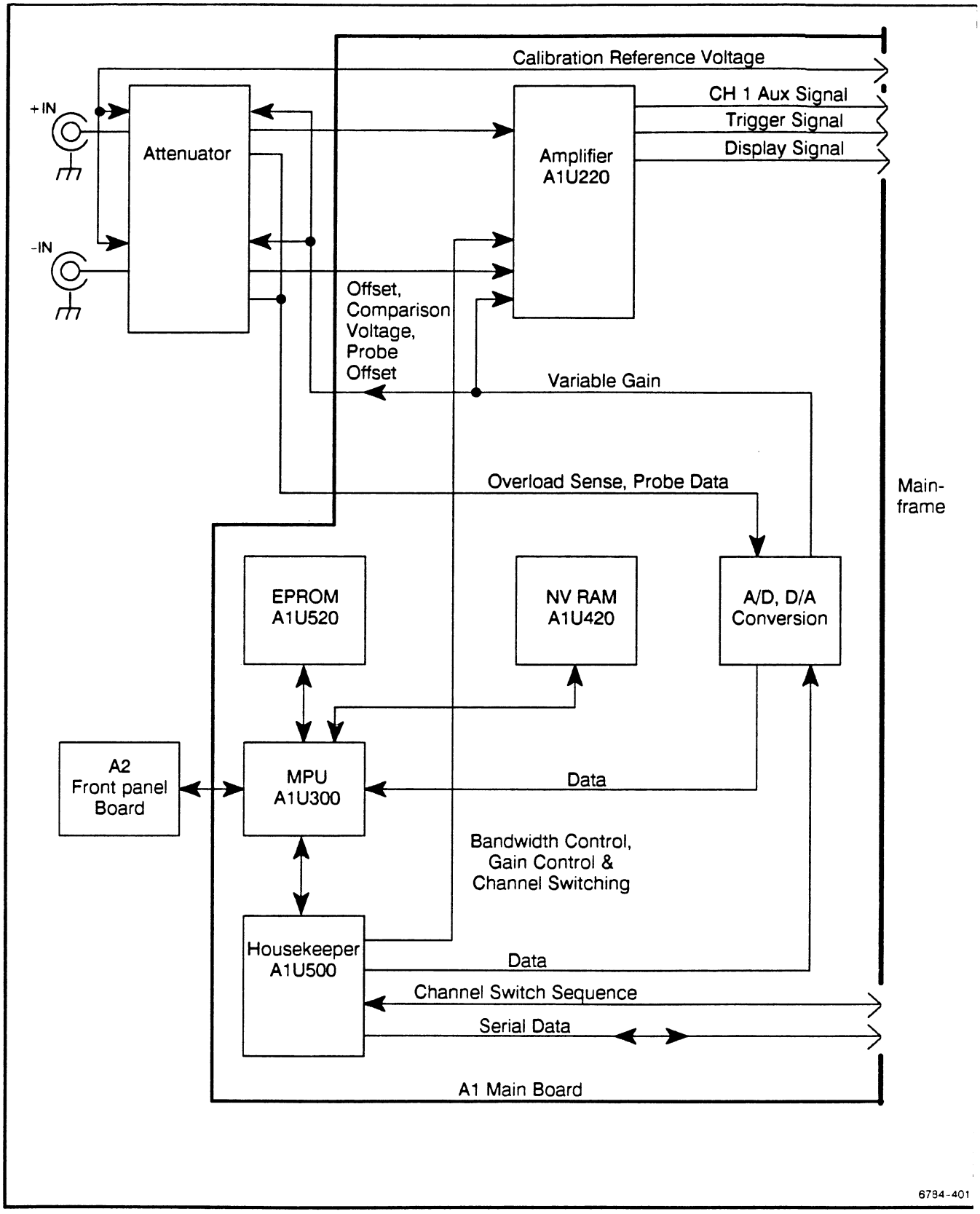


Figure 4–1. 11A33 Differential Comparator block diagram.

The MPU reads the front-panel pushbuttons. The MPU tells the mainframe when a front-panel button is pushed. The mainframe then tells the plug-in what action to take (for example, display the channel and turn on the channel's respective front-panel LED).

Control Flow

Under the control of the mainframe's channel switch sequencing signals, the Housekeeper sequentially turns the outputs on or off. The MPU and Housekeeper control the settings of the Amplifier and the Attenuator.

Power

The mainframe supplies all the power to the plug-in.

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
01536	TEXTRON INC CAMCAR DIV SEMS PRODUCTS UNIT	1818 CHRISTINA ST	ROCKFORD IL 61108
22599	AMERACE CORP ESNA DIV	15201 BURBANK BLVD SUITE C	VAN NUYS CA 91411-3532
34649	INTEL CORP	3065 BOWERS AVE	SANTA CLARA CA 95051
75915	LITTELFUSE INC	800 E NORTHWEST HWY	DES PLAINES IL 60016
80009	TEKTRONIX INC	4900 S W GRIFFITH DR P O BOX 500	BEAVERTON OR 97077
83385	MICRODOT MFG INC GREER-CENTRAL DIV	3221 W BIG BEAVER RD	TROY MI 48098
91260	CONNOR SPRING AND MFG CO	1729 JUNCTION AVE	SAN JOSE CA 95112
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61101
TK1326	NORTHWEST FOURSLIDE INC	5858 WILLOW LANE	LAKE OSWEGO OR 97034
TK1918	SHIN-ETSU POLYMER AMERICA INC	1181 NORTH 4TH ST	SAN JOSE CA 95112

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-1	366-0600-00			2	PUSH BUTTON:0.269 X 0.409,ABS	80009	366-0600-00
-2	366-1058-00			1	KNOB:GRAY,0.625 X 0.255 X 0.485	80009	366-1058-00
					(ATTACHING PARTS)		
-3	214-1095-00			1	PIN,SPRING:0.187 L X 0.094 OD,STL,CD PL	22599	52-022-094-0187
					(END ATTACHING PARTS)		
-4	105-0076-04			1	RELEASE BAR,LCH:PLUG-IN UNIT	80009	105-0076-04
-5	214-1280-00			1	SPRING,HLCPS:0.14 OD X 1.126 L,TWIST LOOP	91260	ORDER BY DESCR
-6	214-1054-00			1	SPRING,FLAT:0.825 X 0.322,SST	TK1326	ORDER BY DESCR
-7	105-0075-00			1	BOLT,LATCH:	80009	105-0075-00
-8	348-0235-00			2	SHLD GSKT,ELEK:FINGER TYPE,4.734 L	80009	348-0235-00
-9	333-3398-00			1	PANEL,FRONT:ALUMINUM	80009	333-3398-00
					(ATTACHING PARTS)		
-10	211-0392-00			4	SCREW,MACHINE:4-40 X 0.25,FLH,82 DEG,STL	80009	211-0392-00
					(END ATTACHING PARTS)		
-11	670-9698-00			1	CIRCUIT BD ASSY:FRONT PANEL	80009	670-9698-00
					(SEE A2)		
					(ATTACHING PARTS)		
-12	211-0390-00			3	SCREW,MACHINE:2-56 X 0.188,FH,STL CD PL	80009	211-0390-00
					(END ATTACHING PARTS)		
-13	407-3616-00			1	BRKT,HEAT SINK:LEFT,ALUMINUM	80009	407-3616-00
					(ATTACHING PARTS)		
-14	211-0409-00			2	SCR,ASSEM WSHR:4-40 X 0.312,PNH,STL	93907	ORDER BY DESCR
-15	211-0392-00			2	SCREW,MACHINE:4-40 X 0.25,FLH,82 DEG,STL	80009	211-0392-00
					(END ATTACHING PARTS)		
-16	407-3615-00			1	BRKT,HEAT SINK:RIGHT,ALUMINUM	80009	407-3615-00
					(ATTACHING PARTS)		
-17	211-0409-00			2	SCR,ASSEM WSHR:4-40 X 0.312,PNH,STL	93907	ORDER BY DESCR
-18	211-0392-00			2	SCREW,MACHINE:4-40 X 0.25,FLH,82 DEG,STL	80009	211-0392-00
					(END ATTACHING PARTS)		
-19	337-1064-12			2	SHIELD,ELEC:SIDE FOR PLUG-IN UNIT	80009	337-1064-12
-20	119-2447-01			1	ATTEN,NOVAR:DIFFERENTIAL ATTENUATOR W/	80009	119-2447-01
					AMPLIFIER		
					(ATTACHING PARTS)		
-21	211-0390-00			6	SCREW,MACHINE:2-56 X 0.188,FH,STL CD PL	80009	211-0390-00
-22	211-0391-00			4	SCREW,MACHINE:2-56 X 0.437,P4,STL CD PL	80009	211-0391-00
					(END ATTACHING PARTS)		
-23	354-0654-01			2	RING,CONN:BNC	80009	354-0654-01
-24	352-0780-00			2	HOLDER,CNDCT:ELASTOMERIC	80009	352-0780-00
-25	131-3383-01			4	CONN ASSY,ELEC:ELASTOMERIC,3.8MM X 3.0MM X	TK1918	.4PX24X3.8X3.0
					24.0MM,0.4MM L CONTACT PT		
-26	386-5219-00			1	SUBPANEL,FRONT:	80009	386-5219-00
-27	220-0022-00			6	NUT BLK:0.4 X 0.25 X 0.33,4-40 THRU,NI SIL	80009	220-0022-00
					(ATTACHING PARTS)		
-28	211-0409-00			6	SCR,ASSEM WSHR:4-40 X 0.312,PNH,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-29	214-1061-00			1	CONTACT,ELEC:GROUNDING,CU BE	80009	214-1061-00
-30	334-3438-00			1	MARKER,IDENT:MARKED TURN OFF POWER	80009	334-3438-00
-31	426-2060-00			1	FR SECT,PLUG-IN:UPPER,ALUMINUMN	80009	426-2060-00
					(ATTACHING PARTS)		
-32	211-0392-00			2	SCREW,MACHINE:4-40 X 0.25,FLH,82 DEG,STL	80009	211-0392-00
					(END ATTACHING PARTS)		
-33	334-3540-00			1	MARKER,IDENT:MARKED WARNING	80009	334-3540-00
-34	426-2061-00			1	FR SECT,PLUG-IN:LOWER,ALUMINUM	80009	426-2061-00
					(ATTACHING PARTS)		
-35	211-0392-00			2	SCREW,MACHINE:4-40 X 0.25,FLH,82 DEG,STL	80009	211-0392-00
					(END ATTACHING PARTS)		
-36	407-3363-00			1	BRACKET,HEAT SK:ALUMINUM	80009	407-3363-00
					(ATTACHING PARTS)		
-37	211-0711-00			1	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,TORX,T15	01536	ORDER BY DESCR
					(END ATTACHING PARTS)		
-38	670-9697-00	B010100	B020124	1	CIRCUIT BD ASSY:MAIN	80009	670-9697-00
	670-9697-01	B020125		1	CIRCUIT BD ASSY:MAIN	80009	670-9697-01
					(SEE A1)		
-39	160-4227-01			1	.MICROCKT,DGTL:HMOS,16384 X 8 EPROM,PRGM	80009	160-4227-01
-40	156-2625-00			1	.MICROCKT,DGTL:NMOS,CUSTOM,SENESCHAL	80009	156-2625-00
-41	156-2671-00			1	.MICROCKT,DGTL:CMOS,2048 X 8 SRAM MDL W/	80009	156-2671-00
					.INTEGRAL BATTERY DS1220,24		
-42	156-1684-01			1	.MICROCKT,DGTL:MICROCOMPUTER,8 BIT	34649	P8031AH

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-43	165-2089-05			1	.MICROCKT,LINEAR:VERTICAL PREAMP,100 OHM	80009	165-2089-05
-44	131-3511-00			1	.CONTACT,ELEC:1.22 CM FLAT HYPCON	80009	131-3511-00
-45	159-0253-00			2	.FUSE,CRTG:0.250A,125V,FAST,SUBMINIATURE	75915	251.250 T & R T1
-46	159-0235-00			2	.FUSE,WIRE LEAD:0.75A,125V,FAST	80009	159-0235-00
-47	386-5296-00			1	PANEL,REAR:	80009	386-5296-00
					(ATTACHING PARTS)		
-48	213-0904-00			4	SCREW,TPG,TR:6-32 X 0.5,PNH,STL	83385	ORDER BY DESCR
					(END ATTACHING PARTS)		
					STANDARD ACCESSORIES		
	070-6119-00			1	MANUAL,TECH:USERS,11A33	80009	070-6119-00
	070-6696-00			1	PROCEDURE:INCOMING INSPECTION,11A33	80009	070-6696-00
					OPTIONAL ACCESSORIES		
	070-6784-00			1	MANUAL,TECH:SERVICE REF,11A33	80009	070-6784-00

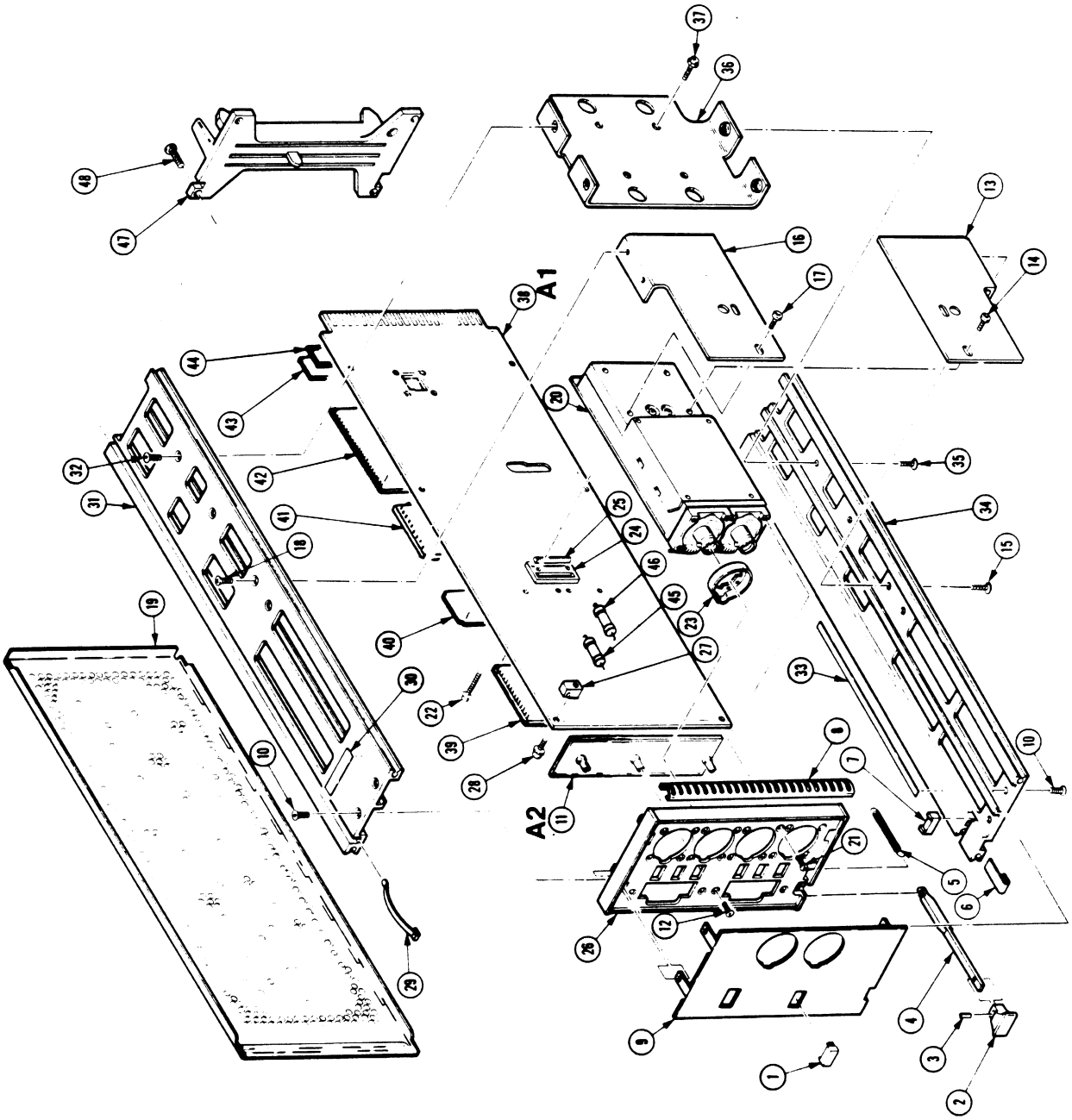


FIG.1 EXPLODED
11A33