# THE 11A81 AMPLIFIER

## Service Reference

Tektronix®
COMMITTED TO EXCELLENCE

# THE 11A81 AMPLIFIER

## Service Reference

**WARNING**

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

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

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**Instrument Serial Numbers**

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

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

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

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

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# Contents

**General Information** ........ **1-1**
Safety Summary ........ 1-2
Terms in Manuals ........ 1-2
Terms on Equipment ........ 1-2
Symbols in Manuals ........ 1-2
Symbols on Equipment ........ 1-2
Power Source ........ 1-2
Grounding the Product ........ 1-2
Danger Arising from Loss of Ground ........ 1-3
Do Not Operate in Explosive Atmospheres ........ 1-3
Do Not Service Alone ........ 1-3
Use Care When Servicing with Power On ........ 1-3
Installing and Removing an Amplifier ........ 1-3
Instrument Options ........ 1-5
Packaging for Shipment ........ 1-5
Operating Environment ........ 1-6

**Checks And Adjustments** ........ **2-1**
Test Equipment ........ 2-3
Using These Procedures ........ 2-5
Procedure 1 Power-On ........ 2-6
Setup to Power-On ........ 2-6
Procedure to Power-On ........ 2-6
Procedure 2 Enhanced Accuracy ........ 2-7
Setup to Achieve Enhanced Accuracy ........ 2-7
Procedure to Achieve Enhanced Accuracy ........ 2-7
Procedure 3 Step Response/ Bandwidth ........ 2-9
Specifications ........ 2-9
Measurement Limits ........ 2-9
Setup to Check/Adjust Step Response and Bandwidth ........ 2-9
Procedure to Check/Adjust Step Response and Calculate Bandwidth . 2-10
Procedure 4 Input Bias Current and Input Impedance ........ 2-13
Measurement Limits ........ 2-13
Setup to Examine Input Bias Current and Input Impedance ........ 2-13
Procedure to Examine Input Bias Current and Input Impedance ........ 2-13
Procedure 5 Oscilloscope Characterization ........ 2-15
Setup to Characterize the Oscilloscope ........ 2-15
Procedure to Characterize the Oscilloscope ........ 2-15
Procedure 6 DV DC Accuracy ........ 2-17
Specifications ........ 2-17
Setup to Check DV DC Accuracy ........ 2-17
Procedure to Check DV DC Accuracy ........ 2-17
Procedure 7 DC Offset Accuracy ........ 2-20
Specifications ........ 2-20
Setup to Check DC Offset Accuracy ........ 2-20
Procedure to Check DC Offset Accuracy ........ 2-20

**Section 2 Checks and Adjustments (cont.)**
Procedure 8 DC Balance .... 2-23
Specification .... 2-23
Setup to Check DC Balance .... 2-23
Procedure to Check DC Balance .... 2-23
Procedure 9 Internal Trigger .... 2-25
Specification .... 2-25
Setup to Check the Internal Trigger .... 2-25
Procedure to Check Internal Trigger .... 2-25
Procedure 10 External Trigger .... 2-26
Specification .... 2-26
Setup to Check the External Trigger .... 2-26
Procedure to Check External Trigger .... 2-26

**Maintenance .... 3-1**
Preventive Maintenance .... 3-1
Amplifier Shield Removal .... 3-1
Cleaning .... 3-1
Visual Inspection .... 3-2
Periodic Electrical Adjustment .... 3-2
Diagnostic Troubleshooting .... 3-3
Diagnostics Overview .... 3-3
Kernel Tests .... 3-3
Self Tests .... 3-5
Error Index Codes .... 3-5
Using the Self Tests/Extended Diagnostics .... 3-6
Enhanced Accuracy Errors .... 3-6
Calibrating a New Configuration .... 3-6
Restoring Calibration Data .... 3-6
Memory Backup Power for the Amplifier .... 3-7
Field Replaceable Unit (FRU) Guide .... 3-8
Abbreviations of FRU Names .... 3-8
Abbreviations of Component and Module Names .... 3-8
Error Index Codes .... 3-9
Decoding an S/H Failure .... 3-10
Fuse Troubleshooting .... 3-12
Jumpers .... 3-12
Corrective Maintenance .... 3-12
Ordering Parts .... 3-12
Static-Sensitive Device Classification .... 3-12
Removing/Replacing FRUs .... 3-14
Removing/Replacing the Front Panel Assembly .... 3-17
Removing/Replacing the A2 Front Panel Board .... 3-20
Removing/Replacing the BNC Connector Assemblies .... 3-21
Removing/Replacing the Cal Relay .... 3-22
Removing/Replacing the RMS Pickoff board .... 3-23
Removing/Replacing an Attenuator .... 3-23
Removing/Replacing the A1 Main Board .... 3-25
Removing/Replacing the Presampler Heat Sink .... 3-27
Removing/Replacing Hypcon Assemblies .... 3-29
Removing/Replacing the Serial Data Interface (SDI) IC (U1540) .... 3-33
Removing/Replacing the NVRAM IC .... 3-34

**Maintenance (cont.)**
Removing/Replacing the EPROM IC ........ 3-35
Programming the Unit Identification and the Calibration Constants .... 3-36
Multi-Pin Connectors ........ 3-38

**Theory of Operation** ........ **4-1**
System Functional Overview ........ 4-1
Attenuator Assembly Block ........ 4-1
Input Protection Block ........ 4-1
Presampler Block ........ 4-1
Front Panel Control Block ........ 4-2
Kernel Block ........ 4-2
External Trigger Block ........ 4-2
Typical Signal Processing Cycle ........ 4-3
Detailed Block Diagram Descriptions ........ 4-4
Cal Relay ........ 4-4
RMS Overload Detect ........ 4-5
Attenuator Block ........ 4-5
A1 Main Board ........ 4-5
A2 Front Panel Board ........ 4-6

**Replaceable Parts** ........ **5-1**
Parts Ordering Information ........ 5-1
Module Replacement ........ 5-1
Using the Replaceable Parts List ........ 5-2
Item Names ........ 5-2
Indentation System ........ 5-2
Abbreviations ........ 5-2

**Change Information**

## List of Illustrations


| | | |
|---|---|---|
| Figure 1-1 | Installing and Removing the 11A81 Amplifier | 1-4 |
| Figure 2-1 | Measurement of Plug-in Contribution to Aberrations | 2-11 |
| Figure 3-1 | FRU and FRU IC Locator | 3-16 |
| Figure 3-2 | Removing/Replacing the Front Panel | 3-18 |
| Figure 3-3 | Components of the Front Panel Assembly | 3-19 |
| Figure 3-4 | Removing/Replacing the BNC Connector Assembly and the A2 Front Panel Board | 3-20 |
| Figure 3-5 | Removing/Replacing the Cal Relay | 3-22 |
| Figure 3-6 | Removing/Replacing the A1 Main Board | 3-26 |
| Figure 3-7 | Torx Screw and Nut Block Orientation | 3-27 |
| Figure 3-8 | Removing/Replacing the Presampler Heat Sink | 3-28 |
| Figure 3-9 | Removing/Replacing a Hypcon Assembly | 3-30 |
| Figure 3-10 | Semiconductor Indexing Diagram | 3-34 |
| Figure 3-11 | IC Insertion-Extraction Pliers | 3-35 |
| Figure 3-12 | Multi-Pin Connector Orientation | 3-38 |
| Figure 4-1 | 11A81 Amplifier System Functional Block Diagram | 4-1 |
| Figure 4-2 | 11A81 Amplifier Detailed Block Diagram | 4-4 |
| Figure 5-1 | Exploded View of the 11A81 Amplifier | 5-6 |


## List of Tables


| | | |
|---|---|---|
| Table 2-1 | Measurement Limits, Specifications, and Adjustments | 2-1 |
| Table 2-2 | Test Equipment | 2-3 |
| Table 2-3 | 11A81 DC Accuracy Error Limits | 2-19 |
| Table 2-4 | 11A81 Amplifier DC Offset Accuracy | 2-22 |
| Table 2-5 | 11A81 DC Balance Error Limits | 2-24 |
| Table 3-1 | Board FRUs | 3-8 |
| Table 3-2 | Component/Module FRUs | 3-8 |
| Table 3-3 | Amplifier Kernel Error Index Codes | 3-9 |
| Table 3-4 | Self Tests/Extended Diagnostics Error Index Codes | 3-9 |
| Table 3-5 | Enhanced Accuracy Error Index Codes | 3-10 |
| Table 3-6 | Sample and Hold Board Failure Codes | 3-11 |
| Table 3-7 | Relative Susceptibility to Damage from Static Discharge | 3-13 |
| Table 3-8 | FRU Removal/Replacement Procedures | 3-14 |

# General Information

This reference is designed for use by qualified service personnel. It contains service information necessary to check, maintain and troubleshoot the 11A81 Amplifier.

Troubleshooting is primarily based upon internal diagnostics. These diagnostics isolate problems to the field replaceable unit (FRU) level. Once the faulty FRU is identified, use the procedures in this manual to remove and replace the faulty FRU. Section 5, *Replaceable Parts* gives a complete list of the FRUs in this amplifier.

The 11A81 is a single channel, wide-bandwidth plug-in amplifier designed for use in CSA 404 and 11403A mainframes only. Commands from the oscilloscope control all the functions of the amplifier. The front panel of the amplifier has a button and an LED indicator for the input channel. Other controls and status indicators are located on the oscilloscope.

The impedance for both the display channel and the EXTERNAL TRIGGER input is 50 Ω. The display channel provides a display and a trigger output to the oscilloscope.

Each input has a TEKPROBE® input connector. The TEKPROBE® input connector is compatible with a Level 1 or Level 2 TEKPROBE®, a probe with a BNC connector, or a BNC connector. When a probe is connected to the display input connector, the amplifier will detect the probe-encoding information, and use this information to automatically achieve the appropriate settings. The EXTERNAL TRIGGER input *does not* sense the probe encoding and, so, does not adjust for any probe attenuation.

This reference contains the following sections:

- **General Information** – discusses information that you should know about the 11A81 before you service it, such as safety information, installation and removal, available options and packaging suggestions.
- **Checks and Adjustments** – describes the procedures for examining and adjusting the measurement limits and electrical specifications of the 11A81.
- **Maintenance** – contains information for performing preventive maintenance, diagnosing faulty field replaceable units (FRUs), and corrective maintenance on the 11A81. This section includes replacement procedures for all FRUs.
- **Theory of Operation** – discusses the general operation and signal path of the 11A81.
- **Replaceable Parts** – provides you with a complete list of replaceable parts found on the 11A81 and an exploded view illustration showing all mechanical parts and FRUs.

## Safety Summary

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

### Terms in Manuals

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

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

### Terms on Equipment

*CAUTION* on equipment warns you of a possible personal injury hazard not immediately accessible as you read the marking, or a hazard to property; including the equipment itself.

*DANGER* on equipment indicates that you are exposed to a personal injury hazard as you read the marking.

### Symbols in Manuals

*Static Sensitive Devices*

### Symbols on Equipment

*DANGER*
*High Voltage*

*Protective ground (earth) terminal*

*ATTENTION*
*Refer to manual*

### Power Source

This amplifier is intended to operate in a oscilloscope 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 oscilloscope power cord, is essential for safe system operation.

### Grounding the Product

This amplifier is grounded through the grounding conductor of the oscilloscope power cord. To avoid electric shock, plug the oscilloscope power cord into a properly wired receptacle before installing the amplifier. A protective-ground connection, through the grounding conductor in the oscilloscope 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 the power is on.

Disconnect the power before removing protective panels, or replacing components.

## Installing and Removing an Amplifier

Install the 11A81 in an 11403A or CSA 404 oscilloscope as follows:

1. Set the oscilloscope ON/STANDBY switch to STANDBY. Power must be off to prevent damage to both the amplifier and the oscilloscope.

**CAUTION**

*If the green indicator light remains on when the STANDBY position is selected, then the switch was internally disabled when the power supply was serviced. To enable the ON/STANDBY switch, refer to the Maintenance section of the Service Reference manual for your oscilloscope.*

2. Align the grooves in the top and bottom of the amplifier with the guides in the oscilloscope plug-in compartment. See Figure 1-1.
3. Insert the amplifier into the compartment until the front panel of the amplifier is flush with the front panel of the oscilloscope.

Remove the amplifier from the mainframe as follows:

1. Set the oscilloscope ON/STANDBY switch to STANDBY.
2. Pull the release latch (see Figure 1-1) to disengage the amplifier from the oscilloscope.
3. Slide the amplifier straight out of the plug-in compartment.

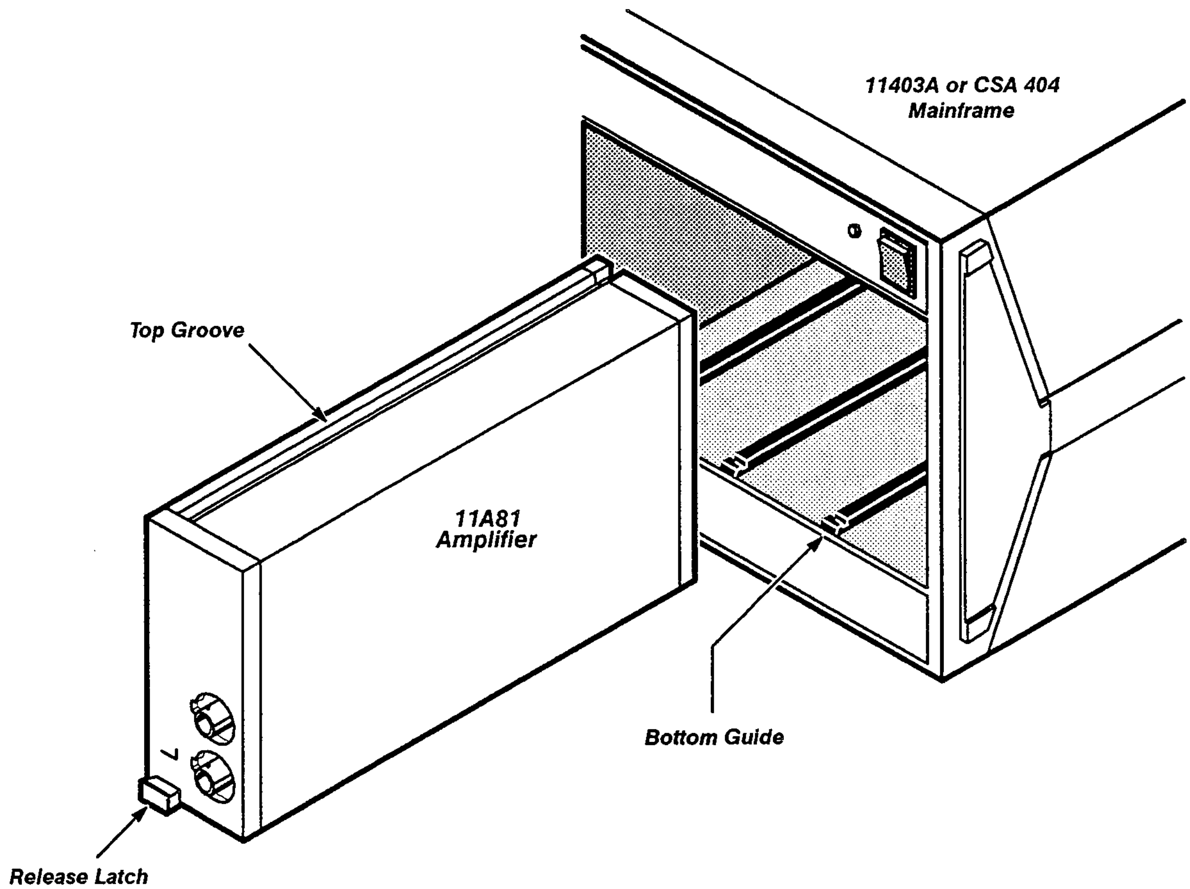



***Figure 1-1** — Installing and Removing the 11A81 Amplifier*

## Instrument Options

Your amplifier might be equipped with one or more options. For further information and prices, see your *Tektronix Products Catalog* or contact your local Tektronix service center.

## Packaging for Shipment

Save and reuse the original carton and packaging, if possible, when shipping the amplifier by commercial transportation. Package and ship amplifier and oscilloscopes separately.

Attach a tag to the amplifier if you ship it to a Tektronix service center for service or repair. Include the following information on the tag:

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

Package the amplifier as follows, if the original package is not available or is not reuseable:

1. Obtain a corrugated cardboard carton with inside dimensions at least six inches (15 cm) greater than the amplifier dimensions. Use a carton with a bursting test strength of at least 200 pounds per square-inch.
2. Fully wrap the amplifier with anti-static sheeting, or its equivalent, to protect the finish.
3. Tightly pack dunnage or urethane foam between the carton and the amplifier to cushion the amplifier 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 so that you can ensure proper functioning and extend the operation of the amplifier:

- Operate the amplifier in an oscilloscope where the ambient air temperature is between 0° and +50°C.
- Store the amplifier in ambient temperatures from -40° to +75°C.
- After storing the amplifier at temperatures outside the operating limits, allow the amplifier to reach the safe operating temperature before installing it in the oscilloscope, and applying power to the oscilloscope.

Enhanced system accuracy is available after a 20-minute warmup period. If the oscilloscope is in the Enhanced Accuracy state and the internal temperature of the oscilloscope changes ±5°C, the oscilloscope reverts to normal accuracy.

# Checks And Adjustments

This section contains procedures to check the 11A81 specifications and measurement limits as listed in Table 2-1. To use these procedures as a test of instrument functionality or as an incoming inspection, perform only the procedures with "yes" in the Functional Test column. Perform the full sequence of procedures following repair or as part of a routine maintenance program. The Specification or Measurement Limit checked by a procedure is listed at the beginning of the procedure.

To ensure accurate operation, check the electrical adjustment after each 2,000 hours of operation; or every 24 months if you use the 11A81 infrequently.

Refer to the *11A81 User Reference* for more information about advertised specifications and operation. Table 2-2, Test Equipment, lists the test equipment used in the procedures. Each procedure begins with an illustration that shows the equipment required for that procedure.

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

| **Part and Description** | **Measurement Limits *(Examine)*** | **Specifications *(Check)*** | **Adjustments *(Adjust)*** | **Functional Test** |
|---|---|---|---|---|
| Procedure 1 Power-On | none | none | none | yes |
| Procedure 2 Enhanced Accuracy | none | none | none | yes |
| Procedure 3 Step Response/ Bandwidth | Aberrations during first 20 ns: +12%, −10%, total of 12% p-p at 50 mV/div | Risetime ≤ 130 ps; bandwidth = $0.38/T_r$ | HOLD-C for specified aberrations and risetime | no |
| Procedure 4 Input Bias Current and Input Impedance | Input bias current ≤10 μA (at zero offset)<br><br>Input impedance of 50 Ω ±0.5 Ω | none | none | yes |
| Procedure 5 Oscilloscope Characterization | none | none | none | yes |
| Procedure 6 ΔV DC Accuracy | | Using a CSA 404 or 11403A Oscilloscope; ±0.60% +0.01 div | none | yes |

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

| **Part and Description** | **Measurement Limits *(Examine)*** | **Specifications *(Check)*** | **Adjustments *(Adjust)*** | **Functional Test** |
|---|---|---|---|---|
| Procedure 7 DC Offset Accuracy | | Offset within ±(0.53% +0.01 div) of the vertical offset setting (refer to Table 2-4 for specific offset error and vertical offset settings) | none | yes |
| Procedure 8 DC Balance | | Balance within ±0.1 division | none | yes |
| Procedure 9 Internal Trigger | | Sensitivity ≥2.0 div at 625 MHz. | none | yes |
| Procedure 10 External Trigger | | 40 mV p-p at 200 MHz; 150 mV p-p at 800 MHz; 200 mV p-p at 2 GHz | none | yes |

## Test Equipment

Table 2-2, Test Equipment, lists equipment recommended for use with the procedures in this manual. The Functional Test column of Table 2-2 indicates, with a check mark (✓), the test equipment that is recommended if you are performing only a functional test of the 11A81. Procedure steps are based on the test equipment examples given, but other equipment with similar specifications can be substituted. Test results, setup information, and related connectors and adapters might be altered if you use different equipment.

***Table 2-2** — Test Equipment*

| Description | Minimum Specification | Examples of Recommended Test Equipment | Functional Test |
|---|---|---|---|
| 11000-Series Oscilloscope compatible with the 11A81 | TEKTRONIX CSA 404 or 11403A | TEKTRONIX CSA 404 or 11403A | ✓ |
| Calibration Generator | Period, 0.1 ms – 10 µs, variable amplitude to 100 V p-p, rise time, <1 ns aberrations after 1 µs <0.1% | TEKTRONIX PG 506A Calibration Generator with a TM 500-Series Power Module | ✓ |
| DC Voltage Calibrator | Output, 0–4 V, accuracy ≤0.01% | Data Precision 8200 Fluke 5440B, Fluke 343A | ✓ |
| Pulse Generator | Output, $T_r$<30 ps | Tektronix Part 067-1338-00 | |
| Sinewave Generator | Frequency 200 MHz to 2 GHz | Wiltron 6709B | ✓ |
| Digital Multimeter (w/test leads) | Accuracy ≤0.01% | Fluke 8842A Digital Multimeter | ✓ |
| Terminal | Terminal with an RS-232-C serial port | Compaq II with communications software | |
| Serial Cable for use with Terminal | RS-232-C Cable | Tektronix Part 012-0911-00 | |
| Coaxial Cable, 18″ (3 required) | 50 Ω, 18-inch, male BNC connectors | Tektronix Part 012-0076-00 | ✓ |
| Coaxial Cable, 36″ | 50 Ω, 36-inch, male BNC connectors | Tektronix Part 012-0482-00 | ✓ |
| Power Divider, 50 Ω | Impedance 50 Ω SMA connectors | Tektronix Part 015-0565-00, (SMA female connectors) | ✓ |
| Adapters | BNC female-to-dual banana (2 required) | Tektronix Part 103-0090-00 | ✓ |
| | SMA male-to-BNC female (3 required) | Tektronix Part 015-1018-00 | ✓ |
| | SMA female-to-BNC male | Tektronix Part 015-0572-00 | |

*Table 2-2 — Test Equipment (Cont.)*

| Description | Minimum Specification | Examples of Recommended Test Equipment | Functional Test |
|---|---|---|---|
| Connector, T | BNC, T: two female and one male BNC connector | Tektronix Part 103-0030-00 | ✓ |
| Attenuator, 5X (2 required) | 14 dB attenuation, 50 Ω, one male and one female BNC connector | Tektronix Part 011-0060-02 | ✓ |
| FRU Replacement Tools | Magnetic Screwdriver/ Holder for tips | | |
| | Torx® Screwdriver Tips<br>#6 tip<br>#8 tip<br>#10 tip (long shank)<br>#15 tip<br><br>Pozidrive® Screwdriver Tips<br>#1 tip | | |
| | IC insertion-extraction pliers, 28-pin type | General Tool P/N U505BG or equivalent | |
| | Thermal Grease | (see *Replaceable Parts* in this manual) | |
| | 24-pin Socket | Tektronix Part 136-0751-00 | |
| | Open Ended Wrench, 5/16″ | | |
| | Needle-nose pliers | | |
| | Tweezers | | |
| | Static Control Mat | | |
| | Wrist Strap | | |

## Using These Procedures

The first-time user should familiarize themselves with the preceding information prior to performing the procedures that follow.

### Conventions in this Manual

In these procedures, the following conventions are used:

- CAPITAL letters within the body of text identify front panel controls, indicators, and connectors on the oscilloscope/amplifier (for example, MEASURE).
- **Bold** letters identify menu labels, display messages, and commands typed in from a terminal or controller.
- Initial Capital letters identify connectors, controls, and indicators on associated test equipment (for example, Position).
- In some steps, the first word is italicized to identify a step that contains a performance verification and/or an adjustment instruction. For example, if *Check* is the first word in the title of a step, an electrical specification is checked. If *Adjust* appears in the title, the step involves an electrical adjustment. If *Examine* is the first word in the title, the step involves measurement limits that are used as calibration guides; these limits are not to be interpreted as electrical specifications.

### Initialized Settings

At the beginning of most steps, you are instructed to **Initialize** the oscilloscope as part of the setup. The **Initialize** feature, available through the UTILITY menu, presets all oscilloscope controls and functions to known values. Initializing the oscilloscope at the beginning of a step eliminates the possibility of settings from previous procedures causing erroneous or confusing results.

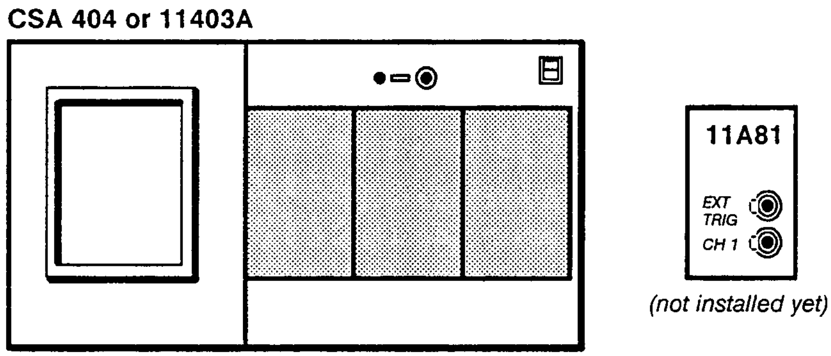
### Menu Selections and Measurement Techniques

Details on measurement techniques and instructions for making menu selections are generally not included in this manual. Comprehensive descriptions of menus and oscilloscope features are located in your oscilloscope *User Reference*.

## Procedure 1 Power-On

This procedure prepares the oscilloscope, the 11A81, and the test equipment for the procedures that follow. This procedure also provides a warm-up period for all equipment. Perform all of the procedures in this section within the ambient temperature range of +18° and +28°C, to ensure that the oscilloscope and amplifier operate properly.

### Setup to Power-On




**CAUTION**

*Avoid damage to equipment by setting the mainframe ON/STANDBY switch to STANDBY before installing or removing plug-in units.*

### Procedure to Power-On

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

11A81 Amplifier .................................. not installed yet
CSA 404 or 11403A
ON/STANDBY switch .............................. STANDBY

☐ Step 2: Install the 11A81 Amplifier in the CENTER compartment.

☐ Step 3: Ensure that the oscilloscope rear panel PRINCIPAL POWER SWITCH is set to OFF and then connect the oscilloscope to a suitable power source.

☐ Step 4: Set the oscilloscope rear panel PRINCIPAL POWER SWITCH to ON and then the front panel ON/STANDBY switch to ON.

☐ Step 5: Power on the following test equipment so that it warms up with the amplifier to be tested:

Digital multimeter
Calibration generator
Pulse Generator
High frequency sine wave generator
Power supply
Terminal

Table 2-2 gives a complete list of recommended test equipment.

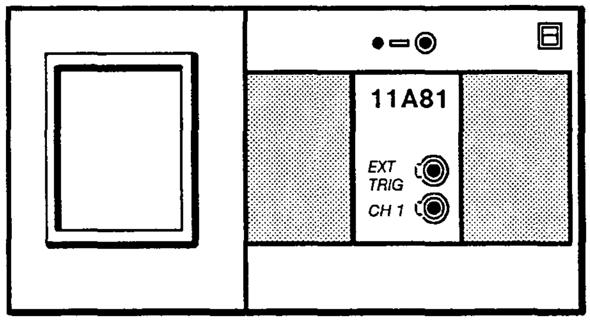
## Procedure 2 Enhanced Accuracy

This procedure ensures that the 11A81 and oscilloscope can achieve the Enhanced Accuracy state. When displayed, the Enhanced Accuracy symbol (**EA**) indicates that the amplifier and oscilloscope are at their highest accuracy state. The amplifier 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 the oscilloscope *User Reference* manual.

### Setup to Achieve Enhanced Accuracy

**CSA 404 or 11403A**




### Procedure to Achieve Enhanced Accuracy

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

11A81 Amplifier .............................. no settings required
CSA 404 or 11403A ............................ no setting changes

☐ Step 2: Twenty minutes after power-on, the oscilloscope must recalibrate itself to achieve the Enhanced Accuracy state. Press the ENHANCED ACCURACY button. A prompt then appears on the display. Press the ENHANCED ACCURACY button again. The system should achieve Enhanced Accuracy after a couple of minutes.

**CAUTION**

*Turning the oscilloscope power off during Enhanced Accuracy testing may result in losing some of the non-volatile RAM data. This could cause diagnostic errors at the next power-up, and cause the oscilloscope to operate unpredictably. If this event occurs, refer to Restoring Calibration Data in your oscilloscope Service Reference manual.*

☐ Step 3: Ensure that the message, **Enhanced Accuracy in Progress** appears, indicating that the oscilloscope is attempting to achieve Enhanced Accuracy.

☐ Step 4: *Examine* that the message, **Enhanced accuracy completed and passed** indicating that the Enhanced Accuracy state has been achieved appears. The **EA** indicator appears on the display below the vertical scale indicator while in the Enhanced Accuracy state.

## Procedure 3 Step Response/ Bandwidth

This procedure examines and adjusts, if necessary, the display step response and calculates the bandwidth. To facilitate adjustments during this procedure, you will need to connect a terminal and configure the mainframe to allow changing of calibration settings. The risetime specification does not include contributions from the generator or from averaging the time jitter.

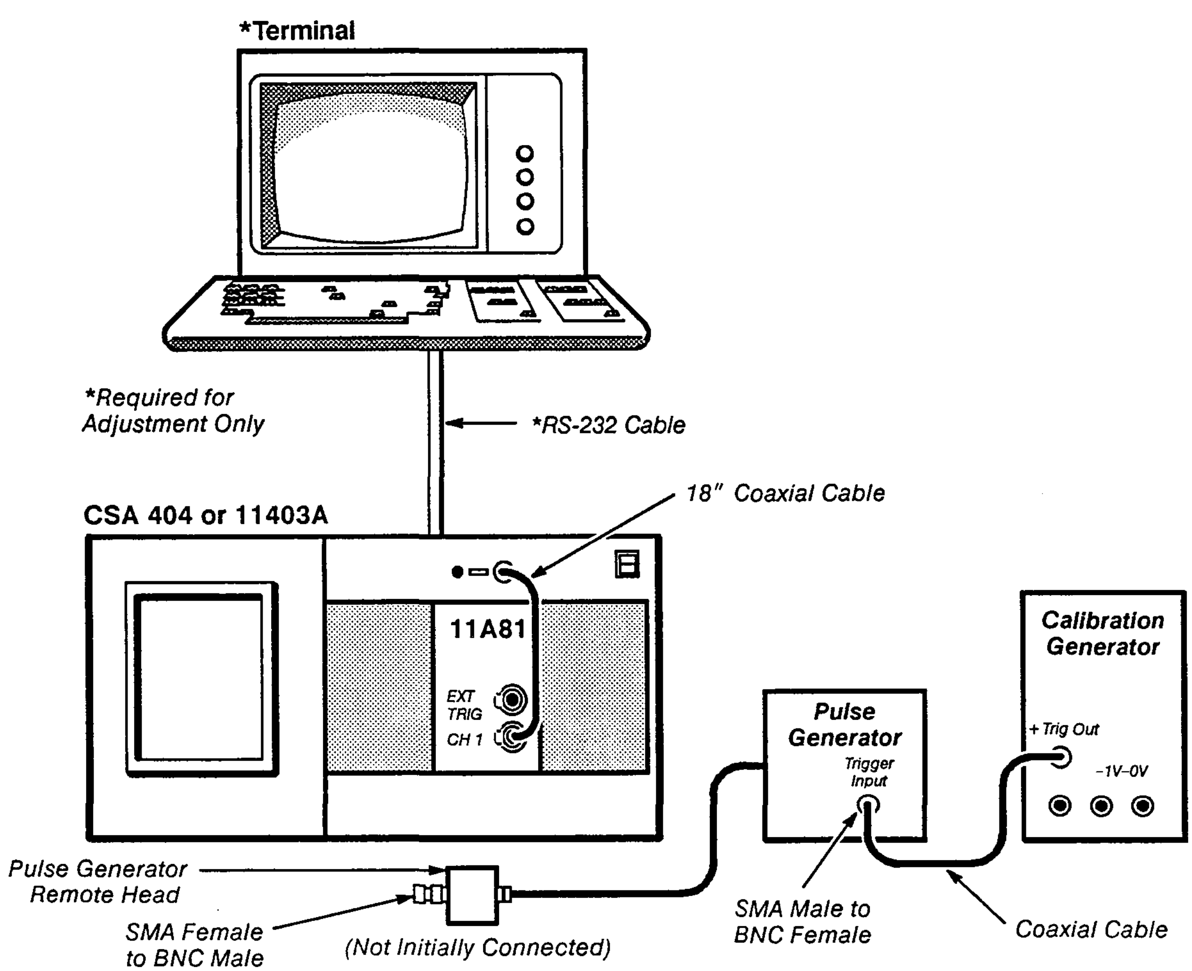
### Specifications

Risetime ≤130 ps; Bandwidth is calculated from the measured risetime using the formula: BW = $0.38/T_r$ (risetime).

### Measurement Limits

High-frequency aberrations during the first 20 ns, +12%, -10%, or 12% p-p maximum at 50 mV/div.

### Setup to Check/Adjust Step Response and Bandwidth



**Procedure to Check/Adjust Step Response and Calculate Bandwidth**

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

Calibration Generator
- Period .......... 1 µs
- Mode .......... Fast Rise

Pulse Generator
- Power .......... ON

Terminal .......... on

11A81 Amplifier
- CH 1 display on/off .......... on

☐ Step 2: Calibrate CH1 signal path as follows:

- Press the UTILITY button then select **Probes** from the Utility major menu.
- Touch **C1** to initiate probe calibration on CH 1.
- When the message **Probe cal complete. Deskew passed** appears, select **Exit Comp**. This completes the probe calibration of CH 1.

☐ Step 3: Disconnect the coaxial cable from CH 1 and connect the Pulse Generator Remote head to CH 1.

☐ Step 4: To setup the risetime measurement, perform the following settings in the order listed:

- **Vert Size** .......... 50 mV/div
- **Vert Offset** .......... –150 mV
- **Main Size** .......... 500 ps/div
- **Main Pos** .......... Position rising edge at 2nd graticule line (see Figure 2-1)
- Waveform major menu .......... **Acquire Desc**
- **Acquire Desc** pop-up menu .. **Average N** (defaults to 32 averages)
- Measure major menu .......... **Measurements**
- **Measurements** pop-up menu .......... **Rise**
- **Stats Comp Test & Def** .......... touch
- **Statistical Functions** pop-up menu .......... **Statistics** (toggles **On**)
- **Statistics N** .......... **100** (default setting)

☐ Step 5: Observe the **Stats Comp Test & Def** status and wait until the **Sample** number reaches 100.

CSA 404 or 11403A
- **Vert Size** .......... 50 mV/div
- **Vert Offset** .......... –150 mV
- **Main Size** .......... 1 ns/div
- **Acquire Desc** .......... **Average N**
- Measure major menu .......... **Measurements**
- **Measure** pop-up menu .......... **Rise**

☐ Step 6: *Check* that the **Rise** measurement is less than or equal to 130 ps.

☐ Step 7: Calculate your amplifier bandwidth (BW) with the formula; $BW=0.38/T_r$ ($T_r$= measured rise time).

☐ Step 8: To measure aberrations, select the **Cursors** icon and then **Cursor Type** from the Cursor menu. In the **Cursor Type** pop-up menu select **Horizontal Bars**. Position the cursor bars to measure the amplitude of the aberrations as shown in Figure 2-1. To select Fine cursor resolution select either knob label and select **Fine** resolution in the **Knob Res** pop-up menu.

☐ Step 9: *Examine* the aberrations measurements (ΔV readout) for the first 20 ns to ensure that they are within +12%, −10%, or 12% p-p total. Change **Main Size** to 2 ns/div temporarily to see the first 20 ns of the waveform topline.

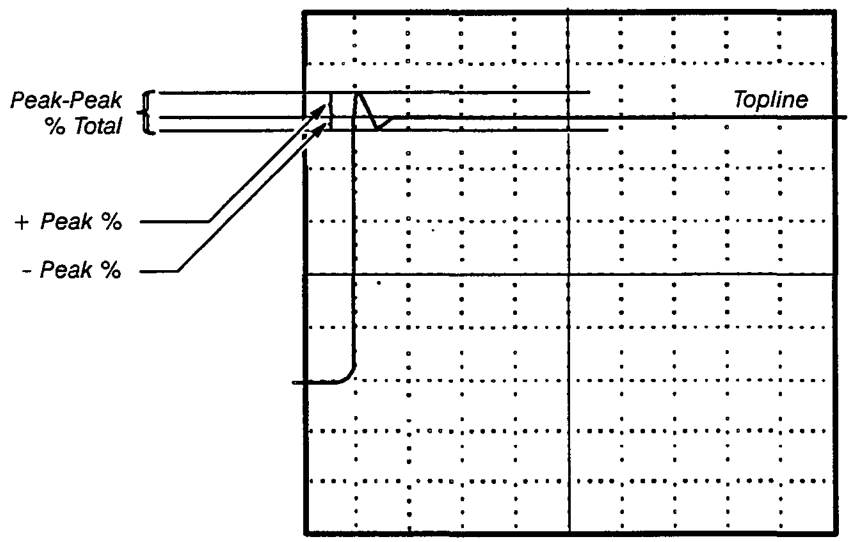



***Figure 2-1*** *— Measurement of Plug-in Contribution to Aberrations*

*DO NOT attempt to adjust the display step response adjustment HOLD-C if the waveform is within the stated limits. Proceed to Procedure 4.*

The step response adjustment requires the entry of a calibration constant via the terminal shown in the Procedure 3 setup illustration.

☐ Step 10: Locate the CSA 404 or 11403A calibration jumper pins, J450, on the A6 Time Base board and install a black, short-circuit jumper across the pins.

☐ Step 11: Locate the J1630 jumper pins on the 11A81 Amplifier, and install the black, short-circuit jumper in the UID position, across Pins 1–2. See Figure 3-1 on page 3-16 for the jumper location.

☐ Step 12: Determine the baud rate of your terminal; the mainframe default is 9600.

☐ Step 13: Set the oscilloscope **Baud Rate** to match the baud rate of the terminal you are using as follows:

- Press the UTILITY button twice, and then touch **RS232C**.
- Set the **Baud Rate** to match the baud rate of the terminal you are using.
- Set **Echo** and **Verbose** to **On**.

The calibration constant (84) should be set to a <*value*> within the range −1.1 (most overshoot) to +0.65 (least overshoot). Exceeding the recommended range could compromise other parameters unrelated to overshoot. (The initial value of −1.1 should be used after replacement of the NVRAM or the Presampler IC and then adjusted as needed.)

☐ Step 14: Check the current setting of the 11A81 installed in the CENTER compartment by entering the command:

**CCA? 84**

If the amplifier is installed in the LEFT or RIGHT compartment use the command LCA? or RCA?, respectively.

☐ Step 15: *Adjust* the display step response adjustment HOLD-C (84) to achieve specified performance. On the terminal keyboard, enter the command:

**CCA 84:**<*value*>

Note the effect on the displayed waveform and try a new value as necessary. The adjustment is non-linear across the possible range.

☐ Step 16: If you changed the HOLD-C value, then the low frequency gain has been altered. Repeat Procedures 2 and 3 to restore Enhanced Accuracy and to check that the step response is still within specifications.

☐ Step 17: Replace the calibration jumpers to original positions on the 11A81 (J1630) and the CSA 404 or 11403A (J450).

## Procedure 4 Input Bias Current and Input Impedance

This procedure examines the input bias current at zero offset, and it examines the input impedance.

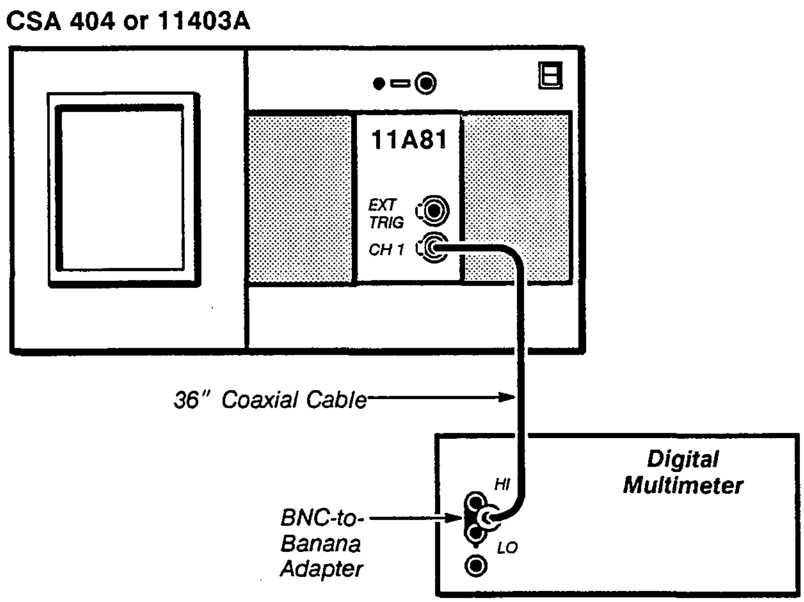
The system must be in the Enhanced Accuracy state for this procedure.

### Measurement Limits

The measurement limits are as follows:

- Open circuit bias current 10 µA at zero offset
- Input impedance = 50 ±0.5 Ω

### Setup to Examine Input Voltage and Input Impedance




### Procedure to Examine Input Bias Current and Input Impedance

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

11A81 Amplifier
  CH 1 display on/off . . . . . . . . . . . . . . . . on
CSA 404 or 11403A
  **Vert Size** . . . . . . . . . . . . . . . . 10 mV/div
Digital multimeter (DMM)
  Range . . . . . . . . . . . . . . . . 200 mA DC

☐ Step 2: *Examine* the DMM for a reading of 0 µA, within the limits of ±10 µA.

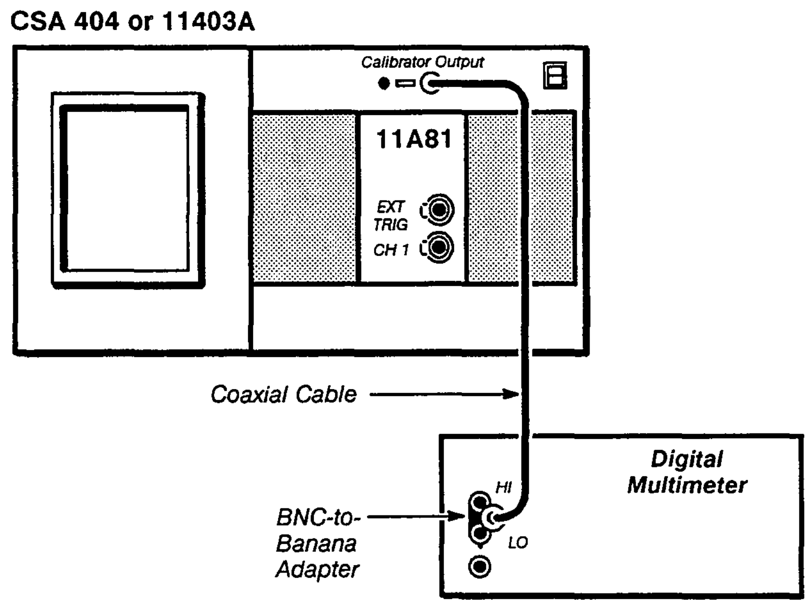
☐ Step 3: Set the DMM to the 200 Ω range.

- [ ] Step 4: Read the DMM and record the value as $Z_1$ for later use.
- [ ] Step 5: Reverse the connection of the BNC-to-dual banana adapter on the DMM.
- [ ] Step 6: Read the DMM, and then record this value as $Z_2$. Calculate the impedance average by adding $Z_1$ and $Z_2$ and dividing the result by 2.
- [ ] Step 7: *Examine* that the average impedance value is within the limits of 49.5 Ω and 50.5 Ω.

## Procedure 5 Oscilloscope Characterization

This procedure determines a characterization factor for the oscilloscope calibration voltage reference. You will use the characterization factor determined in this procedure in performing Procedures 6 and 7.

**Setup to Characterize the Oscilloscope**




**Procedure to Characterize the Oscilloscope**

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

11A81 Amplifier .............................. no setting changes
CSA 404 or 11403A
  UTILITY menu ........................ **Extended Diagnostics**
    **Subsys** .................................... **Digitizer**
    **Block** .................................. **Points Acq**
    **Area** .................................. **FP Cal Refs**
    **Routine** ................................ **FP −10.000 V**
    **Run** ......................................... touch

☐ Step 2: Record the absolute value reading of the DMM as $V_1$ for later use.

☐ Step 3: Touch **Exit** to end the FP −10.000 V diagnostic test.

☐ Step 4: Select the **FP + 9.9951 V** Routine.

☐ Step 5: Touch **Run**.

☐ Step 6: Record the DMM reading as $V_2$ for later use.

☐ Step 7: Touch **Exit** to end the FP +9.9951 V diagnostic test.

☐ Step 8: Touch **Exit Diagnostics** twice to exit the Extended Diagnostics mode.

☐ Step 9: Add the *absolute values* of $V_1$ and $V_2$. Divide the result by 19.9951 V to obtain the characterization factor of the oscilloscope calibration voltage reference.

***Note:*** The characterization factor just obtained is required to perform Procedures *6 and 7*.

## Procedure 6 ΔV DC Accuracy

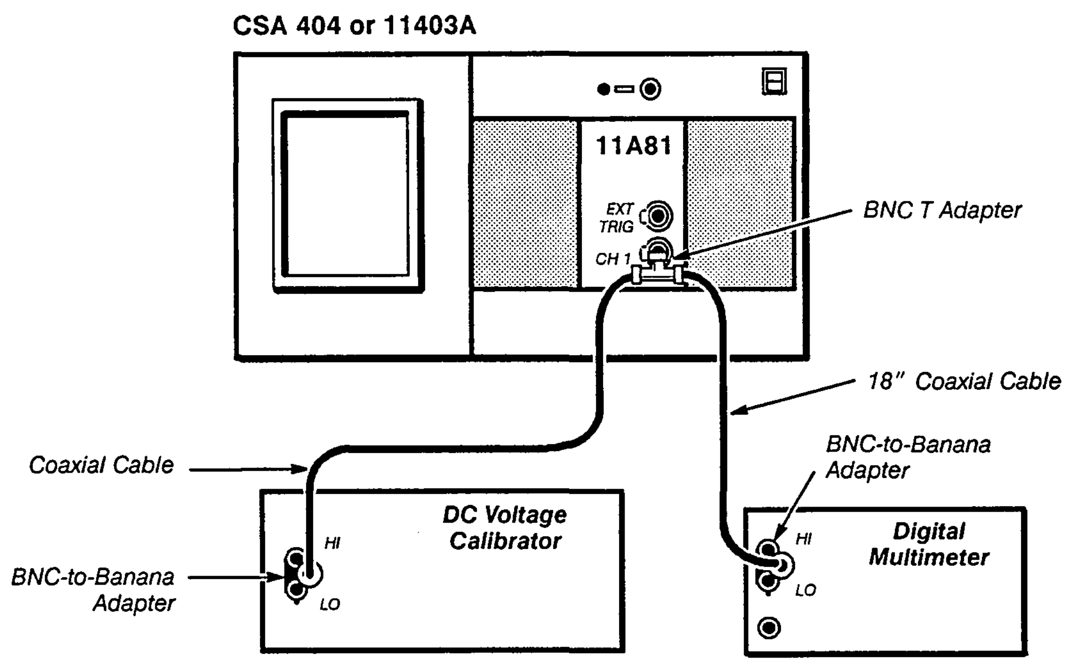
This procedure checks system ΔV DC accuracy using a precision digital multimeter and a precision power supply. The system must be in the Enhanced Accuracy state during this procedure.

This procedure confirms that the amplifier can be accurately calibrated. This procedure does not test for oscilloscope accuracy or long term stability. Therefore, the characterization factor of the oscilloscope's calibration voltage reference must be calculated in Part 5, Oscilloscope Characterization. Also, you should perform this procedure immediately after entry into the Enhanced Accuracy state.

### Specifications

ΔV DC Accuracy must be within ±(0.6% +0.01 div) with an eight division voltage change.

### Setup to Check ΔV DC Accuracy




### Procedure to Check ΔV DC Accuracy

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

- [ ] Step 1: Press the ENHANCED ACCURACY button twice to initiate Enhanced Accuracy calibration and ensure peak performance of the system.
- [ ] Step 2: **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

☐ Step 2: **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

11A81 Amplifier
- CH 1 Display on/off .................................... on

Mainframe .............................................
- **Acquire Desc** .................................... touch
- **Average N** .................................... **On**

DC Voltage Calibrator
- On/Standby .................................... on
- 50 Ω Override .................................... on

Digital multimeter (DMM)
- Mode .................................... DC
- Range .................................... auto

☐ Step 3: Set the oscilloscope to measure the ΔV DC accuracy as follows:

- Press the MEASURE button.
- Touch **Measurements** and then **Mean** in the **Measurements** pop-up menu. Touch **Exit Menu** to finish the measurement selection.
- Touch **Mean** in the MEASURE major menu, and then touch **Data Interval** to select **Whole Zone** in the **Mean** pop-up menu.
- Touch **Stats Comp Test & Def** and then touch **Compare Options.**
- Touch **Compare** to toggle it to **On**. The Δ**Mean** measurement readout now shows a difference or delta measurement.

☐ Step 4: Set **Vert Size** to the first Vertical Size entry in Table 2-3.

☐ Step 5: Set the DC Voltage Calibrator polarity to minus (–), then set its output level to the appropriate Deflection Volts setting from Table 2-3. Check the DMM to ensure the correct voltage setting. (If you apply too high a voltage level, the input coupling will be switched to Off. If this happens, use **Couping** in the Waveform major menu to set coupling back to DC.)

☐ Step 6: Save the current Mean measurement (0 V) as the reference value:

- Touch **Stats Comp Test & Def** and then touch **Compare Options.**
- Touch **Measure Selected Wfm Save as References** to save the current Mean measurement as a reference.

☐ Step 7: Set the DC Voltage Calibrator polarity to plus (+), leaving its output level set to the current Table 2-3 Deflection Volts. Check the DMM to ensure the correct voltage setting.

☐ Step 8: Clear the waveform data by selecting **Remove/Clr Waveform**, then selecting **Clear** waveform name (wfm 1) in the pop-up menu. This restarts waveform averaging and gives a measurement based on the new signal level.

☐ Step 9: Now calculate the ΔV DC error:

- Read the current Δ**Mean** measurement.
- Divide the Δ**Mean** value by the mainframe characterization factor that you determined in Procedure 5.
- Subtract from this value, 2 times the present Deflection Volts setting to obtain the ΔV DC error. For example: (8.012/.996) - ( 2 × 4 V ) = 0.044.

☐ Step 10: *Check* that the ΔV DC error obtained in Step 9 is within the Error Limits for the current Vertical Size given in Table 2-3. (For the above example, the calculated ΔV DC (44 mV) is less than the allowed Error Limit 58 mV.)

☐ Step 11: Repeat Steps 4 through 10 for the remaining Vertical Size settings listed in Table2-3.

***Table 2-3** — 11A81 DC Accuracy Error Limits*

| Vertical Size | Deflection Volts | Error Limits (±V) |
|---|---|---|
| 1 V/div | 4 V | 58.0 mV |
| 500 mV/div | 2 V | 29.0 mV |
| 200 mV/div | 800 mV | 11.6 mV |
| 100 mV/div | 400 mV | 5.8 mV |
| 50 mV/div | 200 mV | 2.9 mV |
| 20 mV/div | 80 mV | 1.16 mV |
| 10 mV/div | 40 mV | 0.58 mV |

## Procedure 7
## DC Offset Accuracy

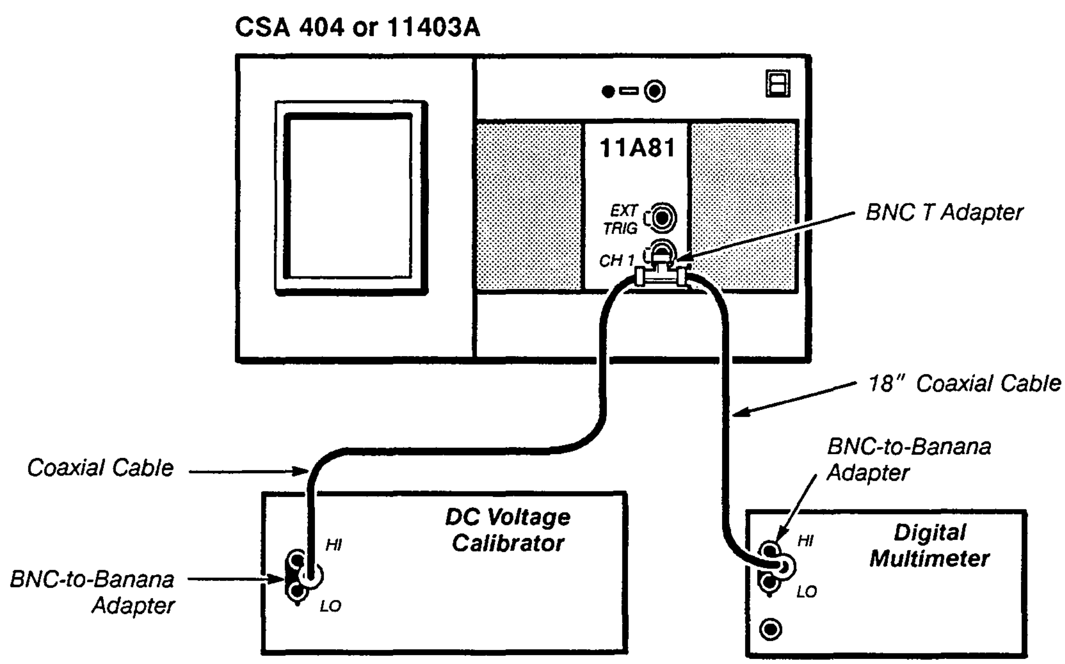
The system DC Offset is checked using a precision digital multimeter and a power supply.

This procedure confirms that the amplifier can be accurately calibrated. This procedure does not test for oscilloscope accuracy or long term stability. Therefore, the characterization factor of the mainframe calibration voltage reference must be calculated in Procedure 5, Oscilloscope Characterization. Also, you must perform the DC Offset Accuracy procedure immediately after entry into the Enhanced Accuracy state.

### Specifications

The offset error must be within ±(0.53% +0.01 div) of the vertical offset setting. Refer to Table 2-4, 11A81 Amplifier DC Offset Accuracy, for specific values for each vertical offset setting.

### Setup to Check DC Offset Accuracy




### Procedure to Check DC Offset Accuracy

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

☐ Step 1: Press the ENHANCED ACCURACY button twice twice to initiate Enhanced Accuracy calibration and ensure peak performance of the system.

☐ Step 2: **Initialize** the oscilloscope settings, then perform the following settings in the order listed:

DC Voltage Calibrator
- On/Standby .......... on
- 50 Ω Override .......... on
- Output Level .......... 0 V

11A81 Amplifier
- CH 1 display on/off .......... on

Mainframe ..........
- **Acquire Desc** .......... touch
- **Average N** .......... **On**

Digital multimeter (DMM)
- Mode .......... DC
- Range .......... auto

☐ Step 3: Measure the position of the displayed waveform (it should be at 0 V on the graticule) as follows:

- Press the MEASURE button.
- Touch **Measurements** and then **Mean** in the **Measurements** pop-up menu. Touch **Exit Menu** to finish the measurement selection.
- Touch **Mean** in the MEASURE major menu, and then touch **Data Interval** to select **Whole Zone** in the **Mean** pop-up menu.
- Touch **Stats Comp Test & Def** and then touch **Compare Options.**
- Touch **Compare** to toggle it to **On**. The Δ**Mean** measurement readout now shows a difference or delta measurement.
- Touch **Measure Selected Wfm Save as References** to save the current Mean measurement (0 V) as the reference value.

☐ Step 4: Set **Vert Size** to the first entry (1 V/div) in Table 2-4.

☐ Step 5: Set **Vert Offset** to the corresponding Vertical Offset in Table 2-4.

☐ Step 6: Set the DC Voltage Calibrator Output Level to the current Vertical Offset divided by the characterization factor that you determined in Procedure 5. Check the DMM to ensure the correct voltage setting.

☐ Step 7: Clear the waveform data by selecting **Remove/Clr Waveform**, then selecting **Clear** waveform name (wfm 1) in the pop-up menu. This restarts waveform averaging and gives a measurement based on the new signal level.

☐ Step 8: Read the Δ**Mean** measurement after it has stabilized. Subtract the Vertical Offset set in Step 5 from the Δ**Mean** measurement to get the DC Offset Error.

☐ Step 9: *Check* that the DC Offset Error obtained in Step 8 is less than the Error Limit listed in Table 2-4 for the current Vertical Size.

☐ Step 10: Repeat Steps 4 through 9 for each Vertical Size and Offset listed in Table 2-4.

***Table 2-4** — 11A81 Amplifier DC Offset Accuracy*

| Vertical Size | Vertical Offset | Error Limit (±Volts) |
|---|---|---|
| 1 V/div | 4 V | 31.3 mV |
| 500 mV/div | 4 V | 26.2 mV |
| 200 mV/div | 2 V | 12.6 mV |
| 100 mV/div | 1 V | 6.3 mV |
| 50 mV/div | 500 mV | 3.15 mV |
| 20 mV/div | 200 mV | 1.26 mV |
| 10 mV/div | 100 mV | 0.63 mV |
| 10 mV/div | 50 mV | 0.37 mV |

±0,53% + 0,01 div

## Procedure 8 DC Balance

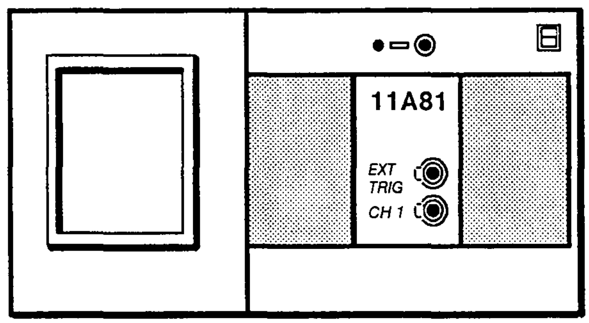
This procedure examines the position of the displayed trace with no input signal applied. It confirms that DC balance has been calibrated accurately. Drift over time or temperature is not tested. Therefore, you must perform this procedure immediately after entry into the Enhanced Accuracy state.

### Specification

Balance within ±0.1 division.

### Setup to Check DC Balance

CSA 404 or 11403A




### Procedure to Check DC Balance

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

11A81 Amplifier
CH 1 display on/off . . . . . . . . . . on
Mainframe . . . . . . . . . . no setting changes

☐ Step 2: Measure the trace position as follows:

- Touch **Acquire Desc** in the Waveform major menu.
- Set **Average N** to **On** in the **Acquire Description** pop-up menu.
- Press the MEASURE button, and then touch **Measurements**.
- Touch **Mean** in the **Measurements** pop-up menu and then **Mean** in the MEASURE major menu.
- Touch **Data Interval** to select **Whole Zone** in the **Mean** pop-up menu.

☐ Step 3: *Check* that the **Mean** readout is within the Error Limit listed adjacent to the current Vert Size setting (1 V/div) in Table 2-5.

☐ Step 4: Repeat Step 3 for each Vert Size setting in Table 2-5. Allow 10 seconds for the **Mean** measurement to settle after each Vert Size change.

***Table 2-5*** *— 11A81 DC Balance Error Limits*

| Vert Size Setting | Error Limit (0.1 div) |
|---|---|
| 1 V/div | 100 mV |
| 500 mV/div | 50 mV |
| 200 mV/div | 20 mV |
| 100 mV/div | 10 mV |
| 50 mV/div | 5 mV |
| 20 mV/div | 2 mV |
| 10 mV/div | 1 mV |

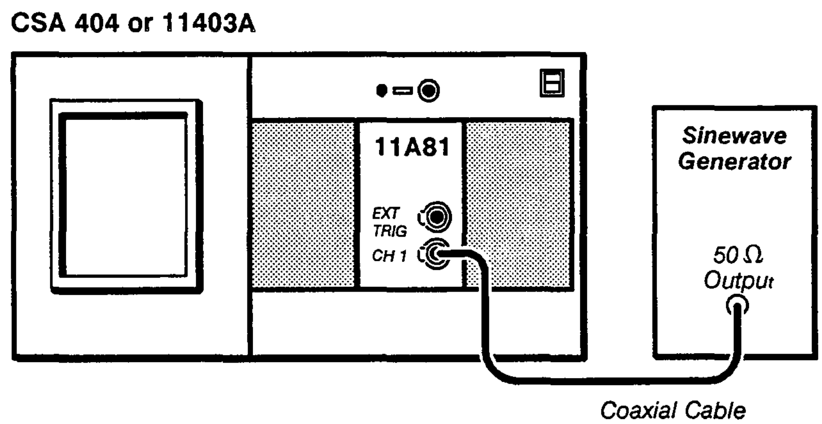
## Procedure 9 Internal Trigger

This procedure examines the sensitivity of the internal trigger to an applied input signal. The internal trigger signal is derived from the CH 1 input. The internal trigger is checked at the minimum specified amplitude for the rated bandwidth.

### Specification

Sensitivity of 2.0 divisions or less at 625 MHz.

### Setup to Check the Internal Trigger




### Procedure to Check Internal Trigger

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

11A81 Amplifier
- CH 1 Display on/off .......... on

Sinewave Generator
- Frequency .......... 625 MHz
- Amplitude .......... 100 mV pp

CSA 404 or 11403A 35.4 mV rms
- **Vertical Size** .......... 50 mV/div
- **Main Size** .......... 1 ns/div

☐ Step 2: Touch the Trigger icon.

☐ Step 3: *Check* that you can adjust the **Trigger Level** for a triggered display.

## Procedure 10 External Trigger

This procedure checks the sensitivity of the EXTERNAL TRIGGER INPUT to an applied input signal. The procedure checks that the External Trigger circuit can trigger on signals at the minimum specified amplitude for each frequency in the following Specification.

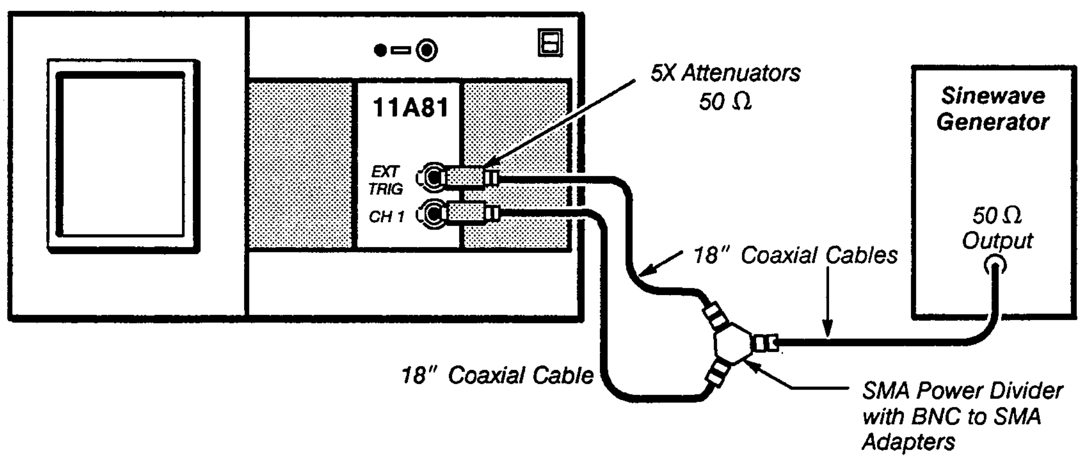
**Specification**

Trigger sensitivity is at least:

- 40 mV p-p at 200 MHz
- 150 mV p-p at 800 MHz
- 200 mV p-p at 2 GHz

**Setup to Check the External Trigger**

**CSA 404 or 11403A**




**Procedure to Check External Trigger**

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

11A81 Amplifier
  CH 1 display on/off .......................................... on
CSA 404 or 11403A
  **Vertical Size** .......................................... 10 mV/div
  **Main Size** .......................................... 2 ns/div
Sinewave Generator
  Frequency .......................................... 200 MHz
  Amplitude (4 divisions as measured on display) ........ 40 mV p-p

☐ Step 2: Press the TRIGGER major menu button and then select **Source Desc.**

- [ ] Step 3: Touch **C2 External** then **Enter Desc** to select the EXTERNAL TRIGGER as the trigger source.
- [ ] Step 4: *Check* that you can adjust the **Trigger Level** for a triggered display.
- [ ] Step 5: Set the **Vertical Size** to 20 mV/div.
- [ ] Step 6: Set the **Main Size** to 1 ns/div.
- [ ] Step 7: Set the Sinewave generator Frequency to 800 MHz.
- [ ] Step 8: Set the Sinewave generator Amplitude for a displayed signal amplitude of 145 mV p-p (7.25 divisions). This setting will ensure a signal level of 150 mV p-p at the EXTERNAL TRIGGER INPUT. Small impedance differences cause this discrepancy between the displayed amplitude and the applied trigger amplitude.
- [ ] Step 9: *Check* that you can adjust the **Trigger Level** for a triggered display.
- [ ] Step 10: Set the **Main Size** to 500 ps/div.
- [ ] Step 11: Set the Sinewave generator Frequency to 2 GHz.
- [ ] Step 12: Set the Sinewave generator Amplitude for a displayed signal amplitude of 160 mV p-p (8 divisions). This setting will ensure a signal level of 200 mV p-p at the EXTERNAL TRIGGER INPUT.
- [ ] Step 13: *Check* that you can adjust the **Trigger Level** for a triggered display.

# Maintenance

This section contains information for performing preventive maintenance, diagnostic troubleshooting, and corrective maintenance on the 11A16 Amplifier. Preventative Maintenance describes cleaning techniques that can extend the life of the 11A81. Diagnostic Troubleshooting describes the internal software diagnostics and provides information that relates diagnostic errors with suspect FRUs (field-replaceable units). The FRUs include circuit boards and some socketed components. Corrective Maintenance describes procedures for removal and replacement of FRUs and checks required after replacement. Service beyond this level must be done at a Tektronix service center.

For more information on the equipment used in this section refer to Table 2-2.

## Preventive Maintenance

Preventive maintenance can prevent the amplifier from failing and will ensure reliable operation. The environment in which the amplifier is operated will affect the frequency of maintenance. For example, operation in a dusty environment will require more frequent cleaning of the plug-in unit to maintain proper component temperatures.

### Amplifier Shield Removal

The side shields, top and bottom frames, and front panel reduce radiation of electromagnetic interference (EMI) from the amplifier. Grooves in the frame hold the side shields in place.

Remove a side shield as follows:

☐ Step 1: Gently pry the side shield up from the rear of the 11A81.

☐ Step 2: Lift up on the shield.

☐ Step 3: Remove the shield from the grooves in the frame and front panel.

Install a side shield as follows:

☐ Step 1: Position the shield over the frame grooves.

☐ Step 2: Slide the front lip of the side shield under the front panel.

☐ Step 3: Press down on the shield until it snaps into place. (Pressure must be applied along the full length of the frames to secure the shield.)

Note that the 11A81 will not slide into the mainframe if the side shields are not fully seated in the frames.

### Cleaning

The amplifier should be cleaned as often as operating conditions require. Dirt on components insulates them preventing efficient heat dissipation. Dirt also provides an electrical conduction path, which can lead to amplifier failure.

The side shields of the amplifier, reduce the amount of dust reaching the interior of the amplifier. Therefore, keep the amplifier side shields in place for safety and cooling (except when you are performing internal adjustments or maintenance procedures).

**CAUTION**

*Avoid the use of chemical cleaning agents which might damage the materials in this amplifier: Use only isopropyl alcohol. Before using any other type of cleaner, consult your local Tektronix service center or representative.*

**Exterior** – dust 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 amplifier is seldom required. If the interior of the amplifier accumulates dust or dirt, clean with dry, low-velocity air. Remove any remaining dirt with a soft brush or a cloth dampened with isopropyl alcohol. A cotton-tipped applicator is good for cleaning in narrow spaces and for cleaning more delicate components. Finally, remove any cleaning residue with dry, low-velocity air.

**CAUTION**

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

### Visual Inspection

The amplifier should be inspected occasionally for loosely-seated or heat-damaged components. The corrective procedure for most visible defects is replacement; however, particular care must be taken if heat-damaged parts are found. Since overheating usually indicates other problems with the amplifier, correcting the cause of overheating is important to prevent the replaced part from being damaged.

### Periodic Electrical Adjustment

To ensure accurate measurements, check the electrical adjustment of the amplifier after each 2,000 hours of operation; or every 24 months if you use the amplifier infrequently. Refer to *Checks and Adjustments* in this manual for the procedures necessary to check these electrical adjustments.

## Diagnostic Troubleshooting

The 11A81 and its supporting mainframe automatically perform a series of diagnostic tests when powered on. The diagnostic tests generate error index codes for any failures. You can cross-reference an error index code to the suspect FRU(s) using the FRU Guide tables, Tables 3-1 and 3-2.

**Note:** *Any diagnostic errors should be suspect until the 11A81 has achieved Enhanced Accuracy in its current mainframe configuration. Exit Extended Diagnostics and invoke Enhanced Accuracy (press the ENHANCED ACCURACY button twice). Upon successful completion of Enhanced Accuracy, run* **Self Test** *in the Utility major menu and check that no diagnostic errors occur. Diagnostic errors would put the instrument into the Extended Diagnostic menu with an error evident beside the 11A81 plug-in unit subsystem entry.*

### Diagnostics Overview

When power is applied, the 11A81 microprocessor (MPU) executes a set of Kernel tests to verify local functionality. If these tests are successful, then the mainframe starts the Self Tests to verify the functionality of each of the subsystems and their ability to communicate. Any Self Tests failure causes the oscilloscope to enter Extended Diagnostics and to display the error index code(s) in the Extended Diagnostics menu. Refer to your mainframe Service Reference for more information on Extended Diagnostics menus and operation. Error codes for the 11A81 Diagnostic tests are described later in this section.

The Kernel tests and Self Tests/Extended Diagnostics produce and format error index codes differently, and so these error index codes will be discussed separately.

### Kernel Tests

Each time the front panel ON/STANDBY switch is set to ON, the mainframe and amplifier perform Kernel diagnostics on their microprocessor subsystems and Self Tests diagnostics on all of their major circuits.

**CAUTION**

*Turning the mainframe power off during execution of the diagnostic tests can result in the lose of some or all data (for example, stored settings and calibration constants) from the non-volatile RAM (NVRAM). This loss of data can cause the oscilloscope to operate unpredictably. If this occurs, refer to* Restoring Calibration Data *later in this section.*

After the amplifier is powered-on, the microprocessor unit (MPU) 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 amplifier can communicate the failure to the mainframe. In most cases, the mainframe will continue to power up without recognizing the faulty 11A81 plug-in amplifier.

The Kernel diagnostics communicate a fault by flashing a fault code on the front panel CH 1 LED. The fault code is an index to the failing Kernel test. Table 3-3 lists the possible error codes. The CH 1 LED will light very briefly as power is applied to the oscilloscope, but this is of much shorter duration than the two second lighting produced by the Kernel diagnostics.

Read the fault code as follows:

- If the amplifier Kernel tests detect a fault, then the CH 1 LED is flashed. The LED is on for approximately two seconds per flash.
- Count the number of times the CH 1 LED is lit.

If one of the following errors occur, refer to Table 3-3 for a list of suspect FRU's. Refer to the appropriate replacement procedure in Table 3-8.

The three 11A81 Kernel tests are:

- **Test 1: The ROM Checksum test** – computes a checksum of the content of the firmware ROM. This calculated checksum is then compared with a checksum stored in the ROM. If the checksums do not match, the test fails and the CH 1 LED is flashed once. After the front panel LED flashes to report the fault code, the amplifier attempts to enter normal operation. However, it is unlikely that the amplifier can function properly as a bad ROM Checksum indicates a problem reading the EPROM.
- **Test 2: The Non-volatile RAM (NVRAM) test** – verifies that the NVRAM is functioning properly. Since the NVRAM contains calibration information which must remain undamaged, this test does not alter critical data. If the testing algorithm detects a failure, then the amplifier reports a fault code of 2 by flashing the CH 1 LED twice. The amplifier continues looping the NVRAM test until the oscilloscope is powered off (ON/STANDBY switch is set to STANDBY). The mainframe does not recognize the amplifier until the condition causing the NVRAM test to fail is corrected.

  The NVRAM test could corrupt data stored in the NVRAM if you power down the oscilloscope during this test. If corruption occurs, then the Calconstant Checksum will be corrupted as well. At the next power-on, the amplifier will reset the cal constants to default ROM settings and report a Plug-in (Amplifier) Calconstant Checksum Error during power-on diagnostics.
- **Test 3: The Serial Data Interface IC test** – verifies the functionality of the Serial Data Interface (SDI) IC. The SDI IC performs the following housekeeping chores of the amplifier: channel sequencing, refreshing the analog control voltage system (ACVS), and providing serial data communications with the mainframe. This test exercises the SDI IC, and records the ICs signature using an algorithm similar to signature analysis. If the resulting signature of the SDI IC does not match a known good signature, then this test fails and the front panel CH 1 LED is flashed three times. If this test does fail, then the amplifier continues looping on this test as long as the oscilloscope is powered on, generating activity on all SDI IC pins.

  After all power-on Kernel tests have completed successfully, the amplifier initializes its settings and communicates with the mainframe.

### Self Tests

After the 11A81 successfully passes its Kernel tests, the oscilloscope requests that the amplifier execute its Self Test routines (unless the oscilloscope Self Tests are disabled). If the oscilloscope returns to normal operation or starts a new configuration calibration, this indicates successful completion of the Self Tests. Any failures cause the oscilloscope to display the Extended Diagnostics menu.

Self-Test diagnostics test the following:

- Probe coding
- Calibration (cal) constant checksums
- Calibration (cal) constant values
- Serial number storage
- Analog Control Voltage system (ACVS)
- Analog-to-digital converter
- Probe power protection circuits
- Signal path
- Mainframe compatibility
- RMS protection circuit
- Calibration voltage buffer circuit

### Error Index Codes

The format of the error index codes is based on the Extended Diagnostics menu structure. Diagnostic 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 failure identity. For example, R1311 is decoded as follows:

| | |
|---|---|
| R | Subsystem – Right Plug-in Amplifier |
| 1 | Block name – R_11A81 |
| 3 | Area name – Group III |
| 1 | Routine name – ACVS Test |
| 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 amplifier is installed:

| | |
|---|---|
| L | Left |
| C | Center |
| R | Right |

The tables in this section, list only the four-digit failure code; the prefix L, C, or R is omitted.

### Using the Self Tests/Extended Diagnostics

After all Self Tests/Extended Diagnostic are executed, 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 experiences failure will indicate the first error encountered and the number of failures in the Block. To get a more complete list of the error index codes in a Block, touch the selector of a failed Block and then the Area selector. To display the lowest level test routines in the selected Area, touch the Routine selector.

Some diagnostic tests are not executed automatically during the Self Tests. These manual tests generate unique error index codes that can aid in troubleshooting failures. You can select and run the manual tests from the Extended Diagnostics menu.

Several operating mode selectors are available on the screen. When certain test routines are selected, some of these operating modes can not be selected.

Refer to your mainframe *User Reference* for more information on Extended Diagnostics menus and operation.

### Enhanced Accuracy Errors

Enhanced Accuracy calibration can also generate error index codes whenever the calibration process fails. These error codes are listed in Table 3-6 with cross reference to the FRU(s) likely to have caused the failure. For an overview of the Enhanced Accuracy mode, refer to Procedure 2, Enhanced Accuracy in the *Checks and Adjustments* section of this manual. Refer to your mainframe *User Reference* for additional information.

### Calibrating a New Configuration

When a amplifier is first installed in an oscilloscope or is moved to a different compartment in the oscilloscope, the oscilloscope enters a new configuration mode. After the oscilloscope executes the power-on 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 then a message appears and the oscilloscope enters the normal operating mode.

### Restoring Calibration Data

If the oscilloscope is powered off (ON/STANDBY switch set to STANDBY) during probe calibration, Self Tests, Extended Diagnostics or other intense system activity, then some internal data can be corrupted. If the Extended Diagnostic menu is displayed when the power is turned on, then this corruption might have occurred.

If the Extended Diagnostics menu displays a **Cksm Probe** error (this error indicates that the power was turned off during probe calibration), then use the following procedure to restore normal operation:

- ☐ Step 1: Note the amplifier at fault from the Extended Diagnostics menu.
- ☐ Step 2: Exit the Extended Diagnostics menu.

- [ ] Step 3: Remove and replace the probes on the amplifier at fault.
- [ ] Step 4: Recalibrate these probes.
- [ ] Step 5: Execute the Self Tests in the Utility2 major menu, and confirm that these tests pass.

If the Extended Diagnostics menu displays a **Serial Sum** or **Cksm Plug** error, the plug-in amplifier will require service. See *Programming the Unit Identification and Calibration Constants* on page 3-36 in this manual or contact your local Tektronix service representative.

### Memory Backup Power for the Amplifier

The non-volatile RAM (NVRAM) within the amplifier allows the data in memory to be retained when the amplifier is removed.

The NVRAM stores system-configuration data such as the amplifier, oscilloscope, and probe identification numbers as well as the factory cal constants. The data that the NVRAM stores, enable the amplifier to resume Enhanced Accuracy performance from a powered-off condition, without performing a full calibration (Enhanced Accuracy) operation.

The rated lifetime of the NVRAMs internal power source is ten years. If, on system power-on, the amplifier habitually loses Enhanced Accuracy status without a system configuration change (that is, the amplifier remains plugged into the same slot in the same oscilloscope), then you may need to replace the NVRAM.

## 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 the order of most-to-least probable cause (assuming only one error is indicated). If any diagnostic errors occur, inspect the suspect FRU for loose connections and components and then repeat the Diagnostic test. If any diagnostic errors reoccur, then replace the suspect FRU(s) with a 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 the old firmware or an updated version.

### Abbreviations of FRU Names

Table 3-1, Board FRUs, lists the abbreviation used in the Suspect Board FRU(s) column of Tables 3-3, 3-6, 3-4 and 3-5.

***Table 3-1** – Board FRUs*

| *Abbreviation* | *Name* | *Designator* |
|---|---|---|
| Main | Main board | A1 |
| S/H1 | Sample/Hold board (J1580) | A1A1 |
| S/H2 | Sample/Hold board (J1570) | A1A2 |
| Front | Front Panel board | A2 |
| RMS Pickoff | RMS Signal Pickoff board | A3 |

### Abbreviations of Component and Module Names

Table 3-2, Component/Module FRUs, lists the abbreviation used in the Suspect Module, Hybrid, or IC FRU(s) column of Tables 3-3, 3-4 and 3-5.

***Table 3-2** – Component/Module FRUs*

| *Abbreviation* | *Name* | *Designator* |
|---|---|---|
| EPROM | Firmware IC | U2140 |
| NVRAM | Memory IC | U2040 |
| Presampler | Presampler Hypcon IC | U650 |
| Diode Bridge | Diode Bridge Hypcon IC | U950 |
| SDI | Serial Data Interface IC | U1540 |
| Attenuator | Attenuator assembly | |
| CAL Relay | CH 1 Cal Relay | |
| Fuse | External Trigger Fuse | F330 |

## Error Index Codes

The error index codes are divided into three tables. A table of Kernel error index codes (Table 3-3), a table of Self Tests/Extended Diagnostic error indexes (Table 3-4), and a table of Enhanced Accuracy error indexes (Table 3-5).

Table 3-3 lists the error codes possible in the Kernel Tests.

***Table 3-3** – Amplifier Kernel Error Index Codes*

| *Error Code (# of CH 1 LED Lightings)* | *Suspect Module, Hybrid, or IC FRU(s)* | *Suspect Board (FRU(s)* |
|---|---|---|
| 1 | EPROM | Main |
| 2 | NVRAM | Main |
| 3 | SDI | Main |

Table 3-4 lists the error codes possible for the Self Tests and Extended Diagnostics.

***Table 3-4** – Self Tests/Extended Diagnostics Error Index Codes*

| *Error Code* | *Suspect Module, Hybrid, or IC FRU(s)* | *Suspect Board (FRU(s)* |
|---|---|---|
| 1111 | NVRAM | Main |
| 1121 | NVRAM | Main |
| 1131 | (mainframe) | Main |
| 1141 | Probe | Main |
| 1151 | | Main, S/H1, S/H2 |
| 1211 | | Main |
| 1221 | (Probe power) | Main, Probe |
| 1231 | | Main |
| 1241 | | Main |
| 1311 | SDI | Main, S/H1, S/H2 |
| 1321 | | RMS Pickoff, Main |
| 1611 | Presampler | Main |
| 1621 | Presampler, Diode Bridge, Attenuator | Main |

**Note:** *Interconnections are not listed but you should consider them as possible problem sources.*

Table 3-5 lists the error codes possible from Enhanced Accuracy calibration. Other error codes may be generated for other installed plug-in units or the oscilloscope mainframe.

***Table 3-5** — Enhanced Accuracy Error Index Codes*

| *Error Code* | *Suspect Module, Hybrid, or IC FRU(s)* | *Suspect Board (FRU(s)* |
|---|---|---|
| 1411 | Presampler | Main |
| 1421 | Pesampler | Main |
| 1431 | Attenuator | |
| 1441 | Pesampler | Main |
| 1451 | Pesampler | Main |
| 1461 | Pesampler, Diode Bridge | Main |
| 1471 | Diode Bridge | Main |

### Decoding an S/H Failure

You can decode the **Actual** data accompanying an X1311 error code to identify the suspect Sample and Hold board. The **Actual** data is a hexadecimal (hex) number. Convert this hex number to binary, then determine which bits are 1. For example, the hex code 0040 is equivalent to the binary 0000 0000 0100 0000. The single 1 is in Binary Bit position 6 which points to the S/H2 board.

Table 3-6 shows the suspect board and the board pin number for the failed ACVS channel. Refer to Figure 3-1 to locate a failed S/H board. If both S/H boards have failures this would point to the SDI IC or other common circuitry.

***Table 3-6** – Sample and Hold Board Failure Codes*

| Binary Bit | Suspect S/H FRU | Board Pin # |
|---|---|---|
| 15 | S/H2 (J1570) | 20 |
| 14 | S/H2 | 22 |
| 13 | S/H1 (J1580) | 20 |
| 12 | S/H1 | 22 |
| 11 | S/H2 | 19 |
| 10 | S/H2 | 23 |
| 9 | S/H1 | 19 |
| 8 | S/H1 | 23 |
| 7 | S/H2 | 17 |
| 6 | S/H2 | 14 |
| 5 | S/H1 | 17 |
| 4 | S/H1 | 14 |
| 3 | S/H2 | 15 |
| 2 | S/H2 | 16 |
| 1 | S/H1 | 15 |
| 0 | S/H1 | 16 |

Refer to Table 3-5 for a list of error indexes resulting from Enhanced Accuracy.

### Fuse Troubleshooting

The fuse F330 protects the External Trigger circuit. Figure 3-1 (FRU locator) shows the location of fuse F330 and the on board spare fuse. To remove the fuse, press down on both ends of the fuse metal spring and slide the spring until it pops up. Remove the metal spring and the fuse. If the fuse has zero resistance across the two contacts on the bottom center of the fuse, it is good.

Diagnostic error code 1221 indicates that one or more of the probe power lines appear defective. Both the CH 1 and EXTERNAL TRIGGER INPUT provide probe power. Check probe connections and/or remove the probes and rerun the failed diagnostic test. Check the flexible cables connecting the TEKPROBE connectors to the Main board for continuity. A continued failure with no probe attached indicates a possible Main board problem.

### Jumpers

The Main board has three jumpers as shown on Figure 3-1. The jumpers are as follows:

- J1630 (default 2–3) configures the 11A81 to allow the plug-in unit ID and factory calibration constants to be modified.
- J1970 (default 2–3) configures the MPU to read from the EPROM.
- J2180 (default 2–3) configures the MPU for reset.

## Corrective Maintenance

Corrective maintenance consists of Field Replaceable Unit (FRU) and FRU IC replacement. This section describes the techniques required to replace the FRUs in the 11A81.

### Ordering Parts

For instructions on how to order replacement parts, refer to *Replaceable Parts*, section 5 of this manual.

### Static-Sensitive Device Classification

**CAUTION**

*Static discharge can damage any semiconductor in the amplifier.*

The amplifier contains electrical components that are susceptible to damage from static discharge. Refer to Table 3-7, Relative Susceptibility to Damage from Static Discharge, for the 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 the original containers if possible; otherwise transport them on a metal surface or conductive foam. Label any package that contains static-sensitive assemblies or components.

3. Wear a wrist strap while handling these components to discharge the static voltage from your body. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel. Use a static control mat during repair.
4. Clear anything from the work station surface that is capable of generating or holding static charge.
5. Keep the component leads shorted together when not installed.
6. Pick up components by the body, never by the leads.
7. Do not slide components over any surface.
8. Avoid handling components in areas that have a floor or a work-surface covering that is capable of generating static charge.

***Table 3-7*** *— 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**
**(The voltage equivalent is the voltage discharged from a 100 pF capacitor through a resistance of 100 Ω.)**

## Removing/Replacing FRUs

Table 3-8, FRU Removal/Replacement Procedures, lists the procedures that describe how to remove and replace the FRUs. The first column in the table lists the FRU to be removed or replaced, and the second column lists the procedures that you should follow to remove/replace this FRU. See Figure 3-1 to determine the location of an FRU.

**CAUTION** *To avoid damage to the amplifier, set the oscilloscope's ON/STANDBY switch to STANDBY, and remove the amplifier from the oscilloscope before removing or replacing FRUs.*

**CAUTION** *If the oscilloscope's green indicator light remains lit when the ON/STANDBY switch is in the STANDBY position, then the switch was internally disabled after the servicing of the Power Supply module. To enable the ON/STANDBY switch, refer to Section 3, Maintenance, of the Service Reference manual for your oscilloscope.*

The exploded-view drawing in Section 5, Replaceable Parts, may also be useful in the removal/replacement procedures that follow. Note that the side shields will have to be removed to gain access to most of the parts listed in the removal/replacement procedures that follow.

***Table 3-8** — FRU Removal/Replacement Procedures*

| FRU to be Replaced | Procedures to Reference During Removal/Replacement | Page |
|---|---|---|
| A2 Front Panel board | Removing/Replacing the Front Panel Assembly | 3-17 |
| | Removing/Replacing the A2 Front Panel board | 3-20 |
| | Multi-Pin Connectors | 3-38 |
| BNC Connectors | Removing/Replacing the Front Panel Assembly | 3-17 |
| | Removing/Replacing the BNC Connector Assemblies | 3-21 |
| | Multi-Pin Connectors | 3-38 |
| Cal Relay | Removing/Replacing the Cal Relay | 3-22 |
| RMS Pickoff | Removing/Replacing the RMS Pickoff board | 3-23 |
| Attenuator | Removing/Replacing the Attenuator | 3-23 |
| | Multi-Pin Connectors | 3-38 |
| A1 Main Board | Removing/Replacing the A1 Main Board | 3-26 |
| | Removing/Replacing the Heat Sink | 3-28 |
| | Multi-Pin Connectors | 3-38 |
| | Programming the Unit Identification and the Calibration Constants | 3-36 |
| Heat Sink | Removing/Replacing the A1 Main Board | 3-26 |
| | Removing/Replacing the Heat Sink | 3-28 |
| | Removing/Replacing Hypcon Assemblies | 3-29 |
| Presampler Hypcon (U1540) | Removing/Replacing Hypcon Assemblies | 3-29 |

*Table 3-8 — FRU Removal/Replacement Procedures*

| FRU to be Replaced | Procedures to Reference During Removal/Replacement | Page |
|---|---|---|
| Diode Bridge Hypcon (U950) | Removing/Replacing Hypcon Assemblies | 3-29 |
| SDI (U1540) | Removing/Replacing the Serial Data Interface (SDI) IC (U1540) | 3-33 |
| NVRAM (U2040) | Removing/Replacing the NVRAM IC<br>Programming the Unit Identification and the Calibration Constants | 3-34<br>3-36 |
| EPROM (U2140) | Removing/Replacing the EPROM IC | 3-35 |

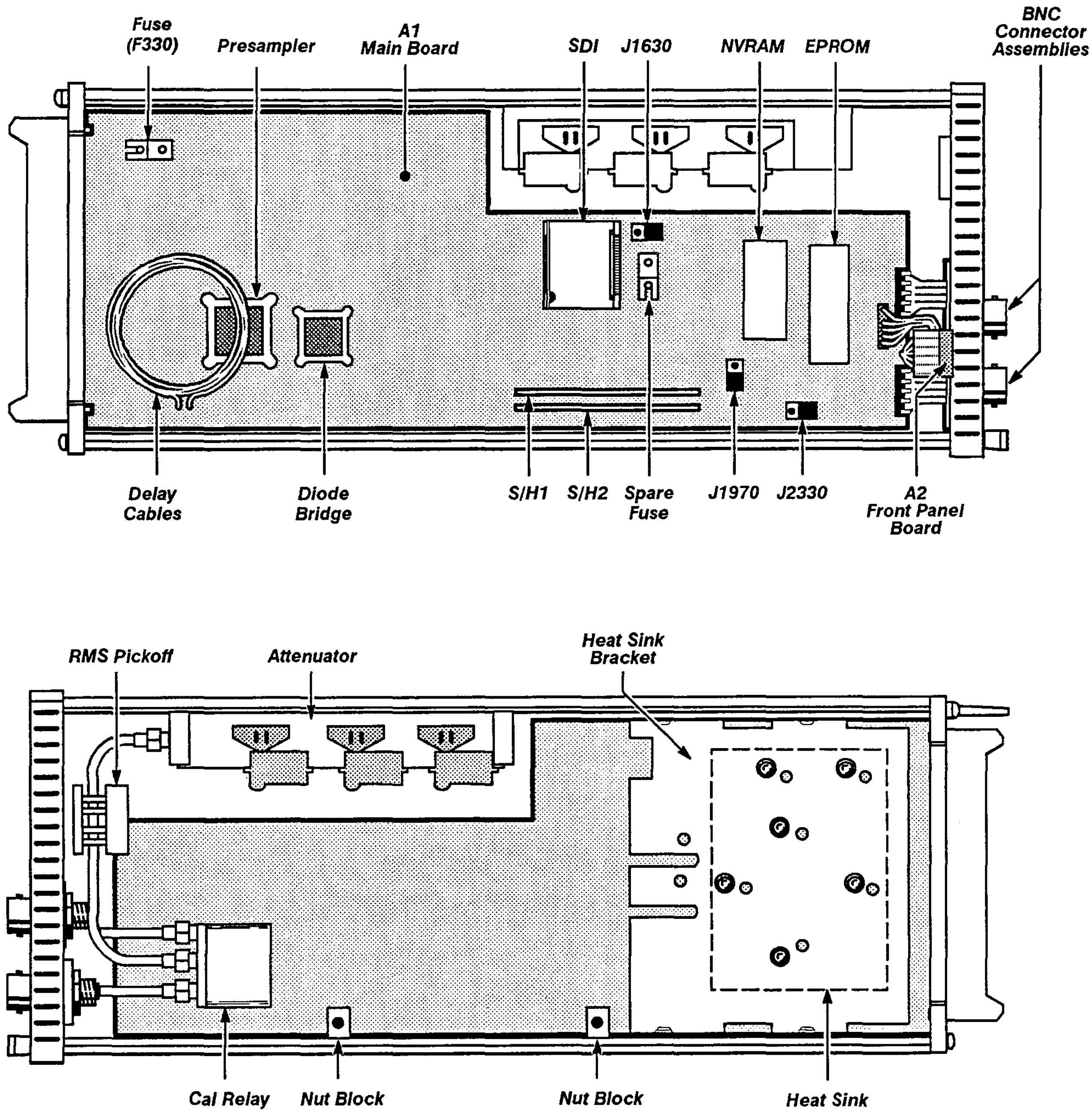


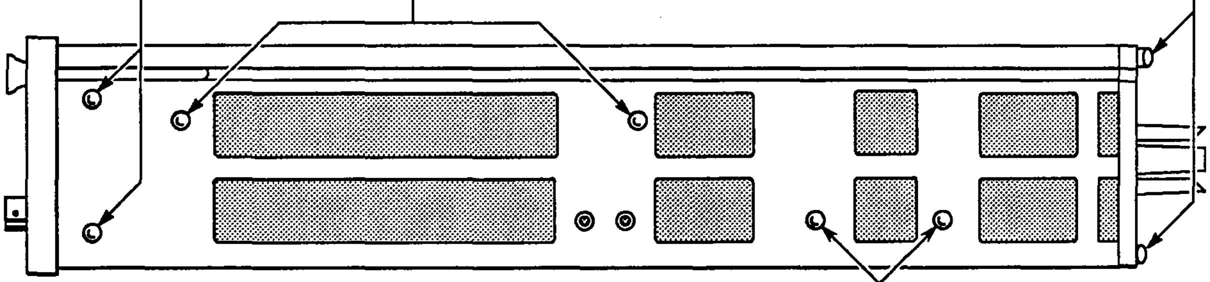

*Figure 3-1 — FRU and FRU IC Locator*

### Removing/Replacing the Front Panel Assembly

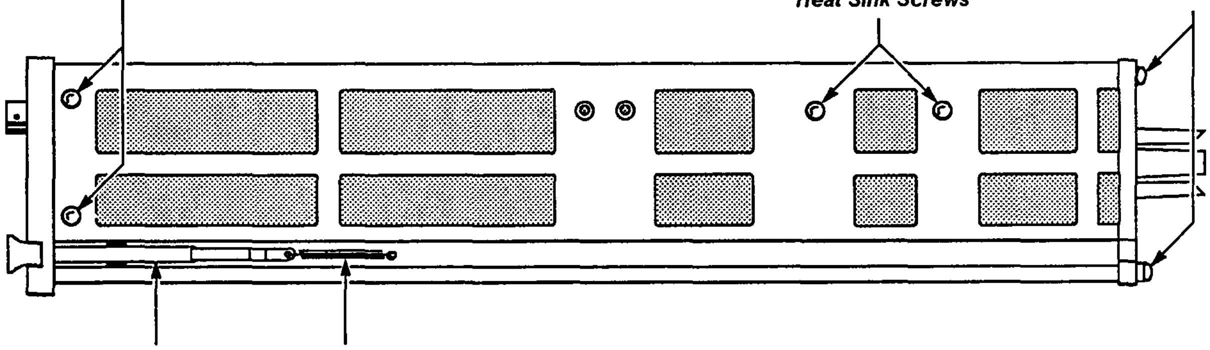
The Front Panel assembly must be removed to gain access to several replaceable FRUs and mechanical parts. The Cal Relay and its bracket are removed with the Front Panel assembly. You will need a $\frac{5}{16}$″ open end wrench for this procedure. See Figures 3-1, 3-2 and 3-3 for connector and screw locations.

Remove the Front Panel assembly as follows:

- [ ] Step 1: Unhook the return spring, located on the bottom of the amplifier, from the bottom frame. Keep this spring for reassembly.
- [ ] Step 2: Carefully pull the coaxial cable from the rear of the EXTERNAL TRIGGER INPUT Peltola connector.
- [ ] Step 3: Loosen the two Pozidrive #1 tip screws on the Cal Relay.
- [ ] Step 4: Using a $\frac{5}{16}$″ open end wrench, disconnect the RMS Pickoff board from the Cal Relay as follows:
  - Disconnect the SMA cable from the N0 connector (nearest plug-in center) on the Cal Relay.
  - Loosen the SMA connector on the front of the Attenuator.
  - Disconnect the SMA cable from the middle connector on the Cal Relay.
  - The RMS Pickoff board will be loose but still connected to the Attenuator by SMA cable and to the Main board by its two-wire cable when you remove the Front Panel assembly.
- [ ] Step 5: Turn the plug-in so the component side faces you. Disconnect the multi-pin connector that comes from the A2 Front Panel board at the A1 Main board. Note the position of the multi-pin connector index triangle to ensure correct replacement.
- [ ] Step 6: Disconnect the probe-information connectors from the A1 Main board as follows:
  - Place your index finger under the metal contacts with your thumb on top.
  - Starting at one end, lift the seven metal contacts out of the receptacle on the A1 Main board.
- [ ] Step 7: Remove the T10 Torx head screw that secures the Cal Relay bracket to the A1 Main board. The screw is located next to the connector J2440 at the front of the A1 Main board.




*Top View of 11A81 Amplifier*
*T8 Torx Head Screws




*Bottom View of 11A81 Amplifier*
*T8 Torx Head Screws

***Figure 3-2*** *– Removing/Replacing the Front Panel*

☐ Step 8: Remove the four flat-head, T8 Torx head screws (two on the bottom and two on the top of the front panel) that secure the front panel to the top and bottom frames.

☐ Step 9: Pull the release bar out of the front subpanel as far as possible. Leave the release bar in this position.

☐ Step 10: Pull the Front Panel assembly loose from the plug-in, taking care to clear the RMS Pickoff board. Figure 3-3 shows the complete Front Panel assembly.

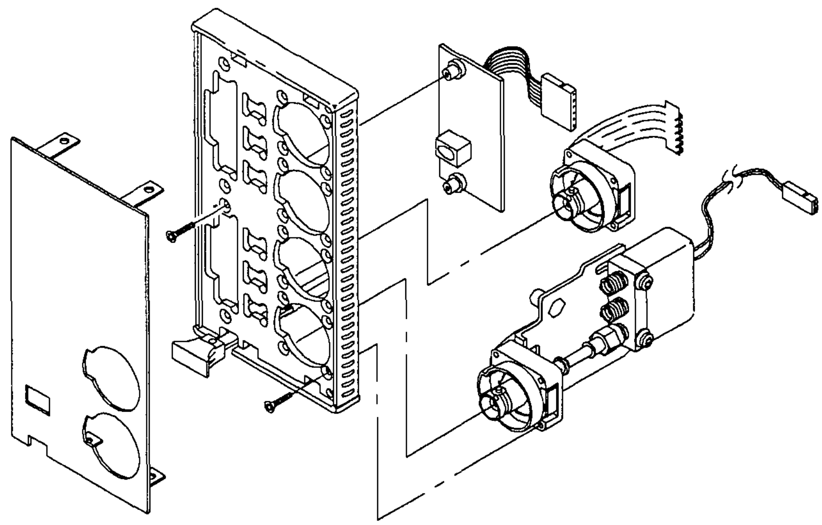


*Figure 3-3 — Components of the Front Panel Assembly*

☐ Step 11: To remove the Front Panel from the front subpanel, press out the Front Panel tabs at the top and bottom where they fit through holes in the front subpanel.

☐ Step 12: Carefully separate the Front Panel from the subpanel and remove the Front Panel from the Front Panel assembly. Take care not to bend the Front Panel.

☐ Step 13: Reinstall the Front Panel assembly by performing in reverse order Steps 1 through 12. Do not over tighten the SMA connectors as this could degrade product bandwidth. Before tightening the Cal Relay Pozidrive® screws, press the Cal Relay fully forward to ensure proper mating of the CH 1 Peltola connector.

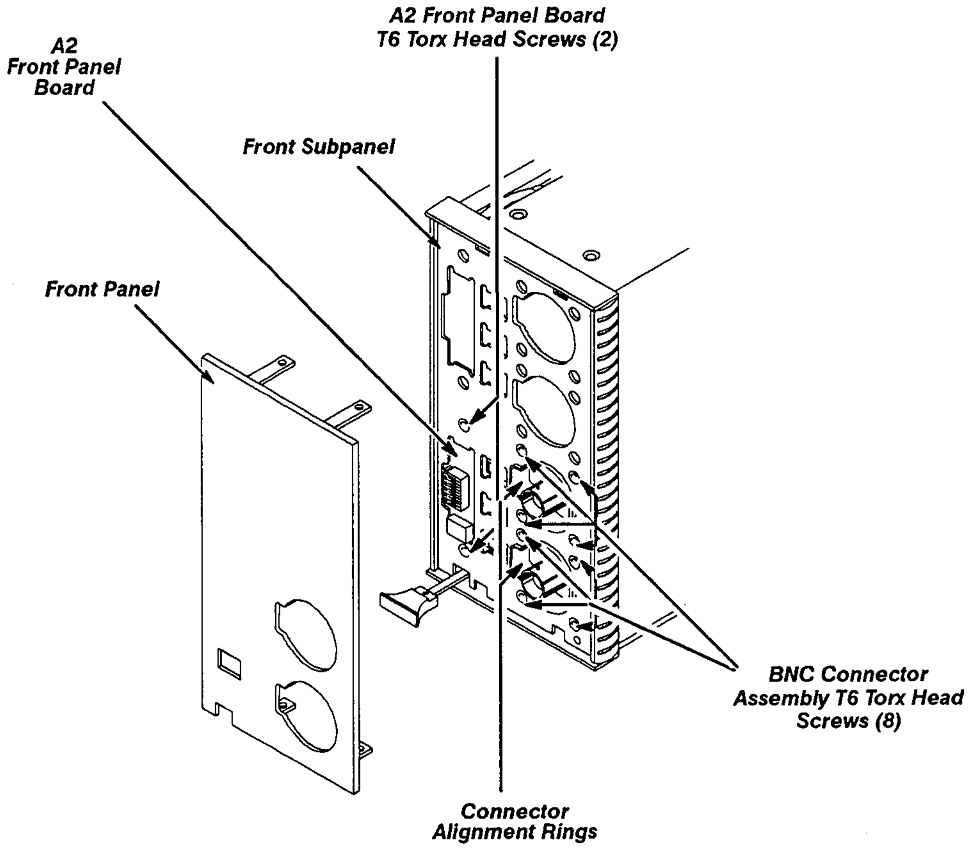



***Figure 3-4*** *— Removing/Replacing the BNC Connector Assembly and the A2 Front Panel Board*

## Removing/Replacing the A2 Front Panel Board

See Figures 3-1, 3-3, 3-4, and 3-12 for connector, screw and index locations.

Remove and replace the A2 Front Panel board as follows:

☐ Step 1: Remove the Front Panel assembly as described on page 3-17.

☐ Step 2: Remove the two T6 Torx head screws that secure the A2 Front Panel board to the front subpanel.

☐ Step 3: Remove the A2 Front Panel board.

☐ Step 4: Replace the A2 Front Panel board by performing in reverse order Steps 1 through 3.

### Removing/Replacing the BNC Connector Assemblies

The procedures needed to remove the two BNC connectors are somewhat different. You will need to remove the Front Panel assembly to gain access to either BNC. These BNC connectors are unique in that their back ends have Peltola connectors. See Figures 3-1, 3-2, 3-3, 3-4 and 3-12.

Remove the BNC connector assemblies as follows:

- [ ] Step 1: Remove the Front Panel assembly including the Front Panel as described on page 3-17.
- [ ] Step 2: For the CH 1 BNC only, *loosen* the two Pozidrive #1 tip screws that secure the Cal Relay to its bracket. For the EXTERNAL TRIGGER INPUT BNC connector proceed to Step 6.
- [ ] Step 3: Loosen the SMA connector on the short, rigid coaxial cable.
- [ ] Step 4: Slide the Cal Relay away from the Front Panel as needed to remove CH 1 rigid coaxial cable.
- [ ] Step 5: Carefully pull the short, rigid coaxial cable straight out of the CH 1 connector and set it aside. Do not bend the center conductor.
- [ ] Step 6: Remove the nut and washer securing the Cal Relay bracket to the back of the CH 1 connector and remove the Cal Relay with bracket.
- [ ] Step 7: Remove the four T6 Torx head screws that secure the BNC connector assembly to the front subpanel.
- [ ] Step 8: Remove the BNC connector assembly from the front subpanel.

Replace the BNC connector assembly as follows:

- [ ] Step 1: Set the gray connector alignment ring on the BNC connector with the ring's index on the inside of the connector assembly (that is, the side where the flat cable enters the connector assembly).
- [ ] Step 2: Insert the BNC connector and the connector alignment ring into the hole in the front subpanel. Ensure that the flat cable is oriented towards the inside of the amplifier and the index on the connector alignment ring fits into the notch in the front subpanel.
- [ ] Step 3: Replace the four Torx head screws that secure the connector assembly to the front subpanel.
- [ ] Step 4: For the CH 1 BNC, reconnect the Cal Relay bracket to the back of the CH 1 BNC using the nut and washer.
- [ ] Step 5: Carefully insert the short, rigid coaxial cable into the CH 1 Peltola connector, then slide the Cal Relay forward and connect the SMA connector. Ensure that the coaxial cable is fully seated in the Peltola connector.
- [ ] Step 6: Replace the Front Panel assembly as described on page 3-17.

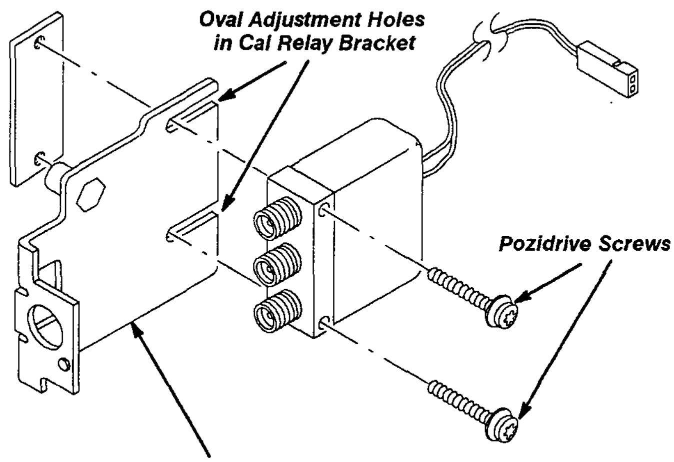



*Figure 3-5 — Removing/Replacing the Cal Relay*

### Removing/Replacing the Cal Relay

See Figures 3-1, 3-3, 3-5 and 3-12 for connector, screw, and index locations.

Remove and replace the Cal Relay as follows:

☐ Step 1: Loosen the two Pozidrive #1 tip screws that secure the Cal Relay to its bracket, but do not remove them.

☐ Step 2: Using the $\frac{5}{16}$″ open end wrench, loosen the SMA connector from the Cal Relay connector nearest to the plug-in center.

☐ Step 3: Remove the two-wire cable from J1100 on the Main board.

☐ Step 4: When the SMA rigid cable is free but still fully seated in the back of the CH 1 connector, slide the Cal Relay back until it is free of the bracket.

☐ Step 5: Reinstall the Cal Relay by performing in reverse order Steps 1 through 4. If you are replacing the Cal Relay the red wire goes toward the label sided of the Cal Relay. When the Cal Relay is installed, the brown wire will be further away from the Main board than the red wire and will connect to pin 1 of J1100. Be certain that the CH 1 SMA cable is fully seated in the CH 1 Peltola connector.

### Removing/Replacing the RMS Pickoff board

See Figure 3-1 for connector, screw, and index locations.

Remove the RMS Pickoff board as follows:

☐ Step 1: Loosen the Cal Relay Pozidrive #1 tip screws.

☐ Step 2: Remove the coaxial cable from the rear of the EXTERNAL TRIGGER INPUT.

☐ Step 3: Using the 5⁄16″ open end wrench, loosen the SMA connectors from the Cal Relay connector nearest to the plug-in center and from the center connector.

☐ Step 4: Remove the RMS Pickoff cable from the Attenuator.

☐ Step 5: Carefully note the orientation of the wire connections from the Pickoff board to the Main board, then desolder the wires at the Main board. Remove the RMS Pickoff board.

☐ Step 6: Reinstall the RMS Pickoff board by performing in reverse order Steps 1 through 5. Note that the RMS Pickoff board will fit one way only; with the shorter, rigid-coaxial-cable toward the Attenuator. The signal lead (brown) connects to Pin 1 (the square pad) on the Main board.

### Removing/Replacing an Attenuator

In this procedure, you will remove the top rail with the Attenuator attached. Read the following cautions before proceeding with the procedure.

**CAUTION**

*Applying excessive stress to the Z-shaped rigid coaxial cable at the rear of the Attenuator can ruin the Main board. The Z-shaped rigid coaxial cable is designed to flex enough to allow SMA connections during Attenuator removal.*

**CAUTION**

*When reconnecting the SMA rigid cables, do not over tighten the connectors. Doing so can damage the connector gasket and distort the cable dielectric, which can degrade the high-frequency performance of the cable.*

See Figures 3-1 and 3-2 for connector and screw locations.

Remove and replace the Attenuator as follows:

☐ Step 1: Pull the SMA cable free from the Peltola connector at the back of the EXTERNAL TRIGGER INPUT.

☐ Step 2: Remove the Attenuator ribbon cable from J1000.

☐ Step 3: Using the 5⁄16″ open end wrench, remove the SMA cable from the Cal Relay connector nearest the plug-in center, and then loosen the SMA connector on the center connector.

☐ Step 4: Loosen the SMA connectors at each end of the Attenuator.

- [ ] Step 5: Remove the T8 Torx head screws that secure the side rail to the plug-in unit, but do not remove the two screws that secure the Attenuator to the side rail. See Figure 3-2.
- [ ] Step 6: Remove the two T15 Torx head screws that secure the Rear panel to the top side rail.
- [ ] Step 7: Disconnect the SMA connector from the front of the Attenuator using the slack gained by loosening the middle SMA connector on the Cal Relay.
- [ ] Step 8: Lift up on the side rail while you remove the Z-shaped rigid coaxial cable from the Attenuator. Remove the side rail and Attenuator from the plug-in.
- [ ] Step 9: Remove the two T8 Torx head screws that secure the Attenuator to the side rail and remove the Attenuator.
- [ ] Step 10: If you are replacing the Attenuator remove the four T10 Torx head screws that secure the bracket to the Attenuator.
- [ ] Step 11: Reinstall the Attenuator by performing in reverse order Steps 1 through 10. Ensure that all SMA connectors are properly tightened.

After replacement of the Attenuator, you should perform the Checks and Adjustment Procedures 1 through 3.

### Removing/Replacing the A1 Main Board

The Main board contains a number of FRU ICs whose replacement is described later in this section. Refer to Table 3-8 on page 3-14 for the locations of these procedures. See Figures 3-1, 3-2, 3-8, 3-6, 3-7, and 3-12 for connector, screw, and index locations.

Remove and replace the A1 Main board as follows:

- [ ] Step 1: Disconnect the multi-pin connector that connects from the A2 Front Panel board to the A1 Main board. Note the position of the multi-pin connector index triangle to ensure that this connector can be correctly replaced.
- [ ] Step 2: Disconnect the probe information connectors from the A1 Main board as follows:
  - Place your index finger under the metal contacts with your thumb on top.
  - Starting at one end, lift the seven metal contacts out of the receptacle on the A1 Main board.
- [ ] Step 3: Disconnect the multi-pin connectors that connect from the Attenuator and Cal Relay to the A1 Main board. Note the position of the multi-pin connector index triangle to ensure that this connector can be correctly replaced.
- [ ] Step 4: Carefully remove the two coaxial cables that connect from the EXTERNAL TRIGGER INPUT and Cal Relay to the Peltola connectors J420 and J1130, respectively. Pull straight up on the cables to keep from bending the center conductors. Note where each cable connects.
- [ ] Step 5: Loosen the SMA connector at the rear of the Attenuator.
- [ ] Step 6: Remove the T10 Torx head screw that secures the Cal Relay to the A1 Main board.
- [ ] Step 7: Remove the four T15 Torx head screws that secure the plastic rear panel to the top and bottom frames.
- [ ] Step 8: Remove the four T8 Torx head screws that secure the heat sink bracket to the top and bottom frames.
- [ ] Step 9: Remove the two T10 Torx head screws and nut blocks that secure the A1 Main board to the bottom frame.
- [ ] Step 10: As you slide the A1 Main board between the frames and out the rear, disconnect the SMA cable from the rear of the Attenuator. Try to minimize stress to the Z-shaped rigid coaxial cable that remains on the A1 Main board.
- [ ] Step 11: If you are replacing the Main board, you will need to remove the Delay Cables and IC Heat Sink bracket (described on page 3-27) from the old A1 Main board and install them on the new A1 Main board. Also, press the rear-panel lock pin out of the alignment hole in the A1 Main board and reinstall the plastic rear panel on the new Main board. Do not remove the Preampler Hypcon IC from the old Main board.
- [ ] Step 12: Reinstall the A1 Main board by performing in reverse order Steps 1 through 10. Do not over tighten the SMA connector as this can adversely affect the high-frequency performance.

☐ Step 13: If the A1 Main board has been replaced, then you will need to re-enter the Unit Identification (UID) number. Refer to *Programming the Unit Identification and Calibration Constants* on page 3-36.

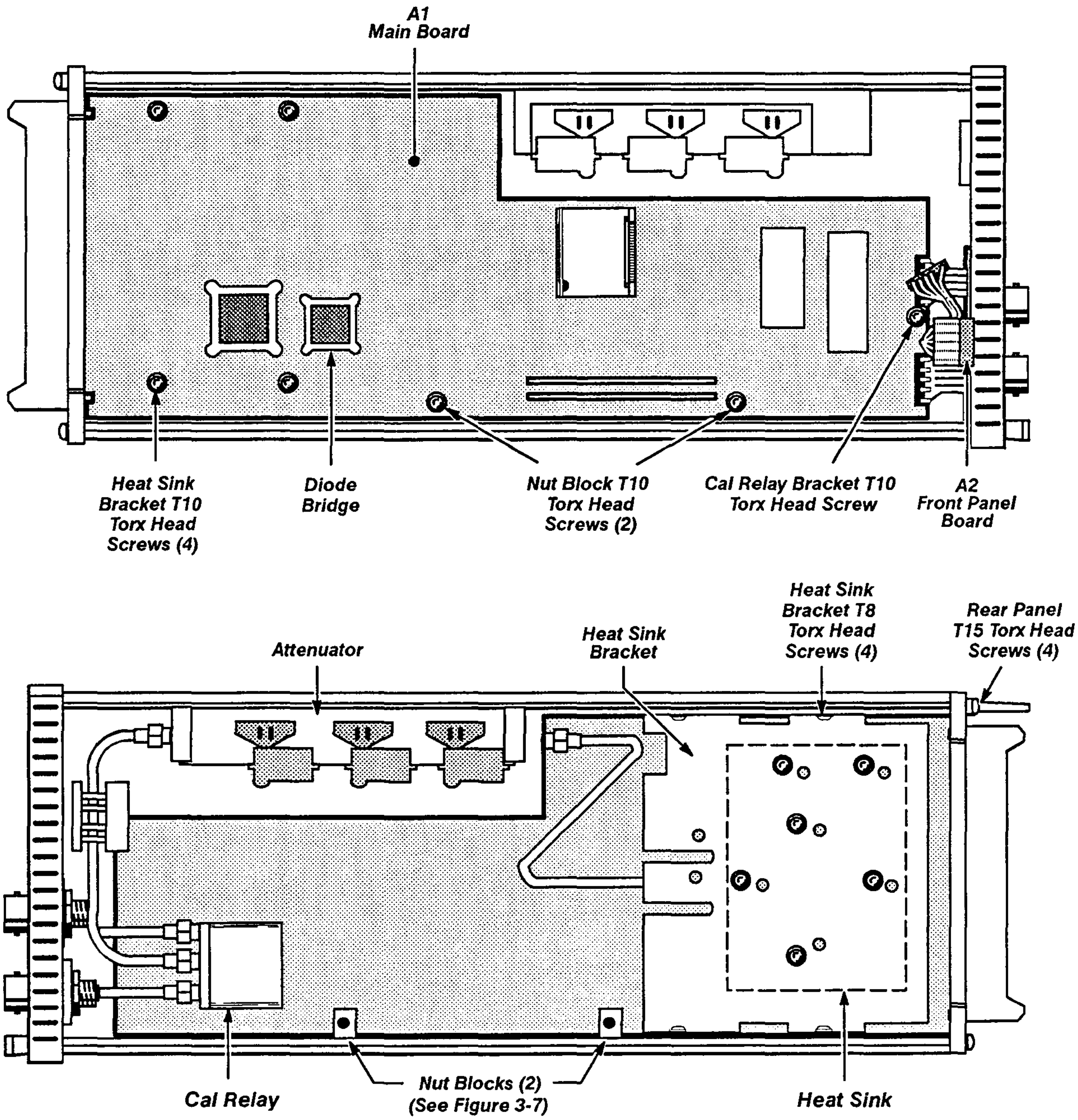



***Figure 3-6** — Removing/Replacing the A1 Main Board*

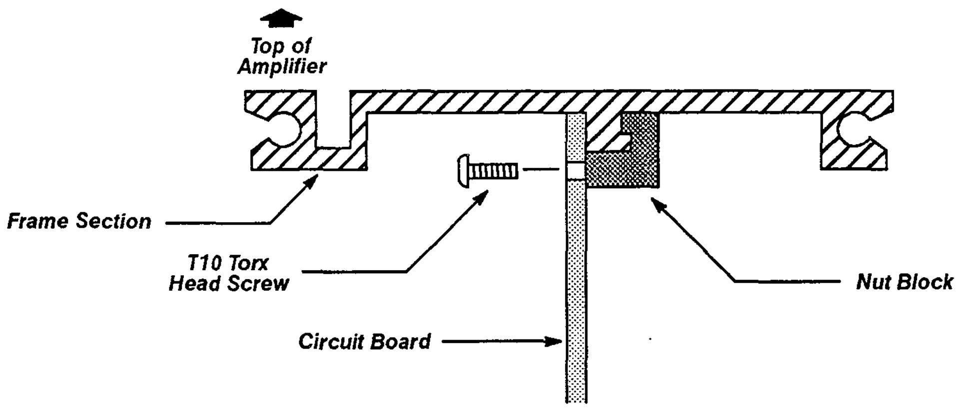



***Figure 3-7** – Torx Screw and Nut Block Orientation*

### Removing/Replacing the Presampler Heat Sink

To access the Presampler heat sink, you must first remove the A1 Main board and then the heat sink bracket as described in the following procedure. The heat sink bracket and heat sink require thermal grease between them to ensure proper cooling of the Presampler IC. Refer to the Test Equipment list on page 2-3 for information on the recommended type of thermal grease. See Figures 3-1, 3-8 and 3-9 for screw and index locations.

Remove and replace the heat sink as follows:

- ☐ Step 1: Remove the A1 Main board as described on page 3-25.
- ☐ Step 2: From the heat sink, remove the six T10 Torx head screws that secure the heat sink bracket to the A1 Main board and heat sink. See Figure 3-8.
- ☐ Step 3: From the component side of the A1 Main board, remove the four T10 Torx head screws that secure the heat sink bracket to the A1 Main board.
- ☐ Step 4: Lift up on the heat sink bracket and remove it from the A1 Main board. Take care not to spread thermal grease to components that do not require it.
- ☐ Step 5: Remove the Presampler Hypcon assembly as described on page 3-29. (This need not be removed if the Main board is being replaced.)
- ☐ Step 6: Remove the Presampler heat sink.
- ☐ Step 7: Reinstall the Presampler heat sink by performing Steps 1 through 6. Spread a thin layer of thermal grease on the Presampler heat sink before installing the heat sink bracket.

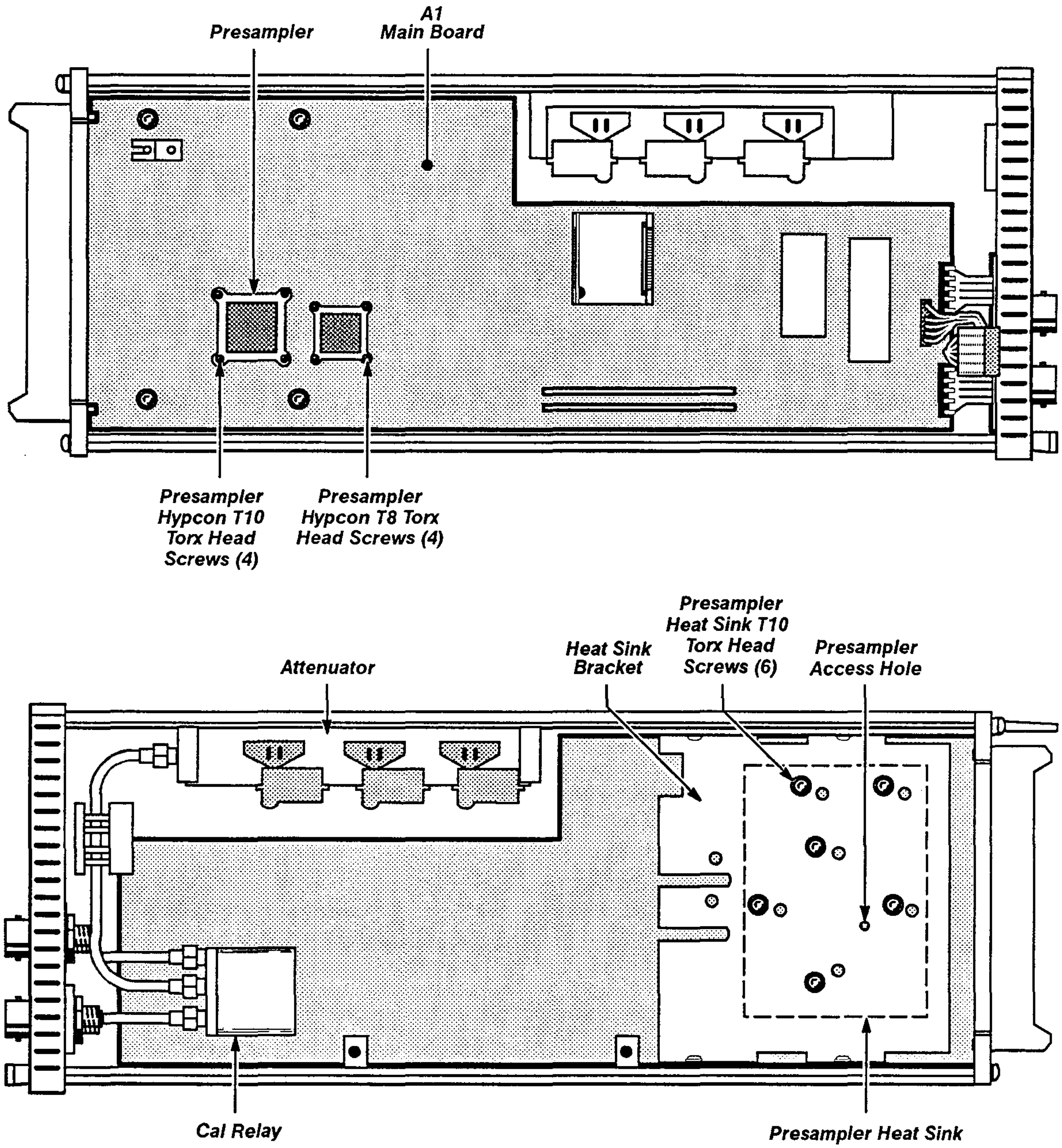



***Figure 3-8** — Removing/Replacing the Presampler Heat Sink*

**CAUTION**

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

### Removing/Replacing Hypcon Assemblies

The 11A81 Main board contains two Hypcon (**Hy**brid-**p**rinted circuit **con**nector) ICs: the Presampler (U650) and the Diode Bridge (U950). Replacement procedures for the two ICs is similar though some extra steps are necessary to ensure proper application of thermal grease for the Presampler IC. The Diode Bridge does not require thermal grease. The Diode Bridge procedure follows the Presampler IC procedure.

Figure 3-9 shows two views of the Hypcon assembly and identifies the parts of a Hypcon assembly. When replacing a Hypcon IC do not touch the elastomer's gold-plated contacts with your fingers. The Hypcon socket contacts are fragile and easily fouled by oil and dirt.

When removing and replacing a Hypcon follow these precautions:

- Clean contaminated hybrid and elastomer contact holders by flushing or spraying them with alcohol. If the contact holder is excessively contaminated, replace the holder.
- Use a 4X magnifying glass to examine the hybrid, elastomer, and the Hypcon contacts for dust, hair, lint, heat-transfer grease or other foreign matter. If the A1 Main board surfaces require more cleaning, then lightly scrub the surface with a soft rubber eraser and then clear any residue with low pressure air or vacuum while dusting the surface with a clean brush.

**CAUTION**

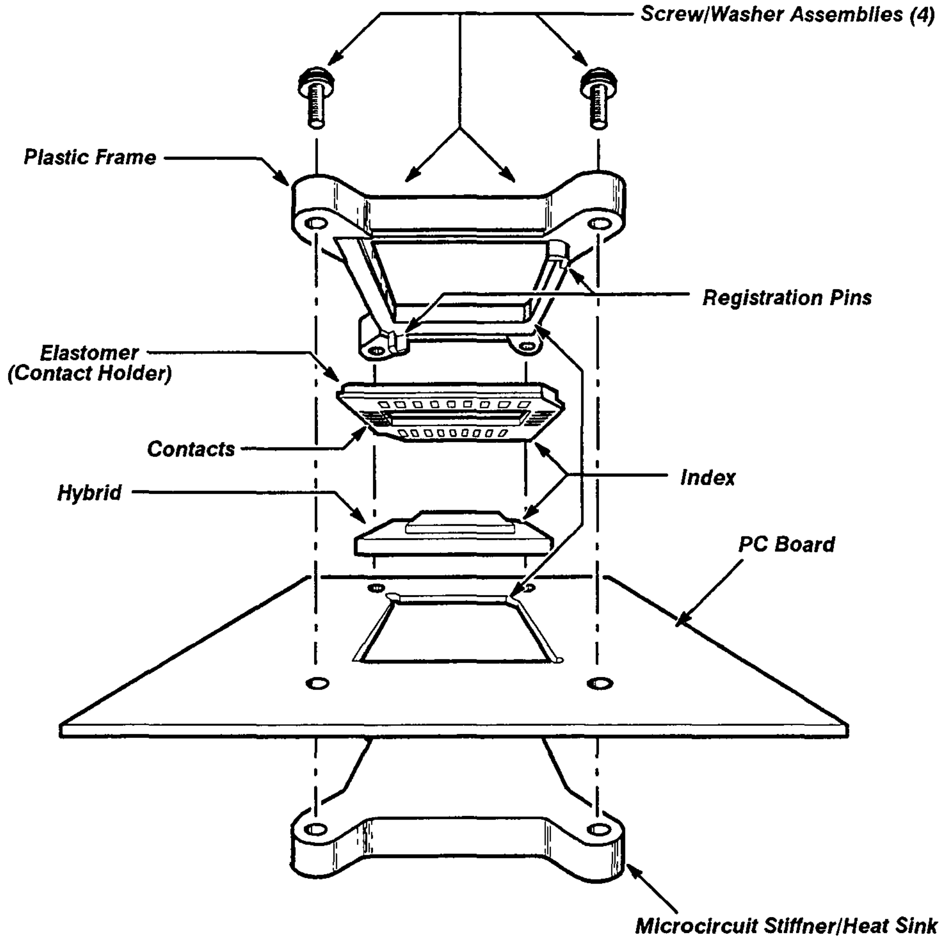
*Do not scrub with a cotton-tipped swab or similar device, since cotton fibers may adhere to the contacts.*

- The Presampler IC requires thermal grease between the IC and its heat sink and between the heat sink and the heat sink bracket. The thermal grease should be kept off all hypcon contacts. To remove any thermal grease from the contacts, flush or spray them with alcohol.
- Ensure that the elastomer is properly seated in the contact holder before remounting the assembly to the A1 Main board. That is, use care when mounting the assembly to the board to ensure that the proper alignment exists between the connector and A1 Main board.

**CAUTION**

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

*Exploded View of Hypcon Connector*




*Cross Section View of Hypcon Connector*

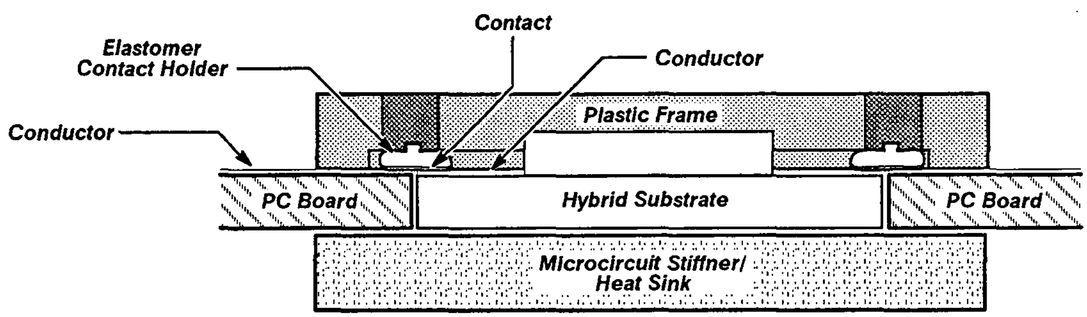



**Figure 3-9** — *Removing/Replacing a Hypcon Assembly*

**Presampler Hypcon (U650) Removal** – See Figure 3-1 for component identification, Figure 3-9 for indexing information and Figure 3-8 for Presampler Heat Sink information. Refer to the Test Equipment list on page 2-3for information on the recommended type of thermal grease.

Remove the Presampler IC as follows:

☐ Step 1: Notice the index on the A1 Main board (arrow) and the plastic frame (pointed tab).

☐ Step 2: Unscrew and remove the four T10 Torx head screws with washers.

☐ Step 3: Lift the plastic frame from the A1 Main board.

☐ Step 4: Notice the index location of the hybrid.

For the next Step you will need a 5–10 mm rod and a pair of tweezers to remove the Presampler hybrid IC.

☐ Step 5: Insert a 5–10 mm rod through the special hole in the Heat Sink bracket (see Figure 3-8) and apply steady, firm pressure on the back on the Presampler hybrid. The Presampler is held in place by adhesion of the thermal transfer grease between it and its heat sink

☐ Step 6: When the Presampler is free, remove it from A1 Main board with the tweezers.

> **Note:** *Step 7 describes the removal of the elastomer from the plastic frame. This step is unnecessary when replacing the hybrid only.*

☐ Step 7: Notice the index location of the elastomer (contact holder). Grasp and lift the corner of the contact holder with the tweezers to remove the holder from the plastic frame. (Do not touch the gold-plated contacts with your fingers.)

Ensure all parts are clean as described above, then replace the Presampler hypcon as follows:

☐ Step 1: Grasp a corner of the elastomer with the tweezers, and place the elastomer into the plastic frame.

☐ Step 2: Align the keyed corner of the elastomer with the keyed corner of plastic frame.

☐ Step 3: Tamp the elastomer into the plastic frame uniformly.

> **Note:** *Keeping the elastomer clean is very important. Small hairs and elastomer flash under the contacts can be almost impossible to see, but they can prevent good electrical contact. Most apparent failures of the hybrid are actually due to contamination of the Hypcon. Therefore, do not touch the gold-plated contacts with your fingers.*

☐ Step 4: Apply a small amount of thermal grease (a spot approximately $\frac{3}{16}$ inch or 5 mm in diameter) to the bottom, center of the Presampler IC. Applying excessive grease will result in fouled Hypcon contacts.

☐ Step 5: Carefully place the hybrid into the square hole in the A1 Main board. The hybrid is keyed so that it will fit into the A1 Main 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 A1 Main board. Take care not to get thermal grease on the IC contacts located on the Main board.

☐ Step 6: Place the plastic frame, with the elastomer installed over the hybrid, so that the key (pointed tab) aligns with the corner arrow on the board.

☐ Step 7: Replace the four Torx head screws with washers, and apply two inch-pounds of torque, (2.3 cm-kg) to secure the connector assembly. Do not overtighten the assembly; doing so can strip the microcircuit stiffener/heat sink mounting threads.

**Diode Bridge Hypcon (U950) Removal** – See Figure 3-9 for indexing information, and see Figure 3-1 for component identification.

Remove the Diode Bridge Hypcon as follows:

☐ Step 1: Notice the index on the A1 Main board (arrow) and the plastic frame (pointed tab).

☐ Step 2: Unscrew and remove the four T8 Torx head screws with washers.

☐ Step 3: Lift the plastic frame from the A1 Main board.

☐ Step 4: Notice the index location of the hybrid and remove the hybrid from the A1 Main board with tweezers.

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

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

Ensure all parts are clean as described above, then replace the Diode Bridge hypcon as follows:

☐ Step 1: Grasp a corner of the elastomer with the tweezers, and place the elastomer into the plastic frame.

☐ Step 2: Align the keyed corner of the elastomer with the keyed corner of plastic frame.

☐ Step 3: Tamp the elastomer into the plastic frame uniformly.

**Note:** *Keeping the elastomer clean is very important. Small hairs and elastomer flash under the contacts can be almost impossible to see, but they can prevent good electrical contact. Most apparent failures of the hybrid are actually due to contamination of the Hypcon. Therefore, do not touch the gold-plated contacts with your fingers.*

☐ Step 4: Carefully place the hybrid into the square hole in the A1 Main board. The hybrid is keyed so that it will fit into the A1 Main 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 A1 Main board.

☐ Step 5: Place the plastic frame, with the elastomer installed over the hybrid, so that the key (pointed tab) aligns with the corner arrow on the board.

☐ Step 6: Replace the four Torx head screws with washers, and apply two inch-pounds of torque, (2.3 cm-kg) to secure the connector assembly. Do not overtighten the assembly; doing so can strip the microcircuit stiffener/heat sink mounting threads.

**Removing/Replacing the Serial Data Interface (SDI) IC (U1540)**

The Serial Data Interface IC (U1540) is indexed to its socket by a beveled corner. The other corners are notched to fit the edges of the socket. The beveled corner aligns with a spring (small metal tab) at one corner of the socket.

See Figure 3-1 for component identification an 3-10 for indexing information.

Remove the Serial Data Interface IC as follows:

☐ Step 1: To remove the retaining clip, press down on the metal cover while you move the retaining clip over the tabs.

☐ Step 2: Slowly remove the cover to prevent the IC from falling out. Note the position of the index on the IC to ensure that this IC can be correctly replaced.

☐ Step 3: Remove the IC with clean tweezers.

CAUTION

*Avoid touching the IC or the socket contacts with your fingers since finger oils can lessen reliability.*

Replace the Serial Data Interface IC as follows:

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

CAUTION

*Do not damage the spring with the beveled corner; this could cause a short in the two corner contacts.*

☐ Step 2: Arrange the other corners, with the tweezers, to fit evenly at the edges of the socket.

☐ Step 3: Set the cover flat on the IC with the cover's end tabs properly aligned with, but not in, the mating recesses of the socket.

☐ Step 4: Push the cover down, keeping the cover flat on the IC, and slide the cover end tabs into place. Then, hold the cover in place while moving the retaining clip over the tabs on the other end of the cover.

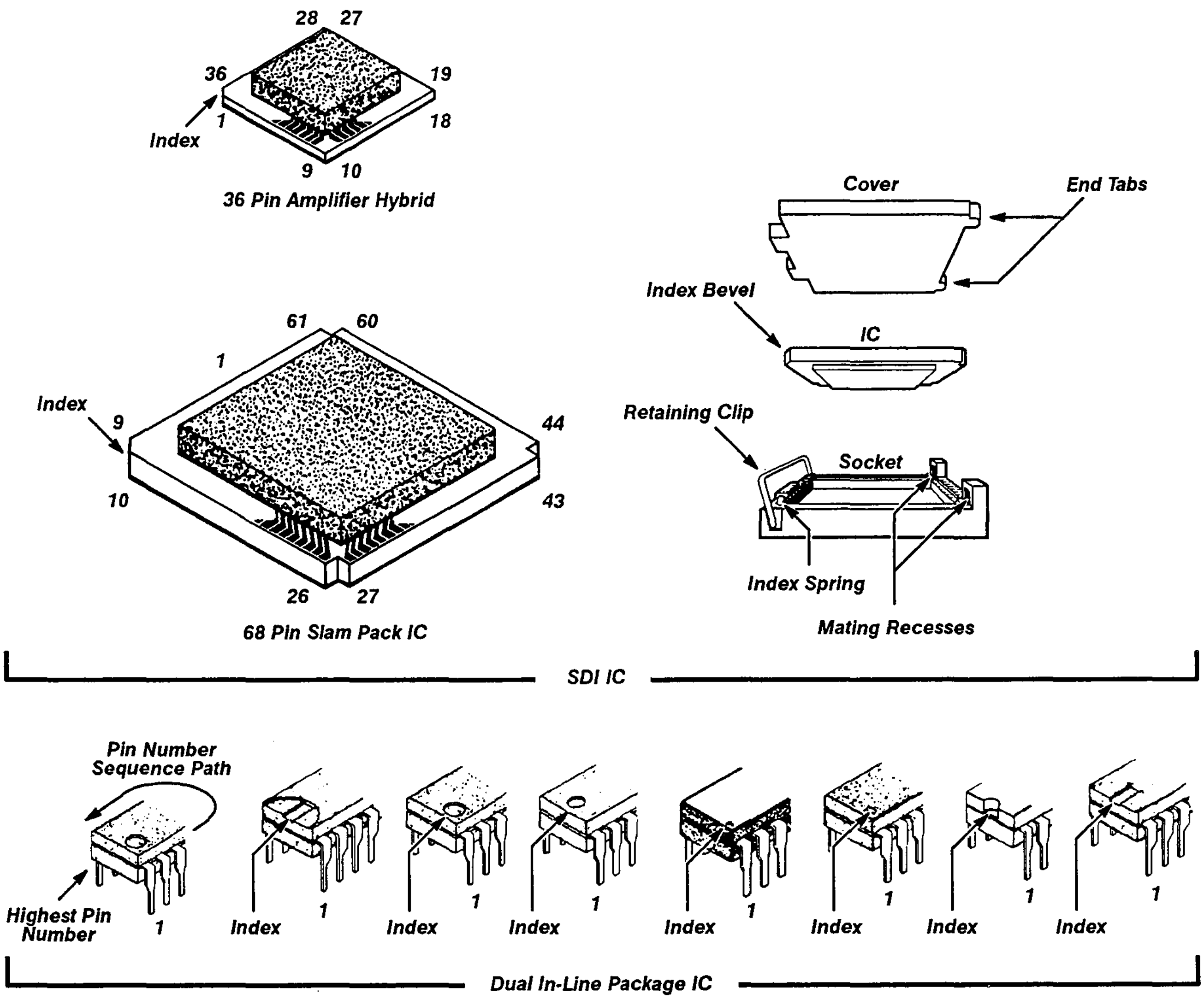



*Figure 3-10 – Semiconductor Indexing Diagram*

## Removing/Replacing the NVRAM IC

The NVRAM IC (U2040) is located on the A1 Main board. Important calibration information and the serial number for your 11A81 are stored in the NVRAM. You must put this information into the new NVRAM.

See Figure 3-1 for component identification and 3-10 for indexing information.

If the NVRAM IC is soldered into the board, then consult a Tektronix service center for recommended removal procedures. Do not solder-in the replacement IC: Instead, install a high quality 24-pin socket, and insert the new NVRAM IC into this socket. Follow the procedure on page 3-36 to record this data. Then perform the Procedures 1 through 3 in the Checks and Adjustments section of this manual.

### Removing/Replacing the EPROM IC

The EPROM IC (U2140) is located on the A1 Main board. You might need to change this IC if the EPROM develops a problem or if you are upgrading the firmware.

**CAUTION** *Do not remove the label affixed to the top of the EPROM. Removing this label will allow light into the IC, and can result in data in this IC being erased.*

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

See Figures 3-1, 3-10 and 3-11 for location, equipment and indexing information.

Remove the EPROM IC as follows:

- ☐ Step 1: Use the insertion-extraction pliers to remove the IC.
- ☐ Step 2: Position the pliers around the outside of the IC. Squeeze the handles to grasp the IC, and slowly pull the IC from the socket.

Replace the EPROM IC as follows:

- ☐ Step 1: Grasp the IC with the insertion-extraction pliers; ensuring that all the pins of the IC are straight and evenly spaced. (Do not use the IC label as an index, instead locate the index on the body of the IC.)
- ☐ Step 2: Align the index slot with the corresponding index on its socket.
- ☐ Step 3: Align the pins with their respective socket contacts.
- ☐ Step 4: Press the IC slowly and evenly into its socket.

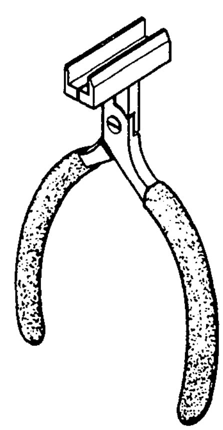


***Figure 3-11*** *– IC Insertion-Extraction Pliers*

### Programming the Unit Identification and the Calibration Constants

If you replace the nonvolatile RAM (NVRAM) or the A1 Main board; or the if the calibration constants are corrupted due to a power down of the oscilloscope during Enhanced Accuracy calibration, you will need to perform one of the following procedures. Jumper settings described in the procedures are not needed if you want only to query the current UIDs or calibration constants.

**Programming the Unit Identification** – The Unit Identification (UID) is stored in the NVRAM and is identical to the serial number of the amplifier. You can find the serial number at the front of the top rail of the 11A81. Program the UID into the NVRAM as follows:

☐ Step 1: Connect a terminal to the RS-232-C port of the oscilloscope.

☐ Step 2: Set the oscilloscope RS232C parameters as follows:

- Press the UTILITY button twice, and then touch **RS232C**.
- Set the **Baud Rate** to match the baud rate of the terminal you are using.
- Set **Echo** to **On** and **Verbose** to **On**.
- Refer to your oscilloscope *User Reference* for additional information on configuring the RS-232-C port.

☐ Step 3: Configure your mainframe by setting the calibration jumper J450 on the A6 Time Base board. Refer to your mainframe *Service Reference* for the jumper location.

☐ Step 4: Set the jumper J1630 across Pins 1 and 2 on the 11A81 A1 Main board. See Figure 3-1 for the jumper location. Obtain the amplifier serial number from the printed tag on the amplifier top rail, near the front panel.

☐ Step 5: Place the amplifier in any compartment.

☐ Step 6: Set the ON/STANDBY switch to ON.

☐ Step 7: Wait until the Diagnostics checks are completed.

☐ Step 8: On the Terminal, enter the command:

**UID [Left|Center|Right]:"**<Serial Number>**"**

**Left|Center|Right** refers to the compartment in which the amplifier resides. The Serial Number should include the initial character, usually B.

☐ Step 9: On the terminal, verify the entry by entering the query:

**UID? [Left|Center|Right]**

Observe that the correct UID is reported.

☐ Step 10: Set the ON/STANDBY switch to STANDBY.

☐ Step 11: Remove the amplifier.

☐ Step 12: Return the jumpers J1630 on the 11A81 Main board and J450 on the oscilloscope Time Base board to their normal operation positions.

If you need only confirm the UID, then you can skip Steps 1, 2, 6 and 10.

**Programming the Calibration Constants** – The calibration constants set the correct bias for the high-frequency signal path. There are five calibration constants to enter. Program the calibration constants as follows:

☐ Step 1: Connect a terminal to the RS-232-C port of the oscilloscope.

☐ Step 2: Set the oscilloscope RS232C parameters as follows:

- Press the UTILITY button twice, and then touch **RS232C**.
- Set the **Baud Rate** to match the baud rate of the terminal you are using.
- Set **Echo** to **On** and **Verbose** to **On**.
- Refer to your oscilloscope *User Reference* for additional information on configuring the RS-232-C port.

☐ Step 3: Configure your mainframe by setting the calibration jumper J450 on the A6 Time Base board. Refer to your mainframe *Service Reference* for the jumper location.

☐ Step 4: Set the jumper J1630 across Pins 1 and 2 on the 11A81 A1 Main board. See Figure 3-1 for the jumper location.

☐ Step 5: Place the amplifier in the CENTER compartment.

☐ Step 6: Set the ON/STANDBY switch to ON.

☐ Step 7: Wait until the Diagnostics checks are completed.

☐ Step 8: The following commands assume the 11A81 is installed in the CENTER compartment. If the 11A81 is installed in the LEFT or RIGHT compartment use the command **LCA:** or **RCA:**, respectively. On the terminal, enter each calibration constant as shown:

**CCA 80:-1.1**
**CCA 81:+0.5**
**CCA 82:-1.1**
**CCA 83:+0.5**
**CCA 84:-1.1**

☐ Step 9: Verify that the calibration constants you entered were correctly received, by entering the following query commands:

**CCA? 80**
**CCA? 81**
**CCA? 82**
**CCA? 83**
**CCA? 84**

Observe that the correct calibration constants are reported.

☐ Step 10: Perform the Procedures 1 through 3 in the *Checks and Adjustments* section of this manual.

☐ Step 11: Set the ON/STANDBY switch to STANDBY.

☐ Step 12: Remove the amplifier.

☐ Step 13: Return the jumpers J1630 on the 11A81 Main board and J450 on the oscilloscope Time Base board to their normal operation positions.

**Multi-Pin Connectors**

Pin 1 on a multi-pin connector is designated with a triangle (or arrowhead) on the holder. A square pad on the board denotes pin 1. When a connection is made to a board, the square pad determines the indexing of the symbol on the multi-pin holder.

A gap between the pin 1 and 3 positions in the holder keys a multi-pin connector. There is a corresponding gap between pins 1 and 3 on the board. (A small plastic plug covers the pin 2 position on the end of the holder.)

Align the plastic plug of the holder with the gap between the board pins (see Figure 3-12).

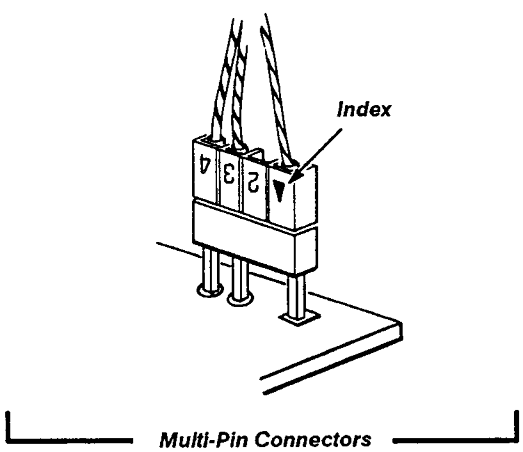



***Figure 3-12** – Multi-Pin Connector Orientation*

# Theory of Operation

The Tektronix 11A81 Amplifier is a wide bandwidth single-channel amplifier that operates only in 11403A and 11404 oscilloscope mainframes.

## System Functional Overview

This section describes and illustrates (see Figure 4-1) the major functional blocks of the 11A81 Amplifier

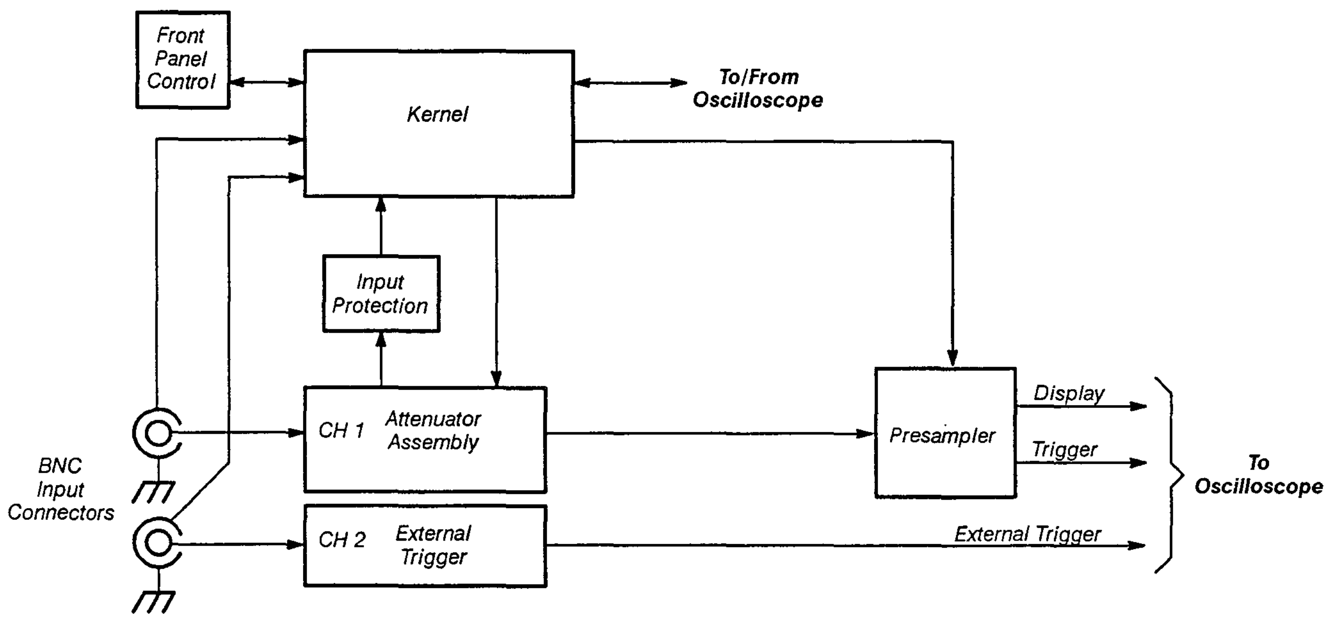



*Figure 4-1 — 11A81 Amplifier System Functional Block Diagram*

### Attenuator Assembly Block

The Attenuator assembly contains ganged attenuators that scale or attenuate the input signal.

### Input Protection Block

The Input Protection block protects the Presampler from both steady voltage levels in excess of 5 V rms and signal spikes.

### Presampler Block

The Presampler block provides amplification and offset of the input signal. The Presampler block produces two output signals: a display signal and a trigger signal. Each of these signals can be independently inverted or switched off.

### Front Panel Control Block

The Front Panel Control block provides information on the status of the front panel buttons to the Kernel block.

### Kernel Block

The Kernel block has the following major functions:

- to monitor the front panel button and probe information (such as type and attenuation)
- to interpret commands from the oscilloscope and then set the appropriate signal path configuration
- to manage the amplifier diagnostics and calibration
- control CH 1 coupling/disconnect

### External Trigger Block

The External Trigger block contains the trigger circuit for the 2 GHz trigger path. The Kernel block sets the trigger level and slope for the trigger circuit. A relay selects either the External Trigger or the internal trigger derived from the CH 1 input.

## Typical Signal Processing Cycle

The following sequence is a brief overview of how the amplifier acquires and processes a signal from the input connector:

1. An analog input signal is connected to the CH 1 BNC input connector.
2. The Cal Relay sets the input coupling mode (DC or Off) and the attenuator assembly scales the input signal prior to amplification.
3. The Presampler block samples the CH 1 input when strobed by the mainframe. This analog sample is briefly held for the mainframe to digitize. The internal trigger, which is derived from the CH 1 signal, is bandwidth limited.
4. At every acquisition strobe from the mainframe digitizer, the input signal is sampled again. This continues until the mainframe halts acquisition.
5. The Kernel block sets the offset voltage for the Presampler block. The Presampler subtracts the offset voltage from the attenuated signal and then amplifies and samples the resultant signal.
6. The Kernel block provides Normal/Invert control signals to the amplifier display and trigger paths, and on/off control for input protection.
7. The Diode Bridge circuit ensures that a high-voltage spike does not damage the Presampler and the 5 V Overload RMS Sense circuit detects sustained overdrive and decouples the input with the Cal Relay.
8. The External Trigger block generates a trigger-received signal to the mainframe when an applied signal has the required slope and trigger level. Slope (+ or –) and trigger level settings are controlled by the MPU.

## Detailed Block Diagram Descriptions

This section describes and illustrates the 11A81 Amplifier block diagram (see Figure 4-2 ).

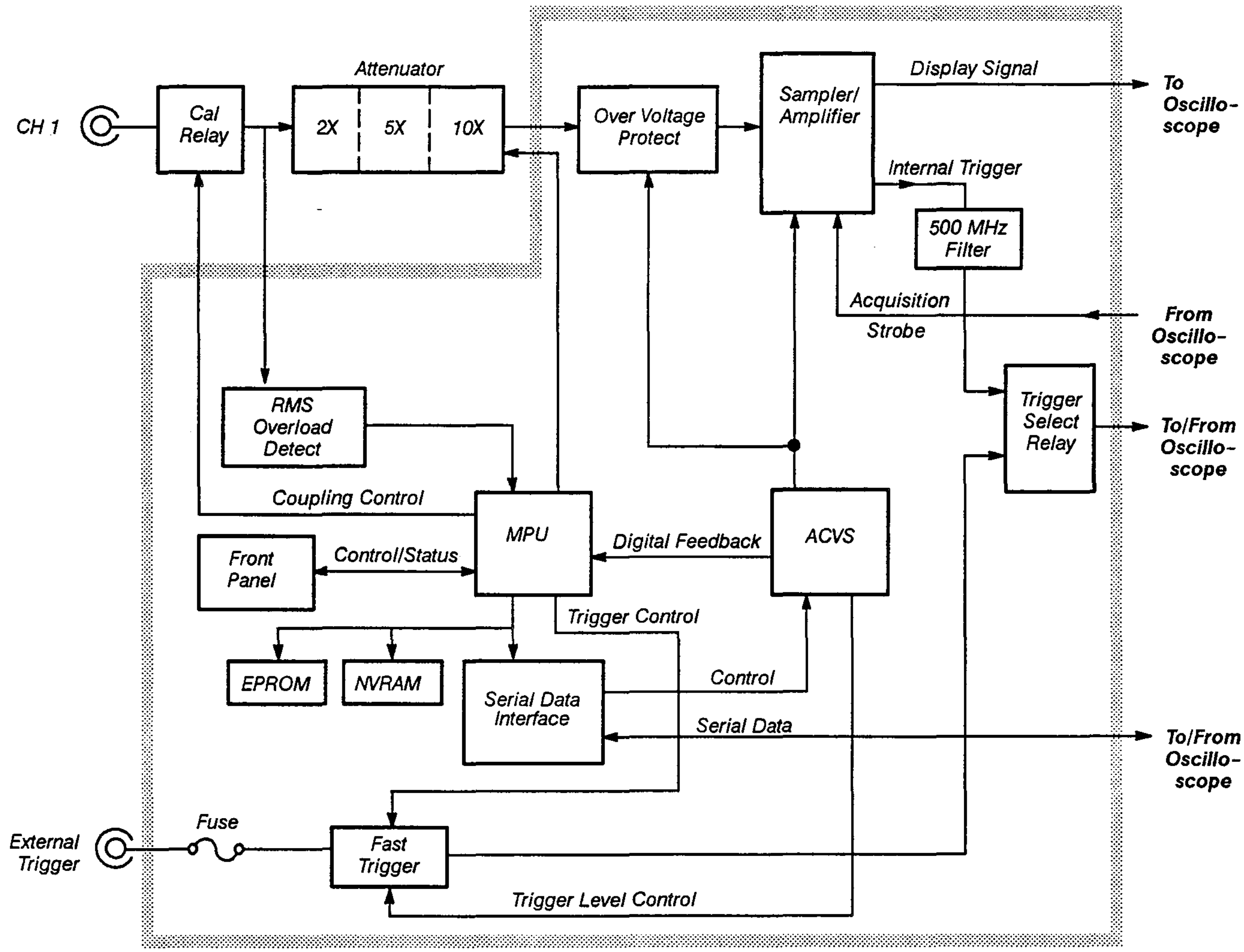



***Figure 4-2** — 11A81 Amplifier Detailed Block Diagram*

### Cal Relay

The Cal Relay provides for calibration of the input channel and for an Off coupling mode. The Off coupling mode is selected automatically when an an excessive input signal is detected by the RMS pickoff circuit. The input coupling mode can be set to DC or off.

During calibration and Self-Tests, the Cal Relay connects a calibration reference signal, from the mainframe, to the attenuator. During these operations, the CH 1 input is disconnected from the attenuator.

### RMS Overload Detect

The RMS Overload Detect circuit senses an overvoltage condition (greater than ±5 V rms) and disconnects the CH 1 input. The MPU receives an overvoltage signal then switches the Cal Relay to Off coupling. The RMS Overload circuit consists of a signal pickoff board in the input SMA line, a sense semi-connector

### Attenuator Block

The Attenuator block provides attenuation of the input signal to scale the signal to within the acceptable range of the Presampler. The attenuator is implemented as three cascaded sections: 2X, 5X, and 10X. Each or all of the attenuators can be switched in to produce the desired vertical size settings. The Attenuator block must be replaced as a unit.

### A1 Main Board

The A1 Main board consists of:

- Presampler
- strobe delay lines
- Microprocessor Unit (MPU)
- EPROM IC
- NVRAM IC
- Serial Data Interface (SDI)
- Analog Control Voltage System (ACVS)

**The Presampler** – amplifies the difference between the input signal and the DC offset voltage. The amplified signal is held briefly by the sampler for digitizing by the mainframe when strobed by the the mainframe acquisition strobe. The input analog signal is picked off and fed through and bandwidth limited to provide the internal trigger.

**The Fast Trigger** – circuit monitors the External Trigger signal. A fuse protects the Fast Trigger circuit from input signals outside the ±1 range. The ACVS system and the MPU control the trigger level and slope settings, respectively.

**The Trigger Relay** – selects either the External Trigger or the internal trigger derived from the CH 1 input signal.

**The MPU** – receives setting information from the oscilloscope and then implements these settings in the amplifier. It monitors the Front Panel and the RMS Overload Detect block. It controls settings in the Cal Relay, the Fast Trigger circuit, and the ACVS block.

**The EPROM IC** – stores the program code. The MPU uses this code to execute its functions.

**The NVRAM IC** – stores information; such as, the amplifier calibration constants, the amplifier serial number, and probe calibration constants.

**The Serial Data Interface (SDI) IC** – manages ACVS system with its array of sample and hold circuits to create eight analog control voltages. The SDI IC performs these functions on commands from the MPU. The MPU also stores the channel switching sequence in the SDI IC.

The SDI IC contains a receiver and transmitter for serial communications between the amplifier and oscilloscope. The SDI IC converts eight-bit data bytes from the MPU into a serial data signal. This signal is then sent to the oscilloscope. Conversely, the SDI IC converts the serial data from the oscilloscope into eight-bit data bytes for the MPU to read.

**The ACVS** – generates analog control voltages under control of the SDI IC and MPU. These control voltages provide biasing for the signal path components, offset for the Presampler, and trigger level for the trigger circuits.

### A2 Front Panel Board

The A2 Front Panel board contains an LED and a push button. The oscilloscope software will turn on the LED when its corresponding push button is pressed.

# Replaceable Parts

This section contains the list of replaceable components for the 11A81 Amplifier. As described below, use this list to identify and order replacement parts. Figure 5-1, at the rear of this section provides an exploded view of all replaceable components.

## Parts Ordering Information

Replacement parts are available from or through your local Tektronix, Inc., service center or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest circuit improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If a part you order has been replaced with a different or improved part, your local Tektronix service center or representative will contact you concerning any change in the part number.

### Module Replacement

The 11A81 is serviced by module replacement; there are three options you should consider:

- **Module Exchange.** In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1-800-TEKWIDE, ext. BVJ5799.
- **Module Repair.** You may ship your module to us for repair, after which we will return it to you.
- **New Modules.** You may purchase new, replacement modules in the same way as other replacement parts.

## Using the Replaceable Parts List

The tabular information in the Replaceable Parts List is arranged for quick retrieval. Understanding the structure and features of the list will help you find the all the information you need for ordering replacement parts.

### Item Names

In the Replaceable Parts List, an Item Name is separated from the description by a colon ( : ). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, use the U.S. Federal Cataloging Handbook H6-1, where available.

### Indentation System

Indentation in this parts list shows the relationship between items. The 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 at the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. Attaching parts must be purchased separately, unless otherwise specified.

### Abbreviations

Abbreviations conform to American National Standards Institute (ANSI) standard Y1.1

## CROSS INDEX – MFR. CODE NUMBER TO MANUFACTURER

| Mfr. Code | Manufacturer | Address | City, State, Zip Code |
|---|---|---|---|
| TK1163 | POLYCAST INC | 9898 SW TIGARD ST | TIGARD OR 97223 |
| TK1326 | NORTHWEST FOURSLIDE INC | 18224 SW 100TH CT | TUALATIN OR 97062 |
| TK1465 | BEAVERTON PARTS MFG CO | 1800 NW 216TH AVE | HILLSBORO OR 97124-6629 |
| TK1967 | SYNDETEK | 3915 E MAIN | SPOKANE WA 99202 |
| TK2197 | E-Z FORM CABLE CORP | 441 CHAPEL ST<br>PO BOX 9442 | NEW HAVEN CT 06534 |
| TK2338 | ACC MATERIALS | ED SNYDER<br>BLDG 38-302 | BEAVERTON OR 97077 |
| TK2469 | UNITREK CORPORATION | 3000 LEWIS & CLARK WAY<br>SUITE #2 | VANCOUVER WA 98601 |
| 0B0A9 | DALLAS SEMICONDUCTOR CORP | 4350 BELTWOOD PKWY SOUTH | DALLAS TX 75244 |
| 0JR05 | TRIQUEST CORP | 3000 LEWIS AND CLARK HWY | VANCOUVER WA 98661-2999 |
| 0J9P9 | GEROME MFG CO INC | PO BOX 737 | NEWBURG OR 97132 |
| 0KB01 | STAUFFER SUPPLY | 810 SE SHERMAN | PORTLAND OR 97214 |
| 07416 | NELSON NAME PLATE CO | 3191 CASITAS | LOS ANGELES CA 90039-2410 |
| 09922 | BURNDY CORP | RICHARDS AVE | NORWALK CT 06852 |
| 22526 | DU PONT E I DE NEMOURS AND CO INC<br>DU PONT ELECTRONICS DEPT | 515 FISHING CREEK RD | NEW CUMBERLAND PA 17070-3007 |
| 22599 | AMERACE CORP<br>ESNA DIV | 15201 BURBANK BLVD<br>SUITE C | VAN NUYS CA 91411-3532 |
| 50667 | DYNATECH MICROWAVE TECHNOLOGY INC<br>DYNATECH MICROWAVE SWITCHES DIV | 26655 W AGOURA RD | CLABASAS CA 91302-1921 |
| 53387 | MINNESOTA MINING MFG CO | PO BOX 2963 | AUSTIN TX 78769-2963 |
| 66302 | VLSI TECHNOLOGY INC | 1109 MCKAY DR | SAN JOSE CA 95131-1706 |
| 8X345 | NORTHWEST SPRING & MFG CO | 5858 WILLOW LANE | LAKE OSWEGO OR 97034-5343 |
| 80009 | TEKTRONIX INC | 14150 SW KARL BRAUN DR<br>PO BOX 500 | BEAVERTON OR 97077-0001 |
| 83385 | MICRODOT MFG INC<br>GREER-CENTRAL DIV | 3221 W BIG BEAVER RD | TROY MI 48098 |
| 83486 | ELCO INDUSTRIES INC | 1101 SAMUELSON RD | ROCKFORD IL 61101 |
| 92101 | SCHULZE MFG | 50 INGOLD RD | BURLINGAME CA 94010-2206 |
| 93907 | TEXTRON INC<br>CAMCAR DIV | 600 18TH AVE | ROCKFORD IL 61108-5181 |

| Fig. & Index No. | Tektronix Part No. | Serial No. Effective | Dscont | Qty | 12345 Name & Description | Mfr. Code | Mfr. Part No. |
|---|---|---|---|---|---|---|---|
| 1 -1 | 214-1061-00 | | | 1 | CONTACT,ELEC:GROUNDING,CU BE | 80009 | 214106100 |
| -2 | 426-2435-00 | | | 1 | FRAME,SECT:PLUG-IN,UPPER,ALUMINUM | TK1465 | ORDER BY DESC |
| -3 | 211-0392-00 | | | 10 | SCREW,MACHINE:4-40 X 0.25,FLH,82 DEG,STL | 93907 | ORDER BY DESC |
| -4 | 174-2606-00 | | | 1 | CABLE ASSY,RF:COAX,11.75 L,6-N | 80009 | 174260600 |
| -5 | 174-2584-00 | | | 1 | CABLE ASSY,RF:50 OHM COAX,23.0 L,6-N | 80009 | 174258400 |
| -6 | 211-0391-00 | | | 4 | SCREW,MACHINE:2-56 X 0.437,P4,STL,T8 | 83486 | ORDER BY DESC |
| -7 | 211-0409-00 | | | 4 | SCR,ASSEM WSHR:4-40 X 0.312,PNH,STL,T10 | 93907 | 829-06888-024 |
| -8 | 407-3918-00 | | | 1 | BRACKET,ANGLE:ATTENUATOR,ALUMINUM | 80009 | 407391800 |
| -9 | 119-4086-00 | | | 1 | ATTEN,PRGM:50 OHM,DC-56HZ,SEL | 80009 | 119-4086-00 |
| -10 | 165-2448-00 | | | 1 | MICROCKT,LIN:DIODE BRDG,1.75CM HYPCONS (A1U950) | 80009 | 165244800 |
| -11 | 119-3690-00 | | | 1 | HYPCON ASSY:44 CONTACT,STEP MOUNT | TK2338 | ORDER BY DESC |
| -12 | 136-0813-00 | | | 3 | SKT,PL-IN ELEK:CHIP CARRIER,68 CONTACTS | 53387 | 268-5400-00-110 |
| -13 | 211-0409-00 | | | 2 | SCR,ASSEM WSHR:4-40 X 0.312,PNH,STL,T10 | 93907 | 829-06888-024 |
| -14 | 211-0411-00 | | | 4 | SCR,ASSEM WSHR:4-40 X 0.5,PNH,STL,T10 | 93907 | ORDER BY DESC |
| -15 | 119-3689-00 | | | 1 | HYPCON ASSY:64 CONTACT,FLUSH MOUNT | TK2338 | ORDER BY DESC |
| -16 | 165-2392-00 | | | 1 | MICROCKT,LINEAR:PRE SAMPLER,H2392 (A1U650) | 80009 | 165239200 |
| | 006-2655-00 | | | 1 | THRM JT CMPD:#249 THERMALLOY | 80009 | 006265500 |
| -17 | 344-0248-00 | | | 2 | CLIP,FUSE:0.866 L,CU BE | 80009 | 344024800 |
| -18 | 159-0118-00 | | | 2 | FUSE,THERMAL:50 OHM (A1F330 & SPARE) | 80009 | 159011800 |
| -19 | 213-0904-00 | | | 4 | SCREW,TPG,TR:6-32 X 0.5,PNH,STL | 83385 | ORDER BY DESC |
| -20 | 386-5296-00 | | | 1 | PANEL,REAR:POLYCARBONATE | TK1163 | ORDER BY DESC |
| -21 | 671-1621-00 | | | 1 | CIRCUIT BD ASSY:MAIN (A1) | 80009 | 671162100 |
| -22 | 407-4089-00 | | | 1 | BRACKET,HT SK:ALUMINUM | 0J9P9 | ORDER BY DESC |
| -23 | 211-0409-00 | | | 10 | SCR,ASSEM WSHR:4-40 X 0.312,PNH,STL,T10 | 93907 | 829-06888-024 |
| -24 | 214-4426-00 | | | 1 | BLOCK,HEAT SINK:ALUMINUM | TK1465 | ORDER BY DESC |
| -25 | 220-0022-00 | | | 2 | NUT BLOCK:0.4 X 0.25 X 0.33,4-40 THRU,NI | 80009 | 220002200 |
| -26 | 131-4258-00 | | | 1 | CONN,RCPT,ELEC:COAX,PELTOLA END,BE-CU (A1J1050) | TK1326 | ORDER BY DESC |
| -27 | 174-2453-00 | | | 1 | CABLE ASSY,RF:50 OHM COAX,10.0 L,6-N | TK2469 | ORDER BY DESC |
| -28 | 211-0100-00 | | | 2 | SCREW,MACHINE:2-56 X 0.750,PNH,STL,POZ | 83385 | ORDER BY DESC |
| -29 | 119-1161-01 | | | 1 | SW,RF XMSN LINE:DC TO 21GHZ,60 DB ISOL | 50667 | D3-412C002 |
| -30 | 174-2426-00 | | | 1 | CABLE ASSY,RF:50 OHM COAX,1.398 L | TK2197 | ORDER BY DESC |
| -31 | 426-2061-00 | | | 1 | FR SECT,PLUG-IN:LOWER,ALUMINUM | TK1465 | ORDER BY DESC |
| -32 | 337-1064-11 | | | 2 | SHIELD,ELEC:PLUG-IN SIDE | 80009 | ORDER BY DESC |
| -33 | 671-2171-00 | | | 1 | CIRCUIT BD ASSY:RMS PICKOFF (A3) | 80009 | 671217100 |
| -34 | 407-4090-00 | | | 1 | BRACKET,RELAY:ALUMINUM | 0J9P9 | ORDER BY DESC |
| -35 | 131-3589-03 | | | 2 | CONN ASSY,ELEC:FRONT PANEL | 80009 | 131358903 |
| -36 | 354-0654-00 | | | 2 | RING,CONN ALIGN:BNC | 0JR05 | ORDER BY DESC |
| -37 | 211-0413-00 | | | 10 | SCREW,MACHINE:2-56 X 0.375,FLH,82 DEG,STL | 93907 | 221-00995-024 |
| -38 | 105-0076-04 | | | 1 | RELEASE BAR,LCH:PLUG-IN UNIT | 0JR05 | ORDER BY DESC |
| -39 | 366-0600-00 | | | 1 | PUSH BUTTON:0.269 X 0.409,ABS | TK1163 | ORDER BY DESC |
| -40 | 214-1095-00 | | | 1 | PIN,SPRING:0.187 L X 0.094 OD,STL | 22599 | 52-022-094-0187 |
| -41 | 214-1054-00 | | | 1 | SPRING,FLAT:0.825 X 0.322,SST | TK1326 | ORDER BY DESC |
| -42 | 105-0075-00 | | | 1 | BOLT,LATCH:7A & 7B SER PL-IN | 80009 | 105007500 |
| -43 | 214-1280-00 | | | 1 | SPRING,HLCPS:0.14 OD X 1.126 L,TWIST LOOP | 8X345 | ORDER BY DESC |
| -44 | 366-1058-00 | | | 1 | KNOB:GRAY,0.625 X 0.255 X 0.485 | 0JR05 | ORDER BY DESC |

| Fig. & Index No. | Tektronix Part No. | Serial No. Effective | Dscont | Qty | 12345 Name & Description | Mfr. Code | Mfr. Part No. |
|---|---|---|---|---|---|---|---|
| 1 -45 | 348-0235-00 | | | 2 | SHLD GSKT,ELEK:FINGER TYPE,4.734 L | 92101 | ORDER BY DESC |
| -46 | 333-3865-00 | | | 1 | PANEL,FRONT:11A81,MODULE | 07416 | ORDER BY DESC |
| -47 | 386-5219-00 | | | 1 | SUBPANEL,FRONT: | TK1465 | ORDER BY DESC |
| -48 | 670-9336-00 | | | 1 | CIRCUIT BD ASSY:FRONT PANEL (A2) | 80009 | 670933600 |
| -49 | 174-0159-00 | | | 1 | CA ASSY,SP,ELEC:6,26 AWG,3.0 L,RIBBON | TK1967 | ORDER BY DESC |
| -50 | 131-0993-00 | | | 3 | BUS,CONDUCTOR:SHUNT/SHORTING (A1J1630,A1J1970, & A1J2180) | 22526 | 65474-006 |
| -51 | 156-2625-00 | | | 1 | MICROCKT,DGTL:NMOS,CUSTOM (A1U1540) | 66302 | VF4124RC CC0001 |
| -52 | 670-8986-00 | | | 2 | CIRCUIT BD ASSY:SAMPLE/HOLD (A1A1 & A1A2) | 80009 | 670898600 |
| -53 | 160-8195-00 | | | 1 | MICROCKT,DGTL:CMOS,16 X 8 EPROM (A1U2140) | 80009 | 160819500 |
| -54 | 136-0755-00 | | | 1 | SOCKET,DIP::PCB,;28 POS,2 X 14,0.1 X 0.6 CTR | 09922 | DILB28P-108 |
| -55 | 156-2671-00 | | | 1 | IC,MEMORY:CMOS,NVRAM;2K X 8,200NS (A1U2040) | 0B0A9 | DS1220Y |
| -56 | 220-0182-00 | | | 1 | PLATE,NUT:0.063 AL | 0J9P9 | ORDER BY DESC |
| | | | | | **ACCESSORIES** | | |
| | 070-8147-00 | | | 1 | MANUAL,TECH:USER REFERENCE,11A81 | 80009 | 070814700 |
| | 070-8148-00 | | | 1 | MANUAL,TECH:SERVICE REFERENCE,11A81 | 80009 | 070814800 |

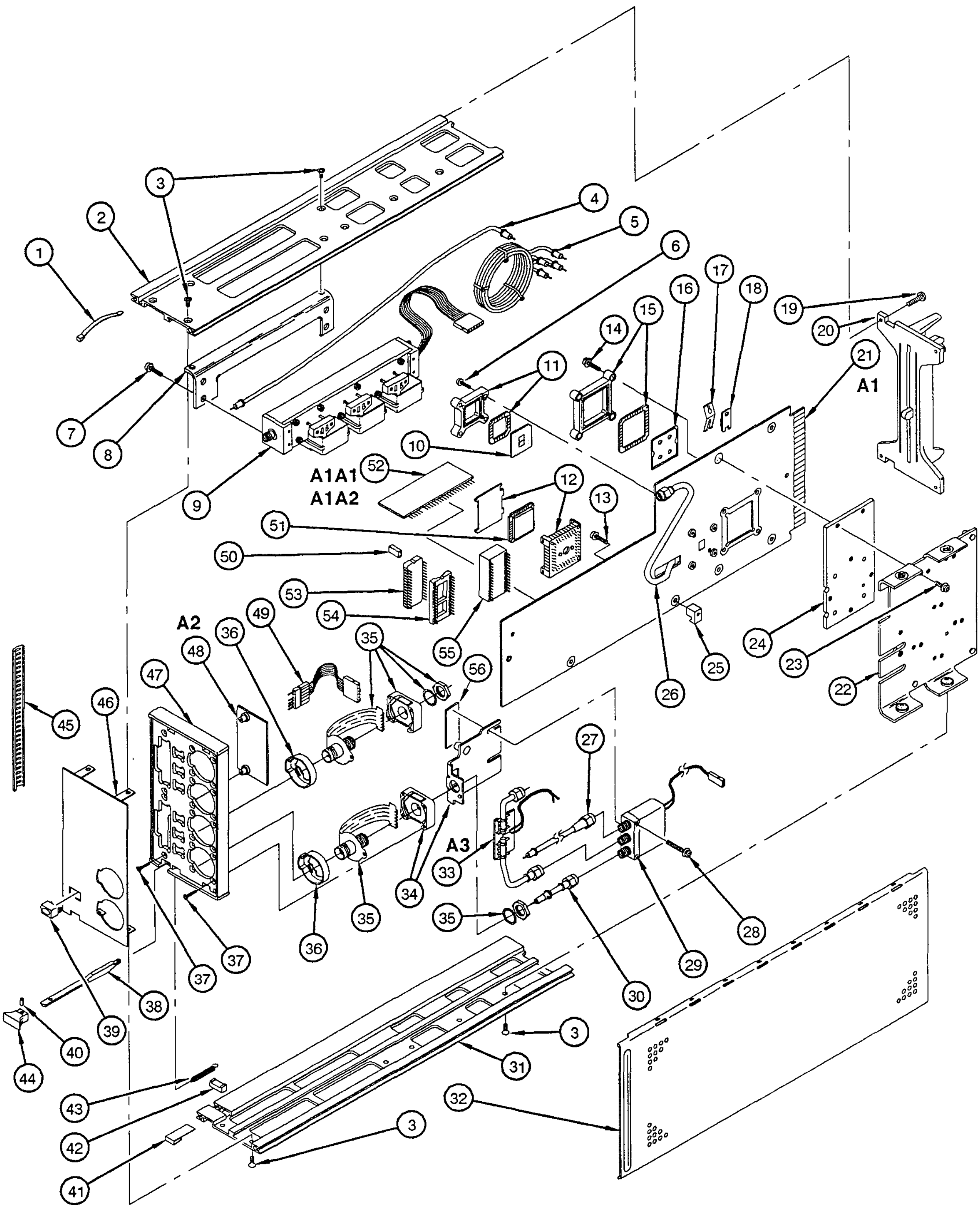



***Figure 5-1*** *— Exploded View of the 11A81 Amplifier*