Service Manual

Tektronix

AM 503A
Current Probe Amplifier

070-8174-01

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

First Printing: December 1993

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

Printed in U.S.A.

WARRANTY

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THIS PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

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Welcome

This manual provides information for testing, adjusting, and repairing the AM 503S Current Probe System. (For detailed operating information, refer to the *AM 503S User Manual*.) This manual is written with the assumption that the reader is technically qualified to service electronic equipment.

Conventions Used in This Manual

This manual uses the following conventions:

- AM 503S refers to the AM 503S Current Probe Amplifier System, which consists of an AM 503A Current Probe Amplifier, an A6302 or A6303 Current Probe, and a TM 502A Power Module.
- AM 503A refers to an AM 503A Current Probe Amplifier.
- A6302 refers to an A6302 Current Probe.
- A6303 refers to an A6303 Current Probe.
- TM 502A refers to a TM 502A Power Module.

For definitions of some terms used in this manual, refer to the glossary following the service safety summary.

Manual Organization

The manual is organized into these sections:

- Section 1, *Specifications*, lists the performance requirements that the AM 503S meets.
- Section 2, *Operating Information*, provides basic operating instructions necessary for service personnel. For detailed operating instructions and applications, refer to the *AM 503S User Manual*.
- Section 3, *Theory of Operation*, describes circuit operation of the AM 503A amplifier, A6302 probe, and A6303 probe. Block-level and component-level descriptions are provided.
- Section 4, *Performance Verification*, includes test procedures which verify that the AM 503S is operating within the published specifications.
- Section 5, *Adjustment Procedures*, provide instructions for calibrating the A6303 Current Probe. No other AM 503S components require adjustment.
- Section 6, *Maintenance*, includes preventive maintenance information, disassembly instructions, and troubleshooting information.
- Section 7, *Options*, lists the various options of the AM 503S and the optional accessories that are available.

- Section 8, *Electrical Parts List*, provides part numbers of the replaceable electrical parts. Use this information when ordering replacement parts from Tektronix.
- Section 9, *Diagrams*, provides schematic diagrams, block diagrams, and component layout drawings of the AM 503A amplifier, A6302 probe, and A6303 probe.
- Section 10, *Mechanical Parts List*, provides part numbers of the replaceable mechanical parts and provides exploded views of the AM 503A amplifier, A6302 probe, and A6303 probe. Use this information when ordering replacement parts from Tektronix.

Safety Summary

Observe the safety precautions described in this summary when operating the AM 503S Current Probe System. Specific warnings and cautions appear throughout the manual but may not appear in this summary.

Symbols and Terms

These two terms appear in manuals:

- CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.
- WARNING statements identify conditions or practices that could result in personal injury or loss of life.

These two terms appear on equipment:

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

This symbol appears in manuals:

Static-Sensitive Devices

These symbols appear on equipment:

DANGER High Voltage	Protective ground (earth) terminal	ATTENTION Refer to manual

Specific Precautions

Observe all of these precautions to ensure your personal safety and to prevent damage to your equipment.

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

Grounding the Product—This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting equipment to the product input or output terminals. The protective ground conductor in the power cord is essential for safe operation.

Danger Arising from Loss of Ground—Upon loss of the protective ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electrical shock.

Use the Proper Power Cord—Use only the power cord and connector specified for your product and use only a power cord that is in good condition. Any changes to the cord or power connector should be performed by qualified service personnel only.

Use the Proper Fuse—To avoid fire hazard, use only the fuse of correct type, voltage rating, and current rating as specified in the parts list for your product. Fuse replacement should be performed by qualified service personnel only.

Do Not Operate in Explosive Atmospheres—To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

Do Not Remove Covers or Panels—To avoid personal injury, do not remove the product covers or panels except while servicing the instrument. Do not operate the product without the covers and panels properly installed.

Operating Temperature

The AM 503A Current Probe Amplifier can be operated in ambient temperatures between 0°C and +50°C and stored in ambient temperatures from −55°C to +75°C. If stored at temperatures outside the operating limits, allow the chassis to reach the specified operating temperature range before applying power.

Glossary

This glossary defines some of the technical terms used in this manual.

amp · second product: the unit of measure defining the maximum amount of pulsed current that can be measured before the probe core becomes saturated. The amp · second rating applies only to measurement values between the maximum continuous and maximum pulse current ratings of the probe. The amp · second rating is equal to the peak current times the pulse width at the 50% point between maximum continuous and maximum pulsed current.

autobalance: a process that removes unwanted DC offsets from the AM 503A circuitry to ensure maximum measurement accuracy. This process is performed during the probe degauss routine.

bucking current: current fed back by the AM503A to the current probe during DC and low-frequency AC measurements. Bucking current nulls most of the magnetic field in the probe core, allowing linear DC and AC measurements simultaneously.

conventional current flow: the flow of the positive charge in a conductor. Conventional current flow is from positive to negative. The arrows on the A6302 and A6303 current probes point in the direction of conventional current flow. Conventional current flow is in the opposite direction of electron flow.

degauss: the process of eliminating residual magnetism from the probe core by feeding a decaying sine wave into the core. In effect, the sine wave randomizes the polarity of magnetic domains within the core material, resulting in a net residual magnetic flux density near zero. One of the units used to describe magnetic flux density is the Gauss. The degaussing process should be performed before clamping the probe around a conductor, whenever the probe becomes saturated by current overloads, or whenever the probe is exposed to strong external magnetic fields.

electron current flow: the flow of the electrons in a conductor. Electron current flow is from negative to positive. The arrows on the A6302 and A6303 current probes point in the opposite direction of electron current flow. Electron current flow is in the opposite direction of conventional flow.

flux: the density of a magnetic field. As the number of flux lines increases, the magnetic field strength increases. Current in the conductor under test generates flux lines in the probe.

Hall device: a thin, rectangular piece of semiconductor material located in the core of the current probe. The Hall device uses the Hall effect for DC and low-frequency AC measurements.

Hall effect: the effect that produces a voltage potential in the Hall device when magnetic flux lines pass through the device. The voltage potential is directly proportional to the magnetic flux. The voltage polarity is determined by the magnetic field polarity. A bias-current supply is required to produce the Hall effect. The AM 503S current probes use the Hall effect for DC and low-frequency AC measurements.

insertion impedance: the equivalent series impedance introduced to a test circuit when the current probe is clamped around a test conductor.

magnetic susceptibility: a figure expressing the amount of current induced into the probe by an external magnetic field of known intensity. The lower the figure is, the less the probe is influenced by external magnetic fields.

saturation: a condition that occurs when the magnetic field strength in the probe core exceeds the maximum level that the core can absorb. When saturation occurs, the probe no longer responds linearly to an increase in magnetic field strength, resulting in measurement inaccuracies. The probe core usually retains residual magnetism, also producing inaccuracies. A current overload condition will cause core saturation. The probe should be degaussed after saturation occurs.

Specifications

This section provides a brief product description and a list of product specifications.

Product Description

The AM 503A uses one current probe to simultaneously measure DC and AC currents. The measurement output is displayed on an oscilloscope or similar measurement device.The standard AM 503A Current Probe Amplifier System (AM503S) includes the following items (shown in Figure 1-1):

- AM 503A Current Probe Amplifier
- A6302 Current Probe (for optional probes, see the options list)
- TM 502A Power Module
- Toolbox
- AC Power Cord
- BNC Output Cable
- 50 Ω Termination
- AM503A User Manual
- Quick Reference Card
- A6302 Instructions

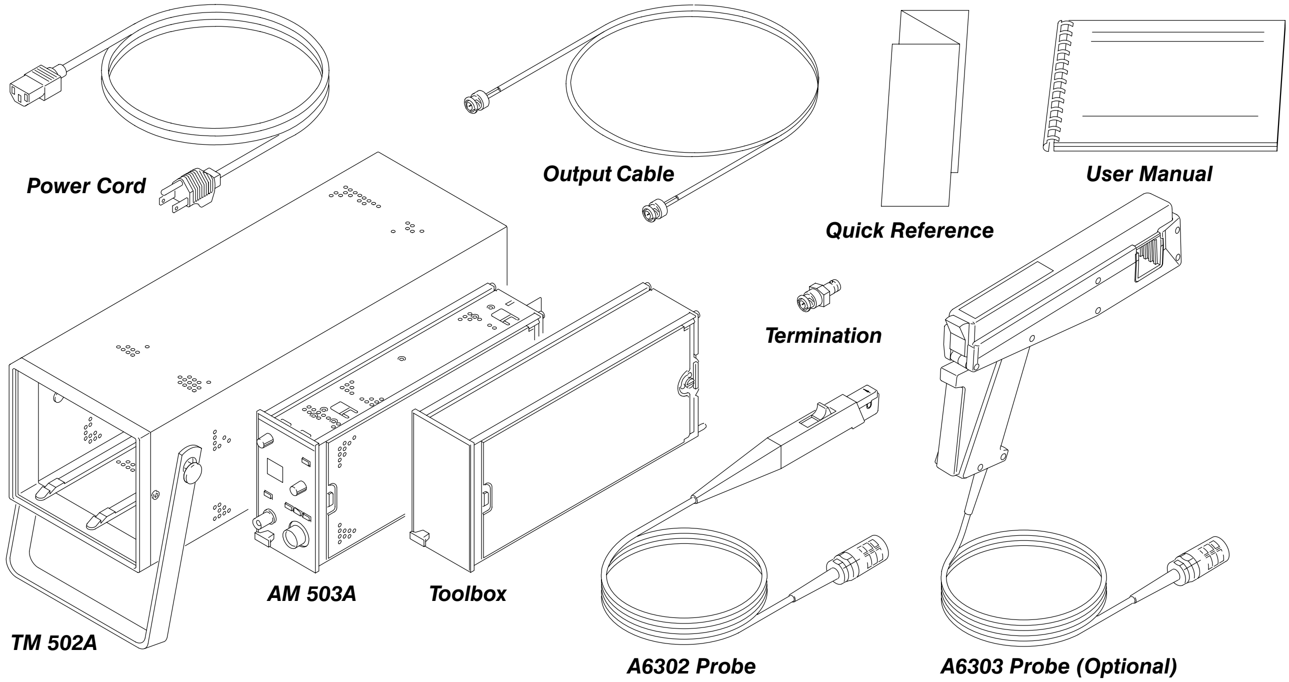


Figure 1-1: Components of the AM503S

AM 503A Current Probe Amplifier

The AM 503A is a single-width instrument that plugs into any Tektronix TM 500- or TM 5000-series power module. The AM 503A amplifies current sensed by the probe and converts the current to a proportional voltage that is displayed on an oscilloscope or other similar measuring device. The AM 503A also provides DC feedback (bucking) current to the probe. Bucking current allows true DC measurements and enables accurate, linear AC measurements.

Current Probes

The probes available for use with the AM 503A system are the A6302 and the A6303. These probes cover a wide range of applications. A standard AM 503A system includes the A6302 Probe; you may add or substitute the A6303 Probe. The A6302 and A6303 probes may also be ordered separately.

TM 502A Power Module

The TM 502A Power Module is a lightweight, portable power supply that operates on either 110 or 220 VAC, 50 or 60 Hz, and accepts up to two single-width TM 500 instruments, such as the AM 503A or TVC 501 Time-to-Voltage Converter.

Power Cord

The power cord supplies power to the TM 502A Power Module. Several options of the power cord are available (see the *Options* section).

Output Cable

The output cable, a 50 Ω BNC cable, connects the output of the AM 503A to your oscilloscope or measuring device.

50 Ω Termination

Because the output impedance of the AM 503A is 50 Ω, the input impedance of your oscilloscope must be 50 Ω. If the input impedance of your oscilloscope is 1 MΩ, attach the 50 Ω feedthrough termination to the oscilloscope.

Toolbox

The AM 503A system includes a toolbox for storing probes, cables, accessories, and small tools. The toolbox can be plugged into the TM 502A next to the AM 503A Amplifier.

User Manual and Quick Reference Card

The user manual explains how to use the AM 503A current measurement system. The quick reference card provides an annotated front panel illustration, lists several important operating guidelines, and lists the essential steps for making a current measurement. Operating and servicing instructions for the TM 502A are in the TM 502A Instruction Manual.

Specification Tables

Tables 1-1 through 1-4 list the specifications of the AM 503A current measurement system. These specifications are valid only under the following conditions:

- the system has been calibrated at an ambient temperature between +20° C and +30° C
- the system is operating in an environment whose limits are described in Table 1-3 (the operating temperature limits are 0° C to +50° C, unless otherwise stated)
- the system has had a warm-up period of at least 20 minutes
- the probe degauss/autobalance routine has been performed after the 20-minute warm-up period
- the AM 503A is properly terminated into 50 Ω

Probe-dependent specifications are categorized by probe type. Specifications that are not probe-dependent have only one entry.

Verifying Specifications

Specifications are separated into two categories, warranted specifications, and nominal or typical characteristics.

Warranted characteristics, Table 1-1, are guaranteed performance specifications. This manual provides performance verification procedures for these specifications.

Nominal and typical characteristics, Table 1-2, are not guaranteed and are provided to characterize the configuration, performance or operation of typical systems.

Other specifications do not have verification procedures because the characteristics are stable and unlikely to change, or the equipment required to verify them is extremely expensive or not readily available.

Physical and environmental specifications are not verified in this manual.

Specifications are subject to change without notice.

Probe Serial Numbers

Because of a change in the probe input connector, the performance specifications are guaranteed only for probes having the following serial numbers:

A6302 . . . . B050000 and above
A6303 . . . . B022000 and above

For detailed information on each probe, refer to the probe *Instructions*.

Table 1-1: Warranted AM 503A Characteristics

Characteristic	AM 503A with A6302	AM 503A with A6303
Bandwidth	DC to 50 MHz	DC to 15 MHz
DC Measurement Accuracy	±3%	±3%
Rise Time	≤7 ns	≤23 ns

Table 1-2: Nominal and Typical AM 503A Characteristics

Characteristic	Description	Supplemental Information
Aberrations	±5%	(Typical) First 100 ns. Using 50 Ω output termination; after degauss/autobalance; DC coupled; 100 MHz oscilloscope system.
Amp · Second Product		Refer to Figure 2-11 and the accompanying discussion for more information.
with A6302 Probe	1×10^{-4} A · s (100 A · µs)	See amp · second curve in the probe manual.
with A6303 Probe	1×10^{-2} A · s (10,000 A · µs)	See amp · second curve in the probe manual.
Battery (AM 503A)		
Battery Life	3 years	(Typical)
Battery Type	1.5 V, silver oxide	Refer to *Electrical Parts List*.
Deflection Factor		(Nominal) Sequence is in 1–2–5 increments (vertical gain of oscilloscope is at 10 mV/div).
with A6302 Probe	1 mA/div to 5 A/div	
with A6303 Probe	10 mA/div to 50 A/div	
Frequency Derating		Maximum continuous current rating decreases above 20 kHz (see frequency derating curve in the probe manual.
with A6302 Probe	2.5 A at 10 MHz	
with A6303 Probe	12 A at 10 MHz	
Insertion Impedance		
with A6302 Probe	0.1 Ω at 1 MHz 0.5 Ω at 50 MHz	See insertion impedance curve in the probe manual.
with A6303 Probe	0.02 Ω at 1 MHz 0.15 Ω at 15 MHz	See insertion impedance curve in the probe manual.
Low-Frequency Limit	≤7 Hz	(Typical) AC coupled.
Maximum Continuous Current		Maximum continuous current is derated with frequency (see the probe manual).
with A6302 Probe	20 A (DC + peak AC)	
with A6303 Probe	100 A (DC + peak AC)	
Maximum Pulsed Current		Maximum pulsed current must not exceed the amp-second product.
with A6302 Probe	50 A	
with A6303 Probe	500 A	
Maximum Voltage (bare wire)		
with A6302 Probe	500 V	
with A6303 Probe	700 V	
Power Consumption	17 Watts maximum	

Table 1-2: Nominal and Typical AM 503A Characteristics

Characteristic	Description	Supplemental Information
Random Noise		(Typical) Using 50 Ω output termination; after degauss/autobalance; oscilloscope bandwidth limit 100 MHz, AC-coupled, 1 ms/division; AM 503A DC-coupled, 1 mA/division
with A6302 Probe	<4 mV_{RMS}	
with A6303 Probe	<4 mV_{RMS}	

Table 1-3: AM 503A Environmental Characteristics

Characteristic	Description
Altitude	
Operating	4,570 m (15,000 ft) maximum
Non-Operating	15,200 m (50,000 ft) maximum
Ambient Temperature	
Operating	0° C to +50° C
Non-Operating	−55° C to +75° C
Humidity	
Operating	≤ 95% R.H., at 50° C or below
Non-Operating	≤ 95% R.H., at 60° C or below

Table 1-4: AM 503A Physical Characteristics

Characteristic	Description
Net Weights	
TM 502A	4.0 kg (8.75 lb)
AM 503A	0.91 kg (2 lb)
TM 502A/AM 503A (excluding knobs)	
Length	40.7 cm (16.6 in)
Width	14.5 cm (5.7 in)
Height	14.0 cm (5.5 in)

Operating Information

The Tektronix AM503S system consists of an AM 503A Current Probe Amplifier, an A6302 Current Probe (the A6303 Current Probe may be ordered optionally), and a TM 502A Power Module.

The AM 503A lets you use one probe to simultaneously measure AC and DC current. The AM 503A amplifier converts the sensed current into a proportional signal that you can measure directly with an oscilloscope or similar measuring device.

In addition to the AM503A system, you need an oscilloscope to display the AM 503A measurements. The oscilloscope bandwidth should be at least twice the bandwidth of your current probe and should be capable of displaying a vertical scale factor of 10 mV/div.

Setting the Operating Voltage

The TM 502A Power Module can operate from one of four AC line voltages. The operating voltage is determined by the voltage selector, located on the rear panel of the TM 502A (see Figure 2-1).

WARNING

To avoid personal injury or equipment damage, do not connect the power module to the AC line receptacle or turn the power module on until you have verified that the proper operating voltage is selected.

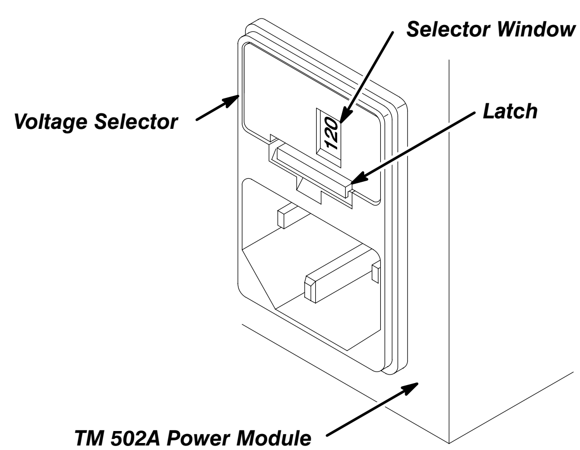


Figure 2-1: TM 502A Voltage Selector

The value displayed in the voltage selector window should match the value of your line voltage. If the two values don't match, perform these steps to select the correct value:

- ☐ **Step 1:** Push up on the latch and pull the voltage selector assembly out.
- ☐ **Step 2:** Disassemble the voltage selector as shown in Figure 2-2.
- ☐ **Step 3:** Rotate the selector until the proper voltage appears in the window.
- ☐ **Step 4:** Reassemble the voltage selector and push it back into the power module until it snaps into place.
- ☐ **Step 5:** Using the correct power cord, connect the power module to the AC line receptacle.

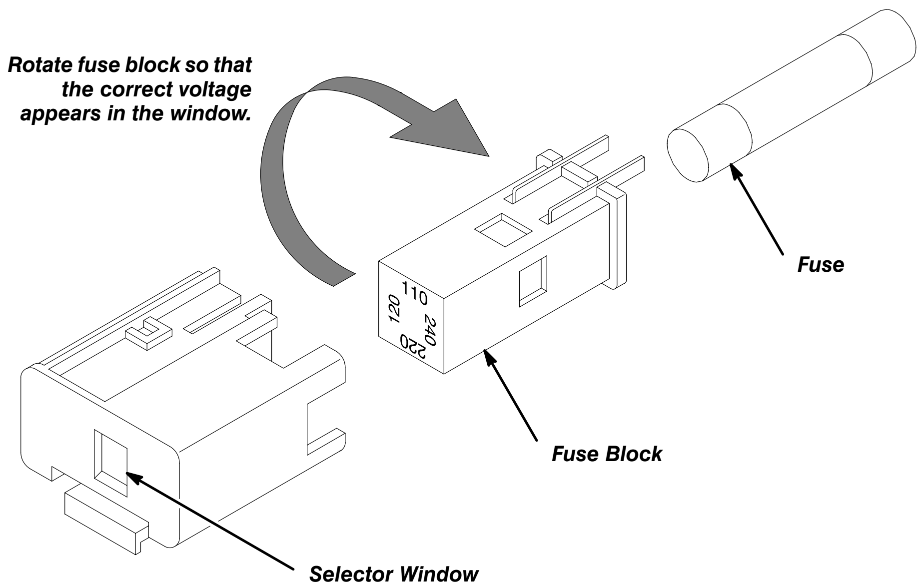


Figure 2-2: Changing the TM 502A Operating Voltage

Installing the AM 503A Into the Power Module

After you have connected the power module to the correct line source and verified that the power switch is off, you may install the AM 503A Amplifier into the power module.

CAUTION

Make sure the power switch of the power module is off before installing the AM 503A. If you install or remove a plug-in instrument while the power module is on, you might damage the equipment.

Align the grooves of the AM 503A with the rails of the power module and push the AM 503A into the power module until the instrument snaps into place (see Figure 2-3). To remove the AM 503A, grasp the release lever and pull the instrument out of the power module.

After you have installed the AM 503A and any other desired plug-in instruments into the power module, you may turn the power module on. A digital readout should appear on the AM 503A front panel and one of the coupling lights should come on.

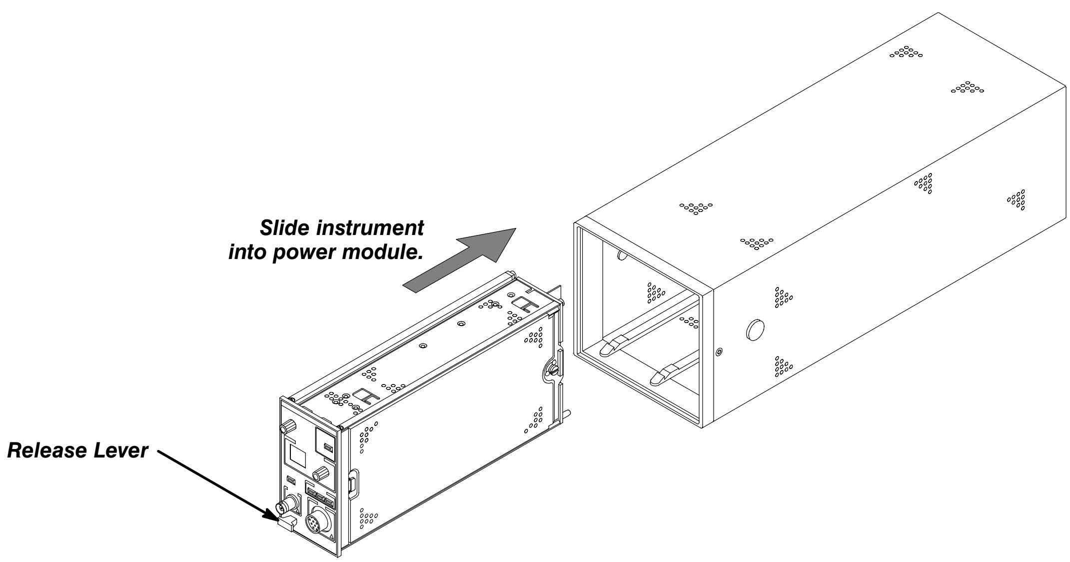


Figure 2-3: Installing the AM 503A Into the Power Module

Front Panel Operation

Figure 2-4 shows the AM 503A front panel and briefly describes the operation of each control, indicator, and connector. For a more complete description of AM 503A operation, see the *AM 503A User Manual*.

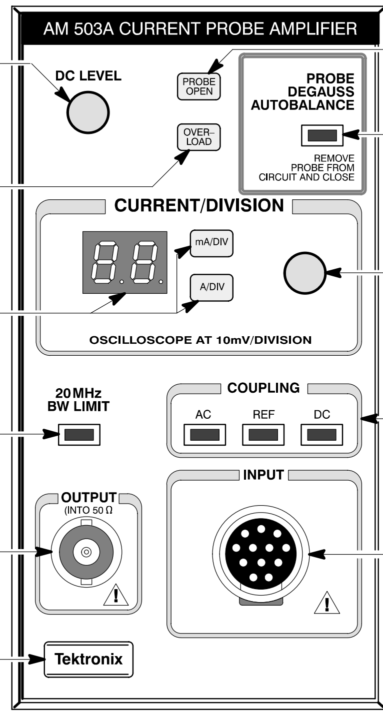


Figure 2-4: The AM 503A Front Panel

Choosing an Oscilloscope to Use with the AM 503A

To utilize the full bandwidth capability of the AM 503A and attached current probe, the oscilloscope bandwidth should be at least twice that of the current probe. For example, when using an A6302 probe, the oscilloscope bandwidth should be at least 200 MHz. When using an A6303 probe, the oscilloscope bandwidth should be at least 60 MHz. The oscilloscope must also be capable of displaying a vertical scale factor of 10 mV/div.

Connecting the AM 503A to an Oscilloscope

To connect the AM 503A output connector to an oscilloscope, use a 50 Ω BNC cable (one is supplied with the AM 503A system). Connect one end of the cable to the AM 503A output connector and the other end to the input of the desired vertical channel of the oscilloscope (see Figure 2-5). The input impedance of the oscilloscope channel must be 50 Ω, otherwise you will encounter slowed pulse response, increased aberrations, or incorrect DC measurement amplitudes.

NOTE

*If your oscilloscope impedance is 1 MΩ, install a 50 Ω feedthrough termination at the oscilloscope input connector, not at the AM 503A output connector (a 50 Ω termination is supplied with the AM 503A). Failure to properly terminate the AM 503A will result in an error code (**54**) being displayed on the AM 503A front panel digital readout if you attempt to degauss/autobalance the system.*

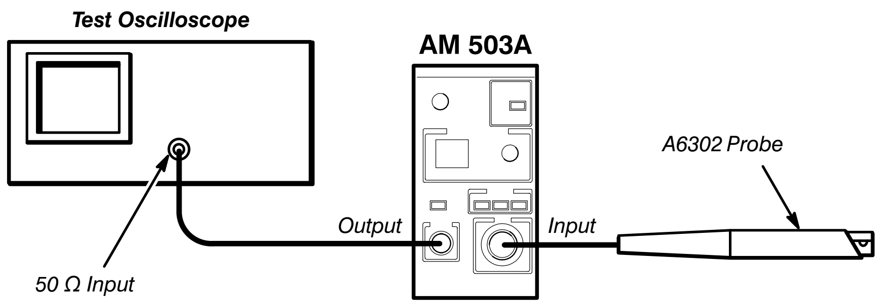


Figure 2-5: Connecting the AM 503A to an Oscilloscope

Using the Rear Interface Output Connector

Some optional power modules allow you to re-route the plug-in instrument output to the rear interface of the power module (refer to the Tektronix catalog or contact your Tektronix sales representative). You can configure the AM 503A for this type of power module. Refer to the disassembly instructions in *Maintenance*.

Adjusting the Oscilloscope

After connecting the AM 503A to the oscilloscope, make the following adjustments to the corresponding oscilloscope channel.

NOTE

Before making any adjustments, allow the equipment to warm up for at least 20 minutes.

- ☐ **Step 1:** Set the vertical gain of the oscilloscope to 10 mV/div.
- ☐ **Step 2:** Set the oscilloscope ground reference so the trace appears at the center graticule line or at the desired zero-current reference.
- ☐ **Step 3:** Set the input coupling of the oscilloscope to DC.

☐ **Step 4:** Turn off any oscilloscope bandwidth filters.

☐ **Step 5:** Make sure the oscilloscope input is terminated with a 50 Ω impedance.

NOTE

Do not change the vertical amplifier settings of the oscilloscope while using the AM 503A. All subsequent measurement adjustments should be made on the AM 503A amplifier. To maintain accurate readings, the vertical gain of the oscilloscope channel must remain at 10 mV/DIV and the coupling must remain at DC.

Using the Current Probes

This section describes how to operate the A6302 and A6303 current probes available with the AM 503A.

Choosing a Probe

Refer to the *AM 503A User Manual* for information about choosing a current probe for a specific application.

Connecting a Current Probe to the System

To connect a current probe to the AM 503A input connector, align the tab of the probe connector with the slot in the AM 503A input connector as shown in Figure 2-6(a). Align the dot on the probe connector with the groove opening of the input connector as shown in Figure 2-6(b). Push the probe connector in while twisting the barrel clockwise to lock the connector.

CAUTION

Handle the current probes with care. To avoid damaging the probe core, do not drop the probe or subject it to impact. Also, to avoid damaging the AM 503A, do not connect or disconnect a current probe while the probe is clamped around a live conductor or while the AM 503A is turned on. Excessive voltages and surge currents can result from improper attachment of a current probe.

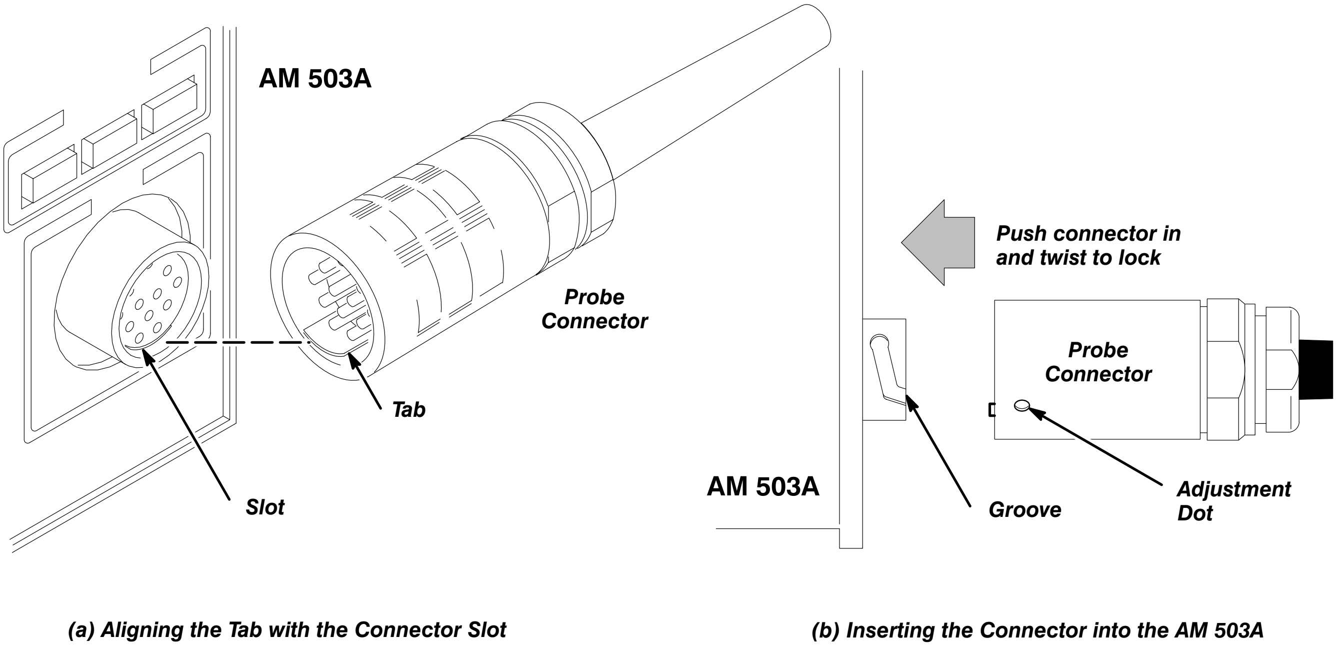


Figure 2-6: Connecting a Current Probe to the AM 503A

Operating the Probe Slide

The A6302 and A6303 current probes each have a slide mechanism that opens and closes the probe jaw, allowing you to clamp the probe around a test conductor. The slide must be locked to accurately measure current or to degauss the probe. If a probe is unlocked or disconnected from the AM 503A, the PROBE OPEN indicator will light.

Figure 2-7 illustrates the slide operation of the A6302 probe. To open the probe, pull the slide back until the jaw is open. To lock the probe, push the slide forward until the detent snaps into place.

Figure 2-8 illustrates the slide operation of the A6303 probe. To open the probe, press the bottom of the lock button and squeeze the handle until the core is open. To lock the probe, release the squeeze handle and press the top of the lock button.

CAUTION

The exposed core pieces are not insulated. To avoid equipment damage, remove power from an uninsulated wire before clamping the current probe around it.

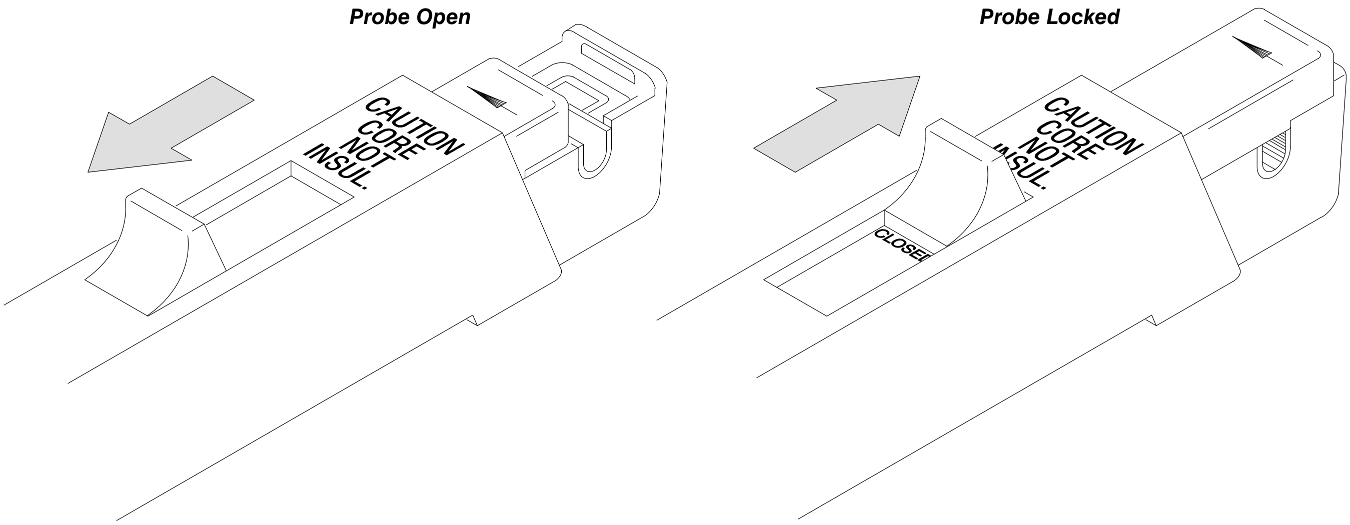


Figure 2-7: Operating the A6302 Current Probe Slide

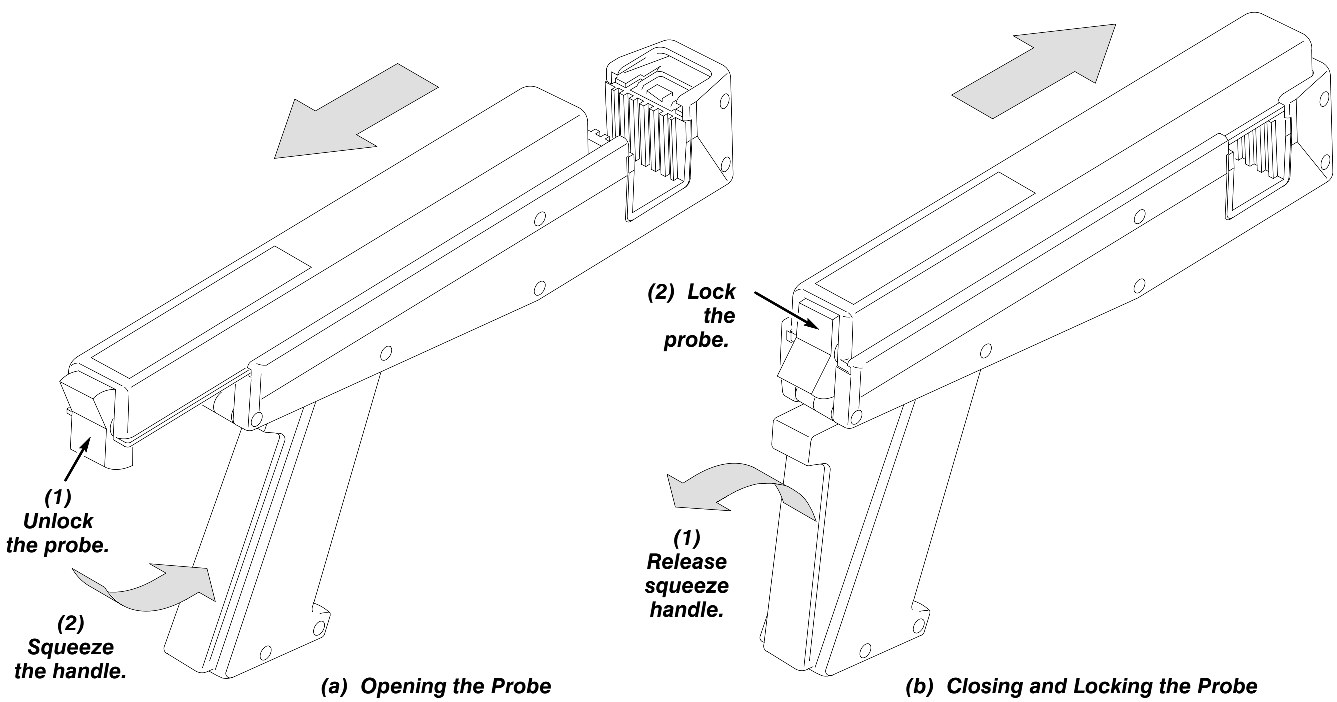


Figure 2-8: Operating the A6303 Current Probe Slide

Degaussing the Probes

Before measuring current, perform the probe degauss/autobalance routine. To initiate the degauss/autobalance routine, perform these steps:

☐ **Step 1:** Verify that the current probe is connected to the AM 503A and removed from the conductor under test.

☐ **Step 2:** Lock the probe slide (see Figures 2-7 and 2-8).

☐ **Step 3:** Press the **PROBE DEGAUSS AUTOBALANCE** button.

To maintain measurement accuracy, degauss the probe for each of these circumstances:

- after turning the AM 503A on and allowing a 20-minute warm-up period
- before connecting the probe to a conductor or changing conductors
- whenever an overload condition occurs
- whenever the probe is subjected to a strong external magnetic field

You should degauss the probe periodically during use. Failure to degauss the probe is a leading cause of measurement errors.

NOTE

*The AM 503A front panel will display an error code (**54**) after the degauss/autobalance routine completes if the AM 503A is not properly terminated into 50 Ω. Verify that the oscilloscope input is 50 Ω and set to DC coupling. Use a 50 Ω feedthrough termination, attached at the oscilloscope input, if necessary.*

Making Current Measurements

After you have completed the oscilloscope adjustments and the AM 503A degauss/autobalance procedure, the system is ready to measure current. This section describes how to make DC and AC measurements.

DC Measurements

To measure DC current, perform these steps:

☐ **Step 1:** Verify that the vertical gain of the oscilloscope is 10 mV/div, the input coupling is DC, and the input impedance is set to 50 Ω.

☐ **Step 2:** Adjust the ground reference of the oscilloscope so the zero-current trace appears at the desired graticule line.

☐ **Step 3:** Lock the probe, press the AM 503A **REF** coupling button, and then press the AM 503A **PROBE DEGAUSS AUTOBALANCE** button.

☐ **Step 4:** After the degauss/autobalance routine completes, reposition the ground reference (if necessary) on your oscilloscope using the AM 503A **DC LEVEL** control.

NOTE

*The AM 503A front panel will display an error code (**54**) after the degauss/autobalance routine completes if the AM 503A is not properly terminated into 50 Ω. Verify that the oscilloscope input is 50 Ω and set to DC coupling. Use a 50 Ω feedthrough termination, attached at the oscilloscope input, if necessary.*

☐ **Step 5:** Open the probe slide, place the probe around the conductor under test, and then lock the slide.

☐ **Step 6:** Press the AM 503A **DC** coupling button and set **CURRENT/DIVISION** to the desired scale.

☐ **Step 7:** To vertically position the resulting waveform, use the **DC LEVEL** control of the AM 503A.

☐ **Step 8:** Adjust the oscilloscope time base as needed.

NOTE

For correct measurement polarity, make sure the probe arrow is pointing in the direction of conventional current flow (conventional current flow is from positive to negative).

Figure 2-9 shows a current probe connected to a power supply line. Notice that the probe arrow points toward the negative terminal of the power supply.

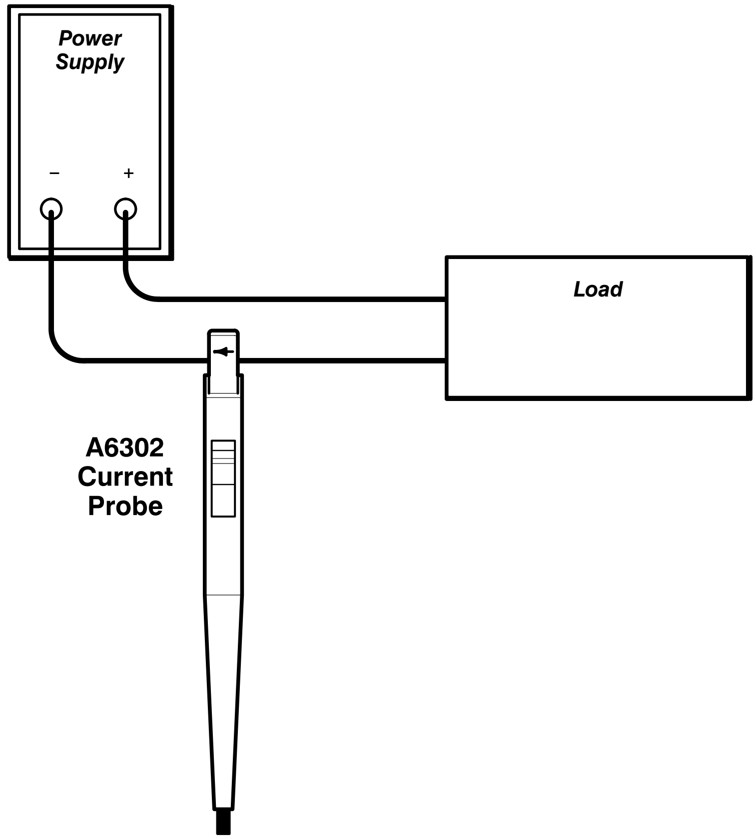


Figure 2-9: Measuring Current with the AM 503A

AC Measurements

To measure AC current only, follow the same basic instructions for DC current measurements except change the AM 503A coupling to **AC**.

NOTE

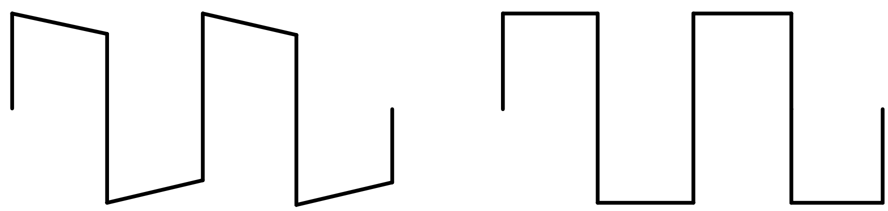
Even when making AC current measurements, leave the oscilloscope coupling on DC. You need only change the AM 503A coupling to AC.

If you need to measure high-amplitude AC currents, consider using a CT-4 High-Current Transformer with an A6302 probe. The CT-4 provides step-down ratios of 20:1 or 1000:1. For more information about the CT-4, consult your Tektronix sales representative.

Probe Coupling Considerations

You can couple the current probe to the AM 503A with either DC or AC coupling. DC coupling shows the DC and AC measurement components while AC coupling removes the DC component.

AC coupling can present some problems at frequencies below 7 Hz. For example, pulsed currents may exhibit rolloff or decreased amplitude. Figure 2-10(a) shows a low-frequency square wave observed using AC coupling. The signal exhibits low-frequency rolloff. By changing the AM 503A coupling to DC, the pulse flattens out, as shown in Figure 2-10(b).



(a) AC-Coupled Signal *(b) DC-Coupled Signal*

Figure 2-10: Effect of Probe Coupling on Low-Frequency Measurements

If you are trying to examine a low-frequency signal that is superimposed on a comparatively large DC component, you can resolve the signal by performing these steps:

- [ ] **Step 1:** Set the AM 503A coupling to **AC**.
- [ ] **Step 2:** Adjust the **CURRENT**/**DIVISION** control of the AM 503A so that the signal shows maximum detail without going off the oscilloscope screen.
- [ ] **Step 3:** Set the AM 503A coupling to **DC**. Center the DC component on the zero-current line by adjusting the **DC LEVEL** control of the AM 503A.

Now you can view large DC component signals without the signal degradation that can occur when low-frequency signals are AC coupled.

Probe Bandwidth Considerations

If you want to observe a low-frequency signal (either DC or AC below 20 MHz) that has high-frequency noise, activate the AM 503A bandwidth limit. The noise level will be reduced.

WARNING

To avoid personal injury or equipment damage, do not exceed the specified bandwidth limits of the current probe. Measuring frequencies in excess of the specified limit can cause the probe to overheat severely.

Maximum Current Limits of the Probes

The current probes have three maximum current ratings: continuous, pulsed, and amp · second product. Exceeding any of these ratings can saturate the probe core, magnetizing the core and causing measurement errors. *Specifications* lists the maximum current ratings for each probe.

Maximum Continuous Current

This rating refers to the maximum current that can be continuously measured at DC or at a specified AC frequency.

Maximum Pulsed Current

This rating defines the maximum peak value of pulsed current the probe can accurately measure, regardless how short the pulse duration is.

Amp · Second Product

The amp · second product defines the maximum width of pulsed current that you can measure when the pulse amplitude is between the maximum continuous and maximum pulsed current specifications (don't forget to derate the maximum continuous specification according to the pulse frequency). If a measurement exceeds the specified amp · second product, probe saturation occurs. For convenience, *Specification*s rates the probes in amp · microseconds and provides an amp · second curve for each probe.

To determine if a measurement exceeds the amp · second product, perform one of the following steps:

- To determine the maximum allowable **pulse width**, measure the peak current of the pulse (see Figure 2-11). Divide the specified amp·second (or µs) product of the probe by the measured peak current of the pulse. The quotient is the maximum allowable pulse width. The pulse width at the 50% point of the measured signal *must be less* than this value. For example, if a pulse measured with an A6302 probe had a peak current of 40 A, the maximum allowable pulse width would be 100 A·µs divided by 40 A, or 2.5 µs.
- To determine the maximum allowable **pulse amplitude**, measure the pulse width at the 50% points (see Figure 2-11). Divide the specified amp·second (or µs) product of the probe by the pulse width in seconds (or µs). The quotient is the maximum allowable current. The peak amplitude of the measured pulse must be less than this value. For example, if a pulse measured with an A6302 probe had a width of 3 µs, the maximum allowable peak current would be 100 A·µs divided by 3 µs, or 33.3 A.

NOTE

Always degauss the probe after measuring a current that exceeds the maximum continuous current, maximum pulsed current, or amp·second product rating of the probe. Exceeding these ratings can magnetize the probe and cause measurement errors.

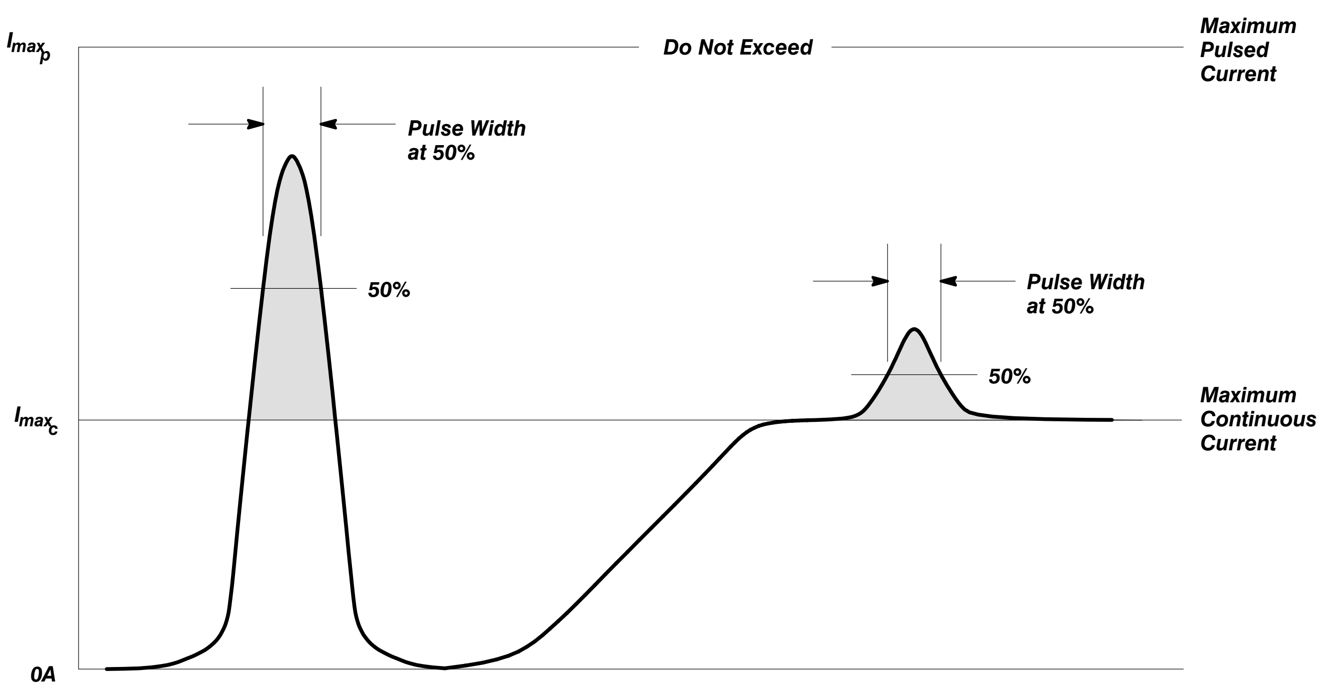


Figure 2-11: Applying the Amp·Second Product Rule

Theory of Operation

This section describes how the AM 503A Current Probe Amplifier and associated current probe operate. Use the information in this section along with the troubleshooting guide in *Maintenance* and the circuit schematics in *Diagrams* to help you perform instrument repairs. The information is presented in four major sections:

- an explanation of how the AM 503A system measures current
- detailed circuit descriptions of the current probes
- detailed circuit descriptions of the AM 503A

How the AM 503A Measures Current

The standard AM 503A Current Probe Amplifier consists of an AM 503A Current Probe Amplifier, an A6302 (or A6303) Current Probe, and a TM 502A Power Module. The probe senses DC and low-frequency current by using a principle known as the Hall effect (explained later). The probe senses high-frequency current by induction, behaving as a transformer. The AM 503A amplifies the probe output and displays the measurement on an oscilloscope.

The Current Probe

Figure 3-1 shows the basic components of the probe: the core, the slide, the coil (also called the current transformer), and the Hall device. The core forms the magnetic circuit of the probe. The slide opens and closes, allowing the probe to clamp around a test conductor. The test conductor essentially becomes the primary winding of the probe. The coil effectively serves as the secondary winding. The Hall device, a rectangular piece of semiconductor film placed in a gap of the core, senses magnetic fields present in the core. Figure 3-2 provides a schematic representation of the probe.

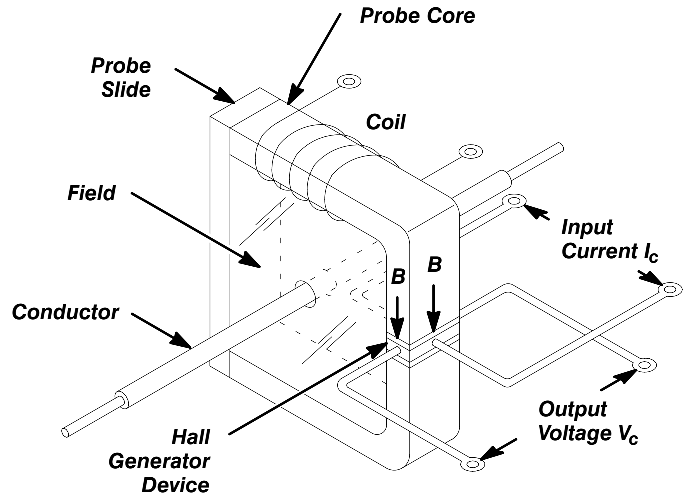


Figure 3-1: Components of the Current Probe

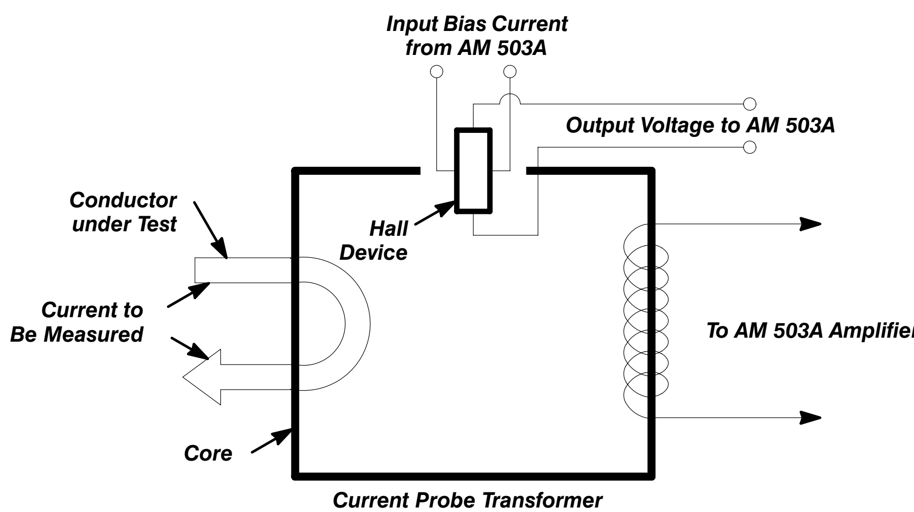


Figure 3-2: Schematic Representation of the Current Probe

The Hall Effect

The Hall device uses the Hall effect to sense DC and low-frequency currents. Current is applied to the Hall device, as shown in Figure 3-3. Electrons flow from point A to point B. The voltage potential between points C and D is zero when there is no magnetic field present.

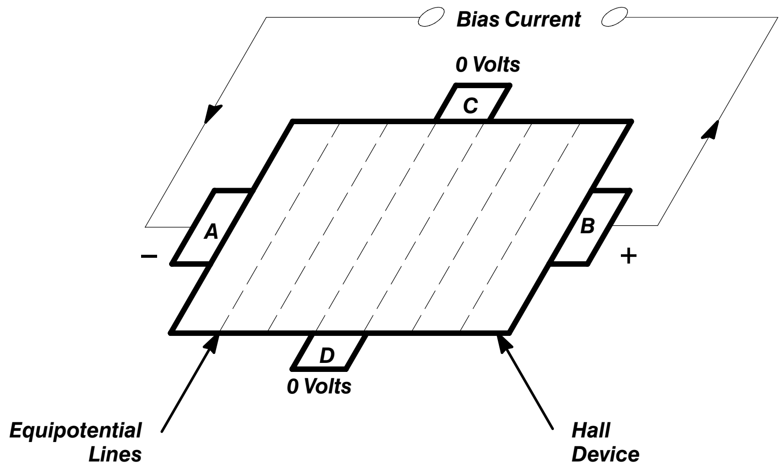


Figure 3-3: Normal Current Flow in the Hall Device

When a magnetic field cuts perpendicularly through the device, as shown in Figure 3-4, the electrons are deflected to one side due to the Lorentz force. A voltage potential (ΔV) now appears between points C and D. The magnitude and polarity of the voltage depends on the magnitude and polarity of the magnetic field. As the magnetic field strength increases, more electrons are deflected and a higher voltage appears at points C and D. If the polarity of the magnetic field is reversed, then the electrons will be deflected to the opposite side of the Hall device, reversing the polarity of the voltage at C and D.

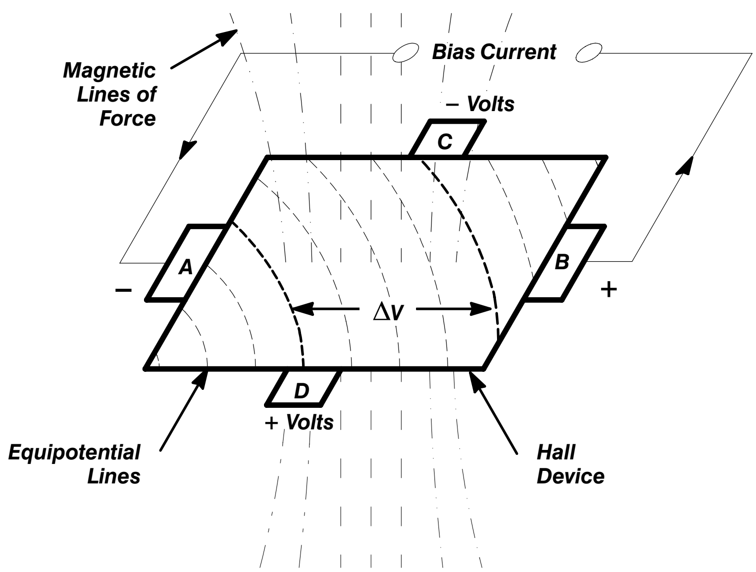


Figure 3-4: Deflected Current Flow in the Hall Device

System Behavior at DC and Low Frequencies

When the current probe is clamped around a conductor with current flowing in it, a corresponding magnetic field appears in the core, as shown in Figure 3-5. The magnetic field deflects the electron flow in the Hall device, producing a proportional voltage differential at the Hall device output. The AM 503A senses the Hall device voltage and produces an inverse, or bucking, current in the coil, as shown in Figure 3-6. Bucking current nulls the magnetic field in the core, preventing core saturation. The AM 503A translates the magnitude of the bucking current into a proportional measurement output. As a result, the probe can measure large currents, including combined AC and DC, with excellent linearity.

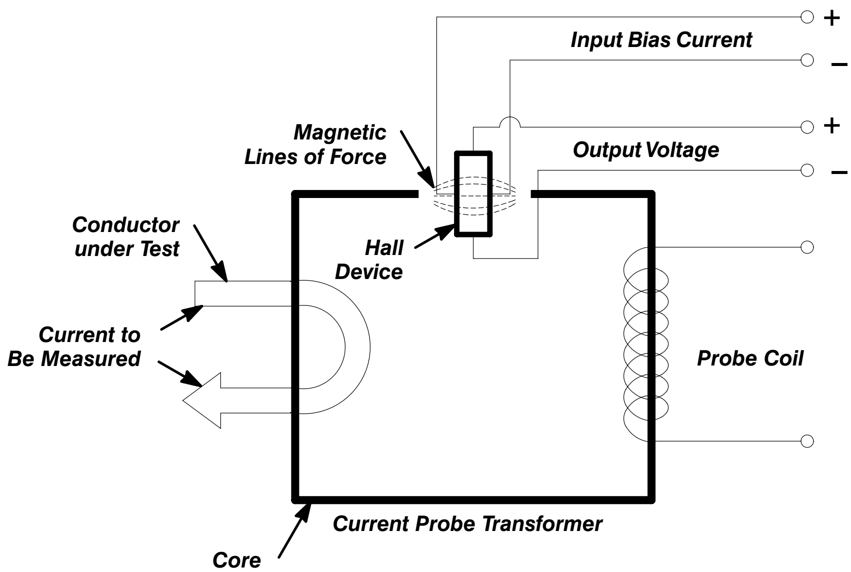


Figure 3-5: Probe Behavior at DC and Low Frequencies

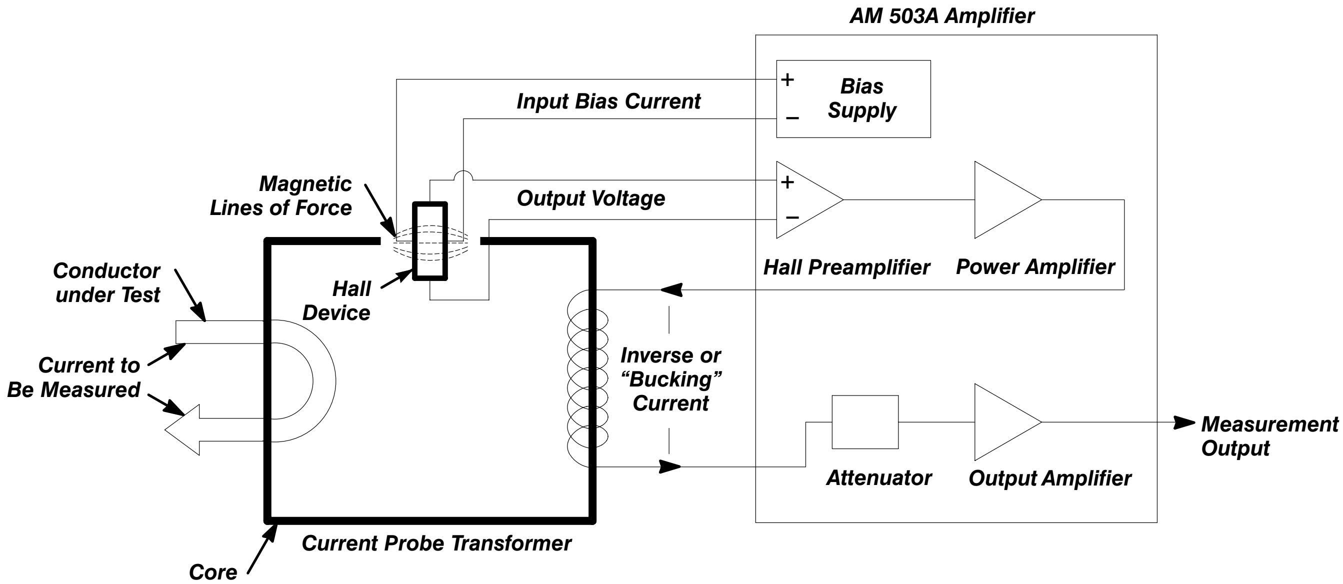


Figure 3-6: The AM 503A Produces Bucking Current

System Behavior at High Frequencies

As the frequency of the current being measured increases, the effect of the Hall device diminishes. When measuring high-frequency current without a DC component, most of the current is induced directly into the probe coil by the expanding and collapsing magnetic field. The probe behaves like a current transformer, as shown in Figure 3-7. Instead of producing bucking current, the AM 503A measures the induced current directly. The output of the power amplifier provides a low-impedance ground path for the coil.

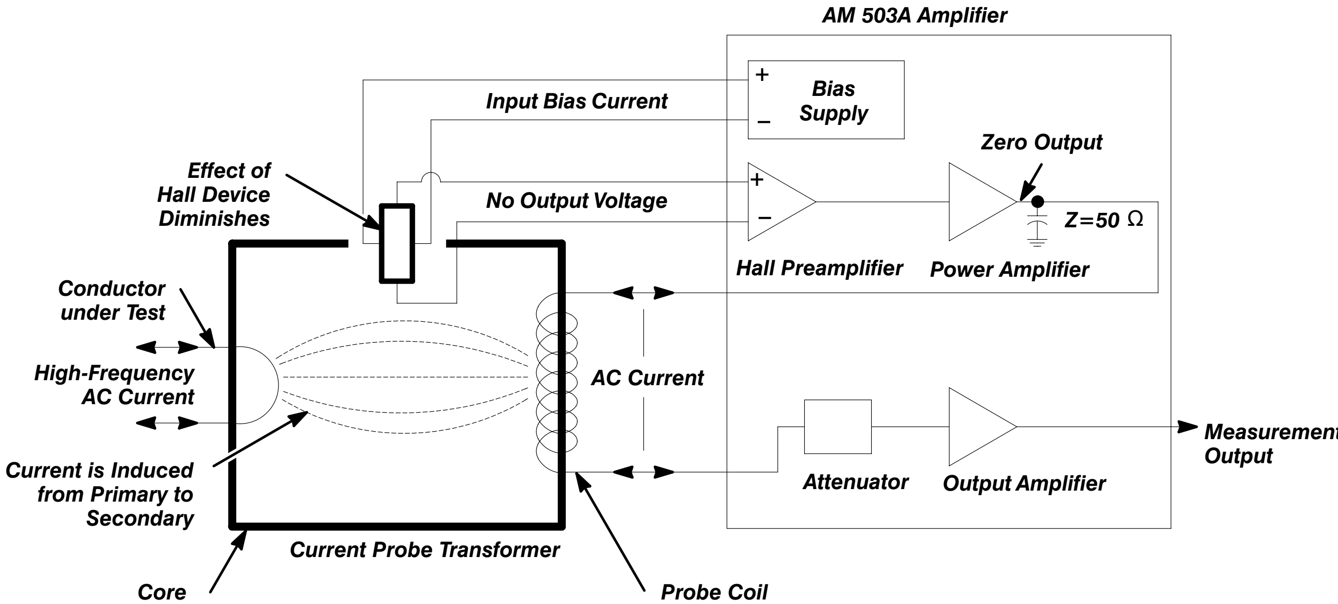
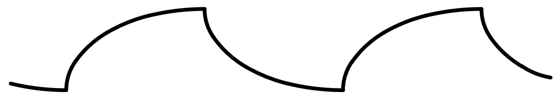


Figure 3-7: Probe Behavior at High Frequencies

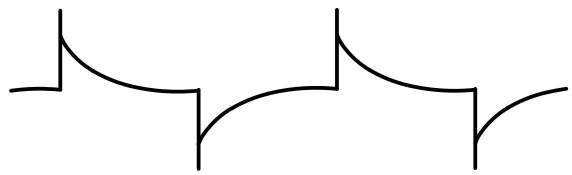
System Behavior in the Crossover Region

When the frequency of the current being measured is in the vicinity of the crossover region (approximately 20 kHz), part of the measurement appears at the Hall device and the other part appears across the coil. The waveforms in Figure 3-8 illustrate how these two components combine to make the total measurement. Waveform (a) shows the current being measured. The frequency of the current is in the crossover region of the probe. Waveform (b) shows the low-frequency bucking current produced from the Hall device output. Waveform (c) shows the high-frequency component that is induced directly into the coil from the current source. Waveforms (b) and (c) are summed together in the probe coil and amplified by the AM 503A amplifier. The amplifier output is connected to a measurement instrument, such as an oscilloscope, where a waveform similar to waveform (d) appears. Waveform (d) conforms to the original signal shown in waveform (a).

(a) Current Waveform in Conductor under Test



(b) Low-Frequency Information from Hall Device, Amplified and Applied to Input of Attenuator



(c) High-Frequency Information from Transformer Applied to Input of Attenuator

(d) Resultant Waveform Seen at the Output of the AM 503A—a Combination of (b) and (c)

Figure 3-8: Waveform Components of the Current Probe

AM 503A Circuit Overview

This section describes the major functional blocks of the AM 503A amplifier. Refer to the block diagram in Figure 3-9 when reading these descriptions. Refer also to the block diagram found in Section 9, *Diagrams*. Detailed circuit descriptions follow this section.

The DC signal path originates in the Hall device and flows through the Hall device preamplifier, power amplifier, probe coil, attenuator, and finally through the output amplifier. The AC signal path originates in the probe coil and flows through the attenuator and output amplifier (for more information about DC and AC operation of the probe, read the functional descriptions, previously described). The overall system gain is determined by the attenuator setting and the gain setting of the output amplifier. These circuits are controlled by the microcontroller and its interface circuits.

The microcontroller processes user-initiated switch closures from the front panel and sends corresponding control signals to the appropriate circuits. Analog control signals are generated by the digital-to-analog converter (DAC), U370. The control signals typically include gain settings and offset voltages.

Digital status signals from various AM 503A circuits are input directly to the microcontroller. Analog status signals are converted by the analog-to-digital converter (ADC), U350, into digital signals that the microcontroller can process. Typical status signals include offset voltages and probe identification.

The power supply circuits regulate the input voltages from the power module to produce ±5 V, ±16 V, and ±18.6 V. A separate supply provides bias voltages of +3 V and −3 V for the Hall device.

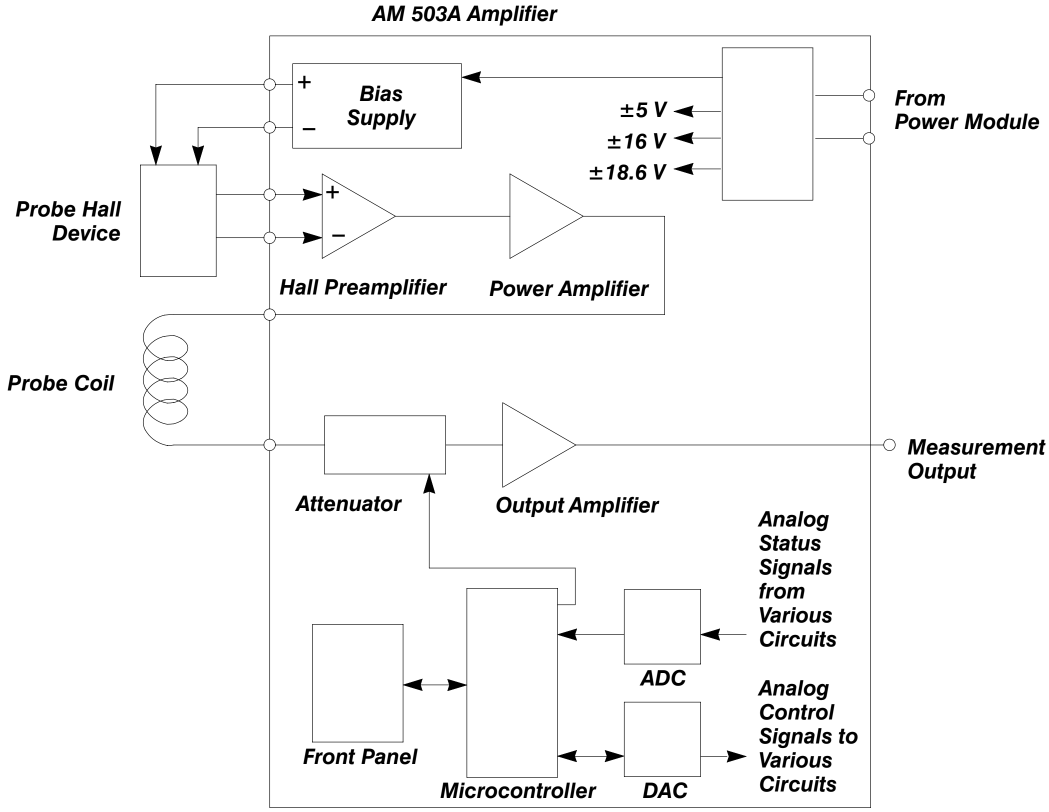


Figure 3-9: Simplified Block Diagram of AM 503A

Detailed Circuit Descriptions of the AM 503A

This section describes the AM 503A circuits to the component level. For better understanding, first read the circuit overview and functional descriptions presented earlier. Refer to the schematic diagrams and component locator tables in the *Diagrams* section while reading the circuit descriptions. The signal glossary in *Diagrams* defines each major AM 503A signal listed on the schematics.

NOTE

The primary schematic(s) for major circuits or assemblies are indicated; note that some circuit elements discussed may appear on other schematics. To find a specific component, check the component locator table for the assembly.

Input Connector — A1 ◇1

The current probe attaches to the AM 503A amplifier at J400, a 12-pin connector. One end of a flexible circuit cable (P391) is soldered to the back of J400 and the other end connects to the main circuit board of the AM 503A at J391, a 20-pin connector. The alpha characters on the schematic diagram represent J400 pins and the numerals represent circuit board pins.

The probe identification (PROBE_ID) line is at pin 18 (B). Each probe type is identified by resistance coding. The voltage range of PROBE_ID is from 0 V to +1.2 V (for a list of probe codes, see the analog-to-digital converter circuit descriptions). Resistor R331 provides the pull-up. Bypass capacitor C303 minimizes noise on the line.

At pin 15 (C), the PROBE_OPEN signal indicates whether the probe slider is open or closed. When the slider is open, pin 15 is at 0 V. When the slider is closed, pin 15 is at approximately +5 V. Operation of the PROBE_OPEN signal is explained later in the bias supply circuit descriptions.

The +3 V and −3 V bias supplies for the Hall device appear at pins 17 (D) and 19 (A), respectively.

The power amplifier output connects to the current transformer of the probe at pin 7 (N). The return line from the current transformer appears at pin 4 (M) and is connected to the input of the attenuator circuit.

All unused pins of flex cable connector P391 are grounded.

Hall Device Preamplifier (U292) — A1 ◇1

The Hall device preamplifier amplifies the differential voltage from the probe Hall device at pins 14 (E) and 12 (F) of the input connector.

The preamplifier gain is fixed at 100 with a rolloff at higher frequencies. The preamplifier output drives the power amplifier U371.

The resultant DC or low-frequency output voltage is applied from pins E and F of the input connector through R298 and R397, to pins 2 and 3 of U292.

Any offset from the Hall device is cancelled in the probe. A portion of the Hall device DC bias voltage is applied to the summing node at pin 2 of U292 through a selected resistor in the probe, pin H of the input connector, and R296.

When the **PROBE DEGAUSS AUTOBALANCE** button is pressed, the microcontroller adjusts HALL_PREAMP_DC_OFS so that the DC output of the Hall preamplifier is zero. The DC offset of the Hall device preamplifier and current probe are nulled by the HALL_PREAMP_DC_OFS input, which is summed into the preamplifier through R297. The HALL_PREAMP_DC_OFS line is discussed further in the microcontroller circuit descriptions. The HALL_PREAMP_DC_OFS source is supplied by DAC U370, which is discussed later in this section under Digital-to-Analog Converter and Digital-to-Analog Interfaces.

Preamp Disconnect Switch (Q374) — A1 ⟨1⟩

The Hall preamp disconnect allows the Hall device preamplifier to be switched out of the circuit. This is particularly important when the current probe is being degaussed.

The switch is controlled digitally through pin 13 of operational amplifier driver U170D (HALL_PREAMP_DISC). U170D provides the negative bias voltage needed to turn Q374 off. The signal path portion of the Hall preamp disconnect circuit consists of CR391, CR392, and Q374.

During normal operation, Q374 is conducting and its gate is pulled to ground through R392. Diodes CR391 and CR392 are used to clamp the drain of Q374 when the signal level exceeds about ±0.6 V.

Before the current probe is degaussed, pin 13 of U170D goes high which causes the output, pin 14 of U170D, to go to the negative rail, applying about −14 V to the gate of Q374 through CR390. This causes Q374 to shut off, disconnecting and isolating the Hall device preamplifier from the rest of the circuit. After the probe is degaussed, Q374 is again biased on to bring the Hall device preamplifier back into the circuit.

The HALL_PREAMP_DISC is a digital control line discussed under Digital-to-Analog Interfaces later in this section.

Hall Device Power Supply and Probe_Open Circuits — A1 ⟨1⟩

The Hall device power supply provides the voltages needed to properly bias the Hall device in the current probe as well as detecting if a current probe Hall device is attached to the input connector.

The Hall device power supply circuit consists of two voltage regulators, U290 and U291, and associated components. U290, R292, R291 and C304, establish the +3 V supply on pin D of the input connector. U291, R293, R294 and C305 establish the −3 V supply on pin A of the input connector.

The probe unlocked (PROBE_OPEN) circuit looks at two criteria that are combined through NAND gate logic to provide a single output to the microcontroller, indicating whether the probe slider is closed or opened.

The +3 V supply is used (in addition to providing a bias voltage for the Hall device) to detect if a current probe Hall device is attached to the input connector. If no Hall device load is present on the +3 V supply then the +3 V supply is pulled up to about +4 V through R299. This causes Q190 to turn off and the input, pin 13 of U132D, to be pulled low through R192. Pin 13 of U132D is one input to the two-input NAND gate.

However, when a Hall device is present on the +3 V supply it is pulled down to the +3 V needed for biasing the Hall device. This indication that a Hall device is connected causes Q190 to turn on, which pulls pin 13 of U132D high.

The state of the probe slider is monitored at pin C of the input connector that connects to pin 12 of U132D. This is the second input to the two-input NAND gate.

When the probe slider is opened (unlocked), pin 12 of U132D is pulled low in the probe. However, once the probe is closed (locked), pin 12 of U132D is pulled high through the pull-up resistor R301. The output of the NAND gate, pin 11 of U132D, reflects these conditions by going low only when a Hall device or load is placed on the +3 V supply *and* the probe slider is closed (locked); otherwise, the output will remain high.

When PROBE_OPEN is high, the probe degauss function is disabled.

PROBE_OPEN is a digital control line discussed under Digital-to-Analog Interfaces later in this section.

Degauss Switch (Q370) — A1 ◇1

During normal operation, DEGAUSS_SIG_ENBL is low and the gate of Q370 is at approximately −14 V, causing Q370 to be open. When the **PROBE DEGAUSS AUTOBALANCE** button is pressed, DEGAUSS_SIG_ENBL goes high and the gate of Q370 goes to ground, causing Q370 to conduct. As a result, DEGAUSS_SIG, a decaying sine wave, passes to the inverting input of the power amplifier. For more information about the degauss signal, see the Digital-to-Analog Converter circuit descriptions later in this section.

Power Amplifier (U371, Q271, Q373) — A1 ◇1

The power amplifier provides bucking current for the current transformer of the probe and applies the degauss signal during the degaussing process.

Bucking current opposes DC and low-frequency current from the conductor under test, minimizing the flux density in the probe core.

The degauss signal is fed through the power amplifier to the current probe transformer to remove any residual magnetism in the transformer core.

The power amplifier also provides gain, crossover-frequency compensation, input overload detection, and the voltage source (V_{in}) necessary to adjust the DC gain of the AM 503A. (The crossover-frequency region is where the current probe transformer signal starts to dominate as the signal supplied by the Hall device starts to roll off.)

The power amplifier circuit consists of U371, Q271, Q373, and associated components. The degauss and overload circuits are discussed later in this section.

The output signal from pin 6 of U371 drives the bases of Q271 and Q373, a push-pull emitter-follower amplifier. R373, CR373 through CR376, and R374 form the DC bias network for Q271 and Q373. CR272 and CR372 are protection diodes that prevent the Darlington transistors, Q271 and Q373, from being damaged by inductive kickback from the current probe.

The power amplifier output has current-limiting circuits that monitor the voltage drop across R274 and R379. These protective circuits guard Q271 and Q373 against any short-circuit conditions that may occur at the power amplifier output.

From DC to the crossover region, the Hall device provides all or most of the signal to the attenuator. Above the crossover region, the current probe transformer provides the signal to the attenuator.

A feedback loop permits the Hall device and transformer core in the current probe to operate at very low flux densities by applying the output of the power amplifier (Q271 and Q373) to the current probe transformer. The current through the transformer coil causes a flux in the core that is opposite and approximately equal to the flux generated by the current being measured by the probe.

The feedback loop consisting of RC networks R393, R391 and C299 help provide a smooth transition in the crossover region. L390, along with a 25 Ω resistor on the hybrid attenuator in parallel with it, in series with the 25 Ω input impedance of the attenuator, terminates the coaxial cable of the probe into 50 Ω at high frequencies.

Above the crossover region, the output of the Hall device preamplifier diminishes. L391 blocks high-frequency signals from the probe coil to prevent damage to the output stage of the power amplifier. C399 and R400 form a 50 Ω termination looking in from the probe cable (pin N of the input connector).

The degauss signal uses the power amplifier to achieve the current magnitudes necessary to effectively degauss the current probe. The degauss circuit comprises U170A, U353A and Q370.

The degaussing signal, supplied by DAC U370, goes through a second order low-pass filter and into the summing node at pin 2 of U371.

Before degaussing the current probe, pin 3 of U170A is set high (DEGAUSS_SIG_ENBL), which causes Q370 to conduct by pulling its gate to ground through R372. C363 serves as a blocking capacitor, preventing any DC offset components present in the degauss circuit from entering into the power amplifier.

After the probe is degaussed, pin 3 of U170A goes low, which causes the output, pin 1 of U170A, to go to the negative rail, applying about −14 V through CR370 to the gate of Q370. This causes Q370 to shut off, disconnecting and isolating the degauss circuitry from the power amplifier so that DAC U370 output pins 3 and 18 can be used for HALL_PREAMP_DC_OFS voltage control.

The PWR_AMP_DC_OFS input serves as a fine adjustment to null out the DC offset of the power amplifier, as well as a coarse adjustment to set V_{in} when adjusting the DC gain of the AM 503A. The fine and coarse adjustments are achieved by turning FET Q371, which is in parallel with R371, on and off respectively. Q371 is controlled digitally through pin 6 of the operational amplifier U170B (V_IN). U170B provides the negative bias voltage needed to turn Q371 off.

During normal operation, and before the DC offset of the power amplifier is nulled, pin 6 (V_IN) of U170B goes low, which causes the output, pin 7 of U170B, to go to the positive rail. With CR371 reverse-biased, Q371 is biased on, its gate being pulled to ground through R375.

When Q371 is on, the voltage at the noninverting input of U371 is approximately $1/500$ of the voltage present at the PWR_AMP_DC_OFS input. Any DC offset present at the output of the power amplifier is nulled before degaussing the current probe. This brings the DC current in the coil of the probe close to zero, which will make effective degaussing of the current probe possible.

When adjusting the DC gain of the AM 503A, the PWR_AMP_DC_OFS input is used to drive the power amplifier to achieve the desired V_{in} levels as detected by the IN_V_DETECT input of ADC U350. To generate the voltages needed, pin 6 (V_IN) of U170B goes high, causing the output, pin 7, to go to the negative rail, applying about −14 V through CR371 to the gate of Q371. This causes Q371 to shut off, increasing the voltage at the noninverting input of U371 to about $1/7$ of the voltage present at the PWR_AMP_DC_OFS input.

DEGAUSS_SIG_ENBL and V_IN are discussed later under Digital-to-Analog Interfaces.

DEGAUSS_SIG, HALL_PREAMP_DC_OFS and PWR_AMP_DC_OFS sources are supplied by DACs and are discussed later under Digital-to-Analog Interfaces.

IN_V_DETECT is discussed later under Analog-to-Digital Interfaces.

Overload Detector — A1 ⟨1⟩

The overload detection circuits, with the front panel overload LED, provide a visual indication when the power amplifier is overdriven. Diodes CR273, CR274, CR275, and CR276 form a bridge whose input is connected to the power amplifier output. The output of the bridge is connected to the front panel overload LED. Zener diode VR271, connected in series with the overload LED, increases the required turn-on voltage by 9 V. To activate the overload LED, the power amplifier must output approximately 12 V. The additional voltage requirement above 9 V is due to the voltage drop across the bridge and the overload LED.

Resistors R271 and R276 form a divider network that is connected to the output of the power amplifier. About 1/12 of the power amplifier output appears across R271. The microcontroller monitors the voltage across R271 for overload conditions. An overload condition occurs when the voltage across R271 exceeds approximately 1 V. R276 and R271 scale down the voltage at the output of the power amplifier so that it can be monitored by the OVLD_DETECT input of ADC U350, which is discussed later under Analog-to-Digital Interfaces.

100 MHz Low-Pass Filter — A1 ◇2

A low-pass filter is formed by the output impedance of the attenuator and Q290, C292, and L190. The filter has a corner frequency of about 100 MHz and a slope of approximately 6 dB/octave.

Placing the filter in the signal path between the attenuator output, pin 27 of J390, and the noninverting input of the output amplifier, pin 4 of U171, limits the AM 503A bandwidth to 100 MHz when the filter is enabled.

The filter is enabled and disabled by turning FET Q290 on and off, respectively. When pin 10 of U170C is high (B2 = 1), the gate of Q290 is pulled to ground through R290.

When the gate of Q290 is near 0 V, Q290 is on, providing a low impedance path to ground for high frequency signals through C292. C292 and the attenuator output impedance form a low-pass RC filter.

L190 provides additional attenuation at higher frequencies and compensates for the finite "on" resistance of FET switch Q290. When pin 10 of U170C is low (B2 = 0), the output of U170C, pin 8, goes to the negative rail, applying about −14 V through CR290 to the gate of Q290. This causes FET Q290 to turn off and full system bandwidth to be preserved.

Attenuator (J390) — A1 ◇2

The attenuator provides attenuation factors of 1, 10, and 100. It also selects the coupling mode (AC, DC, REF) between the probe and output amplifier. The attenuation settings combine with the switchable gain of the output amplifier to produce the front panel scale factors.

The attenuator also provides a 25 Ω input termination for the power amplifier and a 50 Ω input termination at higher frequencies. In the REF coupling position, the attenuator provides a 50 Ω termination for the power amplifier. The attenuator also includes a split-path buffer which provides a 50 Ω output impedance regardless of AC or DC coupling. The output amplifier input requires the 50 Ω output impedance of the attenuator to ensure that its inverting and noninverting inputs are matched.

The attenuator circuit is a 30-pin hybrid with magnetically latched relays for selecting attenuation and coupling settings. The input of the attenuator, the ATTEN_INPUT line, comes from the current probe coil. A sample of this input appears on the FEEDBACK_LOOP line. The FEEDBACK_LOOP signal helps maintain measurement flatness (accuracy) when measuring currents near the crossover region (approximately 20 kHz) of the probe.

A voltage pick-off is taken off pin 1 of the attenuator through R395 and fed to an input of ADC U350. The picked-off voltage is called the IN_V_DETECT signal and is used during gain adjustment. The IN_V_DETECT signal is discussed later under Analog-to-Digital Interfaces and in the microcontroller operating sequence description.

Relays are used to change attenuation settings and AC, DC, and REF coupling. The relays are switched using U270 which is a digitally controlled relay driver. Microcontroller supervision of the attenuator is provided through data latch U270. Serial data from the microcontroller on the RLY_SDATA_IN line is clocked in on the rising edge of RLY_SCLK. After the serial transfer is completed, RLY_STROBE pulses high to latch the data into U270, then RLY_OE pulses low to enable the Q outputs. The data pulses that appear on the Q outputs latch the attenuator relays to the desired settings (for more information about these pulses, see the troubleshooting section in *Maintenance*).

The microcontroller verifies a successful data transfer by comparing the data returned on the RLY_SDATA_OUT line to the originally transmitted data. If the returned data matches the transmitted data, the transfer is successful. If the data does not match, an error code is displayed on the front panel.

Output Amplifier (U171) — A1 ⟨2⟩

The output amplifier provides the measurement output of the AM 503A. It has switchable bandwidth settings, switchable step gain, and variable gain. The output impedance of the amplifier is 50 Ω.

Bandwidth limits (or filters) of full bandwidth or 20 MHz are selectable under digital control. These filters have four complex poles approximating a Bessel filter. The output amplifier uses two of U171's push-pull outputs in parallel to gain additional drive capability, as well as create the 50 Ω environment required by the AM 503A output (the output impedance of a single output is 100 Ω). Since U171 has a differential output, the two paralleled outputs not used are terminated into a 50 Ω load, R172, to keep the outputs balanced.

Step gain may be selected in six steps with a maximum gain for each step of 60, 30, 12, 6, 3, and 1.2.

The microcontroller controls the step gain of the amplifier with bits G0, G1, and G2. Tables 3-1 and 3-2 define the bit values for each scale factor and probe.

Table 3-1: AM 503A System Gain Settings with A6302 Probe

Scale Factor	Attenuation	Step Gain	G0	G1	G2
1 mA/division	1	60	L	L	L
2 mA/division	1	30	L	L	H
5 mA/division	1	12	L	H	L
10 mA/division	1	6	L	H	H
20 mA/division	1	3	H	L	X
50 mA/division	1	1.2	H	H	X
0.1 A/division	10	6	L	H	H
0.2 A/division	10	3	H	L	X
0.5 A/division	10	1.2	H	H	X
1.0 A/division	100	6	L	H	H
2.0 A/division	100	3	H	L	X
5.0 A/division	100	1.2	H	H	X

***The A6302 setting for OUT_AMP_GAIN_ADJ is approximately −280 mV**
X = don't care and are programmed low (L) in the AM 503A

Table 3-2: AM 503A System Gain Settings with A6303 Probe

Scale Factor	Attenuation	Step Gain	G0	G1	G2
10 mA/division	1	60	L	L	L
20 mA/division	1	30	L	L	H
50 mA/division	1	12	L	H	L
100 mA/division	1	6	L	H	H
200 mA/division	1	3	H	L	X
500 mA/division	1	1.2	H	H	X
1 A/division	10	6	L	H	H
2 A/division	10	3	H	L	X
5 A/division	10	1.2	H	H	X
10 A/division	100	6	L	H	H
20 A/division	100	3	H	L	X
50 A/division	100	1.2	H	H	X

***The A6303 setting for OUT_AMP_GAIN_ADJ is approximately −640 mV**
X = don't care and are programmed low (L) in the AM 503A

The variable gain setting is determined by the OUT_AMP_GAIN_ADJ line. The voltage range of this line is from +0 V to −1 V. The variable gain setting is used to fine-adjust overall system gain during the autobalance portion of the degauss/autobalance routine.

The OUT_AMP_GAIN_ADJ control voltage comes from a buffered DAC output and is level-shifted to swing between 0 and −1 V at pin 8 of U171. The OUT_AMP_GAIN_ADJ voltage is supplied by DAC U370, which is discussed later under Digital-to-Analog Converter and Digital-to-Analog Interfaces.

The bandwidth is controlled by bits B0, B1, and B2. Table 3-3 defines the bit values for each gain setting.

In order to position the signal on an oscilloscope, the user introduces a DC offset at the amplifier output by rotating the AM 503A **DC LEVEL** knob. Changing the DC output level of the AM 503A is accomplished using U352D and associated components in a noninverting amplifier configuration. This configuration provides the amplification needed for the AM 503A_DC_LEVEL input. The AM 503A_DC_LEVEL is supplied by two DACs which are discussed later under Digital-to-Analog Converter and Digital-to-Analog Interfaces.

The AM503_DC_LEVEL voltage is temporarily set to zero during the probe degauss/autobalance routine.

The OUT_AMP_DC_OFS and OUT_V_DETECT lines are used during the probe degauss/autobalance routine for self-adjustment. For more information about these lines, read the microcontroller circuit descriptions.

The output of U171 appears at pins 23 and 26. The negative terminals (pins 22 and 25) are grounded through a 50 Ω resistance. During normal operation, OUT_AMP_ENBL (connected to pins 12 and 16) is set high to enable the output amplifier.

The DC offset error of the amplifier output is measured using an ADC input called OUT_V_DETECT. Any DC offset error present at the OUT_V_DETECT input is zeroed by the processor-controlled OUT_AMP_DC_OFS control voltage, which is attenuated by the divider R191 and R190, filtered by L191, C192 and LR190, and fed into the inverting terminal, pin 6 of U171.

The OUT_V_DETECT input is discussed later under Analog-to-Digital Conversion Interfaces. The OUT_AMP_DC_OFS control voltage is supplied by DAC U370, which is discussed later under Digital-to-Analog Converter and Digital-to-Analog Conversion Interfaces.

Power Supply Sequencing and Voltage References — A1 ◇3

The analog-to-digital converter (ADC), U350, requires power supply sequencing. A unity-gain integrator based around U353B and associated components establishes the desired sequence of −5 V, +5 V, and finally the +1.235 V reference. Diodes CR342 and CR343 are used to clamp the output of the integrator to between 0 and +5 V.

The first and most critical reference is the +1.235 V reference based around U351. This reference is used to generate the ±2.5 V references.

A noninverting amplifier consisting of U352A and associated components establishes the +2.5 V reference. A unity gain inverting amplifier based around op amp U352B and associated components is cascaded with the +2.5 V reference to generate the −2.5 V reference. The ±2.5 V references are used by DAC U370 and the clamping circuit on the input to ADC U350. The +2.5 V reference is also used to perform the level-shifting needed on the OUT_AMP_GAIN_ADJ control line.

Digital-to-Analog Converter (U370) — A1 ◇3

The digital-to-analog converter (DAC) provides an interface from the microcontroller to the AM 503A circuits. DAC U370 supplies various control voltages that are used by the AM 503A.

U370 is made up of eight individual eight-bit D/A converters. It is programmed using a 3-wire serial interface by the AM 503A microcontroller.

The ± reference voltages for D/A conversion are $+V_{ref}= +2.5$ VDC and $-V_{ref}= -2.5$ VDC. This yields a resolution of approximately 20 mV/LSB (least significant bit). The AM 503A uses all eight of the U370 outputs, in conjunction with various amplifiers, to perform the functions described under Digital-to-Analog Interfaces.

Serial data from the microcontroller appears on the SERIAL_DATA line and is clocked into the DAC with the rising edge of VCS_CLK. The serial data contains the desired DAC register address followed by the data to be loaded into the register. When the microcontroller strobes VCS_LOAD low, the selected register is updated. The outputs appear at VA through VH. All outputs have a voltage range of −2.5 V to +2.48 V at the DAC output pin.

Digital-to-Analog Interfaces — A1 ◇2◇3◇4

The digital-to-analog interface is accomplished using control and status line signals. The following states apply to the digital signals described below:

0 = zero volts (digital low or **L**)
1 = +5 volts (digital high or **H**)
X = don't care (digital low or high) and are programmed low in the AM 503A

Typical voltage ranges of other status or control lines are described where appropriate.

PROBE_OPEN (pin 6, U152)—Input to the microcontroller. When high, the current probe slider is open or unlocked, or no probe is attached. When low, the current probe slider is closed and locked.

HALL_PREAMP_DISC (pin 34, U152)—Output from the microcontroller. When low, the Hall device preamplifier is enabled, Q374 is biased on and signals pass from the Hall device preamplifier to the power amplifier. When high, the Hall device preamplifier is disconnected from the rest of the circuit, Q374 is biased off and has no effect on the power amplifier.

DEGAUSS_SIG_ENBL (pin 12, U252)—Output of the I^2C eight-bit I/O expander, U252. When high, the path for the DEGAUSS_SIG is enabled, passing the degauss signal generated by the DAC into the power amplifier. When low, the path for DEGAUSS_SIG is disabled, preventing the degauss signal generated by the DAC from passing into the power amplifier.

V_IN (pin 11, U252)—Output of the I^2C eight-bit I/O expander, U252. V_IN sets the PWR_AMP_DC_OFS control line in either a coarse (V_IN=1) or fine (V_IN=0) mode, with respect to the output of the power amplifier. When high, the PWR_AMP_DC_OFS control line from the DAC is used to set V_{in}, which is in turn used for adjusting the DC gain of the AM 503A. When low, the PWR_AMP_DC_OFS control line is used to null the power amplifier output. In the normal operating mode V_IN will remain low.

OUT_AMP_ENBL (pin 33, U152)—Output of the microcontroller. When low, the output of the output amplifier is disabled and no signal is passed through the output amplifier. When high, the output of the output amplifier is enabled, and allows the signal at the input to pass through to the output.

G0, G1, G2 (pins 4,5,6, U252)—Outputs of the I^2C eight-bit I/O expander, U252. These are the gain control bits and determine the gain of the output amplifier, U171. Refer to Tables 3-1 and 3-2 for gain settings for the A6302 and A6303 probes.

B0, B1, B2 (pins 7,8,9, U252)—Outputs of the I^2C 8-bit I/O expander, U252. B0 and B1 are control bits for the bandwidth filters internal to the output amplifier. B2 is the control bit used to enable and disable the filter external to the output amplifier. Refer to Table 3-3 for the bandwidth bit settings.

Table 3-3: Bandwidth Control Settings

Bandwidth	B0	B1	B2
Full	L	H	L
20 MHz	L	L	L

HALL_PREAMP_DC_OFS—Zeros the offset at the output of the Hall device preamplifier. Under normal operation this voltage is held constant after it has been set. Coarse and fine adjustments, VA (pin 3, U370) and VH (pin 18, U370) respectively, are used to accomplish this function.

VA will have approximately a 1:4 relationship to the HALL_PREAMP_DC_OFS. The relationship between the coarse and fine adjustment is approximately 1:30. This output of U370 is shared with DEGAUSS_SIG, which is used only during the degaussing of the current probe. VA is reset after the probe degauss/autobalance routine.

The coarse output, VA, is set to within 1 LSB and is established prior to the adjustment of the fine output. The voltage range of both VA and VH is +2.48/−2.5 V. The resolution of these output voltage ranges is ±20 mV.

DEGAUSS_SIG—Simulates a 160 Hz pseudo-exponentially decaying sine wave function during the current probe degauss cycle. DEGAUSS_SIG is generated at the VA and VH outputs of U370, which are also used to coarse- and fine-adjust the HALL_PREAMP_DC_OFS control line.

This stair-stepped waveform is first filtered, to remove high-frequency components, and then amplified. This signal is initiated as part of the probe degauss/autobalance routine.

Figure 3-10 shows a rough view of the degauss waveform before and after filtering. Each burst contains approximately 256 cycles and the amplitude of the filtered waveform (at pin 1 of U353A) is approximately 3 V. The degauss signal goes to the power amplifier.

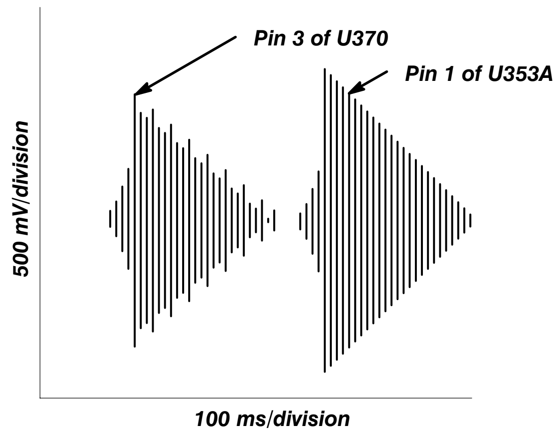


Figure 3-10: The Degauss Signal

The voltage range of the VA and VH outputs for the DEGAUSS_SIG is +2.48/−2.5 V (with a gain of approximately 4 and in phase with VA and VH). The resolution of this voltage range is ±20 mV.

PWR_AMP_DC_OFS—Zeroes the offset at the output of the power amplifier and sets V_{in} during the DC gain adjustment. The PWR_AMP_DC_OFS output can be set into a coarse or fine mode by toggling the bit, V_IN.

During normal operation, the bit V_IN is low and the PWR_AMP_DC_OFS output is used to zero the power amplifier. This establishes zero current flow through the current probe coil. PWR_AMP_DC_OFS is set *after* disconnecting the Hall device preamplifier and *prior* to generating the DEGAUSS_SIG during the probe degauss/autobalance routine.

When the bit V_IN is set high, the PWR_AMP_DC_OFS output is in coarse mode, which is used to set V_{in} for the DC gain adjustment. The relationship between the PWR_AMP_DC_OFS output and the output of the power amplifier is approximately 500:1 for the fine mode (normal operation) and 7:1 for the coarse mode (while setting DC gain).

The voltage range of the PWR_AMP_DC_OFS output VC (pin 5, U370) is +2.48/−2.5 V. The resolution of this voltage range is ±20 mV.

OUT_AMP_GAIN_ADJ—Controls the variable gain-adjust of the output amplifier. This voltage is set during the probe degauss/autobalance routine. An inverted 5:1 relationship exists between VD and the OUT_AMP_GAIN_ADJ control line.

The voltage range of the OUT_AMP_GAIN_ADJ output VD (pin 6, U370) is +2.48/−2.5 V. The resolution of this voltage is ±20 mV.

OUT_AMP_DC_OFS—Sets the output of the output amplifier to zero volts. This corrects for any DC offset errors caused by the output amplifier or attenuator. This voltage is established for each sensitivity setting at the beginning of the probe degauss/autobalance routine, and stored in the non-volatile RAM (NVRAM).

Coarse and fine adjustments, VE (pin 15, U370) and VF (pin 16, U370) respectively, are used to accomplish this function. VE will have approximately a 1:1 relationship to OUT_AMP_DC_OFS. The relationship between the coarse and fine adjustment is approximately 1:85.

The voltage divider that exists between VE and VF establishes the ratio of (12K/(12K + (1M + 12K)))=0.0117 or 1:85. The typical output resistance of each of the DACs in U370 is 12 kΩ.

The coarse output, VE, is set prior to the adjustment of the fine output, VF. The range of VE and VF is +2.48/−2.5 V. The resolution of these output voltage ranges is ±20 mV. However, the resolution of the input at pin 6 of U171 is (0.0117)(20mV/LSB), which is approximately 230 μV/LSB.

AM 503A_DC_LEVEL—Controls the output DC level of the output amplifier. This signal allows the user of the AM 503A to manually shift the output waveform on the oscilloscope (by introducing a controlled DC offset). This voltage can be changed by turning the **DC LEVEL** control on the front panel. The waveform being displayed on the scope will stay centered around this introduced DC level as the AM 503A sensitivity is changed from range-to-range.

After the probe degauss/autobalance routine is complete, the DC level output is set to zero volts if REF coupling is selected. If DC or AC coupling is selected, the pre-degauss/autobalance routine DC level is restored. Coarse and fine adjustments, VB (pin 4, U370) and VG (pin 17, U370) respectively, are used to accomplish this function. VB will have approximately a 1:11 relationship to OUT_AMP_DC_OFS. The relationship between the coarse and fine adjustment is approximately 1:85.

The voltage divider that exists between VB and VG establishes the ratio of (12K/(12K + (1M + 12K)))=0.0117 or 1:85. The typical output resistance of each of the DACs in U370 is 12 kΩ.

The fine output VG is incremented first until the user goes beyond a specified count in one direction, allowing the user to set the DC level with precision. The coarse output VB is then incremented, allowing the user to make large DC level adjustments with greater speed.

Output VB is also monitored by the A/D convertor to determine if U370 is operating properly.

The range of both of these outputs, VB and VG, is +2.48/−2.5 V. The resolution of these output voltage ranges is ±20 mV.

Analog-to-Digital Converter (U350) — A1 ◇3

The analog-to-digital converter (ADC) provides an analog interface from the AM 503A circuits to the microcontroller. ADC U350 converts various analog signals into serial data words that the microcontroller can read.

The microcontroller programs the mode configuration of ADC U350 with an eight-bit serial data word on the DATA_IN line. The data word addresses the desired conversion channel, configures the mode of operation, and specifies the format of the conversion data.

To initiate a data transfer, CS is set low and the data is then clocked in with the rising edge of SHIFT_CLK. While the configuration data is being clocked in on the DATA_IN line, the previous conversion data is clocked out on the DATA_OUT line. When the data transfer is complete, CS goes high until the next transfer cycle. Timing for the analog-to-digital conversion is provided by A/D_CLK.

Reference U351 provides +1.235 V for the +REF line of ADC U350. The −REF line is grounded.

The channel 0 input is the probe identification (PROBE_ID) line. ADC U350 reads the voltage of this line to identify the type of probe connected to the AM 503A. Table 3-4 lists the voltages represented by each probe type.

Table 3-4: Probe ID Codes

Probe	Resistance Code	Voltage Level
A6302	Infinite	+1.1856 to +1.2474
A6303	0 Ω	−0.05 to + 0.05

The channel 1 input checks the DAC output during power-up diagnostics to verify that the DAC is working properly. If a failure occurs, an error code will appear on the front panel.

The channel 2 input is the overload detection (OVLD_DETECT) line. An overload condition is indicated if the voltage on this line is outside the range of −1.0 V to +1.0 V.

The channel 3 input monitors the attenuator input voltage (IN_V_DETECT) during the probe degauss/autobalance routine. For more information about this signal, read the microcontroller circuit descriptions.

The channel 4 input monitors the output of the output amplifier (OUT_V_DETECT) during the probe degauss/autobalance routine. For more information about this signal, read the output amplifier circuit descriptions.

The channel 5 input monitors the backup battery voltage (BTRY_VOLTAGE). When this voltage falls below 0.7 V, a low-voltage condition is indicated on the front panel during instrument power-up.

Analog-to-Digital Interfaces — A1 ◇3

The analog-to-digital interface is accomplished using a multiplexed A/D converter, U350. U350 is an eight-input device that samples each input and converts each voltage, with 12-bit resolution, to a digital serial output. The AM 503A uses six of the inputs to perform the following functions:

PROBE_ID (channel 0, U350)—Senses the type of current probe attached to the AM 503A input connector using a ratio-metric resistor coding scheme. The AM 503A has a reference 10 kΩ resistor that is compared to the internal coding resistor in the attached current probe. A ratio-metric voltage resulting from the resistor pair determines the input voltage to the PROBE_ID line. The input voltages range from 0 to +1.235 VDC. Table 3-4 (previous) lists the resistor coding for A6302 and A6303 probes.

OVLD_DETECT (channel 2, U350)—Senses a current probe overload condition at the power amplifier.

IN_V_DETECT (channel 3, U350)—Senses the voltage that appears across the 25 Ω attenuator termination. It is used during the probe degauss/autobalance routine to help set the gain of the output amplifier.

OUT_V_DETECT (channel 4, U350)—Senses the output voltage of the output amplifier. It is used during the probe degauss/autobalance routine to help cancel DC offset errors in the system, and to set the DC gain of the output amplifier.

BTRY_VOLTAGE (channel 5, U350)—Senses the voltage of the battery used to back up the PCF8570 NVRAM. A voltage less than 1.0 VDC indicates a low battery condition.

Channel 1 of U350—Connects to VB of U370. The purpose of this connection is to allow tests assessing the health of the A/D and D/A converters.

Microcontroller (U152) — A1 ◇4

The microcontroller circuit translates front panel commands into corresponding circuit responses, reports circuit status information to the front panel indicators, and manages overall instrument operation.

The microcontroller has four parallel interface buses, P0 through P3. Each bus is eight bits wide. The address latch enable at pin 30 is used for analog-to-digital conversion timing. A 12 MHz ceramic resonator, Y250, sets the internal clock frequency at pins18 and 19. Because internal ROM is used, the external access line at pin 31 is set to +5 V. The program store enable line at pin 29 is not used.

The microcontroller uses the Signetics Inter-IC bus (IIC or I^2C), a two-way serial communication bus, to communicate with components U250, U251, U252, and the front panel controller. For more information about the I^2C bus, refer to the Signetics data book for the S87C654 microcontroller.

Component U250 is an electrically-erasable programmable read-only memory (EEPROM) that stores probe ID data. To use the data, the microcontroller first reads the probe ID code obtained from ADC U350. The microcontroller then reads the EEPROM data corresponding to that code. The EEPROM data includes the probe type, minimum and maximum current ratings, bandwidth limit, and attenuation factor of the probe.

Component U251 is a volatile random-access memory (RAM). It stores the front panel settings and calibration data that is generated during the probe degauss/autobalance routine. An NVRAM if formed by using a battery (BT130) in conjunction with U251 to maintain the data when the AM 503A is powered off. When power is restored, the microcontroller reads the NVRAM data to restore the previous settings.

Component U252 is an I^2C I/O port expander. It converts the I^2C serial data into corresponding settings for step gain, bandwidth, and degauss enable (lines G0, G1, G2, B0, B1, B2, V_IN, and DEGAUSS_SIG_ENBL). For more information about these signals, read the power amplifier and output amplifier circuit descriptions.

Component U151 monitors the +5 V analog power supply and checks for malfunction of the microcontroller. Pin 7 of U151 holds the microcontroller in a reset state when the power supply drops below +4.65 V. Also, the microcontroller must toggle pin 6 of U151 at least once every 1.6 seconds or U151 will send a reset pulse to the microcontroller.

Readout U231 is a seven-segment display used for displaying internal error codes. For a list defining these codes, see the troubleshooting information in *Maintenance*. Circuit U230 latches the code data from the microcontroller and drives the display.

Component U133 is a test port used by Tektronix.

Microcontroller Operating Sequence During Degauss/Autobalance

During normal operation, the microcontroller monitors the front panel switches for closure. When a button is pressed or a knob turned, the microcontroller responds to the corresponding line being pulled low by the switch. The microcontroller initiates an operation corresponding to the line. Most operations are fairly simple. The most complex sequence of events occurs when the **PROBE DEGAUSS AUTOBALANCE** button is pressed. The AM 503A sets the DC offsets of the circuits to zero, sets the attenuator, sets the output amplifier gain, and degausses the current probe. The following list briefly summarizes the sequence of events that occur during the degauss/autobalance routine:

- [ ] **Step 1:** Disable the Hall preamplifier (set HALL_PREAMP_DISC high).
- [ ] **Step 2:** Set attenuator to DC coupling and REF (ground) input.
- [ ] **Step 3:** Set AM503_DC_LEVEL to zero.
- [ ] **Step 4:** Adjust OUT_AMP_DC_OFS (DAC channels E and F) so that the DC output of the output amplifier is zero. Monitor the output with the OUT_V_DETECT line (ADC channel 4).

- ☐ **Step 5:** Set PWR_AMP_DC_OFS (DAC channel C) so that the voltage on the IN_V_DETECT line is approximately 200 mV. Monitor the IN_V_DETECT line with ADC channel 3.
- ☐ **Step 6:** Adjust OUT_AMP_GAIN_ADJ (DAC channel D) so that the output amplifier gain is correct. Monitor the output with the OUT_V_DETECT line (ADC channel 4).
- ☐ **Step 7:** Repeat Step 4 for all current/division and bandwidth settings.
- ☐ **Step 8:** Adjust PWR_AMP_DC_OFS (DAC channel C) so that the power amplifier DC output is zero. Monitor the output with the OUT_V_DETECT line (ADC channel 4).
- ☐ **Step 9:** Enable the degauss circuit (set DEGAUSS_SIG_ENBL high).
- ☐ **Step 10:** Generate the degauss signal (DEGAUSS_SIG produces a decaying sine wave).
- ☐ **Step 11:** Disable the degauss circuit (set DEGAUSS_SIG_ENBL low).
- ☐ **Step 12:** Enable the Hall preamplifier (set HALL_PREAMP_DISC low).
- ☐ **Step 13:** Adjust HALL_PREAMP_DC_OFS so that the DC output of the Hall preamplifier is zero. Monitor the output with the OUT_V_DETECT line (ADC channel 4).
- ☐ **Step 14:** End degauss/autobalance routine.
- ☐ **Step 15:** Restore AM 503A front panel settings, restore DC level (if AC or DC coupling is enabled) and return instrument to normal operating mode.

Front Panel — A2 ◇1

The front panel translates user-initiated switch closures into corresponding data for the microcontroller. It also displays AM 503A circuit status with LED indicators. The switches are normally open and connected to the microcontroller I/O ports. The indicators (with the exception of the overload indicator) are controlled by U102.

Controller U102 communicates with the microcontroller via the I^2C bus (described in the microcontroller circuit description). All indicators driven by U102 have a common-anode configuration. Output lines P1 through P8 use MX1 and Q100 for the common anode. Output lines P9 through P16 use MX2 and Q101 for the common anode. Controller U102 multiplexes the indicators by alternately switching MX1 and MX2 high at a 200 kHz rate.

There are two rotary switches and five momentary pushbutton switches on the front panel. The momentary switches short a signal line to ground when pressed. When rotated clockwise, the rotary switches pulse low at the clockwise terminals. When rotated counterclockwise, the rotary switches pulse low at the counterclockwise terminals.

Power Supplies — A1 ⟨5⟩

The power supply consists of seven separate voltage supplies:

- +5 V digital (+5D)
- ±5 V analog (±5A)
- ±16 V analog (±16A)
- ±18.6 V analog

+5D is achieved using the rectified and filtered +11.5 VDC from the mainframe, pins 2A and 2B of the rear connector. The +11.5 VDC from the mainframe is regulated to its designated voltage, +5D, using U150.

±5A is achieved using the 17.5 VAC center-tapped supply in the mainframe, pins 5A and 5B of the rear connector. These AC voltages are full-wave rectified using CR310 through CR313 and filtered using C310 (for −5A) and C311 (for +5A).

+5A and −5A are achieved through the regulators U131 and U130, respectively. The ground for +5D and ±5A are connected on one side of R238. The other side of R238 is connected to the grounds of C153, C310 and C311 and to pins 3A, 3B, 4A and 4B of the rear connector. The diagram in Figure 3-11 shows the major circuit components.

±16A is achieved using two 25 VAC windings inside the mainframe in series. They are pins 13A, 13B, 1A and 1B of the rear connector. Pins 13B and 1A are connected together forming a center-tap, and tied to ground. The AC voltages from pins 13A and 1B are full-wave rectified using CR210 through CR213 and filtered using C213 (for +16A) and C214 (for −16A).

To achieve a regulated ±16 V, a dual-tracking regulator (U110) is used to control the series bypass transistors in the mainframe. Q111 and Q112 are used to limit the voltage into U110 to +20 V and −20 V, respectively.

R213 and R214 are the load-current sensing resistors which establish the bias on the series-pass transistors located in the mainframe. The output voltage, ±16 V, is sensed at the sense inputs, pins 4 and 11 of U110. The sense voltage determines the current in R213 and R214. For example, if the voltage at the +16 V output decreases, the + sensing circuit increases the current in R213, which increases the forward bias on the series-pass transistor. Thus, the output voltage increases to +16 V.

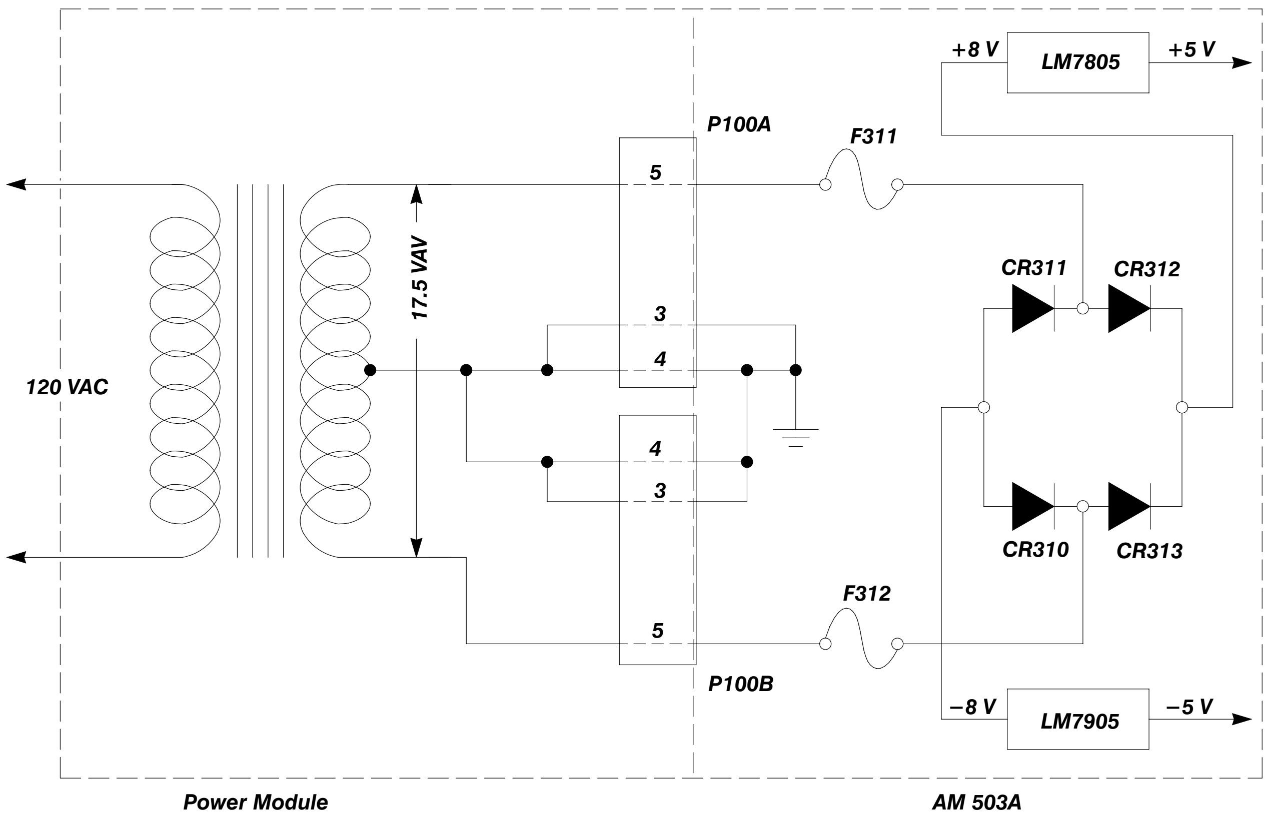


Figure 3-11: Major Components of the ±5 V Analog Supplies

R111 and R130 are used to set the maximum current limits of the ±16 V supply and R212 and R114 form a divider that sets the output voltage to ±16 V.

The ±18.6 V analog supplies are used to power the power amplifier op amp driver, U371. The current through VR110 and VR111 is set to cause a 19.3 V drop across each of them. This 19.3 V sets the pass-transistor bases of Q110 and Q130 to ±19.3 V. With the bases set at ±19.3 V, the output (emitters) are set to about ±18.6 V. The diagram in Figure 3-12 shows the major circuit components.

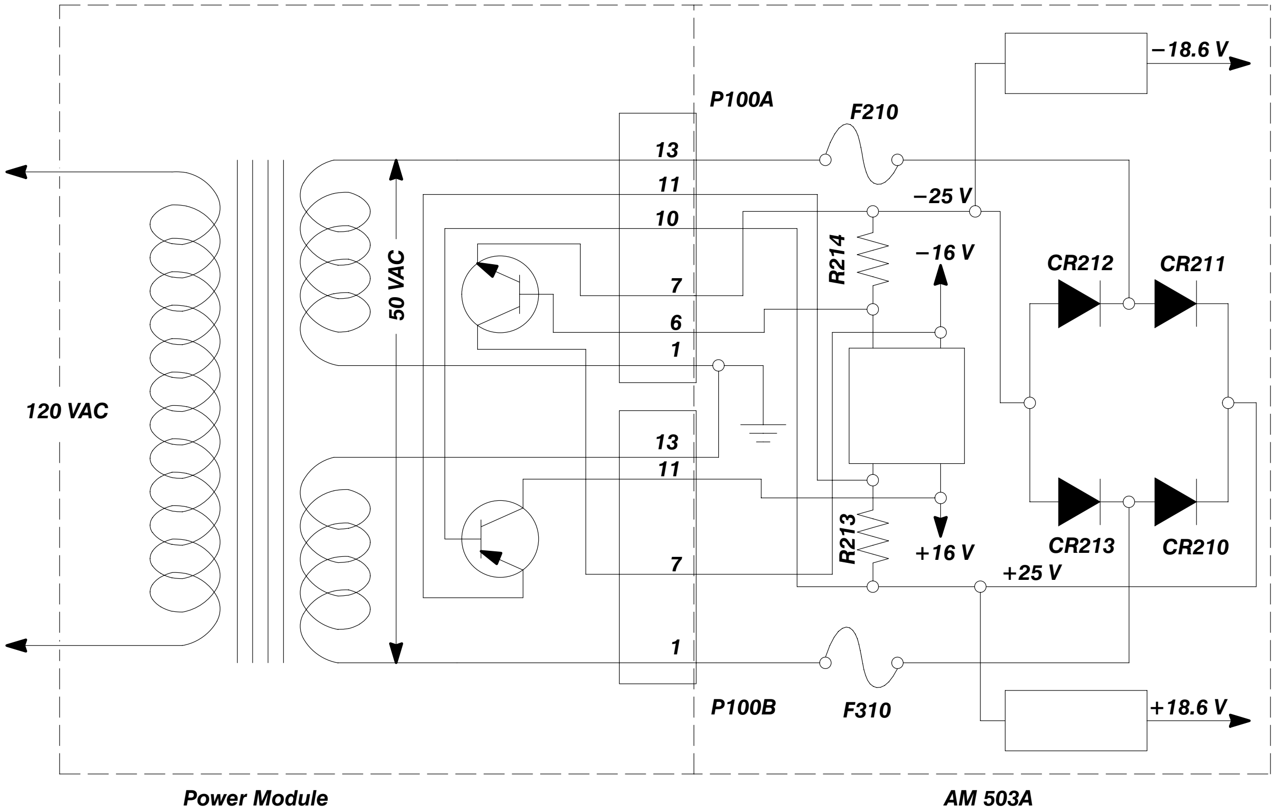


Figure 3-12: Major Components of the 16 V and 18.6 V Supplies

Each of the supplies are fused as they come onto the board from the rear connector of the mainframe. For more information about the power module circuits, refer to the service manual for your power module.

Performance Verification

The test procedures in this section verify proper performance of the AM 503A for incoming inspection or after instrument repair. Tolerances that are specified in these procedures apply to the AM 503A and do not include test equipment error. These procedures are valid only under the following conditions:

- the system has been calibrated at an ambient temperature between +20°C and +30°C
- the system is operating in an environment whose limits are described in Table 1-3 (the operating temperature limits are 0°C to +50°C, unless otherwise stated)
- the system, including probe, has had a warm-up period of at least 20 minutes
- the probe degauss/autobalance routine has been performed after the 20-minute warm-up period

No probe or AM 503A adjustments are required during these test procedures. Should any tests fail, refer to the troubleshooting section for troubleshooting recommendations.

The tests in this section check each of the following specifications listed in specification tables:

- bandwidth (with an A6302 or A6303 current probe)
- rise time (with an A6302 or A6303 current probe)
- DC accuracy

Required Test Equipment

To perform the acceptance tests in this section, you will need the test equipment listed in Table 4-1. The test equipment must meet or exceed the specifications listed. The test procedures may need to be modified if Tektronix equipment is not used.

Table 4-1: Required Test Equipment

Qty	Item	Description	Recommended Example
1	Oscilloscope	350 MHz bandwidth	TDS 460 or equivalent
1	Leveled Sine Wave Generator	3 MHz to >50 MHz	SG 503
1	Digital Multimeter	3½ digit resolution	DM 5110
1	Calibration Generator	1 MHz square wave, rise time <1 ns, 5 V p-p into 50 Ω	PG 506A
1	Power Supply		TM 5006A or equivalent
1	Voltage/ Current Source	0 to 20 volts at 200 mA	PS 5004
1	Current Loop	50 Ω, BNC connector	015-0601-50
1	Current Transformer	#31 coated wire, loop diameter ≈3 inches, 100 turns	
1	Termination	50 Ω±2%, 0.5 W	011-0049-01
3	BNC Cables	50 Ω, 42″ long	012-0057-01
1	Resistor	100 Ω, 5 W, 0.5%	

The procedures is this section assume that you are using the equipment specified. For information about operating the test equipment, refer to the appropriate user manual.

If you substitute equipment, you may have to alter the procedures to reflect the equipment used.

Equipment Preparation

Before performing the acceptance tests, install all plug-in units into the power modules and turn the power on. Verify that the AM 503A front panel controls operate as described in the operation information section. Turn any remaining equipment on and allow the entire system, including attached probe, to warm up for a minimum of 20 minutes.

NOTE

Before performing any verification procedure, properly degauss the probe. Remove the probe from any current-carrying conductor, lock the probe, and press the AM 503A ***PROBE DEGAUSS AUTOBALANCE*** *button. The degauss/autobalance routine is complete when the indicator light turns off.*

*The AM 503A front panel will display an error code (**54**) after the degauss/autobalance routine completes if the AM 503A is not properly terminated into 50 Ω. Verify that the oscilloscope input is 50 Ω and set to DC coupling. Use a 50 Ω feedthrough termination, attached at the oscilloscope input, if necessary.*

Bandwidth (A6302)

This procedure tests the bandwidth of the AM 503A if you have an A6302 Current Probe. In this test you measure a signal at a relatively low frequency and again at the rated bandwidth of the system. The two measurements are compared to verify that the signal amplitude does not fall below −3 dB at the system bandwidth. Refer to Figure 4-1 when making equipment connections.

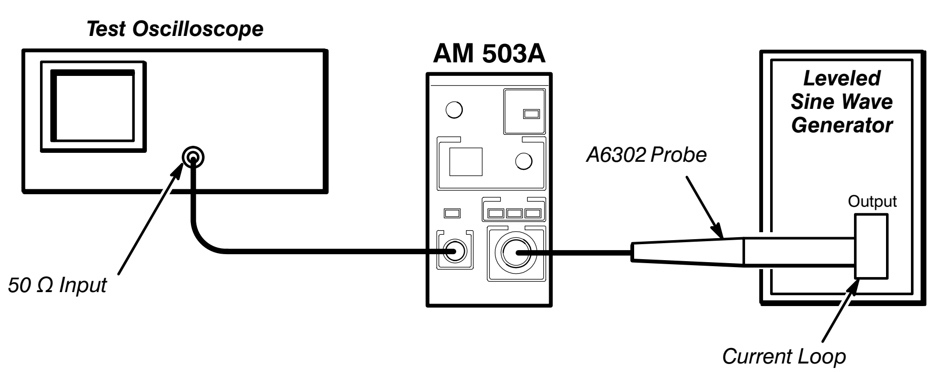


Figure 4-1: Bandwidth Test Setup — A6302

Equipment Connections

☐ **Step 1:** Using a BNC cable, connect the AM 503A output to a 50 Ω oscilloscope input. If the input impedance of your oscilloscope is 1 MΩ, connect a 50 Ω feedthrough termination to the oscilloscope input. Do not connect the termination to the AM 503A output.

☐ **Step 2:** Connect the A6302 Current Probe to the AM 503A input.

☐ **Step 3:** Connect the current loop to the output of the leveled sine wave generator (SG 503).

Equipment Settings

Make or verify the following equipment settings:

Oscilloscope

Vertical input . . . . 50 Ω
Vertical gain . . . . 10 mV/division
Time base . . . . 200 ns/division
Record length 500
Coupling . . . . DC
Offset . . . . 0 volts (mid-scale)
Trigger type . . . . edge
Trigger mode . . . . auto
Trigger position 50%
Acquire mode . . . . Average
Number of waveforms to average 8
Measurement type . . . peak-peak

Sine Wave Generator

Frequency . . . . 3 MHz
Amplitude . . . . 1 V peak-peak

AM 503A

Coupling . . . . DC
BW Limit . . . . off (full bandwidth)
Current/Division . . . . . . 5 mA

Procedure

☐ **Step 1:** Press the AM 503A **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.

☐ **Step 2:** Clamp the A6302 Current Probe around the current loop.

☐ **Step 3:** Adjust the signal generator output so that the AM 503A output is ≈60 mV_{p-p}, or six graticule divisions on the oscilloscope.

☐ **Step 4:** Using the peak-peak measurement capability of the oscilloscope, measure and record the peak-peak reading as M_1.

☐ **Step 5:** Set the oscilloscope time base to 10 ns/division. Increase the signal generator frequency to 50 MHz.

☐ **Step 6:** Using the peak-peak measurement capability of the oscilloscope, measure and record the peak-peak reading as M_2.

☐ **Step 7:** The system meets the bandwidth specification if the ratio of the signal amplitude at 50 MHz is at least 0.707 of the signal amplitude at 3 MHz. Using the following calculation, verify system bandwidth:

$$\left(\frac{Loop\ \ Impedance\ \ at\ \ 3\ \ MHz}{Loop\ \ Impedance\ \ at\ \ 50\ \ MHz}\right)\left(\frac{M_2\ \ [50\ \ MHz]}{M_1\ \ [3\ \ MHz]}\right) > 0.707$$

NOTE

The impedance of the current loop used in this test changes slightly between 3 MHz and 50 MHz. Typically the impedance changes from 50 Ω at 3 MHz to 53 Ω at 50 MHz. Thus you can substitute the following equation to simplify this test:

$$(0.94)\left(\frac{M_2\ \ [50\ \ MHz]}{M_1\ \ [3\ \ MHz]}\right) > 0.707$$

The impedance change of the current loop is negligible at the lower frequencies used to test the A6303.

Bandwidth (A6303)

This procedure tests the bandwidth of the AM 503A if you have an A6303 Current Probe. In this test you measure a signal at a relatively low frequency and again at the rated bandwidth of the system. The two measurements are compared to verify that the signal amplitude does not fall below −3 dB at the system bandwidth. Refer to Figure 4-2 when making equipment connections.

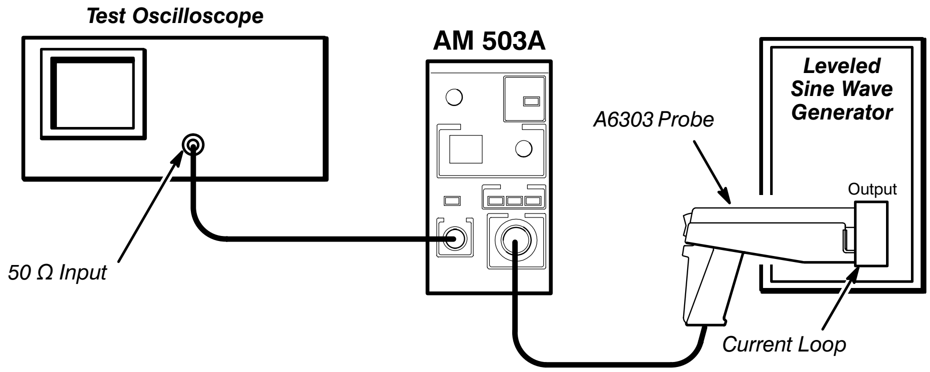


Figure 4-2: Bandwidth Test Setup — A6303

Equipment Connections

☐ **Step 1:** Using a BNC cable, connect the AM 503A output to a 50 Ω oscilloscope input. If the input impedance of your oscilloscope is 1 MΩ, connect a 50 Ω feedthrough termination to the oscilloscope input. Do not connect the termination to the AM 503A output.

☐ **Step 2:** Connect the A6303 Current Probe to the AM 503A input.

☐ **Step 3:** Connect the current loop to the output of the leveled sine wave generator (SG 503).

Equipment Settings

Make or verify the following equipment settings:

Oscilloscope

Vertical input . . . . 50 Ω
Vertical gain . . . . 10 mV/division
Time base . . . . 200 ns/division
Record length 500
Coupling . . . . DC
Offset . . . . 0 volts (mid-scale)
Trigger type . . . . edge
Trigger mode . . . . auto
Trigger position 50%
Acquire mode . . . . Average
Number of waveforms to average 8
Measurement type . . . peak-peak

Sine Wave Generator

Frequency . . . . 3 MHz
Amplitude . . . . 5 V peak-peak

AM 503A

Coupling . . . . DC
BW Limit . . . . off (full bandwidth)
Current/Division . . . . . . 20 mA

Procedure

☐ **Step 1:** Press the AM 503A **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.

☐ **Step 2:** Clamp the A6303 Current Probe around the current loop.

☐ **Step 3:** Adjust the signal generator output so that the AM 503A output is ≈50 $mV_{p\text{-}p}$, or five graticule divisions on the oscilloscope.

☐ **Step 4:** Using the peak-peak measurement capability of the oscilloscope, measure and record the peak-peak reading as M_1.

☐ **Step 5:** Set the oscilloscope time base to 50 ns/division. Increase the signal generator frequency to 15 MHz.

☐ **Step 6:** Using the peak-peak measurement capability of the oscilloscope, measure and record the peak-peak reading as M_2.

☐ **Step 7:** The system meets the bandwidth specification if the ratio of the signal amplitude at 15 MHz is at least 0.707 of the signal amplitude at 3 MHz. Using the following calculation, verify system bandwidth:

$$\frac{M_2 \quad (15 \quad MHz)}{M_1 \quad (3 \quad MHz)} > 0.707$$

Rise Time (A6302)

This procedure measures the rise time of the AM 503A if you have an A6302 Current Probe. In this test you directly measure the rise time of a step input. Refer to Figure 4-3 when making equipment connections.

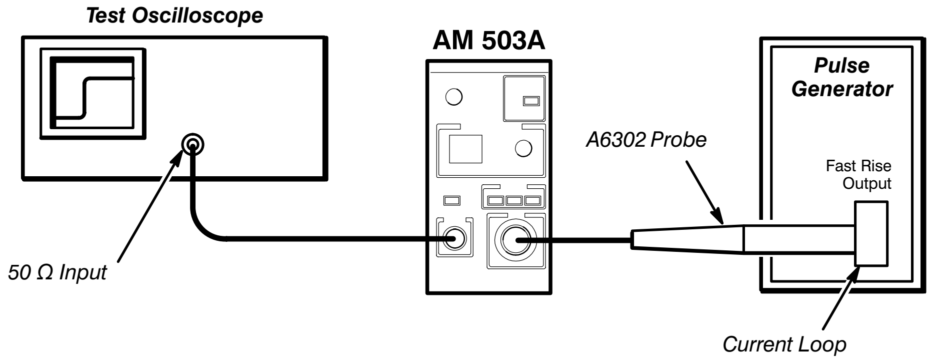


Figure 4-3: Rise Time Test Setup — A6302

Equipment Connections

☐ **Step 1:** Using a BNC cable, connect the AM 503A output to a 50 Ω oscilloscope input. If the input impedance of your oscilloscope is 1 MΩ, connect a 50 Ω feedthrough termination to the oscilloscope input. Do not connect the termination to the AM 503A output.

☐ **Step 2:** Connect the A6302 probe to the AM 503A input.

☐ **Step 3:** Connect the current loop to the pulse generator (PG 506A) fast rise output.

NOTE

If your oscilloscope cannot trigger on the pulse, use another BNC cable to connect the trigger output of the pulse generator to the trigger input of the oscilloscope. Configure the oscilloscope for an external trigger.

Equipment Settings

Make or verify the following equipment settings:

Oscilloscope

Vertical input . . . . 50 Ω
Vertical gain . . . . 10 mV/division
Time base . . . . 10 ns/division
Record length 500

Coupling	DC
Offset	0 volts (mid-scale)
Trigger type	edge
Trigger mode	auto
Trigger position	50%
Acquire mode	Average
Number of waveforms to average	8
Measurement type	rise time

Pulse Generator

Period	1 μs
Output	fast rise
Amplitude	maximum

AM 503A

Coupling	DC
BW Limit	off (full bandwidth)
Current/Division	5 mA

Procedure

☐ **Step 1:** Press the AM 503A **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.

☐ **Step 2:** Clamp the A6302 Current Probe around the current loop. Verify that the arrow-shaped indicator on the probe points away from the pulse source.

☐ **Step 3:** Using the measurement capability of the oscilloscope, measure the rise time of the displayed pulse from 10% to 90% amplitude.

☐ **Step 4:** Verify that the rise time is less than 7 ns.

Rise Time (A6303)

This procedure measures the rise time of the AM 503A if you have an A6302 Current Probe. In this test you directly measure the rise time of a step input. Refer to Figure 4-4 when making equipment connections.

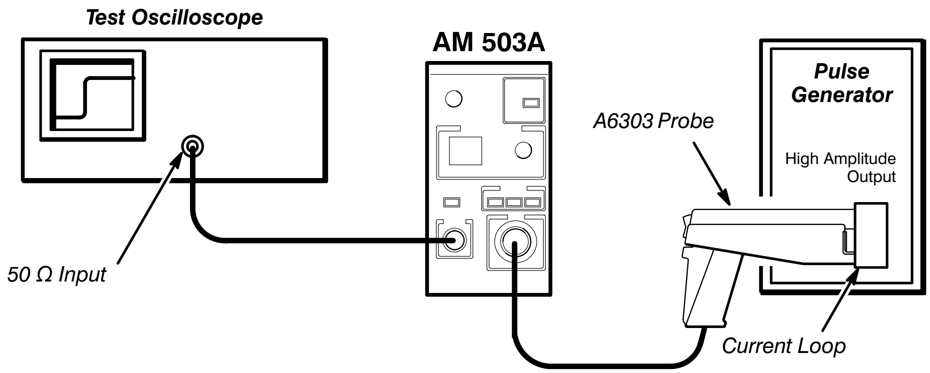


Figure 4-4: Rise Time Test Setup — A6303

Equipment Connections

- [ ] **Step 1:** Using a BNC cable, connect the AM 503A output to a 50 Ω oscilloscope input. If the input impedance of your oscilloscope is 1 MΩ, connect a 50 Ω feedthrough termination to the oscilloscope input. Do not connect the termination to the AM 503A output.
- [ ] **Step 2:** Connect the A6303 probe to the AM 503A input.
- [ ] **Step 3:** Connect the current loop to the pulse generator (PG 506A) high amplitude output.

NOTE

If your oscilloscope cannot trigger on the pulse, use another BNC cable to connect the trigger output of the pulse generator to the trigger input of the oscilloscope. Configure the oscilloscope for an external trigger.

Equipment Settings

Make or verify the following equipment settings:

Oscilloscope

Vertical input . . . . 50 Ω
Vertical gain . . . . 10 mV/division
Time base . . . . 10 ns/division
Record length 500
Coupling . . . . DC
Offset . . . . 0 volts (mid-scale)
Trigger type . . . . edge
Trigger mode . . . . auto
Trigger position 50%
Acquire mode . . . . Average
Number of waveforms to average 8
Measurement type . . . rise time

Pulse Generator

Period . . . . 1 μs
Output . . . . high amplitude
Amplitude . . . . maximum

AM 503A

Coupling . . . . DC
BW Limit . . . . off (full bandwidth)
Current/Division . . . . . . 20 mA

Procedure

☐ **Step 1:** Press the AM 503A **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.

☐ **Step 2:** Clamp the A6303 Current Probe around the current loop. Verify that the arrow-shaped indicator on the probe points away from the pulse source.

☐ **Step 3:** Using the measurement capability of the oscilloscope, measure the rise time of the displayed pulse from 10% to 90% amplitude.

☐ **Step 4:** Verify that the rise time is less than 23 ns.

DC Accuracy Current Transformer Loop

You will need to construct a simple current transformer loop in order to complete the DC accuracy tests. Construct the transformer loop as follows:

☐ **Step 1:** Using a cylindrical form approximately 3 inches in diameter, wind *exactly* 100 turns of #31 coated wire.

NOTE

Ensure that the current transformer loop has exactly 100 turns. A 1% error will result for each turn variance from 100 turns.

☐ **Step 2:** Solder a precision (0.5%) 5 W, 100 Ω resistor in series with one end of the current transformer loop.

Figure 4-5 shows how the current transformer loop is connected to the test equipment in the DC accuracy test setup.

DC Accuracy (A6302)

This procedure tests the DC accuracy of the AM 503A if you have an A6302 Current Probe. In this test you compare the voltage output of the AM 503A to a reference input. A multiple-loop current transformer is used to keep the measured test current equivalent to a five-division signal for each current/division setting of the AM 503A. Refer to Figure 4-5 when making equipment connections.

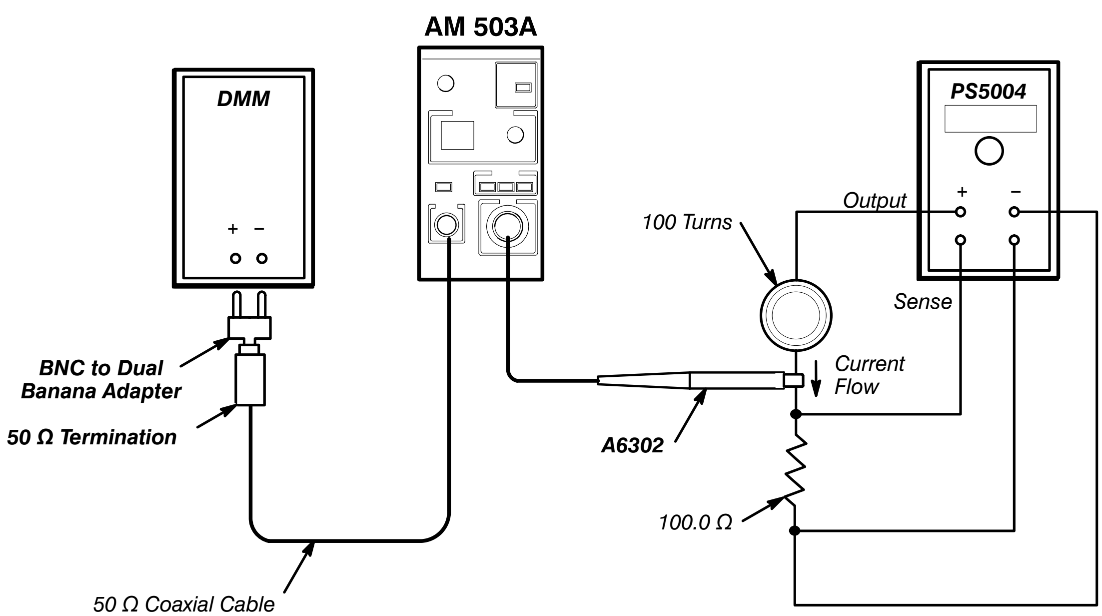


Figure 4-5: DC Accuracy Test Setup — A6302, 1 mA – 20 mA

Equipment Connections

☐ **Step 1:** Using a BNC cable, connect the AM 503A output to the 50 Ω feedthrough termination. Attach the termination to a BNC-to-dual banana adapter. Taking care to observe and maintain polarity, insert the dual banana adapter into the digital multimeter DC voltage input.

☐ **Step 2:** Connect the current transformer loop and resistor to the current/voltage source as shown in Figure 4-5.

Equipment Settings

Make or verify the following equipment settings:

Digital Multimeter

Measurement type . . . . DCV
Range . . . . autoranging

PS 5004

Output . . . . off
Limit . . . . maximum
Voltage 0.0

AM 503A

Coupling . . . . DC
BW Limit . . . . on (20 MHz)
Current/Division . . . . . . 1 mA

Procedure

☐ **Step 1:** Press the AM 503A **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.

☐ **Step 2:** Clamp the A6302 Current Probe around the one conductor of the current transformer loop. Verify that the arrow-shaped indicator on the probe points away from the current source.

☐ **Step 3:** For each of the AM 503A current/division settings in Table 4-2, perform the following steps:

a. Verify that the PS 5004 output is off.

b. Adjust the AM 503A **DC LEVEL** control counter-clockwise to obtain a digital multimeter reading of approximately −25 mV (±5 mV). Record the exact measurement as M_1.

Example:
M_1 = −24.6 mV or -24.6×10^{-3}

c. Enable the PS 5004 output and adjust the output voltage to obtain the output voltage and current specified in Table 4-2.

d. Record the digital multimeter reading as M_2.

Example:
M_2 = 25.0 mV or 25.0×10^{-3}

e. Calculate the measured current (I_m)using the following formula:

$$I_m = \frac{M_2 - M_1}{0.01} \times (current/division)$$

Example using 10 mA/Division AM 503A setting:

$$I_m = \frac{(25.0x10^{-3}) - (-24.6x10^{-3})}{0.01} \times (10x10^{-3})$$

$$I_m = 0.0496 \; or \; 49.6 \, mA$$

f. Verify that the measured current (I_m) is within ±3% of the test current (I_t). You can copy and then use Table 4-6, a worksheet, to record the results of your measurements.

$$\%Error = \frac{I_m - I_t}{I_t} \times 100$$

Example using 50 mA test current:

$$\%Error = \frac{49.6 - 50.0}{50.0} \times 100 = -0.8\%$$

Table 4-2: DC Accuracy Test Conditions — A6302, 1 mA – 20 mA

Loop Turns Through Probe	AM503A Current/Division	PS 5004 Output Voltage	Test Current
1	1 mA	0.5 V	5 mA
1	2 mA	1.0 V	10 mA
1	5 mA	2.5 V	25 mA
1	10 mA	5.0 V	50 mA
1	20 mA	10.0 V	100 mA

☐ **Step 4:** Clamp the A6302 Current Probe around 100 turns of the current transformer loop. Verify that the arrow-shaped indicator on the probe points away from the current source. Refer to Figure 4-6.

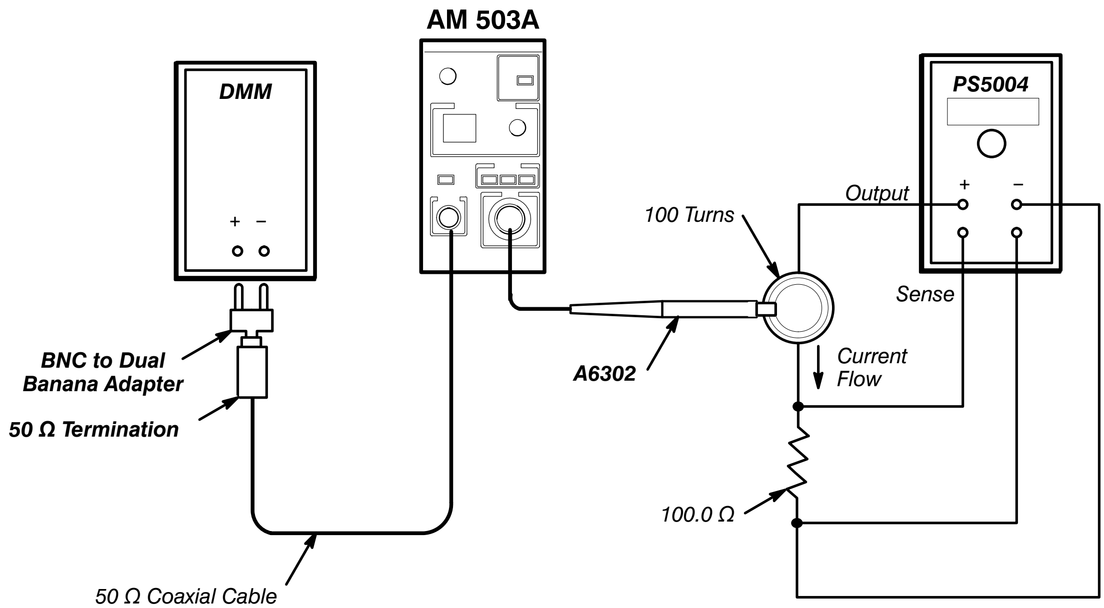


Figure 4-6: DC Accuracy Test Setup — A6302, 50 mA – 5 A

☐ **Step 5:** For each of the AM 503A current/division settings in Table 4-3, perform the following steps:

a. Verify that the PS 5004 output is off.

b. Adjust the AM 503A **DC LEVEL** control counter-clockwise to obtain a digital multimeter reading of approximately −25 mV (±5 mV). Record the exact measurement as M_1.

c. Enable the PS 5004 output and adjust the output voltage to obtain the output voltage and current specified in Table 4-3.

d. Record the digital multimeter reading as M_2.

e. Calculate the measured current (I_m)using the following formula (refer to Step 3 for examples of applying the formula):

$$I_m = \frac{M_2 - M_1}{0.01} \times (current/division)$$

f. Verify that the measured current (I_m) is within ±3% of the test current (I_t). You can copy and then use Table 4-6 to record the results of your measurements.

$$\%Error = \frac{I_m - I_t}{I_t} \times 100$$

Table 4-3: DC Accuracy Test Conditions — A6302, 50 mA – 5 A

Loop Turns Through Probe	AM503A Current/Division	PS 5004 Output Voltage	Test Current (I_t)
100	50 mA	0.25 V	250 mA
100	0.1 A	0.5 V	0.5 A
100	0.2 A	1.0 V	1 A
100	0.5 A	2.5 V	2.5 A
100	1 A	5.0 V	5 A
100	2 A	10.0 V	10 A
100	5 A	20.0 V	20 A

DC Accuracy (A6303)

This procedure tests the DC accuracy of the AM 503A if you have an A6303 Current Probe. In this test you compare the voltage output of the AM 503A to a reference input. A multiple-loop current transformer is used to keep the measured test current equivalent to a five-division signal for each current/division setting of the AM 503A. Refer to Figure 4-7 when making equipment connections.

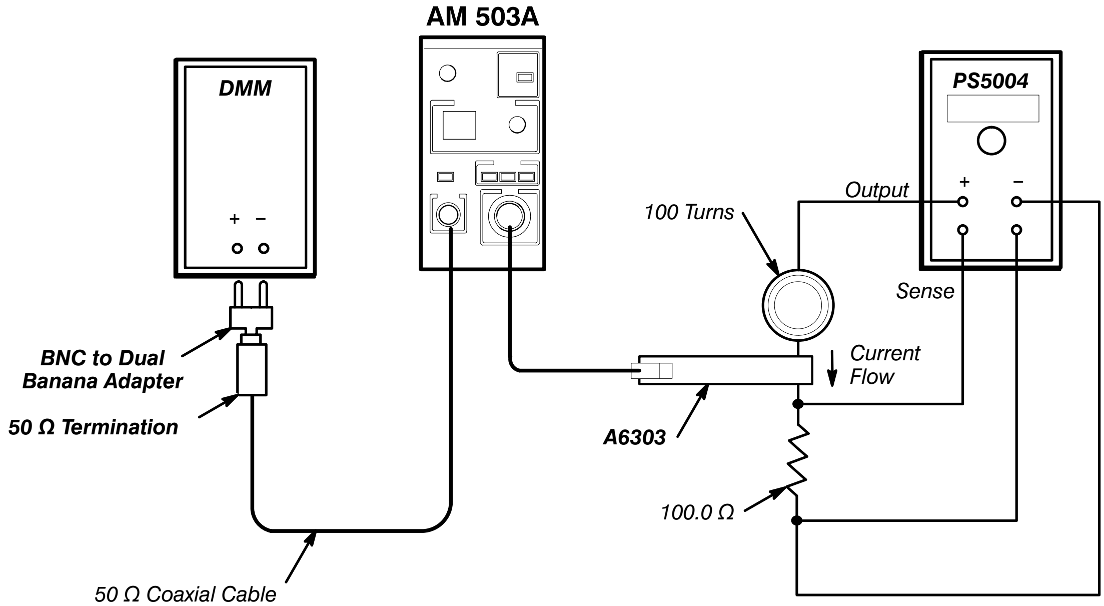


Figure 4-7: DC Accuracy Test Setup — A6303, 1 mA – 20 mA

Equipment Connections

☐ **Step 1:** Using a BNC cable, connect the AM 503A output to the 50 Ω feedthrough termination. Attach the termination to a BNC-to-dual banana adapter. Taking care to observe and maintain polarity, insert the dual banana adapter into the digital multimeter DC voltage input.

☐ **Step 2:** Connect the current transformer loop and resistor to the current/voltage source as shown in Figure 4-5.

Equipment Settings

Make or verify the following equipment settings:

Digital Multimeter

Measurement type . . . . DCV
Range . . . . autoranging

PS 5004

Output . . . . off
Limit . . . . maximum
Voltage 0.0

AM 503A

Coupling . . . . DC
BW Limit . . . . on (20 MHz)
Current/Division . . . . . . 1 mA

Procedure

☐ **Step 1:** Press the AM 503A **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.

☐ **Step 2:** Clamp the A6303 Current Probe around the one conductor of the current transformer loop. Verify that the arrow-shaped indicator on the probe points away from the current source.

☐ **Step 3:** For each of the AM 503A current/division settings in Table 4-4, perform the following steps:

a. Verify that the PS 5004 output is off.

Example:
$M_1 = -24.6$ mV or $-24.6x10^{-3}$

b. Adjust the AM 503A **DC LEVEL** control counter-clockwise to obtain a digital multimeter reading of approximately −25 mV (±5 mV). Record the exact measurement as M_1.

c. Enable the PS 5004 output and adjust the output voltage to obtain the output voltage and current specified in Table 4-4.

Example:
$M_2 = 25.0$ mV or $25.0x10^{-3}$

d. Record the digital multimeter reading as M_2.

e. Calculate the measured current (I_m)using the following formula:

$$I_m = \frac{M_2 - M_1}{0.01} \times (current/division)$$

Example using 10 mA/Division AM 503A setting:

$$I_m = \frac{(25.0x10^{-3}) - (-24.6x10^{-3})}{0.01} \times (10x10^{-3})$$

$$I_m = 0.0496 \ or \ 49.6 \ mA$$

f. Verify that the measured current (I_m) is within ±3% of the test current (I_t). You can copy and then use Table 4-6, a worksheet, to record the results of your measurements.

$$\%Error = \frac{I_m - I_t}{I_t} \times 100$$

Example using 50 mA test current:

$$\%Error = \frac{49.6 - 50.0}{50.0} \times 100 = -0.8\%$$

Table 4-4: DC Accuracy Test Conditions — A6303, 1 mA – 20 mA

Loop Turns Through Probe	AM503A Current/Division	PS 5004 Output Voltage	Test Current
1	1 mA	0.5 V	5 mA
1	2 mA	1.0 V	10 mA
1	5 mA	2.5 V	25 mA
1	10 mA	5.0 V	50 mA
1	20 mA	10.0 V	100 mA

☐ **Step 4:** Clamp the A6303 Current Probe around 100 turns of the current transformer loop. Verify that the arrow-shaped indicator on the probe points away from the current source. Refer to Figure 4-8.

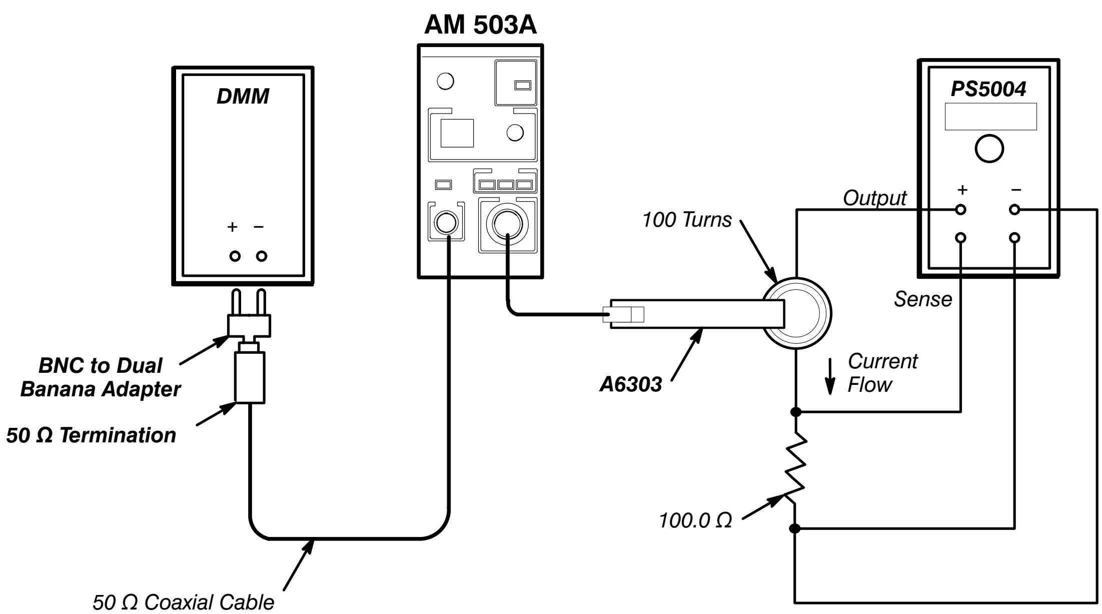


Figure 4-8: DC Accuracy Test Setup — A6303, 50 mA – 5 A

☐ **Step 5:** For each of the AM 503A current/division settings in Table 4-5, perform the following steps:

a. Verify that the PS 5004 output is off.

b. Adjust the AM 503A **DC LEVEL** control counter-clockwise to obtain a digital multimeter reading of approximately −25 mV (±5 mV). Record the exact measurement as M_1.

c. Enable the PS 5004 output and adjust the output voltage to obtain the output voltage and current specified in Table 4-5.

d. Record the digital multimeter reading as M_2.

e. Calculate the measured current (I_m)using the following formula (refer to Step 3 for examples of applying the formula):

$$I_m = \frac{M_2 - M_1}{0.01} \times (current/division)$$

f. Verify that the measured current (I_m) is within ±3% of the test current (I_t). You can copy and then use Table 4-6 to record the results of your measurements.

$$\%Error = \frac{I_m - I_t}{I_t} \times 100$$

Table 4-5: DC Accuracy Test Conditions — A6303, 50 mA – 5 A

Loop Turns Through Probe	AM503A Current/Division	PS 5004 Output Voltage	Test Current (I_t)
100	50 mA	0.25 V	250 mA
100	0.1 A	0.5 V	0.5 A
100	0.2 A	1.0 V	1 A
100	0.5 A	2.5 V	2.5 A
100	1 A	5.0 V	5 A
100	2 A	10.0 V	10 A
100	5 A	20.0 V	20 A

NOTE

The test method described here can be used to evaluate the AM 503A at the higher test currents possible with the A6303 Current Probe. To extend the measurements, wind a transformer loop with more turns (for instance, 400) and modify the test table appropriately. If you choose to do so, ensure that you do not exceed the maximum continuous current limits of the probe. Refer to Specifications*.*

Table 4-6: DC Accuracy Test Worksheet

Loop Turns Through Probe	AM503A Current /Division	PS 5004 Output Voltage	Test Current (I_t)	M_1	M_2	I_m (Note a)	% Error (Note b)
1	1 mA	0.5 V	5 mA				
1	2 mA	1.0 V	10 mA				
1	5 mA	2.5 V	25 mA				
1	10 mA	5.0 V	50 mA				
1	20 mA	10.0 V	100 mA				
100	50 mA	0.25 V	250 mA				
100	0.1 A	0.5 V	0.5 A				
100	0.2 A	1.0 V	1 A				
100	0.5 A	2.5 V	2 A				
100	1 A	5.0 V	5 A				
100	2 A	10.0 V	10 A				
100	5 A	20 V	20 A				

Note a:

$$I_m = \frac{M_2 - M_1}{0.01} \times (current/division)$$

Note b:

$$\%Error = \frac{I_m - I_t}{I_t} \times 100$$

Adjustment Procedure

This section explains how to perform the calibration procedures for applicable components of the AM 503A Current Probe Amplifier. The only adjustable component in the system is the A6303 Current Probe. No other components in the AM 503A system have internal adjustments.

Each of the following calibration procedures describes how to adjust the performance characteristic of a specific AM 503A component. Tolerances that are specified in these procedures apply to the AM 503A and do not include test equipment error.

Required Test Equipment

To perform the calibration procedures in this section, you will need the test equipment listed in Table 5-1. The test equipment must meet or exceed the specifications listed. The test procedures may need to be modified if Tektronix equipment is not used.

Table 5-1: Required Test Equipment

Qty	Item	Description	Tektronix Equivalent
1	Oscilloscope	150 MHz bandwidth	2465B
1	Calibration Generator	DC or 1 kHz squarewave, 5 V p-p into 50 Ω	PG506A
1	Current Loop	50 Ω, BNC connector	015-0601-50
1	Termination (Optional)	50 Ω, BNC connector, feed-through	011-0049-01
3	BNC Cable	50 Ω, 42″ long	012-0057-01
1	BNC T-adapter	50 Ω	103-0030-00

Equipment Preparation

Before performing the calibration procedures, attach the current probe to be adjusted, install all plug-in units into the power modules, and turn the power on. Turn any remaining equipment on and allow the entire system to warm up for a minimum of 20 minutes.

A6303 Offset Adjustment

This procedure describes how to adjust the DC offset of the A6303 Current Probe using the DC Offset adjustment. Refer to Figure 5-1 when performing this procedure.

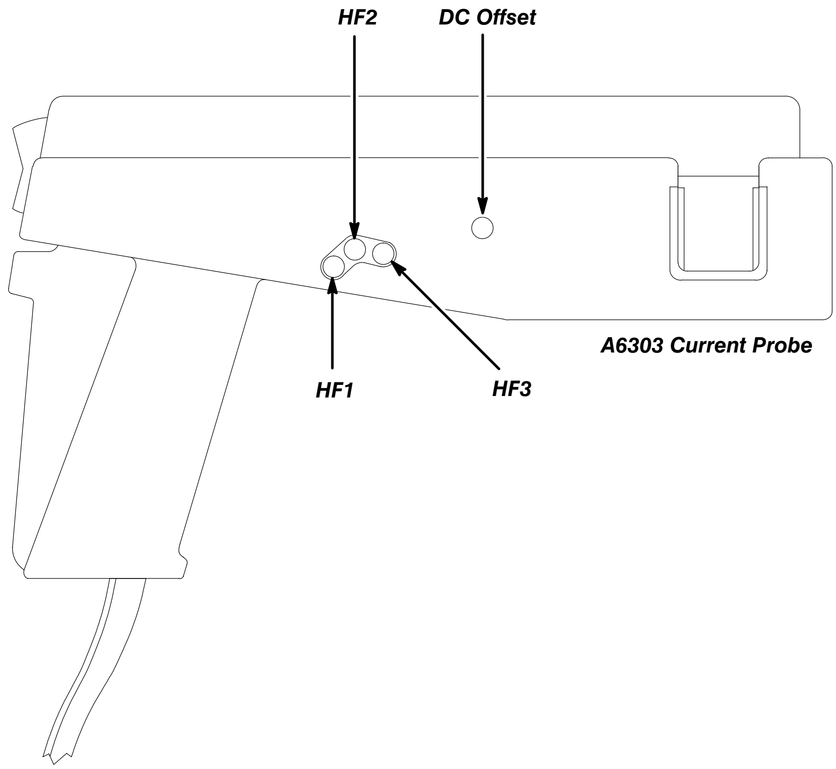


Figure 5-1: A6303 Adjustment Locations

Equipment Connections

- [ ] **Step 1:** Using a 50 Ω BNC cable, connect the AM 503A output to a 50 Ω oscilloscope input. If the input impedance of your oscilloscope is 1 MΩ, connect a 50 Ω feedthrough termination to the oscilloscope input. Do not connect the termination to the AM 503A output.

- [ ] **Step 2:** Connect the A6303 Current Probe to the AM 503A input connector.

Equipment Settings

Set the equipment to the settings indicated.

AM 503A

Coupling . . . . DC
BW Limit . . . . off (full bandwidth)
Current/Division . . . . 10 mA/division

Oscilloscope

Vertical Gain . . . . 10 mV/division
Timebase . . . . 1 ms/division
Input Coupling . . . . DC

Check Procedure

☐ **Step 1:** Establish a ground reference on the oscilloscope by temporarily grounding the oscilloscope input and positioning the trace on the center graticule line.

☐ **Step 2:** Switch the oscilloscope input coupling to DC.

☐ **Step 3:** Press the AM 503A **PROBE DEGAUSS AUTOBALANCE** button.

NOTE

*The AM 503A front panel will display an error code (**54**) after the degauss/autobalance routine completes if the AM 503A is not properly terminated into 50 Ω. Verify that the oscilloscope input is 50 Ω and set to DC coupling.*

☐ **Step 4:** If no error codes are displayed after the degauss/autobalance routine completes, no offset adjustment is necessary. If any of the following error codes are displayed, continue with the procedure:

Table 5-2: Error Codes Requiring A6303 Offset Adjustment

Error Code	Meaning
46	AM 503A unable to complete positive coarse offset adjustment
47	AM 503A unable to complete negative coarse offset adjustment
48	AM 503A unable to complete positive fine offset adjustment
49	AM 503A unable to complete negative fine offset adjustment

Adjustment Procedure

☐ **Step 1:** Remove the A6303 access plug for the DC Offset (see Figure 5-1).

☐ **Step 2:** Press and hold the **BW LIMIT** button; press the **PROBE DEGAUSS** button. This puts the AM 503A into an internal test mode.

☐ **Step 3:** Rotate the **CURRENT/DIVISION** knob until the front panel display reads **21**; press the **BW LIMIT** button. This sets AM 503A internal offsets to zero.

☐ **Step 4:** Adjust the DC Offset so that the oscilloscope trace is on the center graticule line (zero offset) ± one-half division.

☐ **Step 5:** Press and release the **BW LIMIT** button. Press and release the **PROBE DEGAUSS AUTOBALANCE** button. This exits the AM 503A test mode.

A6303 Transient Response and Gain Adjustment

This procedure describes how to optimize the transient response and gain of the A6303 Current Probe using adjustments HF1, HF2, and HF3. Refer to figures 5-1 and 5-2 when performing this procedure.

Equipment Connections

☐ **Step 1:** Using a 50 Ω BNC cable, connect the calibration generator (PG506A) output to a 50 Ω oscilloscope input. If the input impedance of your oscilloscope is 1 MΩ, connect a 50 Ω feedthrough termination to the oscilloscope input. Do not connect the termination to the calibration generator output.

☐ **Step 2:** Connect the A6303 Current Probe to the AM 503A input connector.

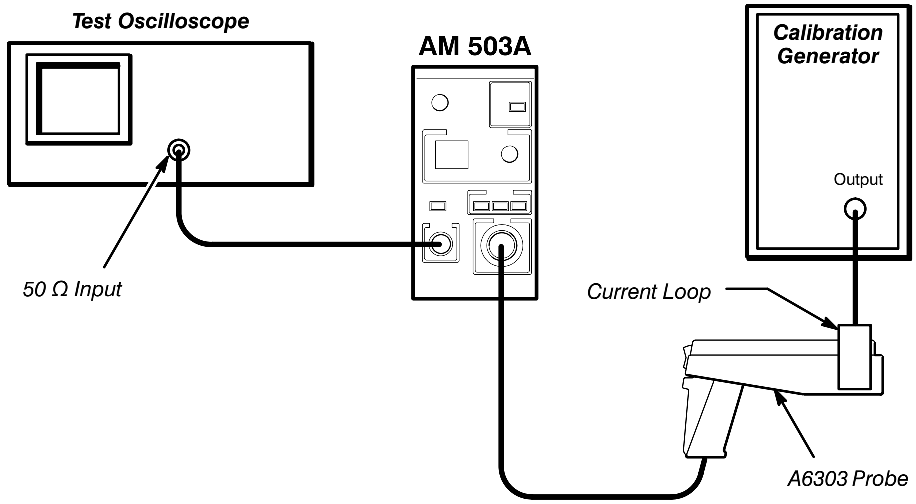


Figure 5-2: A6303 Adjustment Setup, Step 7

Equipment Settings

Set the equipment to the settings indicated.

AM 503A

Coupling	DC
BW Limit	off (full bandwidth)
Current/Division	20 mA/division

Oscilloscope

Vertical Gain	1 V/division
Timebase	100 µs/division
Input Coupling	DC

Calibration Generator

Period	0.1 ms
Function	high amplitude

Procedure

☐ **Step 1:** Establish a ground reference on the oscilloscope by temporarily grounding the oscilloscope input and positioning the trace one graticule line from the bottom of the screen.

☐ **Step 2:** Switch the oscilloscope input coupling to DC.

☐ **Step 3:** Press the AM 503A **PROBE DEGAUSS AUTOBALANCE** button.

NOTE

*The AM 503A front panel will display an error code (**54**) after the degauss/autobalance routine completes if the AM 503A is not properly terminated into 50 Ω. Verify that the oscilloscope input is 50 Ω and set to DC coupling.*

☐ **Step 4:** Adjust the calibration generator to produce an amplitude of 5 graticule divisions (5 volts).

NOTE

Do not adjust the calibration generator amplitude for the remainder of this procedure.

☐ **Step 5:** Disconnect the BNC cable from the calibration generator and attach it to the AM 503A output connector (see Figure 5-2).

☐ **Step 6:** Attach the current loop to the A6303 current probe and lock the probe.

☐ **Step 7:** Using another coaxial cable, connect the current loop to the calibration generator output.

☐ **Step 8:** Reset the vertical gain of the oscilloscope to 10 mV/division and the timebase to 100 μs/division.

☐ **Step 9:** Reset the period of the calibration generator to 1 ms.

☐ **Step 10:** Remove the A6303 access plugs for HF1, HF2, and HF3 (see Figure 5-1).

☐ **Step 11:** Adjust HF1, HF2, and HF3 for an oscilloscope display of five divisions and optimum transient response.

NOTE

The HF1, HF2, and HF3 adjustments interact. Adjusting them can be a repetitive process. You may need to sub-optimize either transient response or gain in order to have both meet specification at once.

Preventive Maintenance

Preventive Maintenance

The AM 503A requires little maintenance during normal use. The primary maintenance involves cleaning accumulated dirt from the probe body and, if necessary, cleaning the exposed core surfaces in the probe jaw.

To clean the probe body, use a soft cloth dampened in a solution of mild detergent and water.

To clean the core, open the jaw and clean the exposed core surfaces with the cloth.

CAUTION

Avoid using chemical cleaning agents that damage plastic. For example, avoid using chemicals that contain benzene, toluene, xylene, acetone, or similar solvents. Recommended cleaning agents are isopropyl alcohol (Isopropanol) or ethyl alcohol (Fotocol or Ethanol).

Disassembly Instructions

The following instructions describe how to remove and replace major components or assemblies of the AM 503A Current Probe Amplifier and associated probes. Use these procedures when repairing or replacing defective components. Please read the static device precautions below before performing any disassembly procedures. Refer to the *Parts List* section for an exploded view of the AM 503A along with a list of part numbers.

Static Device Precautions

CAUTION

Static discharge can damage semiconductors in the AM 503A.To avoid damaging semiconductor devices in the AM 503A, observe the following precautions:

- Minimize handling of static sensitive devices.
- Transport and store static-sensitive components or assemblies in their original containers, either on a metal surface or conductive foam. Label any package that contains static-sensitive assemblies or components.
- 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. The use of a static control mat is recommended.
- Clear anything from the work station surface that is capable of generating or holding static charge.
- Keep component leads shorted together whenever possible.
- Pick up components by the body, never by the leads.
- Do not slide components over any surface.
- Avoid handling components in areas that have a floor or a work surface that is capable of generating static charge.

This symbol identifies procedures involving static-sensitive devices.

Front Panel Knobs

To remove a front panel knob simply pull the knob off.

To reinstall the knob, align the slotted end of the shaft with the rib inside the knob. Push the knob onto the shaft.

Side Covers

To remove the side covers, turn the securing screw 90° counterclockwise and pull the cover off, as shown in Figure 6-1. To reassemble, reverse the procedure.

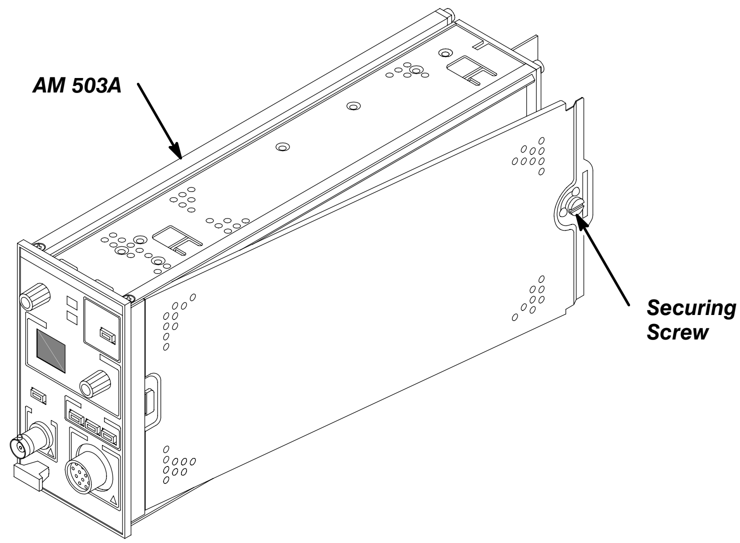


Figure 6-1: Removing the AM 503A Side Covers

Release Lever Assembly

The AM 503A contains devices that are susceptible to damage from static discharge. To prevent damage to static-sensitive devices, observe the precautions listed at the beginning of this section whenever the covers are off the instrument or you handle component assemblies.

The release lever assembly consists of the release lever, latch bar, and retaining latch. These procedures describe how to remove and replace each item.

☐ **Step 1:** Remove the left side cover (described earlier).

☐ **Step 2:** Push the latch bar forward as shown in Figure 6-2. Pry the back end of the release lever up and pull the release lever through the front panel.

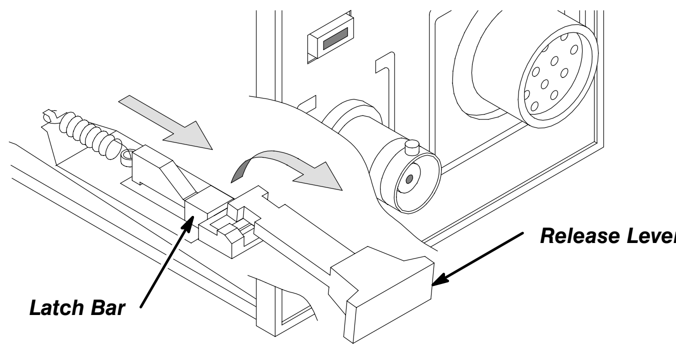


Figure 6-2: Removing the AM 503A Release Lever

☐ **Step 3:** Unplug the input, output, and front panel interface cables from the main circuit board. Figure 6-3 shows the location of these cables.

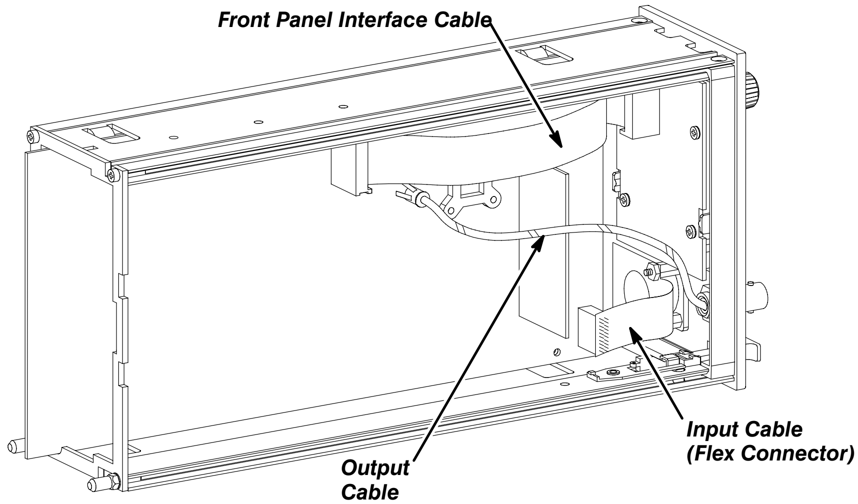


Figure 6-3: Location of AM 503A Interface Cables

☐ **Step 4:** Using a Pozidriv #1 screwdriver, remove the two top screws and the two bottom screws that secure the front panel and remove the front panel. Figure 6-4 shows the screw locations.

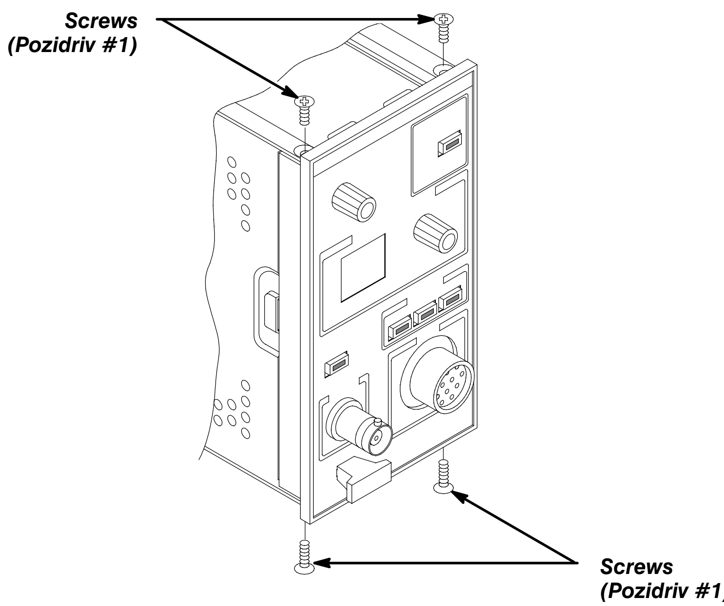


Figure 6-4: Location of Front Panel Screws

☐ **Step 5:** Using a springhook or a pair of needle-nose pliers, remove the retaining spring.

☐ **Step 6:** Push the latch bar forward until it clears the the retaining latch. Refer to Figure 6-5.

☐ **Step 7:** Push the retaining latch upward past the retaining clip.

☐ **Step 8:** To reassemble, reverse this procedure.

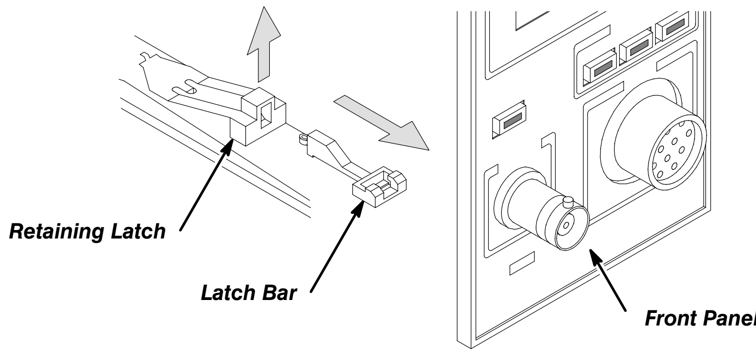


Figure 6-5: Removing the Latch Bar Assembly

Front Panel

This procedure describes how to remove the front panel from the AM 503A.

The AM 503A contains devices that are susceptible to damage from static discharge. To prevent damage to static-sensitive devices, observe the precautions listed at the beginning of this section whenever the covers are off the instrument or you handle component assemblies.

- [ ] **Step 1:** Remove both side covers (described earlier).
- [ ] **Step 2:** Remove the release lever by pushing the latch bar forward and prying the back end of the release lever up (see the disassembly procedures for the release lever assembly). You need only remove the release lever, not the entire release lever assembly.
- [ ] **Step 3:** Unplug the input, output, and front panel interface cables from the main circuit board (refer back to Figure 6-3 for cable locations).
- [ ] **Step 4:** Using a Pozidriv #1 screwdriver, remove the two top screws and the two bottom screws that secure the front panel and remove the front panel (refer back to Figure 6-4 for screw locations).
- [ ] **Step 5:** To reassemble, reverse this procedure.

Front Panel Circuit Board

This procedure describes how to remove and replace the circuit board that is located on the front panel. Refer to Figure 6-6 when performing this procedure.

☐ **Step 1:** Remove the front panel (described earlier).

☐ **Step 2:** Remove the knobs by pulling them off.

☐ **Step 3:** Using a Torx #T-10 screwdriver, remove the four screws holding the front panel circuit board in place and lift the board out of the panel.

☐ **Step 4:** To reassemble, reverse this procedure

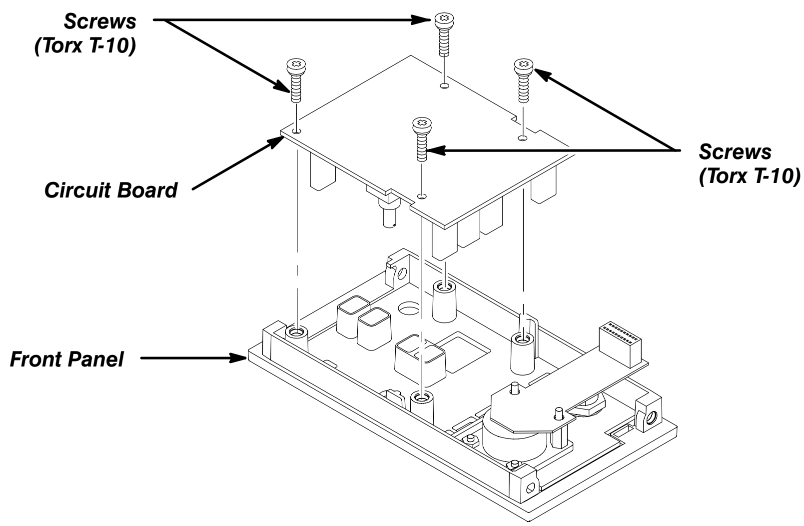


Figure 6-6: Removing the AM 503A Front Panel Board

Input Connector

This procedure describes how to remove and replace the input connector located on the front panel. Refer to Figure 6-7 when performing this procedure.

- ☐ **Step 1:** Remove the front panel and front panel circuit board (described earlier).
- ☐ **Step 2:** Using a 5⁄32″ nutdriver, remove the two nuts that secure the input connector.
- ☐ **Step 3:** Using a 5⁄32″ nutdriver, remove the two nuts securing the flex connector.

CAUTION

To prevent the flex connector from tearing, avoid bending it excessively. Minor tearing may occur without damage to the flex connector providing the conductive material is not damaged.

- ☐ **Step 4:** Using a 3⁄16″ open-end wrench, remove the two remaining hex posts that secure the input connector.
- ☐ **Step 5:** After the nuts have been completely unscrewed, desolder and remove the input connector.
- ☐ **Step 6:** To reassemble, reverse this procedure. Torque the hex posts to 0.23 N·m (2 in-lb). Do not over-tighten the flex circuit mounting nuts.

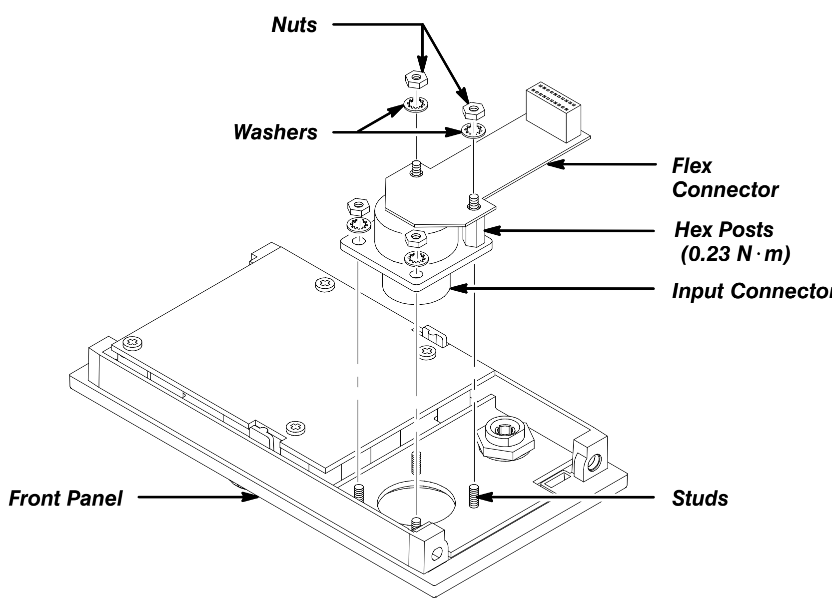


Figure 6-7: Removing the AM 503A Input Connector

Output Connector

This procedure describes how to remove and replace the output BNC connector located on the front panel. Refer to Figure 6-8 when performing this procedure.

- ☐ **Step 1:** Remove the front panel and front panel circuit board (described earlier).
- ☐ **Step 2:** Unplug the Peltola connector from the back of the BNC connector.
- ☐ **Step 3:** Using a ½″ wrench, remove the retaining nut on the back of the BNC connector and remove the washer.
- ☐ **Step 4:** Pull the BNC connector out of the front panel.
- ☐ **Step 5:** To reassemble, align the flat spot of the connector's threaded end with the flat spot of the front panel hole and push the connector into the front panel.
- ☐ **Step 6:** Perform steps 1 through 3 in reverse order.

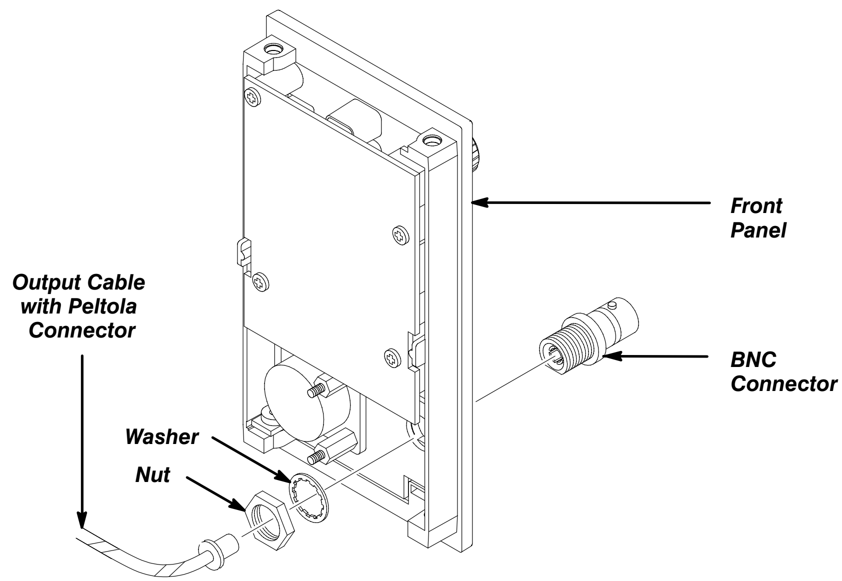


Figure 6-8: Removing the AM 503A Output Connector

Using the Rear Interface Output Connector

Some optional power modules allow you to re-route the plug-in instrument output to the rear interface of the power module (refer to the Tektronix catalog or contact your Tektronix sales representative). You can configure the AM 503A for this type of power module by following these steps. Refer to Figure 6-9 as necessary.

☐ **Step 1:** Remove the left side cover of the instrument as described in the *Maintenance* section.

☐ **Step 2:** Locate the output cable that plugs into the rear of the front panel BNC output connector.

☐ **Step 3:** Carefully withdraw the output cable from the BNC output connector.

☐ **Step 4:** Taking care to prevent damage to the easily bent center conductor, insert the output cable into the rear interface output connector as shown in Figure 6-9.

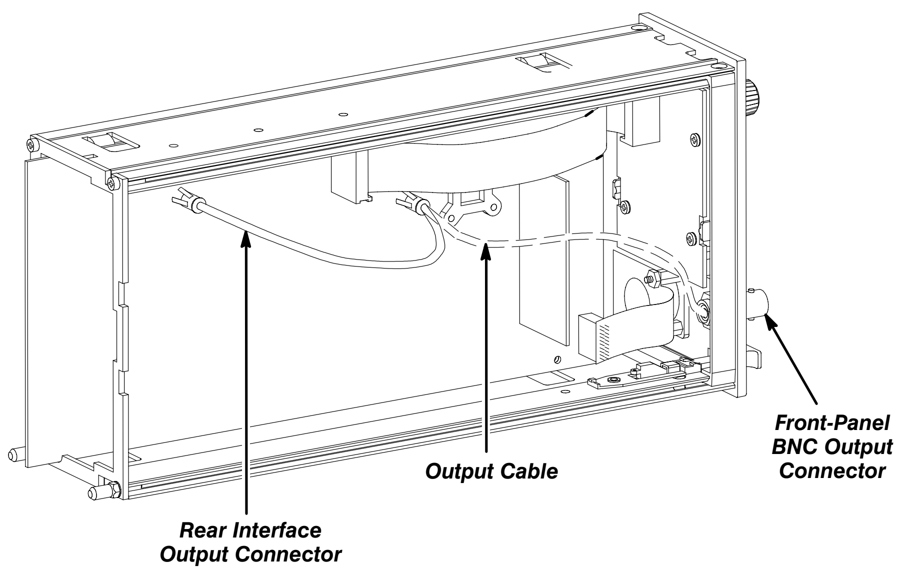


Figure 6-9: Using the Rear Interface Output Connector

☐ **Step 5:** To restore instrument output to the front panel BNC output connector, reverse the procedure.

Voltage Regulator Transistors

This procedure describes how to remove and replace the three voltage regulator transistors located on the top inside of the AM 503A. Two of the transistors have an insulating washer and flange. Figure 6-10 shows an exploded view of these parts.

- ☐ **Step 1:** Remove the side covers (described earlier).
- ☐ **Step 2:** Unsolder the transistor leads.
- ☐ **Step 3:** Using a 3⁄16″ open-end or box-end wrench, hold the nut securing the transistor.
- ☐ **Step 4:** Using a Pozidriv #1 screwdriver, remove the screw that holds the transistor in place. Remove the transistor.

NOTE

Two of the transistors have an insulating washer and flange. Refer to Figure 6-10. Be careful not to lose the insulating washer and flange.

- ☐ **Step 5:** Repeat steps one through four for each transistor.
- ☐ **Step 6:** To reassemble, reverse this procedure. To insure proper transistor alignment, mount the transistors to the chassis before soldering them onto the circuit board.

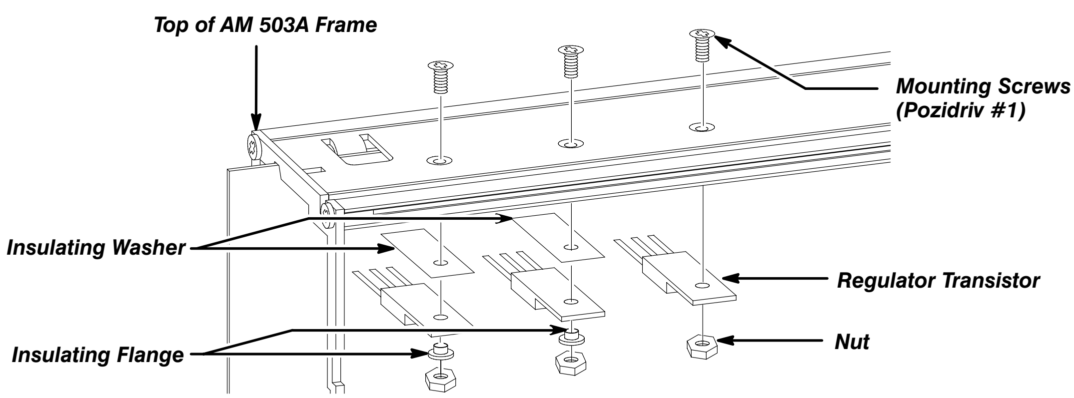


Figure 6-10: AM 503A Regulator Transistor Assembly

Main Circuit Board

This procedure describes how to remove and replace the main circuit board inside the AM 503A.

The AM 503A contains devices that are susceptible to damage from static discharge. To prevent damage to static-sensitive devices, observe the precautions listed at the beginning of this section whenever the covers are off the instrument or you handle component assemblies.

☐ **Step 1:** Remove the side covers (described earlier).

☐ **Step 2:** Unplug the input, output, and front panel interface cables from the main circuit board (refer back to Figure 6-3 for cable locations).

☐ **Step 3:** Remove the screws that secure the three regulator transistors to the top of the instrument (for more information, refer to the disassembly procedure for the regulator transistors).

☐ **Step 4:** Undo the four frame screws that secure the main circuit board. Access these screws from the component side of the board (see Figure 6-11 for location of screws).

☐ **Step 5:** Carefully pull the circuit board out through the front of the instrument. You may find it helpful to push on the rear edge connector.

☐ **Step 6:** To reassemble, reverse this procedure. Torque the T-10 screws to 0.45 N·m (4 in-lb).

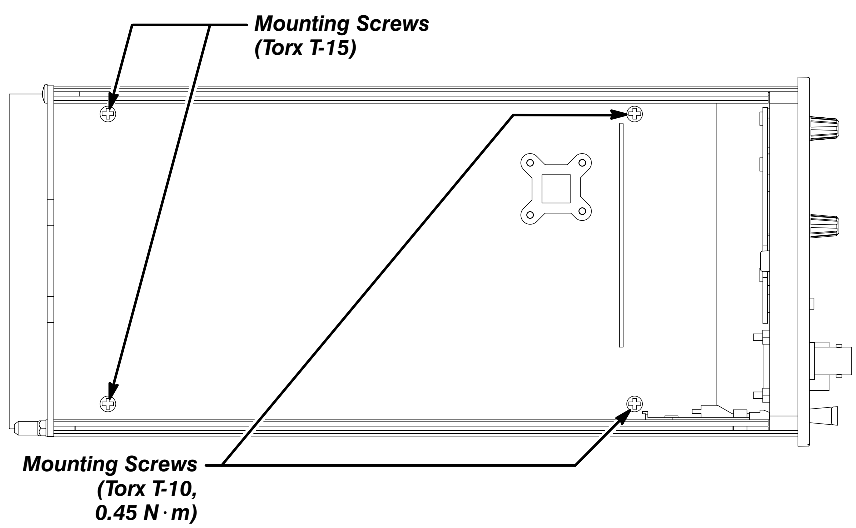


Figure 6-11: Removing the AM 503A Main Circuit Board

Output Amplifier IC

This procedure describes how to remove the output amplifier IC located on the main circuit board.

The AM 503A contains devices that are susceptible to damage from static discharge. To prevent damage to static-sensitive devices, observe the precautions listed at the beginning of this section whenever the covers are off the instrument or you handle component assemblies.

☐ **Step 1:** Using a Torx #T-8 screwdriver, remove four flange screws. Figure 6-12 shows the location of these screws and the indexing of the flange and Figure 6-13 shows an exploded view of the output amplifier assembly.

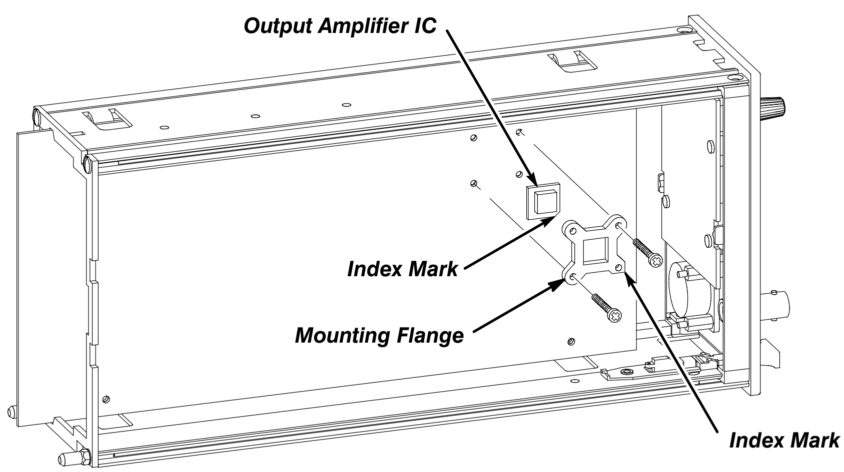


Figure 6-12: Location of Output Amplifier IC

☐ **Step 2:** Using a pair of needle-nosed pliers, gently lift the IC out of the board.

☐ **Step 3:** If you want to remove the heat sink, use a Torx #T-15 screwdriver to remove the center screw that holds the heat sink to the heat sink bracket. Figure 6-14 shows the location of the bracket.

☐ **Step 4:** Using a Torx #T-10 screwdriver, remove the two front screws that secure the main circuit board to the frame and carefully move the bracket to the side.

CAUTION

Be careful not to break the leads of the output transistors that are attached to the heat sink bracket. As a precaution, unscrew the transistors from the bracket.

☐ **Step 5:** To reassemble, align the IC index pin with the arrow on the circuit board and insert the IC into the board.

☐ **Step 6:** Align the index mark of the flange with the arrow on the circuit board and place it on top of the IC.

☐ **Step 7:** Hold the heat sink in place on the back side of the circuit board.

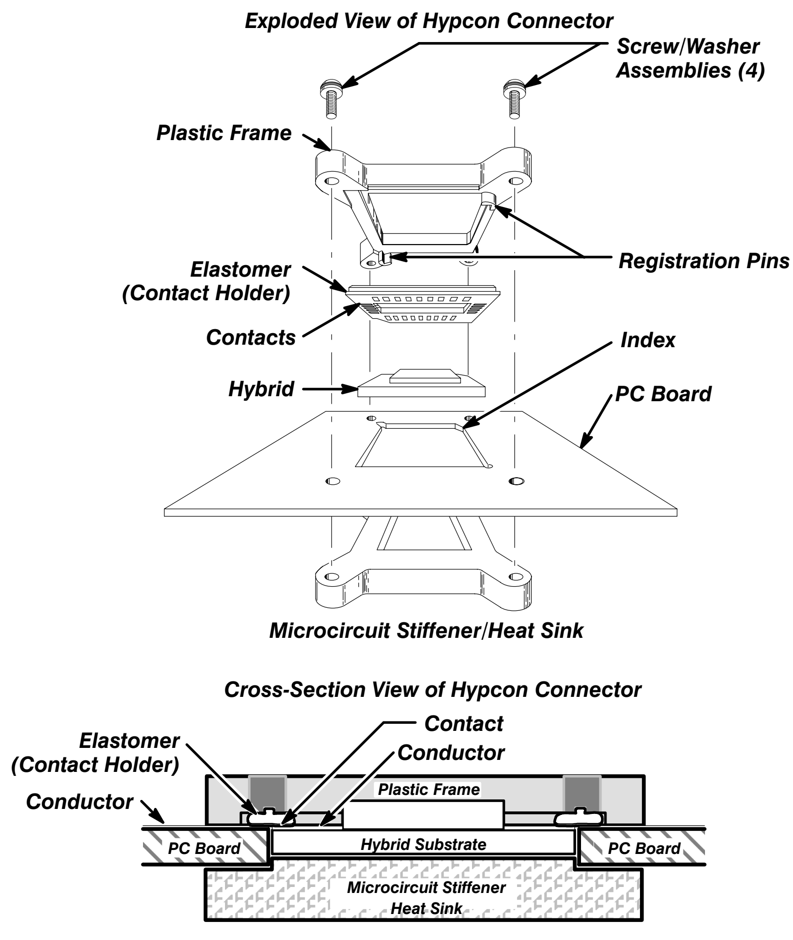


Figure 6-13: AM 503A Output Amplifier Assembly

☐ **Step 8:** Insert two of the flange screws, each in opposite corners.

☐ **Step 9:** Tighten each screw one turn at a time, alternating between screws until each screw just begins to become snug. This action tightens the flange evenly.

☐ **Step 10:** Insert the two remaining flange screws and tighten them until they just become snug.

☐ **Step 11:** Using a torque wrench, tighten each screw to 0.23 N·m (2 in-lb).

☐ **Step 12:** Install the heat sink bracket and the two screws that secure it to the frame. Do not tighten the screws yet.

☐ **Step 13:** Install and tighten the center screw that secures the heat sink to the heat sink bracket. Torque the screw to 0.90 N·m (8 in-lb).

☐ **Step 14:** Tighten the screws that secure the heat sink bracket. Torque the screws to 0.45 N·m (4 in-lb).

☐ **Step 15:** If the transistors were removed, install the transistors onto the heat sink bracket.

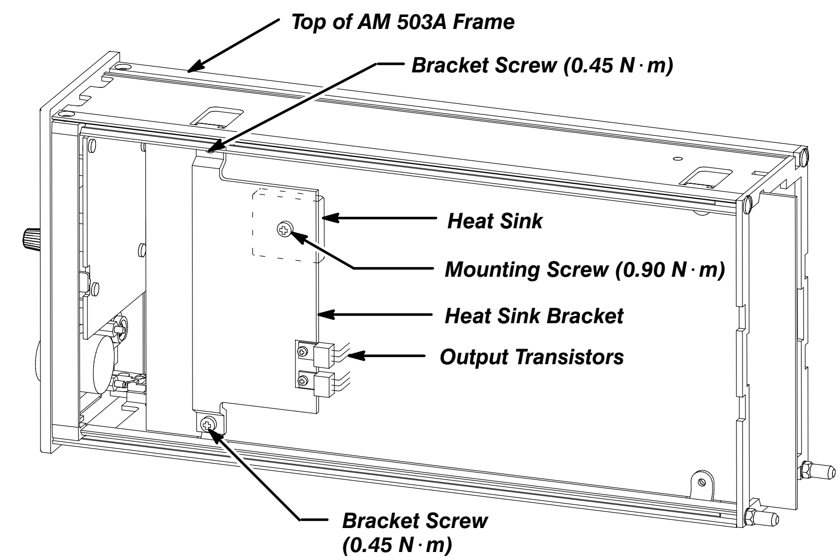


Figure 6-14: Location of Output Amplifier Heat Sink

Output Transistors

This procedure describes how to remove and replace the power amplifier output transistors inside the AM 503A.

The AM 503A contains devices that are susceptible to damage from static discharge. To prevent damage to static-sensitive devices, observe the precautions listed at the beginning of this section whenever the covers are off the instrument or you handle component assemblies.

- [ ] **Step 1:** Remove the side covers (described earlier).
- [ ] **Step 2:** Unsolder the transistor leads.
- [ ] **Step 3:** Using a Torx #T-7 screwdriver, remove the screw that secures the transistor to the heat sink bracket (see Figure 6-15 for location of screw).

NOTE

Be careful not to lose the fiber washer located in the bracket screw counterbore. If the fiber washers become lost or damaged, you must replace them. Refer to the parts list section of this manual.

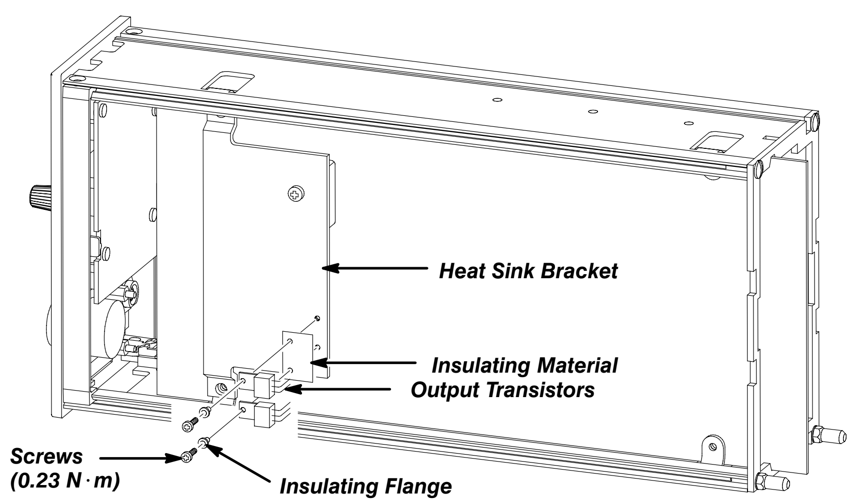


Figure 6-15: Removing the Output Transistors

☐ **Step 4:** Remove the transistors.

☐ **Step 5:** To replace the transistors, reverse this procedure.

NOTE

To prevent damage to the insulating material beneath the transistors, tighten the securing screws to 0.23 N·m (2 in-lb). If the insulating material becomes torn, you must replace it.

To aid in lead alignment, mount the transistors on the heat sink bracket before soldering them to the circuit board.

Battery Replacement

This procedure describes how to replace the AM 503A backup battery.

☐ **Step 1:** Using a small flat-blade screwdriver, gently pry against the battery terminal as shown in Figure 6-16 until the battery just starts to slide out.

CAUTION

Avoid using excessive force when prying against the battery terminal. Excessive force can damage the spring tension of the terminal, resulting in poor battery contact or no contact at all.

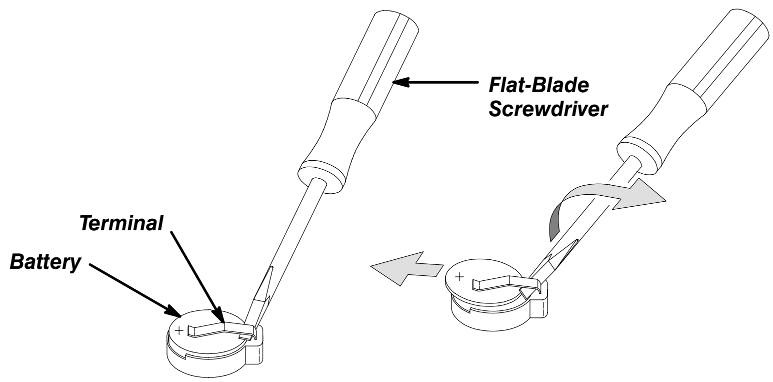


Figure 6-16: Prying Battery Terminal to Remove Battery

☐ **Step 2:** Once the battery starts to slide out, push against the edge of the battery with the screwdriver blade until the battery is completely out. Figure 6-17 illustrates this action.

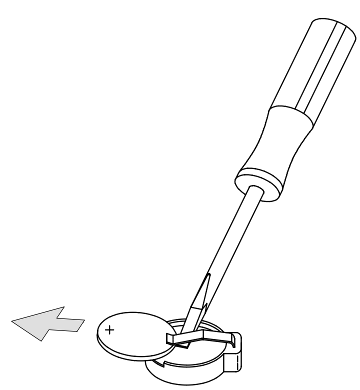


Figure 6-17: Removing the Backup Battery

☐ **Step 3:** To replace the battery, gently pry up on the battery terminal as shown in Figure 6-18 and push the battery into place.

CAUTION

Observe the proper polarity for the battery. The + side should be exposed on top. Improper polarity can damage the instrument.

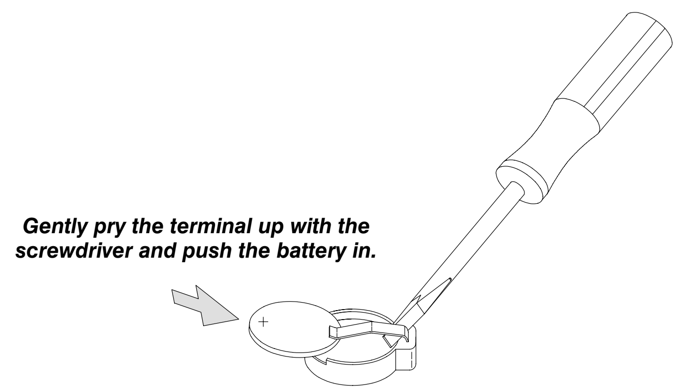


Figure 6-18: Replacing the Backup Battery

☐ **Step 4:** After installing the battery, run test routines 97 and 99. Refer to "AM 503A Test Mode" and "Test Routine Description" under Troubleshooting for information about the AM 503A test routines.

Troubleshooting

The information in this section will help you isolate AM 503A and current probe circuit problems (for service information pertaining to the TM 502A power module, refer to TM 502A Instruction Manual).

The troubleshooting information is organized into these sections:

- returning equipment to Tektronix for repair
- required test equipment
- test mode operation
- description of test mode routines
- error code list
- troubleshooting flow diagrams
- symptom/corrective action list

Returning Equipment to Tektronix for Repair

If you decide to return an AM 503A component to Tektronix for repair, attach a tag to it with the following information:

- name and address of owner
- name of a contact person at your firm
- type of AM 503A component (probe, AM 503A, or TM 502A) and serial number
- description of the service required

If available, reuse the original shipping carton and packing material when shipping the AM 503A component. If the original carton is not available, then wrap the instrument in anti-static sheeting to reduce the risk of static damage and surface scratches and pack the instrument in a carton with specifications similar to the original. If you have any questions about shipping the instrument, contact your Tektronix representative.

Required Test Equipment

No special equipment is required to troubleshoot circuit problems with the AM 503A system. However, you should have at least the following items:

- a digital multimeter
- a general-purpose oscilloscope with a bandwidth of at least 100 MHz
- two voltage probes appropriate for the oscilloscope

- a TM 502A power module extender cable, to permit operation of the AM 503A with access to circuit test points and components (Tektronix part number 067-0645-02)

In addition to the test equipment listed above, you should have basic maintenance tools such as Torx and Posidriv screwdrivers, nutdrivers, pliers, and a soldering iron.

NOTE

Additional equipment is required to complete the performance verification procedures. Refer to Table 4-1 and the Performance Verification *section of this manual for more information.*

AM 503A Test Mode

In addition to normal operation, the AM 503A features a test mode that runs specialized routines to aid in troubleshooting. To use the test mode, perform these steps:

☐ **Step 1:** Press and hold the **BW LIMIT** button.

☐ **Step 2:** Press the **PROBE DEGAUSS AUTOBALANCE** button.

☐ **Step 3:** Release both buttons. The **CURRENT/DIVISION** readout should display **00**. This number represents the currently selected test routine. To change routine numbers, rotate the **CURRENT/DIVISION** knob.

☐ **Step 4:** To activate the selected test, press the **BW LIMIT** button until its LED is on.

☐ **Step 5:** To terminate the selected test, press the **BW LIMIT** button until its LED is off.

☐ **Step 6:** To exit the test mode, terminate the selected test (as described in Step 5) and press any button other than **BW LIMIT**. The AM 503A will return to normal operation if an error condition did not exist prior to entering test mode. If an error condition existed (an error code was flashing on the front panel display) when you entered test mode, then the AM 503A will reset when you exit test mode.

When observing signals in test mode, use the TRIG line at TP230 to trigger your oscilloscope. Figure 6-19 shows the location of TP230 and other AM 503A test points. Table 6-1 lists the AM 503A test points.

Table 6-1: AM 503A Test Points

Test Point	Description	Circuit
TP230	TRIGGER	A1-3: MICROCONTROLLER
TP231	+5D	A1-5: POWER SUPPLY
TP232	DGND	A1-5: POWER SUPPLY
TP233	+5A	A1-5: POWER SUPPLY
TP250	DGND	A1-5: POWER SUPPLY
TP330	−5A	A1-5: POWER SUPPLY
TP331	+16 V	A1-5: POWER SUPPLY
TP332	−16 V	A1-5: POWER SUPPLY
TP333	AGND	A1-5: POWER SUPPLY
TP334	IN_V_DETECT	A1-2: DIGITAL & ANALOG INTER-FACE
TP335	OUT_V_DETECT	A1-2: DIGITAL & ANALOG INTER-FACE
TP390	PA (PWR AMP)	A1-1: LF AMPLIFIERS
TP391	AGND	A1-1: LF AMPLIFIERS
TP392	HP (HALL PREAMP)	A1-1: LF AMPLIFIERS

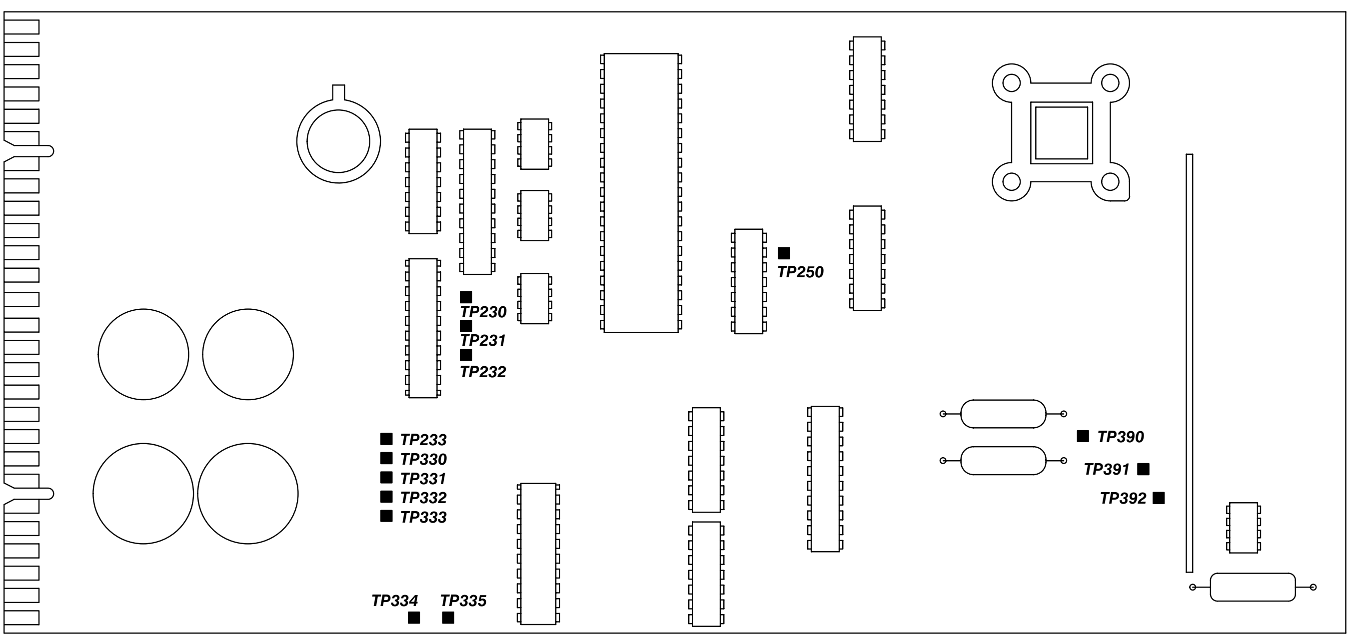


Figure 6-19: AM 503A Test Point Locations

Test Routine Description

Table 6-2 lists the test routines available with the AM 503A amplifier. Some test routines remain in effect until you activate another routine to disable them or you exit test mode. For example, if you disable the Hall device preamp (routine 04), the preamp remains disabled until you activate routine 03 (enable Hall device preamp) or until you exit test mode. Normal AM 503A operation is restored after exiting the test mode.

Detailed routine descriptions follow Table 6-2. For information about using these routines to troubleshoot specific circuit problems, refer to the troubleshooting flow diagrams later in this section, and *Theory of Operation*.

Table 6-2: AM 503A Test Descriptions

Test No.	Description
00	Blink all front panel indicators and display segments, except the **OVERLOAD** indicator, at 250 ms intervals.
01	Generate the degauss signal at channel A output of the DAC.
02	Display the AM 503A firmware version number on the front panel display.
03	Enable the Hall Device preamplifier (set HALL_PREAMP_DISC low).
04	Disable the Hall Device preamplifier (set HALL_PREAMP_DISC high).
05	Set attenuator to 1X attenuation.
06	Set attenuator to 10X attenuation, relay 1.
07	Set attenuator to 10X attenuation, relay 2.
08	Set attenuator to 100X attenuation.
09	Set attenuator to DC Coupling/Input Normal.
10	Set attenuator to AC Coupling/Input Normal.
11	Set attenuator to DC Coupling/Input Ground.
12	Set output amplifier step gain to 60.
13	Set output amplifier step gain to 30.
14	Set output amplifier step gain to 15.
15	Set output amplifier step gain to 6.
16	Set output amplifier step gain to 3.
17	Set output amplifier step gain to 1.2.
18	Set output amplifier bandwidth to full bandwidth.
19	Set output amplifier bandwidth to 100 MHz.

Table 6-2: AM 503A Test Descriptions (Cont.)

Test No.	Description
20	Set output amplifier bandwidth to 20 MHz.
21	Allow manual adjustment of DAC channel A, coarse DC offset of the Hall Preamplifier, by rotating the **DC LEVEL** control.
22	Allow manual adjustment of DAC channel B, coarse DC offset of the power amplifier, by rotating the **DC LEVEL** control.
23	Allow manual adjustment of DAC channel C, fine DC offset of the power amplifier, by rotating the **DC LEVEL** control.
24	Allow manual adjustment of DAC channel D, analog gain of the output amplifier, by rotating the **DC LEVEL** control.
25	Allow manual adjustment of DAC channel E, coarse DC offset of the output amplifier, by rotating the **DC LEVEL** control.
26	Allow manual adjustment of DAC channel F, fine DC offset of the output amplifier, by rotating the **DC LEVEL** control.
27	Allow manual adjustment of DAC channel G, fine **DC LEVEL**, by rotating the **DC LEVEL** control.
28	Allow manual adjustment of DAC channel H, fine DC offset of the Hall preamplifier, by rotating the **DC LEVEL** control.
29	Enable the probe degauss signal (set DEGAUSS_SIG_ ENBL high).
30	Disable the probe degauss signal (set DEGAUSS_SIG_ ENBL low).
31	Enable the output amplifier (set OUT_AMP_ENBL high).
32	Disable the output amplifier (set OUT_AMP_ENBL low).
33	Enable the probe identify function by performing an A/D conversion on channel 0 of U350, PROBE_ ID.
34	Wait for watchdog reset. This routine checks the microcontroller watchdog circuit by causing the microcontroller to enter a loop until a reset pulse is generated. **This routine exits the test mode when the microcontroller is reset.**
35	Set the B2 bit in the output amplifier controller.
36	Clear the B2 bit in the output amplifier controller.
37	Set the V_IN bit in the output amplifier controller.
38	Clear the V_IN bit in the output amplifier controller.
96	EEPROM diagnostic check.

Table 6-2: AM 503A Test Descriptions (Cont.)

Test No.	Description
97	NVRAM Diagnostic check. **This test destroys previously stored data.** To restore the data, run routine 99, exit test mode, and then degauss the probe prior to turning off the AM 503A.
98	Write validation and probe identification data into EEPROM.
99	Update upper locations in NVRAM with validation data (to allow battery backup of NVRAM data). If the AM 503A internal battery has been changed, run this test.

Routine 00

This routine turns front panel controller U102 on and off at approximately a 250 ms rate. Use this test to check the front panel indicators.

Lines MX1 and MX2 pulse positive during the on cycle. Lines P1 through P16 sink the LED current, producing approximately 1 V at each pin. If an LED doesn't work, check the corresponding controller line. If the voltage on the line is always zero, the LED is probably open.

Routine 01

This routine causes a decaying pseudo-sine wave (part of the degauss/auto-balance signal) to be generated at the channel A (pin 3) and channel H (pin 18) outputs of DAC U370. When deactivated, this routine disables the degauss/autobalance signal. (Because front panel switches are not polled by the microprocessor until the completion of the routine, press and hold the **BW LIMIT** button until the LED extinguishes to deactivate this routine.) Figure 6-20 shows a rough view of the degauss waveform before and after filtering. Each burst contains approximately 250 cycles and the amplitude of the filtered waveform (at pin 1 of U353A) is approximately 3 V.

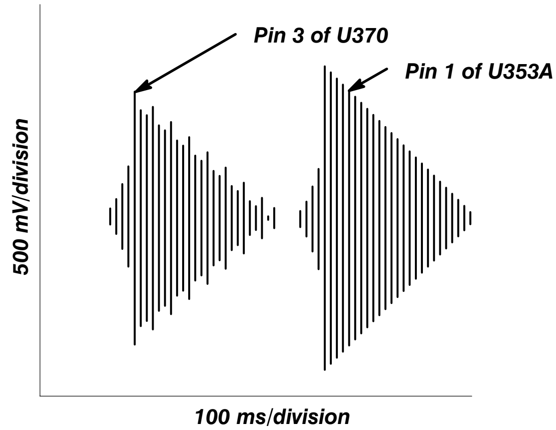


Figure 6-20: The Degauss Signal

Routine 02

This routine alternately displays the routine number (02) and the version number of the installed firmware. To determine if the firmware version you have is the latest version available, contact your Tektronix sales representative.

Routine 03

When activated, this routine sets HALL_PREAMP_DISC low. Pin 14 of U170D goes to +14 V and the gate of Q374 goes to 0 V, turning Q374 on.

Routine 04

When activated, this routine sets HALL_PREAMP_DISC high. Pin 14 of U170D and the gate of Q374 go to −14 V, turning Q374 off.

Routines 05 through 11

These routines cause the attenuator controller, U270, to repeatedly send attenuator control pulses that correspond to the selected setting.

To observe the pulses, connect the external trigger input of your oscilloscope to the TRIG test point TP230 and connect the oscilloscope probe to the desired output pin of U270. An active output produces a +5 V output with a negative-going spike, as shown in Figure 6-21. An inactive line should produce a 0 V output. (Some inactive outputs may have a positive-going spike due to crosstalk on floating outputs. These spikes can be ignored.)

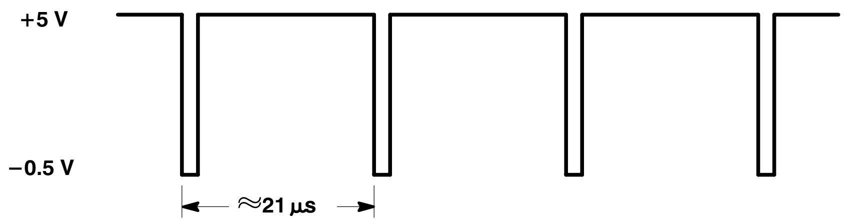


Figure 6-21: Attenuator Control Pulses

To determine if U270 is working properly, run routines 05 through 11 and check for negative-going pulses on outputs as specified in Table 6-3. If the pulses are good, then the attenuator is probably defective. If the pulses are bad, then check the input of U270 for data pulses. If data pulses are present, then U270 is probably defective. If data pulses are not present, then a microcontroller problem may exist.

Table 6-3: Attenuator Control Pulse Code (U270)

Routine	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9	Pin 10	Pin 11	Pin 12
05	0 V	0 V	pulse	0 V	0 V	0 V	pulse	0 V
06	0 V	0 V	pulse	0 V	0 V	pulse	0 V	0 V
07	0 V	0 V	0 V	0 V	0 V	0 V	pulse	pulse
08	0 V	0 V	0 V	0 V	0 V	pulse	0 V	pulse
09	pulse	0 V	0 V	0 V	pulse	0 V	0 V	0 V
10	0 V	pulse	0 V	0 V	pulse	0 V	0 V	0 V
11	pulse	0 V	0 V	pulse	0 V	0 V	0 V	0 V

Routines 12 through 17

Routines 12 through 17 check the step gain of the output amplifier. For each gain setting, bits G0 through G2 are set to the values listed in Table 6-4.

Check the output amplifier controller U252 for the correct bit settings. If bits G0 through G2 and the OUT_AMP_GAIN_ADJ voltage are at the proper values but the amplifier gain is not correct, or if there is a problem with the OUT_AMP_GAIN ADJ line from U353C pin 8, then the output amplifier may be defective. If bits G0 through G2 are not at the proper values, U252 may be defective.

Table 6-4: Bit Settings for Gain Test (U252)

Routine No.	G0	G1	G2
12	H	L	L
13	L	H	L
14	H	H	L
15	L	L	H
16	L	H	H
17	H	H	L

Routines 18 through 20

Routines 18 through 20 check the bandwidth function of the output amplifier. These routines work in a similar manner as routines 12 through 17 except they check bits B0 and B1 of U252. Table 6-5 defines the bandwidth bit settings.

Table 6-5: Bit Settings for Bandwidth Test (U252)

Routine No.	B0	B1
18	L	H
19	L	H
20	L	L

Routines 21 through 28

Routines 21 through 28 allow you to manually adjust the output voltage of the selected DAC channel. Upon activating the selected routine, the initial value of the corresponding DAC channel is set to 0.00 VDC. To alter the output voltage, rotate the **DC LEVEL** knob and monitor the results. For most routines, the output voltage range will be approximately ±2.5 V. Refer to the manufacturer's data book for detailed conversion information.

Routine 29

This routine connects the degauss/autobalance signal to the power amplifier input by setting DEGAUSS_SIG_ENBL high. Pin 1 of U170A should be at +14 V and the gate of Q370 should be at 0 V, turning Q370 on.

Routine 30

This routine disconnects the degauss/autobalance signal from the power amplifier input by setting DEGAUSS_SIG_ENBL low. Pin 1 of U170A and the gate of Q370 should be at −14 V, turning Q370 off.

Routine 31

When activated, this routine sets OUT_AMP_ENBL high, enabling the output amplifier.

Routine 32

When activated, this routine sets OUT_AMP_ENBL low, disabling the output amplifier.

Routine 33

This routine performs an A/D conversion on channel 0 of U350, PROBE_ID. Probe identification is accomplished using ratio-metric resistor coding in the AM 503A and compatible probes.

Routine 34

This routine checks the microcontroller watchdog circuit U151. During normal operation, the microcontroller pulses pin 6 of U151 low at least once every 1.6 seconds. If pin 6 fails to go low within that time, U151 assumes a problem has occurred and resets the microcontroller. Routine 34 holds the microcontroller in a software loop, preventing it from toggling pin 6 of U151 low. As a result, U151 resets the microcontroller and returns the AM 503A to normal operating mode.

If a reset does not occur shortly after running this routine, U151, NAND gate U132A, or the microcontroller may be defective. Check the signal conditions to determine which component is bad.

Routine 96

This routine checks the EEPROM (U250).

Routine 97

CAUTION

This test destroys all previously stored data.

This routine writes data to all NVRAM (U251) memory locations.To restore the data after running the test, run routine 99, exit test mode, and then degauss the probe prior to turning the AM 503A off. If you do not restore the data, the AM 503A will not be able to store instrument settings when powered down.

Routine 98

This routine restores A6302 and A6303 validation data to the EEPROM (U250).

Routine 99

This routine restores validation data to NVRAM (U251) to allow battery backup of NVRAM data. Run this routine to restore the original data. Next, exit test mode and degauss the probe using the front panel push button.

Error Codes

To assist you in identifying the source of system failures, the AM 503A displays internal and external error codes. Internal error codes appear on an LED inside the AM 503A (U231) and external error codes appear on the digital readout of the front panel. Internal error codes are generated when the microcontroller circuits prevent the front panel display from operating. External error codes are generated when a failure that does not affect the front panel display occurs. Table 6-6 defines the internal error codes and Table 6-7 defines the external (front panel) error codes.

If you encounter an error code during normal operation, follow this procedure:

- ☐ **Step 1:** Change any of the front panel settings (select a switch or rotate a knob).
- ☐ **Step 2:** Retry the function that caused the error. If the error does not occur again, there is probably no circuit failure.
- ☐ **Step 3:** If the error persists, leave the instrument in the error condition (error code flashing). This leaves the AM 503A circuits in the error state to assist you in troubleshooting.

For information showing how to use error codes when troubleshooting instrument problems, refer to the flow diagrams later in this section.

The internal error codes listed in Table 6-6 can occur only when the instrument is turned on, not once it is operational. These error codes are displayed on the main circuit board (U231), not on the front panel.

Table 6-6: AM 503A Internal Error Codes

Code No.	Description
0	undefined
1	ROM checksum error
2	RAM read/write error
3	the SCLK line of the I^2C bus is inoperative (microcontroller port 1, bit 6)
4	the SDA line of the I^2C bus is inoperative (microcontroller port 1, bit 7)
5	no I^2C acknowledge bit from the front panel display controller (U102)
6−9	undefined

The external (front panel) error codes listed in Table 6-7 can occur at different times. Error codes 14 and 80 through 88 can occur only during power up.

Error codes 10, 11, 12, 13, 15, and 17 can occur during normal operation.

Error codes 20 through 76 can occur only when the **PROBE DEGAUSS AUTOBALANCE** button is pressed (for more information about the processes that occur during the degauss/autobalance routine, read the microcontroller circuit description in *Theory of Operation*).

These error codes are displayed on the front panel.

Table 6-7: AM 503A External (Front Panel) Error Codes

Code No.	Description
10	no I^2C acknowledge bit from the output amplifier controller (U252)
11	no I^2C acknowledge bit from the NVRAM (U251)
12	no I^2C acknowledge bit from EEPROM (U250)
13	read-back error from most-significant bit of attenuator controller (U270)
14	EEPROM (U250) has not been programmed with probe identification data or AM 503A validation data; run test routines 97, 98, and 99

Table 6-7: AM 503A External (Front Panel) Error Codes (Cont.)

Code No.	Description
15	probe ID error (connected probe has an unknown resistance code)
16	EEPROM has not been programmed with probe identification data for the attached current probe
17	probe data in EEPROM is corrupt
18–19	undefined
20	positive rail of DAC (U370) channel E reached during DC coarse offset adjustment of the output amplifier with step gain at 60
21	negative rail of DAC (U370) channel E reached during DC coarse offset adjustment of the output amplifier with step gain at 60
22	positive rail of DAC (U370) channel F reached during DC fine offset adjustment of the output amplifier with step gain at 60
23	negative rail of DAC (U370) channel F reached during DC fine offset adjustment of the output amplifier with step gain at 60
24	positive rail of DAC (U370) channel E reached during DC coarse offset adjustment of the output amplifier with step gain at 30
25	negative rail of DAC (U370) channel E reached during DC coarse offset adjustment of the output amplifier with step gain at 30
26	positive rail of DAC (U370) channel F reached during DC fine offset adjustment of the output amplifier with step gain at 30
27	negative rail of DAC (U370) channel F reached during DC fine offset adjustment of the output amplifier with step gain at 30
28	positive rail of DAC (U370) channel E reached during DC coarse offset adjustment of the output amplifier with step gain at 12
29	negative rail of DAC (U370) channel E reached during DC coarse offset adjustment of the output amplifier with step gain at 12
30	positive rail of DAC (U370) channel F reached during DC fine offset adjustment of the output amplifier with step gain at 12
31	negative rail of DAC (U370) channel F reached during DC fine offset adjustment of the output amplifier with step gain at 12
32	positive rail of DAC (U370) channel E reached during DC coarse offset adjustment of the output amplifier with step gain at 6

Table 6-7: AM 503A External (Front Panel) Error Codes (Cont.)

Code No.	Description
33	negative rail of DAC (U370) channel E reached during DC coarse offset adjustment of the output amplifier with step gain at 6
34	positive rail of DAC (U370) channel F reached during DC fine offset adjustment of the output amplifier with step gain at 6
35	negative rail of DAC (U370) channel F reached during DC fine offset adjustment of the output amplifier with step gain at 6
36	positive rail of DAC (U370) channel E reached during DC coarse offset adjustment of the output amplifier with step gain at 3
37	negative rail of DAC (U370) channel E reached during DC coarse offset adjustment of the output amplifier with step gain at 3
38	positive rail of DAC (U370) channel F reached during DC fine offset adjustment of the output amplifier with step gain at 3
39	negative rail of DAC (U370) channel F reached during DC fine offset adjustment of the output amplifier with step gain at 3
40	positive rail of DAC (U370) channel E reached during DC coarse offset adjustment of the output amplifier with step gain at 1.2
41	negative rail of DAC (U370) channel E reached during DC coarse offset adjustment of the output amplifier with step gain at 1.2
42	positive rail of DAC (U370) channel F reached during DC fine offset adjustment of the output amplifier with step gain at 1.2
43	negative rail of DAC (U370) channel F reached during DC fine offset adjustment of the output amplifier with step gain at 1.2
44	positive rail of DAC (U370) channel C reached during DC offset adjustment of the power amplifier
45	negative rail of DAC (U370) channel C reached during DC offset adjustment of the power amplifier
46	positive rail of DAC (U370) channel A reached during DC coarse offset adjustment of the Hall preamplifier
47	negative rail of DAC (U370) channel A reached during DC coarse offset adjustment of the Hall preamplifier
48	positive rail of DAC (U370) channel H reached during DC fine offset adjustment of the Hall preamplifier
49	negative rail of DAC (U370) channel H reached during DC fine offset adjustment of the Hall preamplifier

Table 6-7: AM 503A External (Front Panel) Error Codes (Cont.)

Code No.	Description
50	the OUT_AMP_GAIN_ADJUST line reached +1 V during the analog gain adjustment of the output amplifier
51	negative rail of DAC (U370) channel B reached during adjustment of attenuator INPUT voltage to 200 mV
52	positive rail of DAC (U370) channel B reached during adjustment of attenuator INPUT voltage to 200 mV
53	negative rail of DAC (U370) channel C reached during adjustment of attenuator input voltage (while checking for 50 Ω termination at AM 503A output)
54	could not perform degauss/autobalance routine because AM 503A not terminated into 50Ω
55–59	undefined
60	diagnostic error of NVRAM (U251)
61	diagnostic error of EEPROM (U250)
62	diagnostic error of A/D and D/A converter, channel 1 detects excessive deviation of V_{out} B from +2.5 VDC reference
63	diagnostic error of A/D and D/A converter, channel 1 detects excessive deviation of V_{out} B from 0 V ground reference
64	diagnostic error of A/D and D/A converter, channel 1 detects excessive deviation of V_{out} B from −2.5 VDC reference
65–69	undefined
70	diagnostic error of output amplifier controller (U252), bit P0
71	diagnostic error of output amplifier controller (U252), bit P1
72	diagnostic error of output amplifier controller (U252), bit P2
73	diagnostic error of output amplifier controller (U252), bit P3
74	diagnostic error of output amplifier controller (U252), bit P4
75	diagnostic error of output amplifier controller (U252), bit P5
76	diagnostic error of output amplifier controller (U252), bit P6
77	diagnostic error of output amplifier controller (U252), bit P7
78–79	undefined
80	clockwise switch of **CURRENT/DIV** control is holding an I/O line low
81	counterclockwise switch of **CURRENT/DIV** control is holding an I/O line low

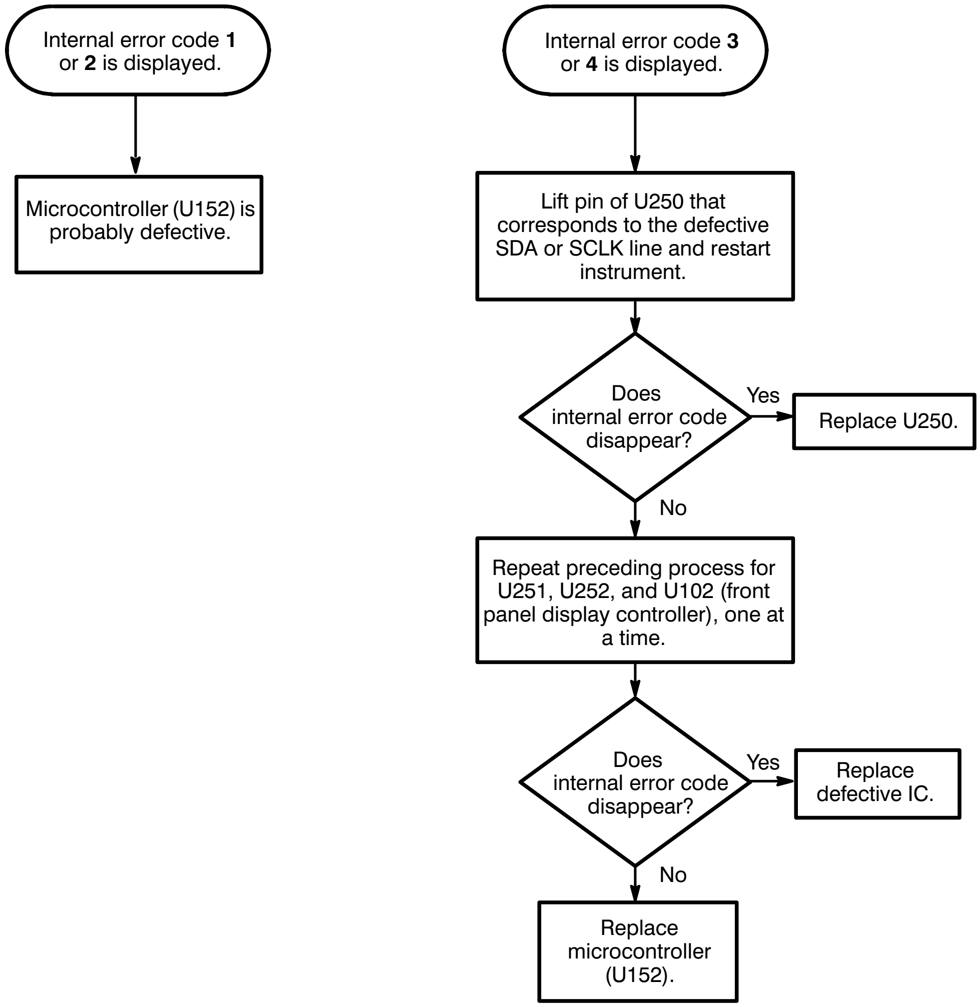
Table 6-7: AM 503A External (Front Panel) Error Codes (Cont.)

Code No.	Description
82	clockwise switch of **DC LEVEL** control is holding an I/O line low
83	counterclockwise switch of **DC LEVEL** control is holding an I/O line low
84	**AC** coupling switch is holding an I/O line low
85	**DC** coupling switch is holding an I/O line low
86	**REF** coupling switch is holding an I/O line low
87	**PROBE DEGAUSS AUTOBALANCE** switch is holding an I/O line low
88	**20 MHz BW LIMIT** switch is holding an I/O line low

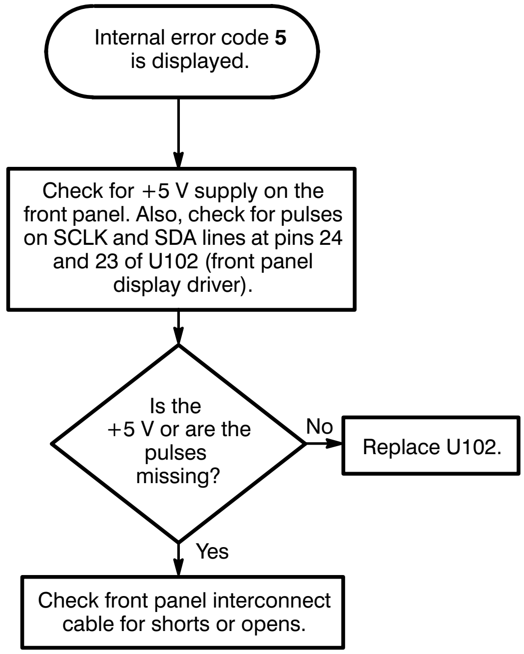
Troubleshooting with Error Codes

This section provides flow charts to help you isolate the defective circuit block when an error code is reported. Refer to Table 6-8 for troubleshooting information for operational problems that don't have error codes. This troubleshooting information applies to the AM 503A amplifier and associated probes. For specific power module service information, see the instruction manual for your power module.

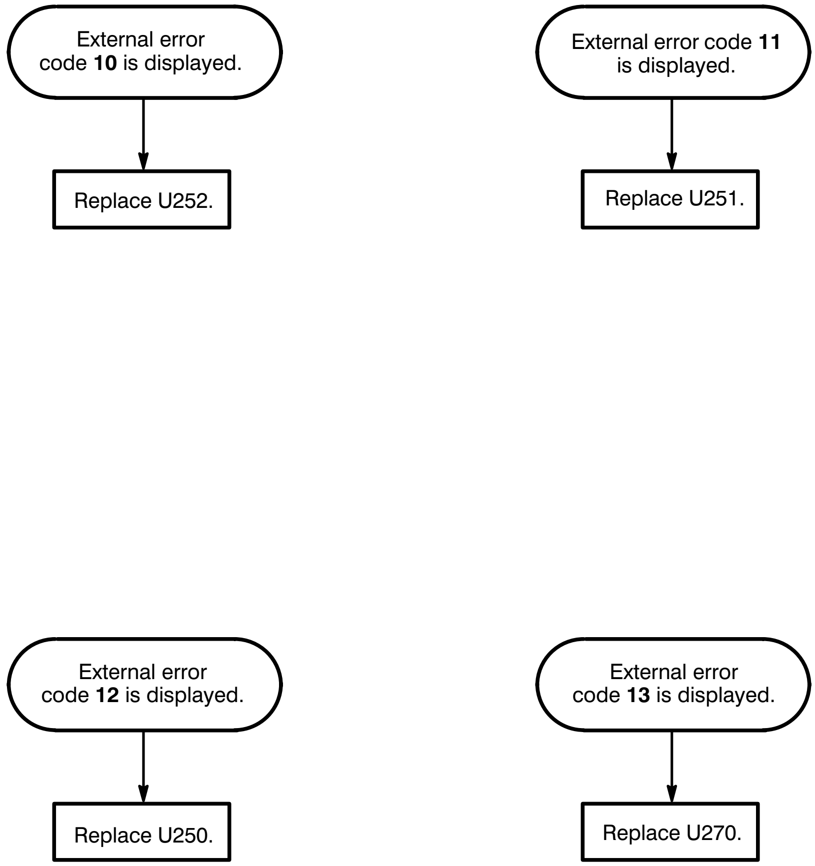
Internal Error Codes 1 through 4



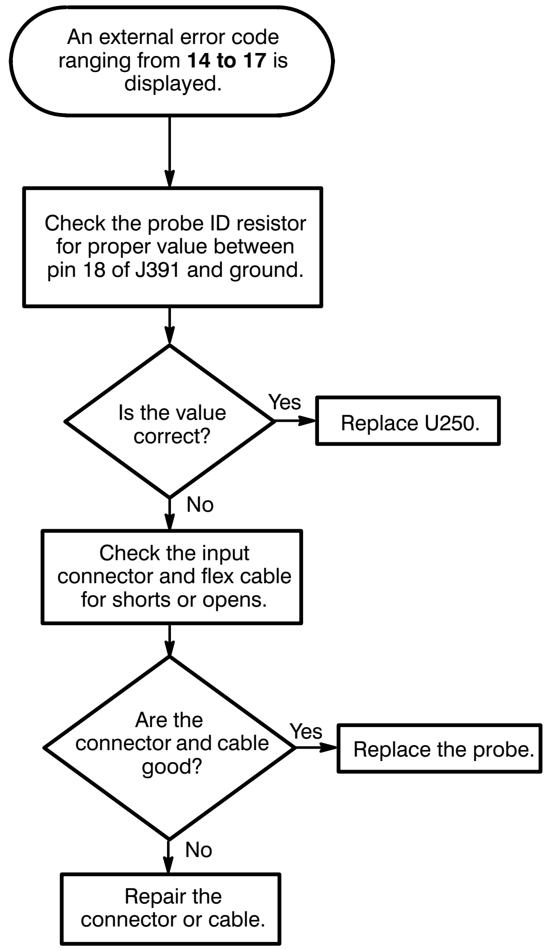
Internal Error Code 5



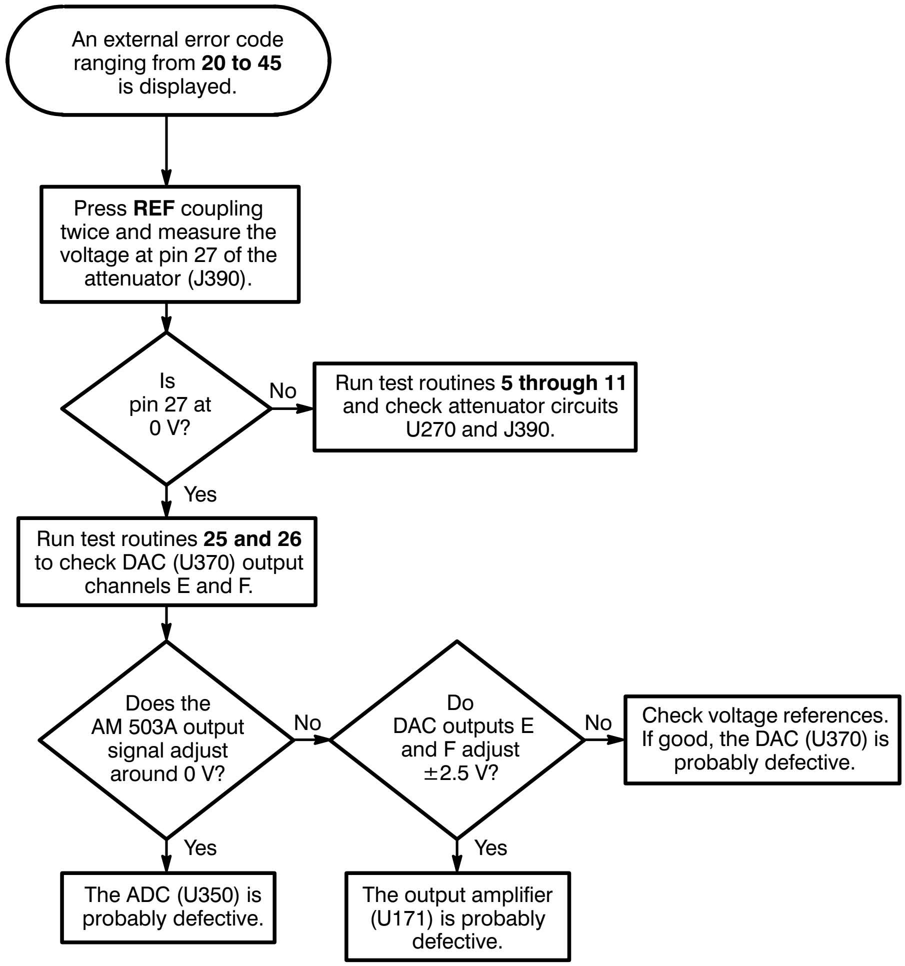
External Error Codes 10 through 13



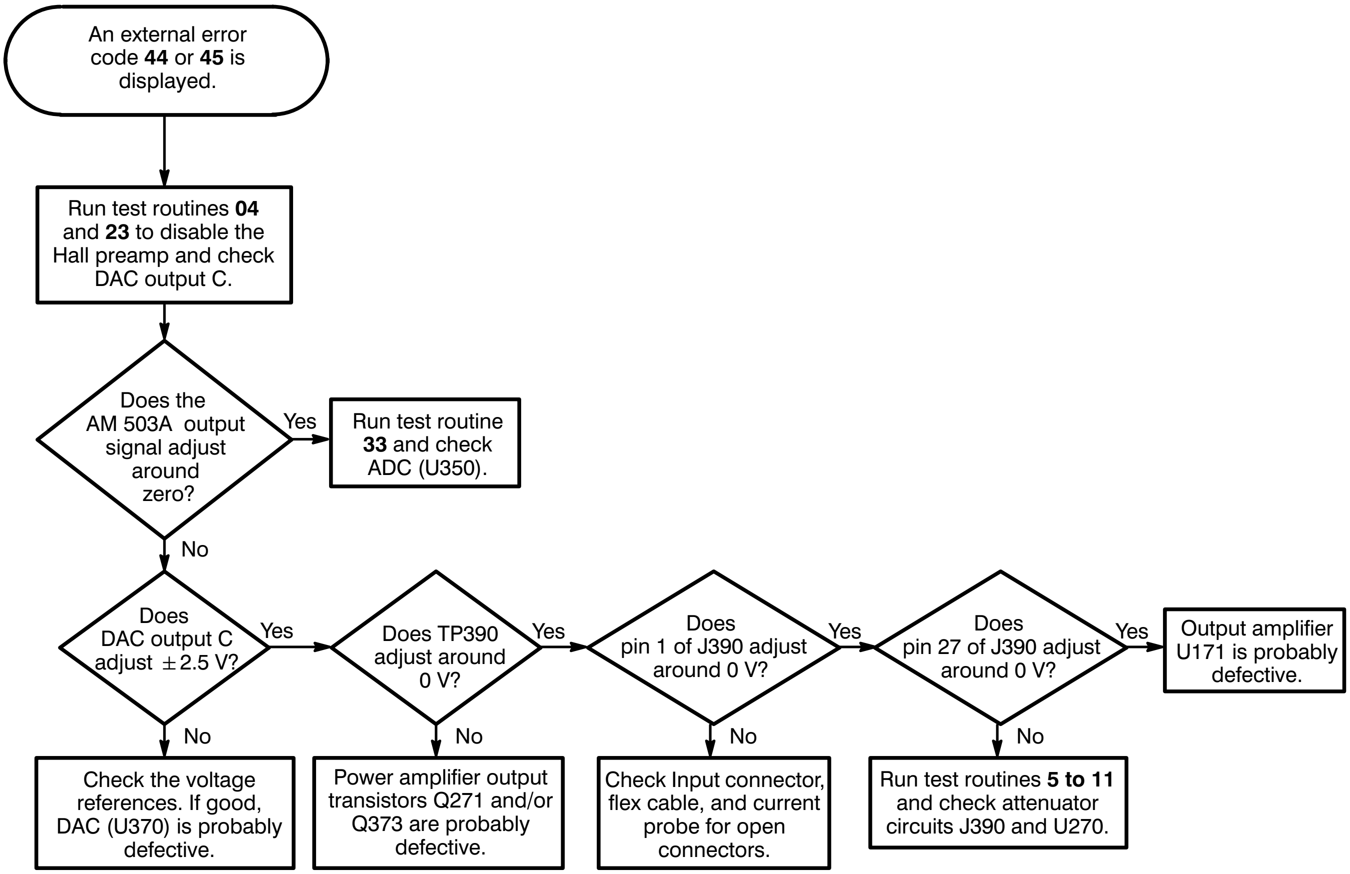
External Error Codes 14 through 17



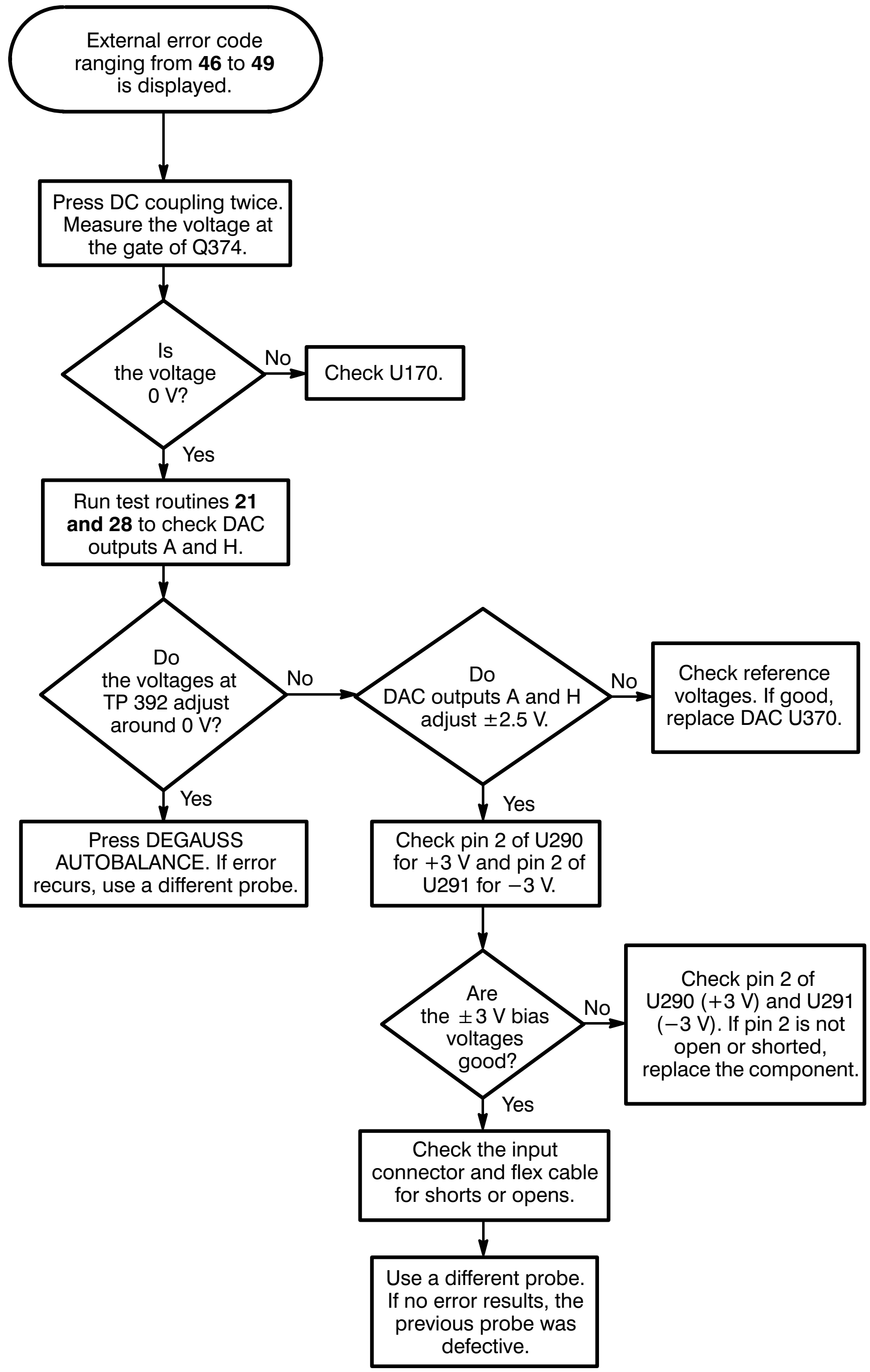
External Error Codes 20 through 45



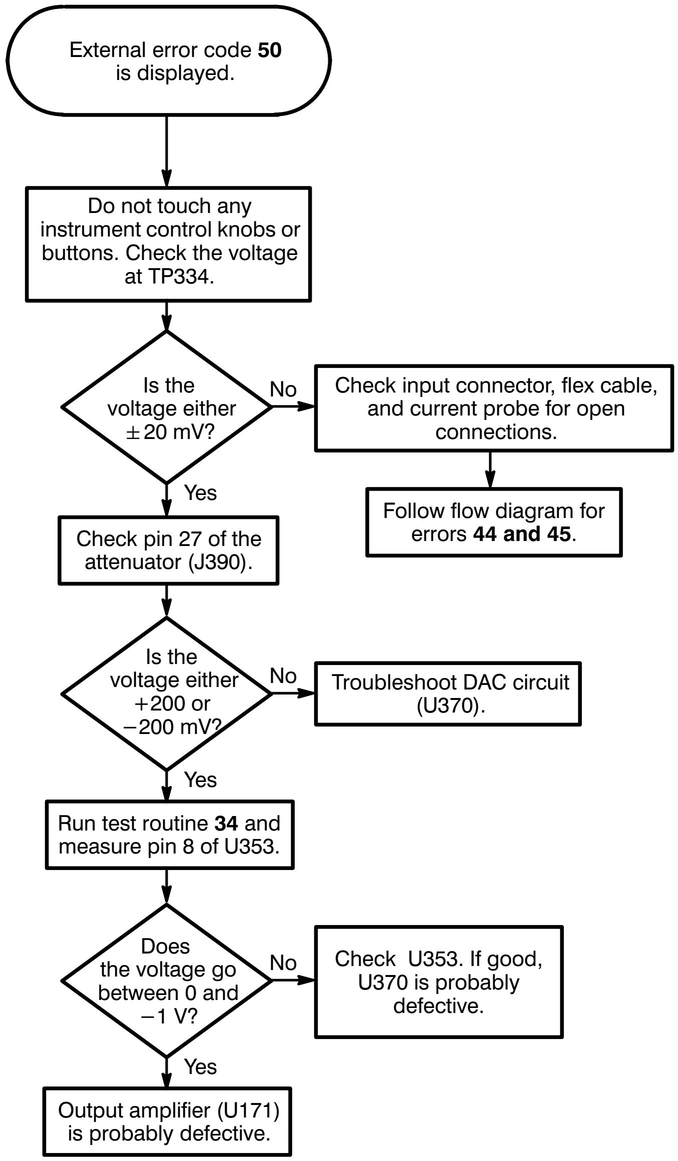
External Error Codes 44 and 45



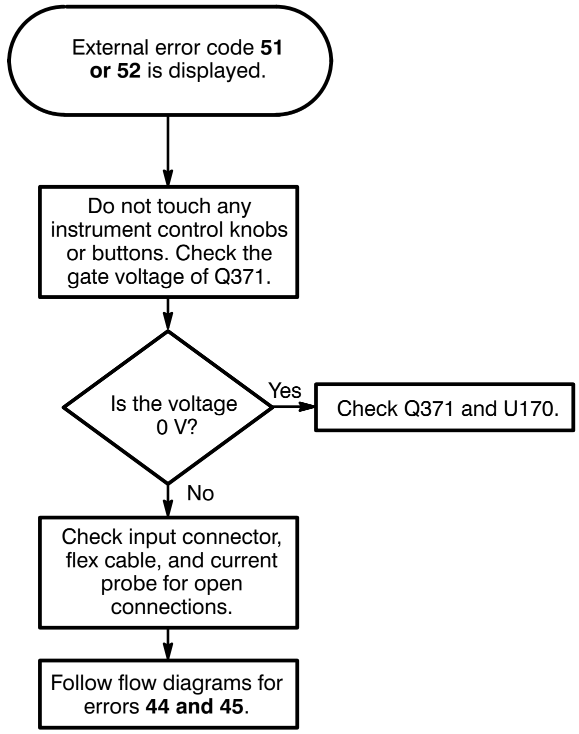
External Error Codes 46 through 49



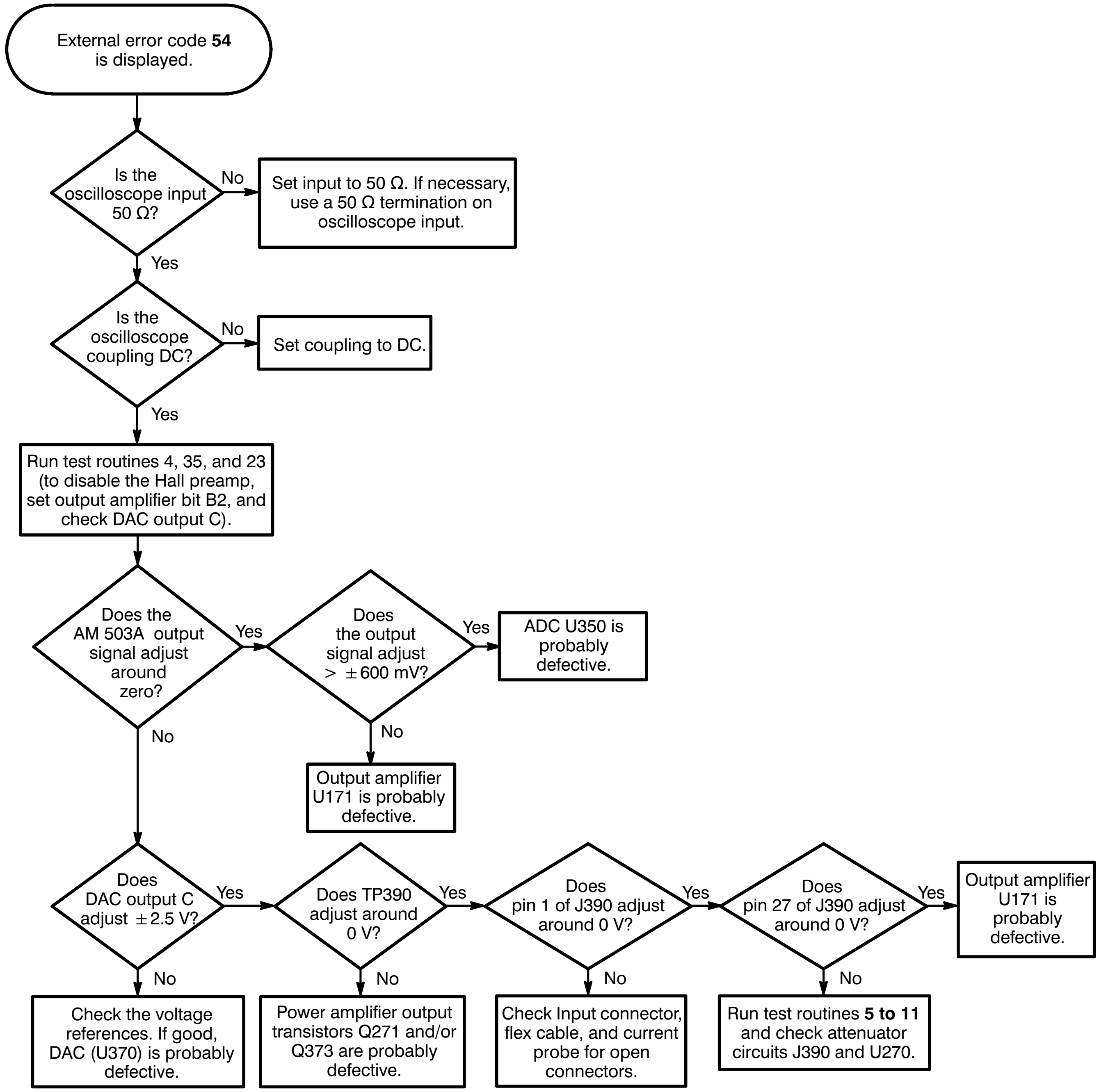
External Error Code 50



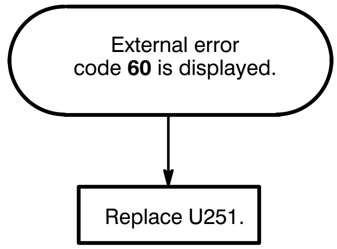
External Error Code 51 and 52

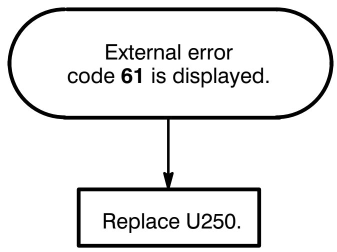


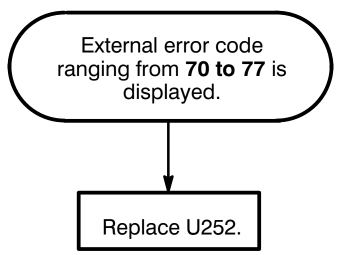
External Error Code 54



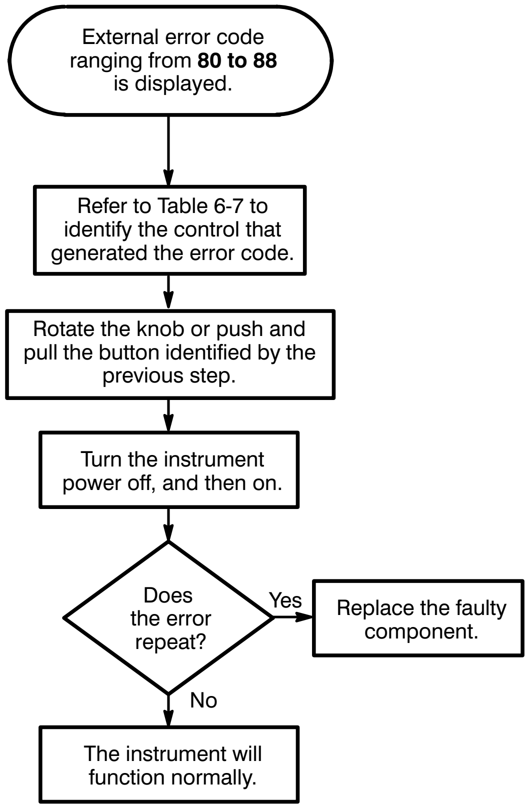
External Error Codes 60 through 77







External Error Codes 80 through 88



Troubleshooting Operational Problems

This section provides a table to help you troubleshoot problems that do not result in an external error code. Refer to Table 6-8 for a list of symptoms, their probable causes, and corrective actions. This troubleshooting information applies to the AM 503A amplifier and associated probes. For specific power module service information, see the instruction manual for your power module.

Table 6-8: AM 503A Operational Problems

Symptom	Probable Cause	Corrective Action
AM 503A appears dead	TM 502A power module off	Turn on power module
	Fuse open in TM 502A power module	Replace fuse in power module
	AM 503A power supply fuse open	Replace fuse in AM 503A
No measurement output from AM 503A	Oscilloscope input not set to DC	Set oscilloscope to DC coupling
	AM 503A coupling set to **REF**	Set AM 503A coupling to **AC** or **DC**
	Bad cable or BNC connector	Replace cables and connectors (and termination, if used)
	AM 503A **CURRENT**/**DIVISION** set too high	Decrease AM 503A **CURRENT**/**DIVISION** (increase sensitivity)
	AM 503A output cable re-routed to rear interface	Re-route output cable to front panel connector
AM 503A indicators light but probe will not degauss	Probe is not locked	Engage probe lock
	Degauss/autobalance routine was performed with probe connected to conductor	Disconnect probe from conductor, lock, and degauss
Cannot adjust DC level	Oscilloscope is AC coupled	Set oscilloscope to DC coupling
	Output amplifier dynamic range exceeded	Increase AM 503A **CURRENT**/**DIVISION** (decrease sensitivity)

Table 6-8: AM 503A Operational Problems (Cont.)

Symptom	Probable Cause	Corrective Action
Front panel displays error **54**.	Oscilloscope input not set to DC	Set oscilloscope to DC coupling
	Oscilloscope input not set to 50 Ω	Set oscilloscope input to 50 Ω
	50 Ω termination (if required) attached to AM 503A output	Attach termination to oscilloscope input

Options

Options

You can order the following options for the AM 503A Current Probe Amplifier:

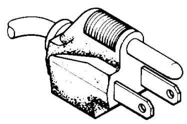
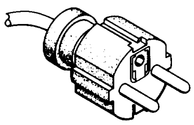
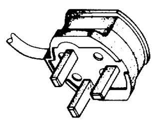
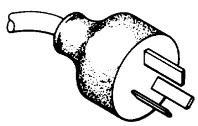
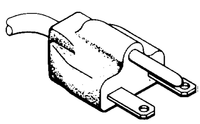
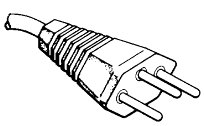
Option 01: Add the A6303 Probe.
Option 03: Substitute the A6303 Probe for the A6302 Probe.

Power Cord Options

You can order the following power cord options for the AM 503A Current Probe Amplifier (refer also to Table 7-1):

Option A1: Universal European, 220 V
Option A2: United Kingdom, 240 V
Option A3: Australia, 240 V
Option A4: North America, 240 V
Option A5: Switzerland, 220 V

Table 7-1: Power-Cord and Plug Identification

Plug Configuration	Usage (Max Rating)	Reference Standards & Certification	Option #
	North America 125 V/6 A	ANSI C73.11[1] NEMA 5-15-P[2] IEC 83[3] UL[10] CSA[11]	Standard
	Europe 220 V/16 A	ICE 83[3] CEE (7), II, IV, VII[4] VDE[8] SEMKO[9]	A1
	United Kingdom 240 V/13 A	IEC 83[3] BSI 1363[5]	A2
	Australia 240 V/10 A	AS C112[6] ETSA1[2]	A3
	North America 240 V/15 A	ANSI C73.20[1] NEMA 6-15-P[2] IEC 83[3] UL[10] CSA[11]	A4
	Switzerland 220 V/10 A	SEV[7]	A5

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

Optional Accessories

You can order the following optional accessories for the AM 503A Current Probe Amplifier:

- AM 503A Service Manual (Tektronix part number 070-8174-00)
- Current Loop (Tektronix part number 015-0601-50)

The current loop is a test accessory required for checking the performance characteristics of the AM 503A. Refer to the *Performance Verification* section of this manual for information about using the current loop.

Replaceable Electrical Parts

Parts Ordering Information

Replacement parts are available from or through your local Tektronix, Inc., Field Office or representative.

When ordering parts, include the following information in your order: part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc., Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

List of Assemblies

A list of assemblies can be found at the beginning of the electrical parts list. The assemblies are listed in numerical order. When the complete component number of a part is known, this list will identify the assembly in which the part is located.

Cross Index-Mfr. Code Number to Manufacturer

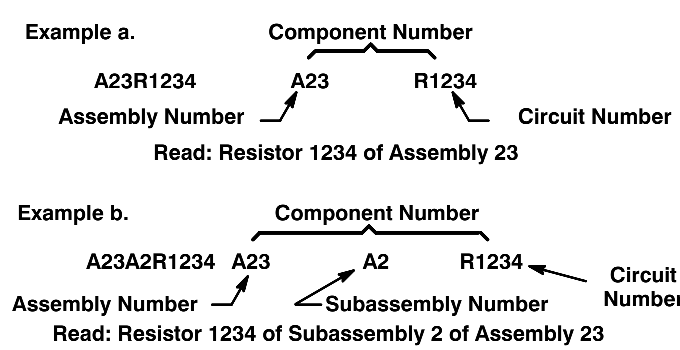
The Mfg. Code Number to Manufacturer Cross Index for the electrical parts list is located immediately after this page. The cross index provides codes, names, and addresses of manufacturers of components listed in the electrical parts list.

Abbreviations

Abbreviations conform to American National Standard Y1.1.

Component Number

(column 1 of the parts list)



The circuit component's number appears on the diagrams and circuit board illustrations. Each diagram and circuit board illustration is clearly marked with the assembly number. Assembly numbers are also marked on the mechanical exploded views located in the mechanical parts list. The component number is obtained by adding the assembly number prefix to the circuit number.

The electrical parts list is divided and arranged by assemblies in numerical sequence (for example, assembly A1 with its subassemblies and parts, precedes assembly A2 with its subassemblies and parts).

Chassis-mounted parts have no assembly number prefix and are located at the end of the electrical parts list.

Tektronix Part No.

(column 2 of the parts list)

Indicates part number to be used when ordering replacement part from Tektronix.

Serial No.

(columns 3 & 4 of the parts list)

Column three (3) indicates the serial number at which the part was first used. Column four (4) indicates the serial number at which the part was removed. No serial number entered indicates part is good for all serial numbers.

Name & Description

(column five of the parts list)

In the parts list, an item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. For further item name identification, the U.S. Federal Catalog handbook H6-1 can be used where possible.

Mfr. Code

(column 6 of the parts list)

Indicates the code number of the actual manufacturer of the part. (Code to name and address cross reference can be found immediately after this page.)

Mfr. Part No.

(column 7 of the parts list)

Indicates actual manufacturer's part number.

CROSS INDEX – MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
TK0875	MATSUO ELECTRONICS INC	831 S DOUBLAS ST	EL SEGUNDO CA 92641
TK1111	SHIGMA INC (IMPORTER)	80 MARTIN LN	ELK GROVE VILLAGE IL 60007–1308
TK1864	INTERFET CORP	322 GOLD ST	GARLAND TX 75042
TK2172	WYLE LABORATORIES (DIST)	5250 NE ELAM YOUNG PARKWAY SUITE 600	HILLSBORO OR 97124
0CVK3	ALLEGRO MICROSYSTEMS INC INTEGRATED CIRCUITS DIV	115 NE CUTOFF	WORCHESTER MA 01606
0JR03	ZMAN MAGNETICS INC	7633 S 180th	KENT WA 98032
0JR04	TOSHIBA AMERICA INC ELECTRONICS COMPONENTS DIV BUSINESS SECTOR	2692 DOW AVE	TUSTIN CA 92680
0J9R5	MARCON AMERICA CORP	3 PEARL COURT	ALLENDALE NJ 07401
01295	TEXAS INSTRUMENTS INC SEMICONDUCTOR GROUP	13500 N CENTRAL EXPY PO BOX 655012	DALLAS TX 75265
04222	AVX CERAMICS DIV OF AVX CORP	19TH AVE SOUTH P O BOX 867	MYRTLE BEACH SC 29577
04713	MOTOROLA INC SEMICONDUCTOR PRODUCTS SECTOR	5005 E MCDOWELL RD	PHOENIX AZ 85008–4229
09922	BURNDY CORP	RICHARDS AVE	NORWALK CT 06852
1ES66	MAXIM INTEGRATED PRODUCTS INC	120 SAN GABRIEL DRIVE	SUNNYVALE CA 94086
1W344	UNITED CHEMI–CON INC	9801 W HIGGINS SUITE 430	ROSEMONT IL 60018–4704
14936	GENERAL INSTRUMENT CORP DISCRETE SEMI CONDUCTOR DIV	600 W JOHN ST	HICKSVILLE NY 11802
18324	SIGNETICS CORP MILITARY PRODUCTS DIV	4130 S MARKET COURT	SACRAMENTO CA 95834–1222
21845	SOLITRON DEVICES INC CORP HQ & SEMICONDUCTOR MFG GROUP	1177 BLUE HERON BLVD BLDG 1	RIVIERA BEACH FL 33404–4703
22526	DU PONT E I DE NEMOURS AND CO INC DU PONT ELECTRONICS DEPT	515 FISHING CREEK RD	NEW CUMBERLAND PA 17070–3007
24546	BRADFORD ELECTRONICS	550 HIGH ST	BRADFORD PA 16701–3737
25403	PHILIPS COMPONENTS DISCRETE PRODUCTS DIV DISCRETE SEMICONDUCTOR GROUP	GEORGE WASHINGTON HWY	SMITHFIELD RI 02917
27014	NATIONAL SEMICONDUCTOR CORP	2900 SEMICONDUCTOR DR	SANTA CLARA CA 95051–0606
50434	HEWLETT–PACKARD CO OPTOELECTRONICS DIV	370 W TRIMBLE RD	SAN JOSE CA 95131
51167	ARIES ELECTRONICS INC	62 TRENTON AVE PO BOX 130	FRENCHTOWN NJ 08825–1221

CROSS INDEX – MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
51406	MURATA ERIE NORTH AMERICA INC HEADQUARTERS AND GEORGIA OPERATIONS	2200 LAKE PARK DR	SMYRNA GA 30080
53387	MINNESOTA MINING MFG CO	PO BOX 2963	AUSTIN TX 78769–2963
55680	NICHICON /AMERICA/ CORP	927 E STATE PKY	SCHAUMBURG IL 60195–4526
56845	DALE ELECTRONICS INC	2300 RIVERSIDE BLVD PO BOX 74	NORFOLK NE 68701–2242
59660	TUSONIX INC	7741 N BUSINESS PARK DR PO BOX 37144	TUCSON AZ 85740–7144
61058	MATSUSHITA ELECTRIC CORP OF AMERICA PANASONIC INDUSTRIAL CO DIV	ONE PANASONIC WAY PO BOX 1502	SECAUCUS NJ 07094–2917
61857	SAN–0 INDUSTRIAL CORP	85 ORVILLE DR PO BOX 511	BOHEMIA LONG ISLAND NY 11716–2501
64155	LINEAR TECHNOLOGY CORP	1630 MCCARTHY BLVD	MILPITAS CA 95035–7417
75042	IRC ELECTRONIC COMPONENTS PHILADELPHIA DIV TRW FIXED RESISTORS	401 N BROAD ST	PHILADELPHIA PA 19108–1001
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077–0001
91637	DALE ELECTRONICS INC	2064 12TH AVE PO BOX 609	COLUMBUS NE 68601–3632

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1	671–2044–02			CIRCUIT BD ASSY:MAIN	80009	671204402
A2	671–2043–00			CIRCUIT BD ASSY:FRONT PANEL	80009	671204300
A1	671–2044–02			CIRCUIT BD ASSY:MAIN	80009	671204402
A1BT130	146–0087–00			BATTERY,DRY:1.5V,80 MAH,SILVER OXIDE,SP389	61058	SP389
A1C110	290–0804–00			CAP,FXD,ELCTLT:10UF,+50–20%,25V	0J9R5	CEUSM1E100
A1C111	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C112	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C113	290–0804–00			CAP,FXD,ELCTLT:10UF,+50–20%,25V	0J9R5	CEUSM1E100
A1C130	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C131	290–0973–00			CAP,FXD,ELCTLT:100UF,20%,25VDC	0J9R5	CEUSM1E101
A1C132	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C133	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C134	290–0973–00			CAP,FXD,ELCTLT:100UF,20%,25VDC	0J9R5	CEUSM1E101
A1C135	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C136	290–0944–00			CAP,FXD,ELCTLT:220UF,+50–20%,10V	0J9R5	CEUSM1A221
A1C150	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C151	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C152	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C153	290–0973–00			CAP,FXD,ELCTLT:100UF,20%,25VDC	0J9R5	CEUSM1E101
A1C154	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C155	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C156	290–0973–00			CAP,FXD,ELCTLT:100UF,20%,25VDC	0J9R5	CEUSM1E101
A1C157	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C158	290–0944–00			CAP,FXD,ELCTLT:220UF,+50–20%,10V	0J9R5	CEUSM1A221
A1C170	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C171	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C172	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C173	290–0944–00			CAP,FXD,ELCTLT:220UF,+50–20%,10V	0J9R5	CEUSM1A221
A1C174	290–0944–00			CAP,FXD,ELCTLT:220UF,+50–20%,10V	0J9R5	CEUSM1A221
A1C175	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C190	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C191	290–0778–00			CAP,FXD,ELCTLT:1UF,20%,50V,NPLZD	0J9R5	CEBPM1H010M(Q)
A1C192	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C193	290–0973–00			CAP,FXD,ELCTLT:100UF,20%,25VDC	0J9R5	CEUSM1E101
A1C194	290–0973–00			CAP,FXD,ELCTLT:100UF,20%,25VDC	0J9R5	CEUSM1E101
A1C210	290–0973–00			CAP,FXD,ELCTLT:100UF,20%,25VDC	0J9R5	CEUSM1E101
A1C211	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C212	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C213	290–0922–00			CAP,FXD,ELCTLT:1000UF,20%,50V	1W344	SM50VB102Q16X31
A1C214	290–0922–00			CAP,FXD,ELCTLT:1000UF,20%,50V	1W344	SM50VB102Q16X31

Component Number	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1C215	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C216	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C230	290–0718–00			CAP,FXD,ELCTLT:22UF,20%,35V	TK0875	DTSA3502–226M
A1C231	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C232	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C250	283–0051–00			CAP,FXD,CER DI:0.0033UF,5%,100V	04222	SR301A332JAA
A1C251	281–0761–00			CAP,FXD,CER DI:27PF,5%,100V	04222	SA101A270JAA
A1C252	281–0761–00			CAP,FXD,CER DI:27PF,5%,100V	04222	SA101A270JAA
A1C253	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C254	281–0785–00			CAP,FXD,CER DI:68PF,10%,100V	04222	SA101A680KAA
A1C270	290–0973–00			CAP,FXD,ELCTLT:100UF,20%,25VDC	0J9R5	CEUSM1E101
A1C271	290–0973–00			CAP,FXD,ELCTLT:100UF,20%,25VDC	0J9R5	CEUSM1E101
A1C273	283–0114–00			CAP,FXD,CER DI:1500PF,5%,200V	59660	805–534–Y5D0–15
A1C274	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C275	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C290	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C291	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C292	281–0797–00			CAP,FXD,CER DI:15PF,10%,100V,,TUBULAR,MI	04222	SA106A150KAA
A1C293	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C294	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C295	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C296	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C297	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C298	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C299	283–0114–00			CAP,FXD,CER DI:1500PF,5%,200V	59660	805–534–Y5D0–15
A1C300	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C301	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C302	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C303	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C304	290–0804–00			CAP,FXD,ELCTLT:10UF,+50–20%,25V	0J9R5	CEUSM1E100
A1C305	290–0804–00			CAP,FXD,ELCTLT:10UF,+50–20%,25V	0J9R5	CEUSM1E100
A1C306	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C307	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C308	281–0785–00			CAP,FXD,CER DI:68PF,10%,100V	04222	SA101A680KAA
A1C309	281–0785–00			CAP,FXD,CER DI:68PF,10%,100V	04222	SA101A680KAA
A1C310	290–0916–00			CAP,FXD,ELCTLT:2200UF,+50–20%,35WVDC	1W344	SM35VB222M18X35
A1C311	290–0916–00			CAP,FXD,ELCTLT:2200UF,+50–20%,35WVDC	1W344	SM35VB222M18X35
A1C330	283–0114–00			CAP,FXD,CER DI:1500PF,5%,200V	59660	805–534–Y5D0–15
A1C331	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C332	283–0114–00			CAP,FXD,CER DI:1500PF,5%,200V	59660	805–534–Y5D0–15
A1C350	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C351	290–0804–00			CAP,FXD,ELCTLT:10UF,+50–20%,25V	0J9R5	CEUSM1E100

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A1C352	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C353	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C354	290–0804–00			CAP,FXD,ELCTLT:10UF,+50–20%,25V	0J9R5	CEUSM1E100
A1C355	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C356	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C357	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C358	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C359	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C360	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C361	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C362	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C363	290–0804–00			CAP,FXD,ELCTLT:10UF,+50–20%,25V	0J9R5	CEUSM1E100
A1C364	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C370	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C372	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C373	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C374	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C375	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C391	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C392	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C394	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C395	281–0785–00			CAP,FXD,CER DI:68PF,10%,100V	04222	SA101A680KAA
A1C396	281–0785–00			CAP,FXD,CER DI:68PF,10%,100V	04222	SA101A680KAA
A1C398	283–0114–02			CAP,FXD,CER DI:1500PF,5%,200V	59660	805–409Y50–152J
A1C399	283–0114–00			CAP,FXD,CER DI:1500PF,5%,200V	59660	805–534–Y5D0–15
A1C400	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1CR130	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR131	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR210	152–0040–00			DIODE,RECT:,;600V,1A,50A IFSM	14936	GP15J–069
A1CR211	152–0040–00			DIODE,RECT:,;600V,1A,50A IFSM	14936	GP15J–069
A1CR212	152–0040–00			DIODE,RECT:,;600V,1A,50A IFSM	14936	GP15J–069
A1CR213	152–0040–00			DIODE,RECT:,;600V,1A,50A IFSM	14936	GP15J–069
A1CR272	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR273	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR274	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR275	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR276	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR290	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR310	152–0040–00			DIODE,RECT:,;600V,1A,50A IFSM	14936	GP15J–069
A1CR311	152–0040–00			DIODE,RECT:,;600V,1A,50A IFSM	14936	GP15J–069
A1CR312	152–0040–00			DIODE,RECT:,;600V,1A,50A IFSM	14936	GP15J–069
A1CR313	152–0040–00			DIODE,RECT:,;600V,1A,50A IFSM	14936	GP15J–069

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A1CR330	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR331	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR332	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR333	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR334	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR335	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR336	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR339	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR342	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR343	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR370	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR371	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR372	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR373	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR374	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR375	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR376	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR390	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR391	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1CR392	152–0141–02			DIODE,SIG:,ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A1F210	159–0194–00			FUSE,WIRE LEAD:5A,125V,0.125 SEC	61857	SP5–5A LEAD TAP
A1F310	159–0194–00			FUSE,WIRE LEAD:5A,125V,0.125 SEC	61857	SP5–5A LEAD TAP
A1F311	159–0194–00			FUSE,WIRE LEAD:5A,125V,0.125 SEC	61857	SP5–5A LEAD TAP
A1F312	159–0194–00			FUSE,WIRE LEAD:5A,125V,0.125 SEC	61857	SP5–5A LEAD TAP
A1F313	159–0194–00			FUSE,WIRE LEAD:5A,125V,0.125 SEC	61857	SP5–5A LEAD TAP
A1J130	131–1003–00			CONN,RF JACK:PCB,PELTOLA;FEMALE,STR,0.141 ID,0.277 H X 0.094 TAIL,GOLD,0.295 PCB,GRD SHELL	80009	131100300
A1J170	131–0608–00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283–036
A1J171	131–1003–00			CONN,RF JACK:PCB,PELTOLA;FEMALE,STR,0.141 ID,0.277 H X 0.094 TAIL,GOLD,0.295 PCB,GRD SHELL	80009	131100300
A1J230	131–0608–00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283–036
A1J290	131–0608–00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283–036
A1J390	165–2427–00			MICROCKT,LINEAR:ATTENUATOR/AMPLIFIER	80009	165242700
A1J391	131–5492–00			CONN,HDR:PCB,;MALE,STR,2 X 10,0.05 X 0.1 CTR, 0.390 H X 0.1 TAIL,SHRD/4 SIDES,CTR PLZ LATCHING	80009	131549200
A1L150	108–1354–00			COIL,RF:FXD,3.3UH,10%	91637	IR–2 3.3 MICRO–

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A1L151	108–1354–00			COIL,RF:FXD,3.3UH,10%	91637	IR–2 3.3 MICRO–
A1L170	108–1354–00			COIL,RF:FXD,3.3UH,10%	91637	IR–2 3.3 MICRO–
A1L171	108–1315–00			COIL,RF:FXD,440NH,+/–10%, DCR 0.012 OHM, I MAX 3 A, AXIAL LEAD PKG DIA 0.14 IN, LENGTH	0JR03	108–1315–00
A1L172	108–1315–00			COIL,RF:FXD,440NH,+/–10%, DCR 0.012 OHM, I MAX 3 A, AXIAL LEAD PKG DIA 0.14 IN, LENGTH	0JR03	108–1315–00
A1L190	108–0642–00			COIL,RF:FIXED,30NH,+/–15%,FORM276–0145–00	0JR03	108–0642–00
A1L191	108–1354–00			COIL,RF:FXD,3.3UH,10%	91637	IR–2 3.3 MICRO–
A1L192	108–1315–00			COIL,RF:FXD,440NH,+/–10%, DCR 0.012 OHM, I MAX 3 A, AXIAL LEAD PKG DIA 0.14 IN, LENGTH	0JR03	108–1315–00
A1L193	108–1315–00			COIL,RF:FXD,440NH,+/–10%, DCR 0.012 OHM, I MAX 3 A, AXIAL LEAD PKG DIA 0.14 IN, LENGTH	0JR03	108–1315–00
A1L390	108–0231–00			COIL,RF:FIXED,4.5UH	0JR03	108–0231–00
A1L391	108–0245–00			CHOKE,RF:FIXED,3.9UH, +/– 10 %, Q 35, DCR 0.264 OHM, SRF 61 MHZON POWERED IRON FORM	0JR03	108–0245–00
A1LR190	108–0408–00			COIL,RF:FIXED,91NH	0JR03	108–0408–00
A1Q110	151–0190–00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,200MA, 300MHZ,AMPLIFIER	04713	2N3904
A1Q111	151–0347–00			TRANSISTOR,SIG:BIPOLAR,NPN;160V,600MA, 100MHZ,AMPLIFIER	0JR04	2N5551
A1Q112	151–0350–00			TRANSISTOR,SIG:BIPOLAR,PNP;150V,600MA, 100MHZ,AMPLIFIER	0JR04	TO BE ASSIGNED
A1Q130	151–0188–00			TRANSISTOR,SIG:BIPOLAR,PNP;40V,200MA, 250MHZ,AMPLIFIER	04713	2N3906
A1Q190	151–0188–00			TRANSISTOR,SIG:BIPOLAR,PNP;40V,200MA, 250MHZ,AMPLIFIER	04713	2N3906
A1Q270	151–0190–00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,200MA, 300MHZ,AMPLIFIER	04713	2N3904
A1Q271	151–0390–00			TRANSISTOR:DARLINGTON,NPN,SI	04713	MPS–U45
A1Q290	151–1110–00			TRANSISTOR,SIG:JFET,N–CH;4V,30MA,10 OHM, SWITCH	21845	2N5434
A1Q370	151–1059–00			TRANSISTOR,SIG:JFET,N–CH;10V,30MA(MIN),30 OHM,SWITCH	TK1864	SNJ132171
A1Q371	151–1059–00			TRANSISTOR,SIG:JFET,N–CH;10V,30MA(MIN),30 OHM,SWITCH	TK1864	SNJ132171
A1Q372	151–0188–00			TRANSISTOR,SIG:BIPOLAR,PNP;40V,200MA, 250MHZ,AMPLIFIER	04713	2N3906
A1Q373	151–0391–00			TRANSISTOR:DARLINGTON,PNP,SI	04713	MPS–U95
A1Q374	151–1059–00			TRANSISTOR,SIG:JFET,N–CH;10V,30MA(MIN),30 OHM,SWITCH	TK1864	SNJ132171
A1R110	323–0068–00			RES,FXD,FILM:49.9 OHM,1%,0.5W,TC=T0	91637	CMF65116G49R90F
A1R111	308–0767–00			RES,FXD:1.1 OHM,5%,1W	75042	SP–20–1.1 OHM –
A1R112	322–3193–00			RES,FXD,FILM:1K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10000F
A1R113	322–3068–00			RES,FXD,FILM:49.9 OHM,1%,0.2W,TC=T0MI,SMALL	91637	CCF501G49R90F
A1R114	322–3268–00			RES,FXD,FILM:6.04K OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G60400F

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A1R130	308–0767–00			RES,FXD:1.1 OHM,5%,1W	75042	SP–20–1.1 OHM –
A1R132	322–3289–00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R150	322–3361–00			RES,FXD,FILM:56.2K OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50–2F56201F
A1R151	322–3204–00			RES,FXD,FILM:1.3K OHM,1%,0.2W,TC=T0MI,SMALL	91637	CCF501G13000F
A1R152	322–3258–00			RES,FXD,FILM:4.75K OHM,1%,0.2W,TC=T0MI,SMALL BODY	56845	ORDER BY DESC
A1R153	322–3289–00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R154	322–3289–00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R155	322–3289–00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R156	322–3289–00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R157	322–3289–00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R158	322–3289–00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R159	322–3289–00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R160	322–3289–00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R170	322–3193–00			RES,FXD,FILM:1K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10000F
A1R171	322–3289–00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R172	322–3068–00			RES,FXD,FILM:49.9 OHM,1%,0.2W,TC=T0MI,SMALL	91637	CCF501G49R90F
A1R173	322–3258–00			RES,FXD,FILM:4.75K OHM,1%,0.2W,TC=T0MI,SMALL BODY	56845	ORDER BY DESC
A1R174	322–3258–00			RES,FXD,FILM:4.75K OHM,1%,0.2W,TC=T0MI,SMALL BODY	56845	ORDER BY DESC
A1R190	322–3068–00			RES,FXD,FILM:49.9 OHM,1%,0.2W,TC=T0MI,SMALL	91637	CCF501G49R90F
A1R191	322–3177–00			RES,FXD,FILM:681 OHM,1%,0.2W,TC=T0	91637	CCF50–2G681R0F
A1R192	322–3193–00			RES,FXD,FILM:1K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10000F
A1R193	322–3177–00			RES,FXD,FILM:681 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50–2G681R0F
A1R210	322–3068–00			RES,FXD,FILM:49.9 OHM,1%,0.2W,TC=T0MI,SMALL	91637	CCF501G49R90F
A1R211	322–3193–00			RES,FXD,FILM:1K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10000F
A1R212	322–3289–00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R213	322–3068–00			RES,FXD,FILM:49.9 OHM,1%,0.2W,TC=T0MI,SMALL	91637	CCF501G49R90F
A1R214	322–3068–00			RES,FXD,FILM:49.9 OHM,1%,0.2W,TC=T0MI,SMALL	91637	CCF501G49R90F

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A1R230	322−3114−00			RES,FXD,FILM:150 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50−2−G1500F
A1R231	322−3114−00			RES,FXD,FILM:150 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50−2−G1500F
A1R232	322−3114−00			RES,FXD,FILM:150 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50−2−G1500F
A1R233	322−3114−00			RES,FXD,FILM:150 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50−2−G1500F
A1R234	322−3114−00			RES,FXD,FILM:150 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50−2−G1500F
A1R235	322−3114−00			RES,FXD,FILM:150 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50−2−G1500F
A1R236	322−3114−00			RES,FXD,FILM:150 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50−2−G1500F
A1R237	322−3114−00			RES,FXD,FILM:150 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50−2−G1500F
A1R238	308−0847−00			RES,FXD,WW:0.62 OHM,5%,1W	91637	CPF−1−0R62JT1
A1R239	321−0510−00			RES,FXD,FILM:2.00M OHM,1%,0.125W,TC=T0	91637	CMF55116G20003F
A1R250	322−3222−00			RES,FXD,FILM:2K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G20000F
A1R251	322−3222−00			RES,FXD,FILM:2K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G20000F
A1R252	322−3289−00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R253	322−3289−00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R270	322−3289−00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R271	322−3258−00			RES,FXD,FILM:4.75K OHM,1%,0.2W,TC=T0MI,SMALL BODY	56845	ORDER BY DESC
A1R272	322−3068−00			RES,FXD,FILM:49.9 OHM,1%,0.2W,TC=T0MI,SMALL	91637	CCF501G49R90F
A1R273	322−3193−00			RES,FXD,FILM:1K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10000F
A1R274	308−0441−00			RES,FXD,WW:3 OHM,5%,3W	91637	CW2B−3R00J T/R
A1R275	322−3177−00			RES,FXD,FILM:681 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50−2G681R0F
A1R276	322−3361−00			RES,FXD,FILM:56.2K OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50−2F56201F
A1R290	322−3354−00			RES,FXD,FILM:47.5K OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G47501F
A1R291	322−3150−00			RES,FXD,FILM:357 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G357R0F
A1R292	322−3135−00			RES,FXD,FILM:249 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G249R0F
A1R293	322−3135−00			RES,FXD,FILM:249 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G249R0F
A1R294	322−3150−00			RES,FXD,FILM:357 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G357R0F

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1R295	322−3354−00			RES,FXD,FILM:47.5K OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G47501F
A1R296	322−3289−00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R297	322−3385−00			RES,FXD,FILM:100K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10002F
A1R298	322−3162−00			RES,FXD,FILM:475 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50G475R0F
A1R299	322−3123−00			RES,FXD,FILM:187 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G187R0F
A1R300	322−3193−00			RES,FXD,FILM:1K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10000F
A1R301	322−3289−00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R302	322−3354−00			RES,FXD,FILM:47.5K OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G47501F
A1R310	131−0566−00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225L	24546	OMA 07
A1R330	131−0566−00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225L	24546	OMA 07
A1R331	322−3289−00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R332	322−3193−00			RES,FXD,FILM:1K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10000F
A1R333	322−3193−00			RES,FXD,FILM:1K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10000F
A1R334	322−3193−00			RES,FXD,FILM:1K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10000F
A1R335	322−3193−00			RES,FXD,FILM:1K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10000F
A1R336	322−3193−00			RES,FXD,FILM:1K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10000F
A1R337	322−3177−00			RES,FXD,FILM:681 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50−2G681R0F
A1R350	322−3258−00			RES,FXD,FILM:4.75K OHM,1%,0.2W,TC=T0MI,SMALL BODY	56845	ORDER BY DESC
A1R351	322−3222−00			RES,FXD,FILM:2K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G20000F
A1R352	322−3289−00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R353	322−3289−00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R354	322−3289−00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R355	322−3289−00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R356	322−3258−00			RES,FXD,FILM:4.75K OHM,1%,0.2W,TC=T0MI,SMALL BODY	56845	ORDER BY DESC
A1R357	322−3306−00			RES,FXD,FILM:15K OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50−2−G1502F

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1R358	322−3289−00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R359	322−3289−00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R360	322−3222−00			RES,FXD,FILM:2K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G20000F
A1R361	322−3481−00			RES,FXD,FILM:1M OHM.1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G10003F
A1R362	322−3481−00			RES,FXD,FILM:1M OHM.1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G10003F
A1R363	322−3481−00			RES,FXD,FILM:1M OHM,1%,0.2W,TC=T0	80009	322348100
A1R364	322−3258−00			RES,FXD,FILM:4.75K OHM,1%,0.2W,TC=T0MI,SMALL BODY	56845	ORDER BY DESC
A1R365	322−3289−00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R366	322−3289−00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R367	322−3222−00			RES,FXD,FILM:2K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G20000F
A1R370	322−3150−00			RES,FXD,FILM:357 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G357R0F
A1R371	322−3306−00			RES,FXD,FILM:15K OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50−2−G1502F
A1R372	322−3354−00			RES,FXD,FILM:47.5K OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G47501F
A1R373	322−3289−00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R374	322−3289−00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R375	322−3354−00			RES,FXD,FILM:47.5K OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G47501F
A1R376	322−3385−00			RES,FXD,FILM:100K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10002F
A1R377	322−3123−00			RES,FXD,FILM:187 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G187R0F
A1R378	322−3001−00			RES,FXD,FILM:10 OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10R00F
A1R379	308−0441−00			RES,FXD,WW:3 OHM,5%,3W	91637	CW2B−3R00J T/R
A1R380	322−3193−00			RES,FXD,FILM:1K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10000F
A1R381	322−3260−00			RES,FXD,FILM:4.99K OHM,1%,0.2W,TC=T0	91637	CCF501G49900F
A1R384	322−3001−00			RES,FXD,FILM:10 OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10R00F
A1R390	322−3177−00			RES,FXD,FILM:681 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50−2G681R0F
A1R391	322−3177−00			RES,FXD,FILM:681 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50−2G681R0F

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1R392	322-3354-00			RES,FXD,FILM:47.5K OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G47501F
A1R393	322-3193-00			RES,FXD,FILM:1K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10000F
A1R394	322-3162-00			RES,FXD,FILM:475 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50G475R0F
A1R395	322-3289-00			RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF50G10001F
A1R396	322-3354-00			RES,FXD,FILM:47.5K OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G47501F
A1R397	322-3162-00			RES,FXD,FILM:475 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50G475R0F
A1R398	322-3001-00			RES,FXD,FILM:10 OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10R00F
A1R399	322-3001-00			RES,FXD,FILM:10 OHM,1%,0.2W,TC=T0,SMALL BODY	91637	CCF501G10R00F
A1R400	322-3068-00			RES,FXD,FILM:49.9 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G49R90F
A1TP230	131-0608-00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283-036
A1TP231	131-0608-00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283-036
A1TP232	131-0608-00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283-036
A1TP233	131-0608-00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283-036
A1TP250	131-0608-00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283-036
A1TP330	131-0608-00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283-036
A1TP331	131-0608-00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283-036
A1TP332	131-0608-00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283-036
A1TP333	131-0608-00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283-036
A1TP334	131-0608-00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283-036
A1TP335	131-0608-00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283-036

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1TP390	131–0608–00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283–036
A1TP391	131–0608–00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283–036
A1TP392	131–0608–00			TERMINAL,PIN:PRESSFIT/PCB,;MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/ FERRULE	22526	48283–036
A1U110	156–4124–00			MICROCKT,LINEAR:VOLTAGE REGULATOR,DUAL TRACKING,ADJUSTABNLE 8 TO 20V,MC1468,DIP14	04713	MC1468L
A1U130	156–0846–00			IC,LINEAR:BIPOLAR,VOLTAGE REGULATOR;NEGATIVE,–5.0V,1.0A,4.0%	01295	UA7905CKC
A1U131	156–2698–00			IC,LINEAR:BIPOLAR,VOLTAGE REGULATOR;POSITIVE,5.0V,1.0A,2%	04713	MC7805ACT
A1U132	156–0466–00			IC,DIGITAL:LSTTL,GATES;QUAD 2–INPUT NAND BUFFER, OC	01295	SN74LS37N
A1U133	156–2755–00			IC,DIGITAL:CMOS,DUAL RS–232 LINE DRIVER/ RECEIVER,+5V VCC,NO EXT CAP,MAX233,DIP20.3	1ES66	MAX233CPP (C701
A1U150	156–2698–00			IC,LINEAR:BIPOLAR,VOLTAGE REGULATOR;POSITIVE,5.0V,1.0A,2%	04713	MC7805ACT
A1U151	156–3547–00			IC,MISC:CMOS,PWR SUPPLY SUPERVISOR;MPU RESET GEN,WATCHDOG TIMER,BATTERY BACKUP,UV DETECT	1ES66	MAX690CPA
A1U152	160–8824–01			IC,DIGITAL:16K EPROM,PRGM 87C654	TK2172	160–8224–01
A1U170	156–1200–00			IC,LINEAR:BIFET,OP–AMP;QUAD	01295	TL074CN
A1U171	165–2456–00			MICROCKT,HYBRID:AMPLIFIER BASED ON THE M377	80009	165245600
A1U230	156–2357–00			IC,DIGITAL:HCTCMOS,FLIP FLOP;OCTAL D–TYPE, NONINV, 3–STATE	01295	SN74HCT574N
A1U231	150–1254–00			LT EMITTING DIO:GREEN,566NM,90MA,HDSP–7801,COMMON ANODE	50434	HDSP–7801, OPTI
A1U250	156–4153–00			IC,MEMORY:CMOS,EPROM,256 X 8,I2C BUS,PCF8582EP,DIP08	18324	PCF8582EP
A1U251	156–3886–00			IC,MEMORY:CMOS,SRAMS,256 X 8,I2C BUS,PCF8570,DIP08	25403	PCF8570P
A1U252	156–4122–00			MICROCKT,DGTL:CMOS,8 BIT I/O EXPANDER FOR I2C BUS,PFC8574,DIP16	18324	PCF8574P
A1U270	156–2710–00			MICROCKT,DGTL:RELAY DRIVER,8 BIT,SERIAL INPUT W/LATCHES,SOURCE OUTPUTS	0CVK3	UCN–5895A–2
A1U290	156–1529–00			IC,LINEAR:BIPOLAR,VOLTAGE REGULATOR;POSITIVE,ADJUSTABLE,100MA,5%	04713	LM317LZ
A1U291	156–2223–00			IC,LINEAR:BIPOLAR,VOLTAGE REGULATOR;NEGATIVE,ADJUSTABLE,100MA,4%	27014	LM337LZ
A1U292	156–3781–00			MICROCKT,LINEAR:BIFET,OPNL AMPL	04713	MC34081AP
A1U350	156–3905–00			IC,CONVERTER:CMOS,A/D CONVERTER;12 BIT,13 US,LTC1290,DIP20	64155	LTC1290 (DCN OR

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1U351	156–3019–00			IC,LINEAR:BIPOLAR,VOLTAGE REFERENCE;1.235V, 1.0%,150PPM,SHUNT,MICROPOWER	27014	LM385BZ–1.2
A1U352	156–1200–00			IC,LINEAR:BIFET,OP–AMP;QUAD	01295	TL074CN
A1U353	156–1200–00			IC,LINEAR:BIFET,OP–AMP;QUAD	01295	TL074CN
A1U370	156–4120–00			IC,CONVERTER:CMOS,D/A,8–BIT,DAC–8800,DIP20	80009	156412000
A1U371	156–3781–00			MICROCKT,LINEAR:BIFET,OPNL AMPL	04713	MC34081AP
A1VR110	152–0680–00			DIODE,ZENER:,;19.3V,1%,0.4W	04713	SZG266
A1VR111	152–0680–00			DIODE,ZENER:,;19.3V,1%,0.4W	04713	SZG266
A1VR271	152–0306–00			SEMICOND DVC,DI:ZEN,SI,9.1V,5%,0.4W,DO–71N 960B,MI	04713	1N960BRL
A1XJ110	136–0252–07			SOCKET,PIN TERM:SINGLE,PCB,T/G,0.030 H,0.054 PCB,0.012–0.22 PIN SIZE,W/O DIMPLE,25000/REEL	22526	75060–012
A1XJ171	136–0252–07			SOCKET,PIN TERM:SINGLE,PCB,T/G,0.030 H,0.054 PCB,0.012–0.22 PIN SIZE,W/O DIMPLE,25000/REEL	22526	75060–012
A1XU152	136–0757–00			SOCKET,DIP:PCB,;FEMALE,STR,2 X 20,40 POS, 0.1 X 0.6 CTR,0.175 H X 0.130 TAIL,BECU,TIN, ACCOM 0.008–0.015 X 0.014–0.022 IC	09922	DILB40P–108
A1XU250	136–0727–00			SOCKET,DIP:PCB,;FEMALE,STR,2 X 4,8 POS,0.1 X 0.3 CTR,0.175 H X 0.130 TAIL,BECU,TIN	09922	DILB8P–108
A1Y250	119–2395–00			RESONATOR,CER:12.0 MHZ, 0.5%,CMOS,PKG 0.4X	51406	CSA 12.00 MT13
A2	671–2043–00			CIRCUIT BD ASSY:FRONT PANEL	80009	671204300
A2C100	283–0028–00			CAP,FXD,CER DI:0.0022UF,20%,50V	59660	0805 585 Y5SO 2
A2C101	281–0775–00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C102	290–1076–00			CAP,FXD,ELCTLT:47UF,20%,10WVDC	55680	TVX1A470MAA1LS
A2DS100	150–1171–00			LT EMITTING DIO:RED	50434	HLMP–1302–002
A2DS101	150–1171–00			LT EMITTING DIO:RED	50434	HLMP–1302–002
A2DS102	150–1163–00			LT EMITTING DIO:GREEN	50434	HLMP–1540 OPT 0
A2DS103	150–1163–00			LT EMITTING DIO:GREEN	50434	HLMP–1540 OPT 0
A2J170	131–3908–00			CONN,HDR:PCB,;MALE,STR,2 X 8,0.1 CTR,0.235 MLG X 0.112 TAIL,30 GOLD	53387	2416–6122TB
A2Q100	151–0190–00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,200MA, 300MHZ,AMPLIFIER	04713	2N3904
A2Q101	151–0190–00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,200MA, 300MHZ,AMPLIFIER	04713	2N3904
A2S100	260–2503–00			SWITCH,PUSH:SPST,SUBMINATURE,W/LED,RED	TK1111	TR2–21–L2
A2S101	260–2503–00			SWITCH,PUSH:SPST,SUBMINATURE,W/LED,RED	TK1111	TR2–21–L2
A2S102	260–2503–00			SWITCH,PUSH:SPST,SUBMINATURE,W/LED,RED	TK1111	TR2–21–L2
A2S103	260–2503–00			SWITCH,PUSH:SPST,SUBMINATURE,W/LED,RED	TK1111	TR2–21–L2
A2S104	260–2503–00			SWITCH,PUSH:SPST,SUBMINATURE,W/LED,RED	TK1111	TR2–21–L2
A2S105	260–2524–00			SWITCH,ROTARY:CONTACTING ENCODER	TK1111	MRP–1–20
A2S106	260–2524–00			SWITCH,ROTARY:CONTACTING ENCODER	TK1111	MRP–1–20
A2S11	260–2503–00			SWITCH,PUSH:SPST,SUBMINATURE,W/LED,RED	TK1111	TR2–21–L2

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A2U100	150−1254−00			LT EMITTING DIO:GREEN,566NM,90MA,HDSP−7801,COMMON ANODE	50434	HDSP−7801, OPTI
A2U101	150−1254−00			LT EMITTING DIO:GREEN,566NM,90MA,HDSP−7801,COMMON ANODE	50434	HDSP−7801, OPTI
A2U102	156−4121−00			MICROCKT,DGTL:CMOS,4 DIGIT LED−DRIVER WITH I2C BUS INTERFACE,SAA1064,DIP24	18324	SAA1064PN
A2XU100	136−1094−00			SKT,PL−IN ELEK:DIP,PCB,STR,10 POS,2 X 5,0.2	51167	10−2511−10
A2XU101	136−1094−00			SKT,PL−IN ELEK:DIP,PCB,STR,10 POS,2 X 5,0.2	51167	10−2511−10
J400	131−5282−00			CONN,CIRC JACK:SLDRCUP/PNL,;FEMALE,STR,12 POS,0.437 MLG X 0.610 TAIL,0.235 L SLDR CUP, BAYONET CPLG,GOLD/NICKEL,W/GRD SPRING	80009	131528200
P391	259−0089−00			FLEX CIRCUIT:	80009	259008900

Diagrams and Circuit Board Illustrations

This section contains the block diagrams, circuit board illustrations, component locator tables, and schematic diagrams for the AM 503A.

Symbols

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975. Abbreviations are based on ANSI Y1.1-1972.

Logic symbology is based on ANSI/IEEE Standard 91-1984 in terms of positive logic. Logic symbols depict the logic function performed and can differ from the manufacturer's data.

The tilde (~) preceding a signal name indicates that the signal performs its intended function when in the low state.

Other standards used in the preparation of diagrams by Tektronix, Inc., include the following:

- Tektronix Standard 062-2476 Symbols and Practices for Schematic Drafting
- ANSI Y14.159-1971 Interconnection Diagrams
- ANSI Y32.16-1975 Reference Designations for Electronic Equipment
- MIL-HDBK-63038-1A Military Standard Technical Manual Writing Handbook

Component Values

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors: Values one or greater are in picofarads (pF).
Values less than one are in microfarads (µF).

Resistors: Values are in Ohms (Ω).

Graphic Items and Special Symbols Used in This Manual

Each assembly in the instrument is assigned an assembly identifier (for example, MAIN or A3). The assembly identifier appears on the circuit board outline on the diagram, in the title for the circuit board component location illustration, and in the lookup table for the schematic diagram and corresponding component locator illustration. The Replaceable Electrical Parts list is arranged by assembly in numerical sequence; the components are listed by component number.

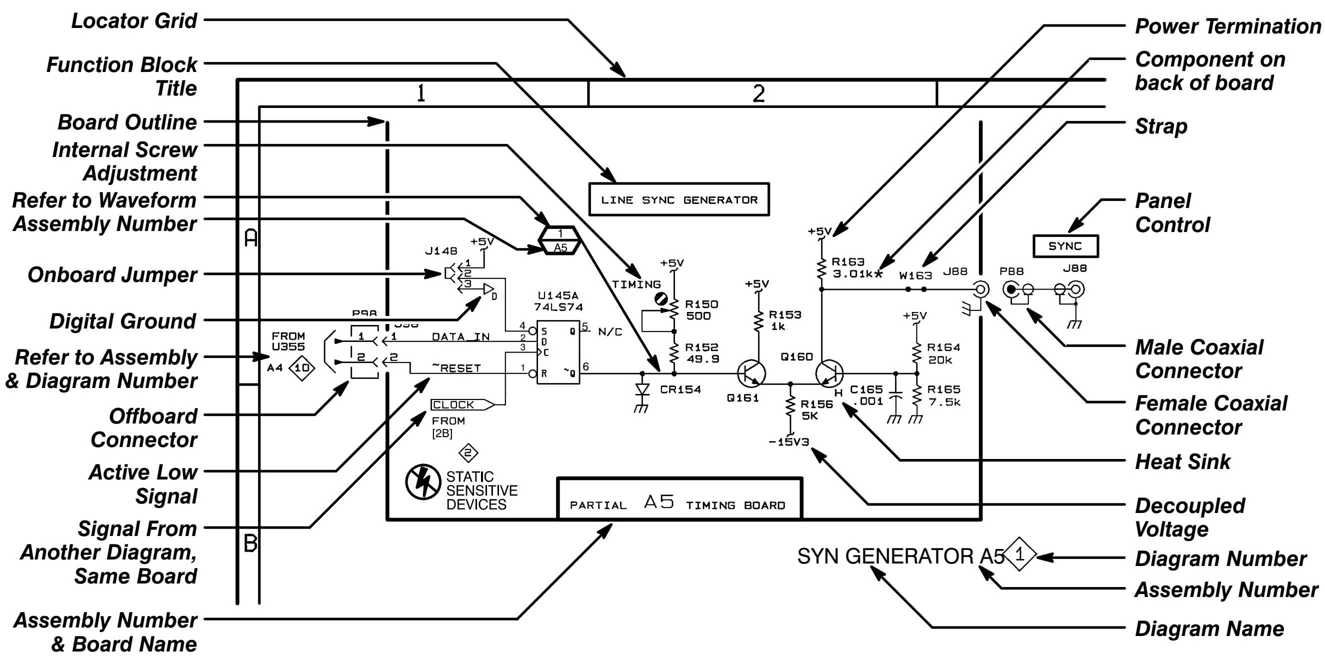

Figure 9-1: Graphic Items and Special Symbols Used in This Manual

Component Locator Diagrams

The schematic diagram and circuit board component location illustrations have grids marked on them. The component lookup tables refer to these grids to help you locate a component. The circuit board illustration appears only once; its lookup table lists the diagram number of all diagrams on which the circuitry appears.

Signal Glossary

The signal glossary defines the signals listed on the schematics in *Diagrams*. For more information regarding how these signals affect circuit operation, read *Theory of Operation*.

+5D_PFI
This is the reference line for the power fail interrupt circuit. Its source is the input to the +5D regulator.

A/D_CLK
The microcontroller generates A/D_CLK for the analog-to-digital converter. The analog-to-digital converter uses this clock for internal conversion circuits.

AM503A_DC_LEVEL
AM503A_DC_LEVEL is an analog signal that sets the DC offset of the output amplifier to the value specified by the DC LEVEL control on the front panel. This signal is generated by the digital-to-analog converter.

ATTEN_INPUT
This is the output of the current transformer (coil) of the probe. It is connected to the input of the attenuator circuit.

B0, B1, B2
These bits control the bandwidth of the output amplifier. The microcontroller sets these bits according to the front panel bandwidth selection or selected test routine.

BTRY_VOLTAGE
This is the voltage from the backup battery.

CS
The microcontroller toggles CS (chip select) low to initiate a data transfer to the analog-to-digital converter.

C_VOLT
This is a DC bias voltage used to establish comparator threshold voltages.

DATA_IN
This is the serial data path that the microcontroller uses to configure the analog-to-digital converter.

DATA_OUT
The analog-to-digital converter outputs conversion data to the microcontroller on the DATA_OUT line.

DEGAUSS_SIG
The digital-to-analog converter generates a decaying sine wave signal, DEGAUSS_SIG, that is used to degauss the probe. Degaussing removes residual magnetism from the current probe core.

DEGAUSS_SIG_ENBL
DEGAUSS_SIG_ENBL controls a FET switch that connects and disconnects the degauss signal from the power amplifier.

FEEDBACK_LOOP
FEEDBACK_LOOP is a signal supplied by the attenuator circuit to help maintain measurement flatness (accuracy) when measuring currents at the crossover frequency of the probe. This signal is applied to the input of the power amplifier.

GO – G2
These bits incrementally control the gain of the output amplifier. The microcontroller sets these bits according to the current/division setting on the front panel.

HALL_PREAMP_DC_OFS
During the probe degauss/autobalance routine, this signal eliminates unwanted DC offsets in the Hall preamplifier circuit.

HALL_PREAMP_DISC
HALL_PREAMP_DISC controls a FET switch that connects or disconnects the Hall preamplifier output from the power amplifier input. During normal operation, the microcontroller sets HALL_PREAMP_DISC low so that the Hall preamplifier output is connected to the input of the power amplifier. During the probe degauss/autobalance routine, the microcontroller sets HALL_PREAMP_DISC high so that the degauss signal may be applied to the power amplifier.

IN_V_DETECT
This is an output line of the power amplifier. During the probe degauss/autobalance routine, the analog-to-digital converter monitors IN_V_DETECT voltage (V_{in}) while the DC gain is being set.

MFG_DATA_IN
This port is used by Tektronix for test purposes only.

MFG_DATA_OUT
This port is used by Tektronix for test purposes only.

MFG_READY_OUT
This port is used by Tektronix for test purposes only.

OUT_AMP_DC_OFS
The digital-to-analog converter generates an analog signal, OUT_AMP_DC_OFS, to compensate for any unwanted DC offsets in the output amplifier during the probe degauss/autobalance routine.

OUT_AMP_ENBL
When this signal is high, the output amplifier is enabled. During normal operation, the microcontroller sets OUT_AMP_ENBL high. During the probe degauss/autobalance routine, the microcontroller sets OUT_AMP_ENBL low.

OUT_AMP_GAIN_ADJ
The OUT_AMP_GAIN_ADJ signal, an analog signal, provides continuous adjustment of the output amplifier gain whereas bits G0 through G2 provide incremental adjustment of the gain.

OUT_V_DETECT
This is an output of the output amplifier. During the probe degauss/auto-balance routine, the analog-to-digital converter monitors OUT_V_DETECT for unwanted DC offsets in the output amplifier circuit and causes a compensation voltage, OUT_AMP_DC_OFS to be generated.

OVLD_DETECT
This signal detects clipping and overload conditions of the power amplifier. The OVLD_DETECT line runs from the power amplifier output to the analog-to-digital converter input.

PROBE_ID
This is the probe identification line. It uses resistance coding to determine which type of current probe is connected to the AM 503A amplifier. The PROBE_ID line is connected to the analog-to-digital converter input.

PROBE_OPEN
The microcontroller monitors PROBE_OPEN to determine whether the slider of the current probe is in the locked or open position. When the probe slider is open, PROBE_OPEN is tied to ground. When the probe slider is locked, PROBE_OPEN goes high.

PWR_AMP_DC_OFS
The PWR_AMP_DC_OFS signal, an analog signal, nulls any DC offsets in the power amplifier circuit prior to degaussing. The digital-to-analog converter passes PWR_AMP_DC_OFS to the inverting input of the power amplifier.

RLY_OE
When the microcontroller sets RLY_OE low, the relay controller outputs control signals to the attenuator.

RLY_SCLK
This microcontroller-generated clock shifts data into register U270 on the rising-edge of the clock pulse.

RLY_SDATA_IN
This line outputs serial data from the microcontroller to shift register U270.

RLY_SDATA_OUT
This line returns serial data from shift register U270 to the microcontroller. The microcontroller uses the data to verify successful data transfers.

RLY_STROBE
The microcontroller strobes RLY_STROBE high to latch serial data into shift register U270.

SERIAL_DATA
This line transfers serial data from the microcontroller to the digital-to-analog converter.

SHIFT_CLK
The rising edge of this clock shifts serial data from the microcontroller to the analog-to-digital converter.

VCS_CLK
The rising edge of this clock shifts serial data from the microcontroller to the digital-to-analog converter).

VCS_LOAD
The microcontroller strobes VCS_LOAD low to load serial data into the registers of the digital-to-analog converter.

Insert folded diagrams here.

Replaceable Mechanical Parts

This section contains a list of the components that are replaceable for the AM 503A Current Probe Amplifier As described below, use this list to identify and order replacement parts. There is a separate Replaceable Parts List for each instrument.

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.

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 all the information you need for ordering replacement parts.

Item Names

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

Indentation System

This parts list is indented to show the relationship between items. The following example is of the indentation system used in the Description column:

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
(END ATTACHING PARTS)
    Detail Part of Assembly and/or Component
    Attaching parts for Detail Part
(END ATTACHING PARTS)
        Parts of Detail Part
        Attaching parts for Parts of Detail Part
(END ATTACHING PARTS)

Attaching parts always appear 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
TK1326	NORTHWEST FOURSLIDE INC	18224 SW 100TH CT	TUALATIN OR 97062
TK2338	ACC MATERIALS	ED SNYDER BLDG 38–302	BEAVERTON OR 97077
TK2469	UNITREK CORPORATION	3000 LEWIS & CLARK WAY SUITE #2	VANCOUVER WA 98601
0JR05	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER WA 98661–2999
0J260	COMTEK MANUFACTURING OF OREGON (METALS)	PO BOX 4200	BEAVERTON OR 97076–4200
0KBZ5	MORELLIS Q & D PLASTICS	1812 16TH AVE	FOREST GROVE OR 97116
0KB01	STAUFFER SUPPLY	810 SE SHERMAN	PORTLAND OR 97214
04713	MOTOROLA INC SEMICONDUCTOR PRODUCTS SECTOR	5005 E MCDOWELL RD	PHOENIX AZ 85008–4229
13103	THERMALLOY CO INC	2021 W VALLEY VIEW LN PO BOX 810839	DALLAS TX 75381
18203	ENGELMANN MICROWAVE DIV DIV OF KDI ELECTRONICS INC	60 S JEFFERSON RD	WHIPPANY NJ 07981–1001
24931	SPECIALTY CONNECTOR CO INC	2100 EARLYWOOD DR PO BOX 547	FRANKLIN IN 46131
55285	BERGQUIST CO INC THE	5300 EDINA INDUSTRIAL BLVD	MINNEAPOLIS MN 55435–3707
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076–9749
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
8X345	NORTHWEST SPRING & MFG CO	5858 WILLOW LANE	LAKE OSWEGO OR 97034–5343
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077–0001
83486	ELCO INDUSTRIES INC	1101 SAMUELSON RD	ROCKFORD IL 61101
93907	TEXTRON INC 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.
10–1–1	366–2166–00			2	KNOB:ABS,IVORY GRAY,0.165 ID X 0.40 OD X 0.4 H	80009	366216600
–2	386–6251–01			1	PANEL,FRONT:W/I.D. LABEL	80009	386625101
–3	131–1315–01			1	CONN,RF JACK:BNC/PNL,;50 OHM,FEMALE,STR,PELTOLA/REAR PNL,SILVER/BRIGHT ALLOY,0.576 MLGX 0.366 TERMN,0.375–32 THD,D–FLAT	24931	28JR306–1
–4	131–5282–00			1	CONN,CIRCJACK:SLDRCUP/PNL,;FEMALE,STR, 12 POS,0.437 MLG X 0.610 TAIL,0.235 L SLDR CUP,BAYONET CPLG,GOLD/NICKEL,W/GRD SPRING	80009	131528200
–5	259–0089–00			1	FLEX CIRCUIT:	80009	259008900
–6	366–0732–00			5	KNOB,KEYCAP:LIGHTED	0KBZ5	ORDER BY DESC
–7	175–5534–00			1	CABLE ASSY,RF:50 OHM COAX,6.25L, 9–2,PELTOLA X PELTOLA	80009	175553400
–8	174–2555–00			1	CA ASSY,SP,ELEC:16,28 AWG,FLAT GRAY W/RCPTW/O STRAIN RELIEF	TK2469	174–2555–00
–9	–––––––––			1	CKT BOARD ASSY:FRONT PANEL(SEE A2 REPL)		
–10	211–0391–00			4	SCREW,MACHINE:2–56 X 0.437,P4,STL CD PL TORX T–8	83486	ORDER BY DESC
–11	119–3685–00			1	HYPCON ASSY:144 CONTACT FLUSH MOUNTED1.22 C.M	TK2338	ORDER BY DESC
–12	426–0725–24			1	FR SECT,PLUG–IN:TOP	0J260	ORDER BY DESC
–13	211–0303–00			2	SCREW,MACHINE:4–40 X 0.25,FLH 100 DEG,STL	93907	ORDER BY DESC
–14	214–3406–00			1	SPRING,FLAT:1.48 L X 0.125 W,CU BE	TK1326	ORDER BY DESC
–15	352–1013–00			1	HOLDER,BATTERY:PLASTIC	80009	352101300
–16	210–0406–00			2	NUT,PLAIN,HEX:4–40 X 0.188,BRS CD PL	73743	12161–50
–17	210–1178–00			2	WASHER,SHLDR:U/W TO–220 TRANSISTOR	13103	7721–7PPS
–18	–––––––––			2	MICROCKT,LINEAR:(SEE A1U131,U150 REPL)		
–19	211–0303–00			2	SCREW,MACHINE:4–40 X 0.25,FLH 100 DEG,STL	93907	ORDER BY DESC
–20	342–0967–00			2	INSULATOR,PLATE:TRANSISTOR	80009	342096700
–21	213–1066–00			2	SCREW,TPG,TF:6–20 X 0.375,PNH,TYPE B, CDPL,STL,TORX T–15	0KB01	213–1066–00
–22	211–0303–00			1	SCREW,MACHINE:4–40 X 0.25,FLH 100 DEG,STL	93907	ORDER BY DESC
–23	–––––––––			1	IC,LINEAR:(SEE A1U130 REPL)		
–24	386–4866–00			1	SUPPORT,FRAME:REAR,AL	0J260	ORDER BY DESC
–25	213–0882–00			2	SCREW,TPG,TR:6–32 X 0.437 TAPTITE,PNH,STL	0KB01	ORDER BY DESC
–26	386–3657–01			2	SUPPORT,PLUG–IN:	83486	ORDER BY DESC
–27	210–0406–00			1	NUT,PLAIN,HEX:4–40 X 0.188,BRS CD PL	73743	12161–50
–28	–––––––––			1	CKT BOARD ASSY:MAIN(SEE A1 REPL)		
–29	214–3785–00			1	HEAT SINK,ELEC:ALUMINUM	80009	ORDER BY DESC
–30	407–4103–00			1	BRACKET,HT SK:ALUMINUM	80009	407410300
–31	211–0747–00			1	SCREW,MACHINE:6–32 X 0.188,PNH,STL	0KB01	ORDER BY DESC
–32	211–0485–00			1	SCREW,MACHINE:2–56 X 0.250 L,PAN HEAD(T7)TORX DRIVE	80009	211048500

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
–33	210–1156–00			1	WASHER,SHLDR:0.09 ID X 0.2 OD X 0.085 D,NYL	80009	210115600
–34	––––––––			1	TRANSISTOR:(SEE A1Q271 REPL)		
–35	342–0947–00			1	INSULATOR,PLATE:POLYMIDE FILM WITH ADHESIVE	55285	348–1180–00
–36	––––––––			1	TRANSISTOR:(SEE A1Q370 REPL)		
–37	210–1156–00			1	WASHER,SHLDR:0.09 ID X 0.2 OD X 0.085 D,NYL	80009	210115600
–38	211–0485–00			1	SCREW,MACHINE:2–56 X 0.250 L,PAN HEAD(T7)TORX DRIVE	80009	211048500
–39	337–3211–00			2	SHIELD,ELEC:SIDE ASSEMBLY	80009	337321100
–40	426–0724–30			1	FR SECT,PL–IN:BOTTOM	0J260	ORDER BY DESC
–41	210–1367–00			1	WASHER, FLAT:0.093 ID X 0.158 OD X 0.032,FBR	80009	210136700
–42	210–1367–00			1	WASHER, FLAT:0.093 ID X 0.158 OD X 0.032,FBR	80009	210136700
–43	211–0114–00			1	SCREW,MACHINE:4–40 X 0.438 L,FLH	80009	211–0114–00
–44	211–0303–00			1	SCREW,MACHINE:4–40 X 0.25,FLH 100 DEG,STL	93907	ORDER BY DESC
–45	214–3143–00			1	SPRING,HLEXT:0.125 OD X 0.545 L,XLOOP	8X345	ORDER BY DESC
–46	105–0866–00			1	LATCH,RETAINING:	0JR05	ORDER BY DESC
–47	105–0865–00			1	BAR,LATCH RLSE:	0JR05	ORDER BY DESC
–48	366–1851–01			1	KNOB,LATCH:IVORY GY,0.625 X 0.25 X 1.09	0JR05	ORDER BY DESC
–49	337–3775–00			1	SHIELD,ELEC:SUBPANEL,AL,ETCH & CHROMATE CVRSN COATING	80009	337377500
–50	210–0001–00			2	WASHER,LOCK:#2 INTL,0.013 THK,STL	78189	1202–00–00–0541
–51	220–0624–00			2	PUSH ON NUT:0.108 ID X 0.312 OD,CU BE	80009	220062400
–52	129–1404–00			2	SPACER,POST:0.375 L,2–56 INT & EXT THD, 0.187 HEX	80009	129140400
–53	210–0001–00			2	WASHER,LOCK:#2 INTL,0.013 THK,STL	78189	1202–00–00–0541
–54	220–0627–00			2	NUT,PLAIN,HEX:2–56 X 0.156 HEX,BRS NP	73743	10002–56–101
–55	211–0378–00			4	SCR,ASSEM WSHR:4–40 X 0.375.PNH,STL,CD PL TORX,T9	0KB01	ORDER BY DESC
–56	211–0378–00			2	SCR,ASSEM WSHR:4–40 X 0.375.PNH,STL,CD PL TORX,T9	0KB01	ORDER BY DESC

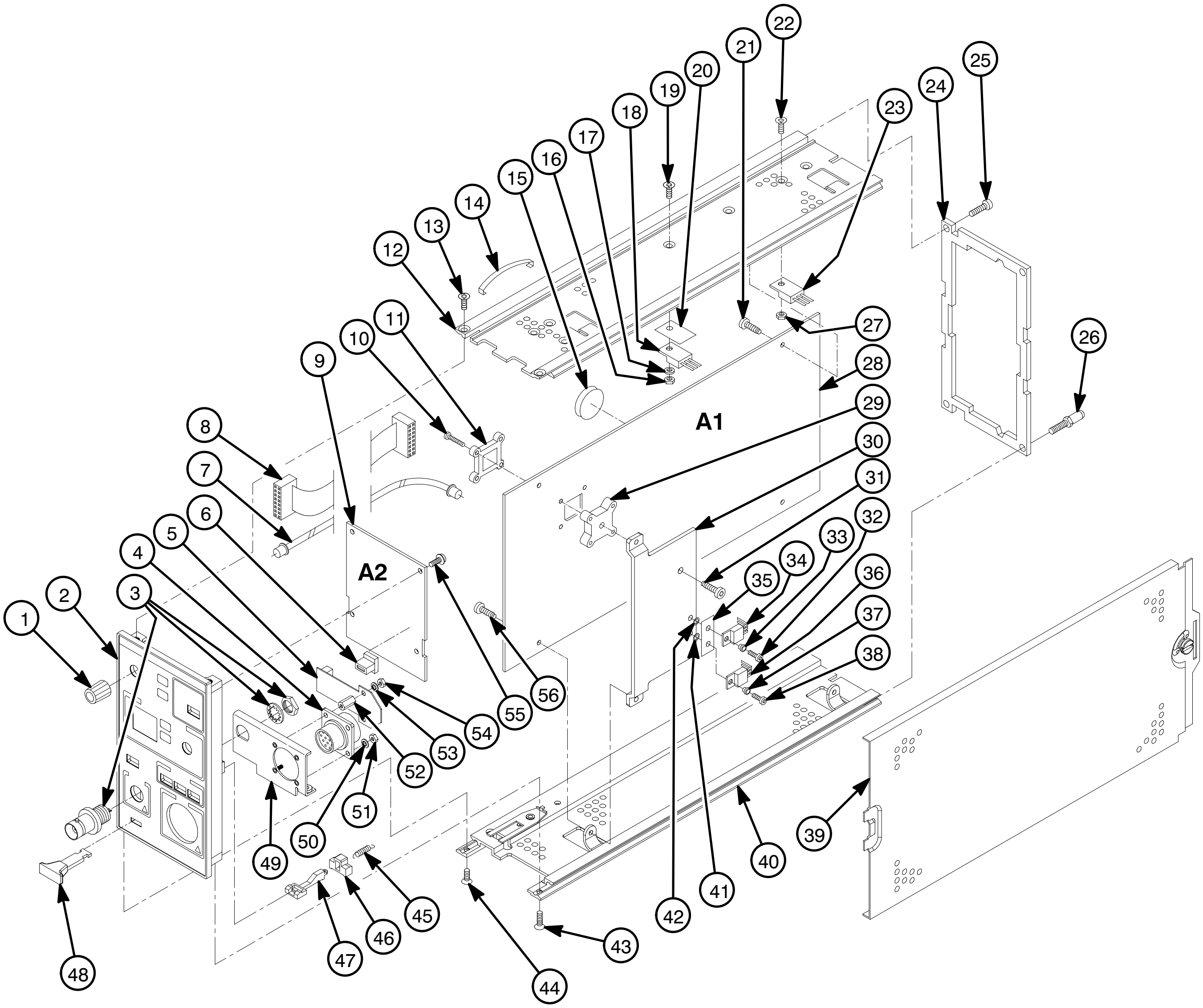

Figure 10-1: AM 503A Exploded View

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
10−2−					**STANDARD ACCESSORIES**		
−1	011−0049−01			1	TERMN,COAXIAL:50 OHM,2W,BNC	18203	T132DS
−2	012−0057−01			1	CABLE ASSY,RF:50 OHM COAX,43.0 L	80009	012005701
	070−8170−00			1	MANUAL,TECH:USER,AM503A	80009	070817000
	−−−−−−−−−			1	CARD,REFERENCE:		
	−−−−−−−−−			1	OPTION A1,EUROPEAN POWER CORD		
	−−−−−−−−−			1	OPTION A2,UNITED KINGDOM POWER CORD		
	−−−−−−−−−			1	OPTION A3,AUSTRALIAN POWER CORD		
	−−−−−−−−−			1	OPTION A4,NORTH AMERICAN POWER CORD		
	−−−−−−−−−			1	OPTION A5,SWISS POWER CORD		
					(SEE TM502A INSTRUCTION MANUAL)		
					OPTIONAL ACCESSORIES		
	015−0601−50			1	ADAPTER:1 TURN CURRENT LOOP,50 OHM	80009	015060150
	070−8174−01			1	MANUAL,TECH:SERVICE,AM503A	80009	070817401

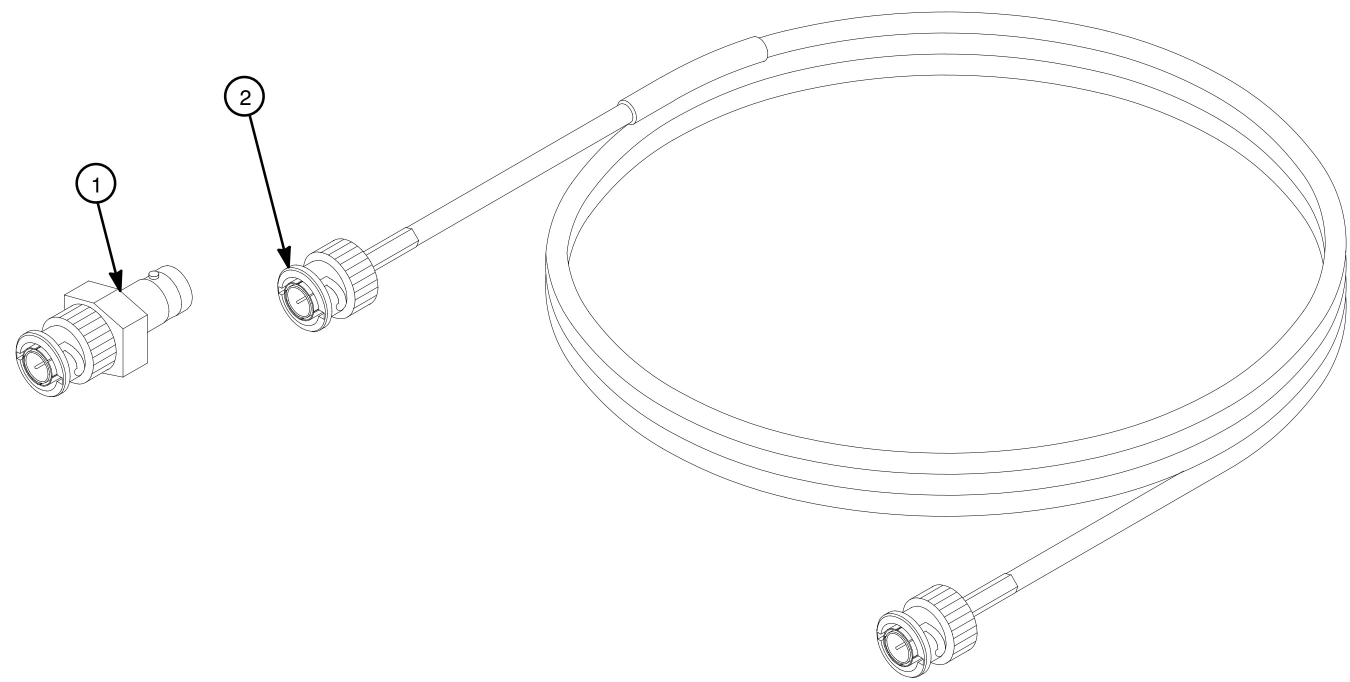

Figure 10-2: AM 503S Standard Accessories

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