Instructions

Tektronix

AM 503B, AM 5030 & A6300 Series 067-0271-00 Verification and Adjustment Kit

070-9352-01

This document applies to firmware version 3.0 and above.

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 all safety summaries prior to performing service.

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Tektronix, Inc., P.O. Box 1000, Wilsonville, OR 97070–1000

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of the system. Read the *General Safety Summary* in other system manuals for warnings and cautions related to operating the system.

Injury Precautions

Ground the Product

This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Do Not Operate Without Covers

To avoid electric shock or fire hazard, do not operate this product with covers or panels removed.

Do Not Operate in Wet/Damp Conditions

To avoid electric shock, do not operate this product in wet or damp conditions.

Do Not Operate in Explosive Atmosphere

To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.

Avoid Exposed Circuitry

To avoid injury, remove jewelry such as rings, watches, and other metallic objects. Do not touch exposed connections and components when power is present.

Product Damage Precautions

Use Proper Power Source

Do not operate this product from a power source that applies more than the voltage specified.

Use Proper Voltage Setting

Before applying power, ensure that the line selector is in the proper position for the power source being used.

Provide Proper Ventilation

To prevent product overheating, provide proper ventilation.

Do Not Operate With Suspected Failures

If you suspect there is damage to this product, have it inspected by qualified service personnel.

Safety Terms and Symbols

Terms in This Manual

These terms may appear in this manual:

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

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Terms on the Product

These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product

The following symbols may appear on the product:

DANGER High Voltage | Protective Ground (Earth) Terminal | ATTENTION Refer to Manual | Double Insulated

Certifications and Compliances

CSA Certified Power Cords

CSA Certification includes the products and power cords appropriate for use in the North America power network. All other power cords supplied are approved for the country of use.

Safety Certification of Plug-in Modules

For plug-in modules that are safety certified by Underwriters Laboratories, UL Listing applies only when the module is installed in a UL Listed product. CSA Certification applies only when the module is installed in a CSA Certified product.

Service Safety Summary

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

Do Not Service Alone

Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect Power

To avoid electric shock, disconnect the main power by means of the power cord or, if provided, the power switch.

Use Care When Servicing With Power On

Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

Kit Description

This kit includes parts and instructions for verifying and adjusting the AM 503B and AM 5030 Current Probe Amplifiers. The recommended calibration interval is one year.

These instructions assume a certain familiarity with the AM 503B and AM 5030 amplifiers. For servicing information, refer to the *AM 503B & AM 5030 Instruction Manual* (070-8766-XX).

Before you begin the AM 503B or AM 5030 amplifiers, assemble the test equipment required and determine if a full calibration is necessary. None of the components contained in this kit require calibration.

Kit Parts List

This kit includes the parts listed in Table 1.

Table 1: Kit Parts List

Tektronix Part Number	Quantity	Description
015-0598-00	1	Voltage adapter
015-0670-00	1	Feed-thru adapter
129-0425-00	2	Spacer, post: 0.9 L, 4-40 thru, 0.25 hex
174-2314-00	1	Ribbon cable
211-0408-00	6	Screw, assem wshr: 4-40 X 0.250, T-10 Torx
220-0729-00	1	Nut block: 4-40 X 0.188
679-2836-02	1	GPIB board
070-9352-XX	1	Calibration Kit Manual

Equipment Required

The installation procedure requires a T-10 Torx® screwdriver and a flat-blade screwdriver.

The performance verification and adjustment procedures require the test equipment listed in Table 2. The test equipment must meet or exceed the specifications listed. You may need to modify the test procedures if you do not use the recommended equipment.

Table 2: Required Test Equipment

Qty	Item	Description	Recommended Equipment
1	Oscilloscope	500 MHz bandwidth	TDS 520B
1	Leveled Sine Wave Generator	3 MHz to 100 MHz	Wavetek 9100 with Option 250 or SG 503 equivalent.
1	Digital Multimeter	0.20%, $3^1/_2$ digit resolution, range ±50 mV	DM2510/G or Fluke 850x/884x
1	Current Source	0.1%, 0 to ±1 A	Fluke 5700A or Wavetek 9100 with Option 250
1	Calibration Fixture	50 Ω, BNC Connector	015-0601-50
1	Termination	50 Ω, ±0.1%, 0.5 W	011-0129-00
2	BNC Cables	50 Ω, 1.05 m (42 in) long	012-0057-01
2	BNC to Dual Banana Adapters		103-0090-00
1	Feed-thru Fixture	supplied with kit	015-0670-00
1	Voltage Adapter	supplied with kit	015-0598-00
1	Current Probe[1]		A6302

[1] **Required for functional test only.**

AM 503B and AM 5030 Performance Verification

Refer to the list of equipment required in Table 2 on page 2. Set up the AM 503B or AM 5030 amplifiers as follows:

1. Plug the AM 503B or AM 5030 amplifier into the TM 5000 mainframe.
2. Power the amplifier on and let it warm up at least 20 minutes.

The procedures in this section verify that the AM 503B or AM 5030 amplifier meets the warranted specifications listed in Table 3.

Table 3: AM 503B and AM 5030 Warranted Specifications

Parameter	Characteristic
DC Gain Accuracy	≤ 1.5% after DC accuracy measurement and cal constant loading.
DC Balance	± 2 mV
RMS Noise	≤ 250 µA (2.5 mV)
Bandwidth	≥ 100 MHz

Test Procedure Conditions

These procedures are valid only under the following conditions:

- The system has been calibrated at an ambient temperature of 23° ±5° C.
- The system is operating in an environment whose limits are described in Table 4.

Table 4: AM 503B and AM 5030 Environmental Characteristics

Parameter	Characteristic
Ambient Temperature	
Operating	0° C to +50° C
Humidity	
Operating	50° C, to 95% R.H.

- The system, including probe, has had a warm-up period of at least 20 minutes.

DC Gain Accuracy

Use the following procedure to verify the DC gain accuracy of the amplifier.

Test Equipment Setup

Refer to Figure 1 and set up the test equipment as follows:

1. Connect the output of the amplifier to the DMM.

- **a.** Connect a BNC Cable from the AM 503B/AM 5030 **OUTPUT** to the 50 Ω feedthrough termination.
- **b.** Attach the termination to a BNC-to-dual banana adapter.
- **c.** Observe polarity and insert the dual banana adapter into the digital multimeter DC voltage input.

2. Connect the input to current source.

- **a.** Connect the other BNC cable from the Voltage Adapter to a BNC-to-dual banana adapter.
- **b.** Observe polarity and insert the dual banana adapter into the current source DC output. Do not connect the voltage adapter to the amplifier at this time.

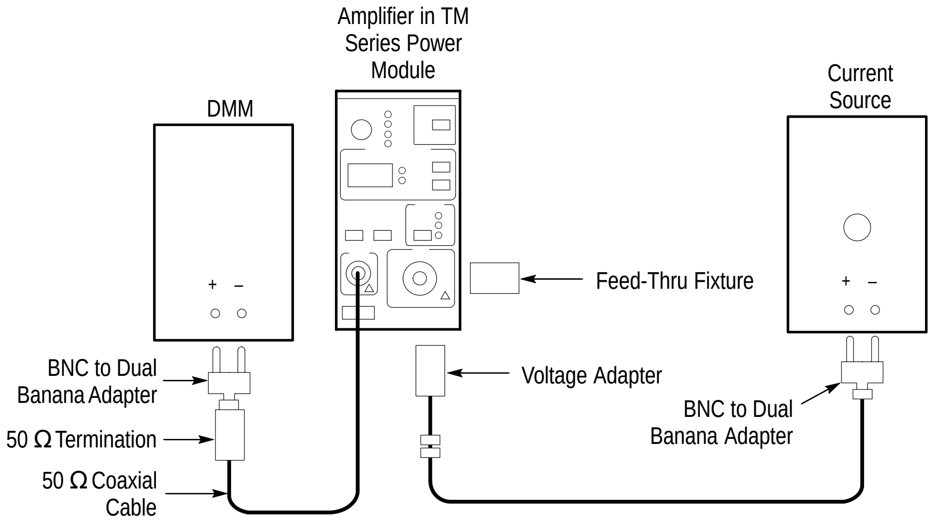

Figure 1: Test Equipment Setup

3. Make or verify the equipment settings in Table 5:

Table 5: Equipment Settings

Digital Multimeter	
Measurement Type	DC volts
Range	Autoranging
Current Source	
Output	Off
AM 503B and AM 5030 Amplifier	
Coupling	DC
BW Limit	On (20 MHz)
Current/division	10 mA/division
Probe Trim	000

Procedure

After the equipment is set up, proceed as follows:

1. Connect the feed-thru fixture (015-0670-00) to the INPUT of the AM 503B/ AM 5030 amplifier and press the **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.

2. Remove the feed-thru fixture from the INPUT of the amplifier and connect the Voltage Adapter (015-0598-00) to the INPUT of the amplifier. Do not press the **PROBE DEGAUSS AUTOBALANCE** button again even though the indicator is flashing.

3. For each of the current/division settings in Table 6, perform the following steps. Remember that any errors that develop here will affect the final DC gain accuracy calculations at the end.

- **a.** Set the Amplifier to the desired current/division setting from Table 6.
- **b.** Set the current source to the correct positive test current using Table 6.
- **c.** Turn on the current source.
- **d.** Record the exact measurement of the digital multimeter as M_1. (You can copy Table 7 on page 8 to record the results of your measurements.)
- **e.** Set the current source for the correct negative test current using Table 6.

Table 6: DC Gain Accuracy Calibration Test for the AM503X

AM 503B and AM 5030 Current/Division	Current Source Output	Test Current (I_t)
1 m A	±100 µA	10 mA
2 m A	±200 µA	20 mA
5 m A	±500 µA	50 mA
10 m A	±1 mA	100 mA
20 m A	±2 mA	200 mA
50 m A	±5 mA	500 mA
100 m A	±10 mA	1 A
200 m A	±20 mA	2 A
500 m A	±50 mA	5 A
1 A	±100 mA	10 A
2 A	±100 mA	10 A
5 A	±100 mA	10 A

f. Record the digital multimeter reading as M_2.

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

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

For example, you might have obtained values of 51.0 mV for M_1 and –53.0 mV for M_2. If you are using an Amplifier setting of 10 mA/division, you can compute I_m as:

$$I_m = \frac{(51.0x10^{-3}) - (-53.0x10^{-3})}{0.01} \times (10x10^{-3}) = 104\ mA$$

h. Calculate the %Error between the measured current (I_m) and the test current (I_t) *%Error* as follows:

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

For example, using a test current I_t of 100 mA and a measured current I_m of 104 mA, the *%Error* would be:

$$\%Error = \frac{104 - 100}{100} \times 100 = +4\%$$

***NOTE**. It is important that the correct polarity be used in order to calculate the % error*

4. Copy the work sheet in Table 7 and fill it in with required data. Calculate the values for each New Rin Cal Constant only if adjustment is required.

Table 7: Work Sheet for DC Gain Accuracy Calibration

AM 503B and AM 5030 Current/ Division	Current/Voltage Source Output	Test Current I_t	M_1	M_2	I_m (Note A)	*%Error* (Note B)	*Rin Name*	*Existing Cal Constant* (Note C)	*New Cal Constant* (Note D)
1 mA	±100 µA	10 mA							
2 mA	±200 µA	20 mA							
5 mA	±500 µA	50 mA							
10 mA	±1 mA	100 mA					Rin1X		
20 mA	±2 mA	200 mA							
50 mA	±5 mA	500 mA							
100 mA	±10 mA	1 A					Rin10X		
200 mA	±20 mA	2 A							
500 mA	±50 mA	5 A							
1 A	±100 mA	10 A					Rin100X		
2 A	±100 mA	10 A							
5 A	±100 mA	10 A							

Note A

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

Note B

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

Note C

Query amplifier for existing Rin1X, Rin10X, and Rin100X Cal Constants (CALC? 00, CALC? 01, and CALC? 02 respectively).

Note D

$$New\ Rin\ Cal\ Constant = \left(1 + \frac{\%Error}{100}\right) \times Existing\ Rin\ Cal\ constant$$

(Calculate this value only if adjustment is required.)

5. Verify that the measured DC gain accuracy is within ±1.5% at all settings.

***NOTE**. If the % Error on any of the settings is greater than ±1.5%, you must perform the Cal Constant loading sequence. Refer to the adjustment procedure that begins on page 19.*

DC Balance

This procedure checks the DC Balance Test of the AM 503B and AM 5030.

1. Connect a BNC cable from the AM 503B/AM 5030 amplifier **OUTPUT** to the 50 Ω feedthrough termination. Attach the termination to a BNC-to-dual banana adapter.

2. Taking care to observe and maintain polarity, insert the dual banana adapter into the digital multimeter DC voltage input. Refer to Figure 2.

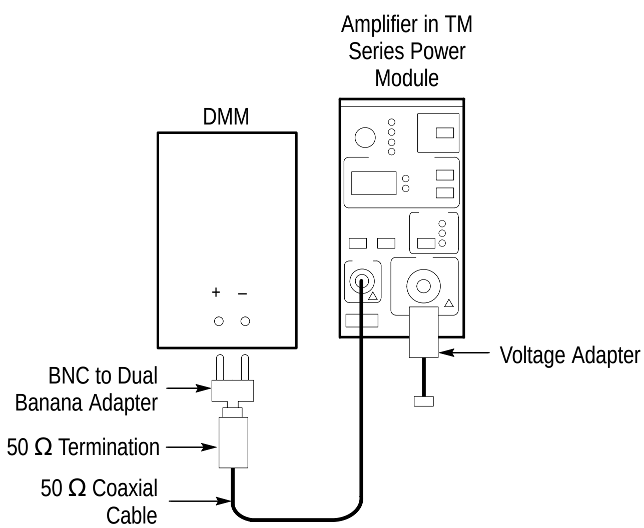

Figure 2: Setup for DC Balance

3. Connect the Voltage Adapter (015-0598-00) to the INPUT of the amplifier and disconnect the other end of the Voltage Adapter from ALL other sources. In other words, the BNC end of the Voltage adapter should not be connected up to any thing.

4. Make or verify the equipment settings in Table 8.

Table 8: Equipment Settings for DC Balance

Digital Multimeter	
Measurement Type	DC volts
Range	Autoranging
AM 503B and AM 5030 Amplifier	
Coupling	REF
BW Limit	On (20 MHz)
Current/division	1 mA/division

5. Press the **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.

6. For each of the Amplifier settings (AC, DC, 1 mA, 2 mA, 5 mA, 10 mA, 20 mA, 50 mA, 100 mA, 200 mA, 500 mA, 1 A, 2 A, 5 A), perform the following steps.

a. Set the amplifier to the desired setting from above.

b. Measure the exact DC voltage with the digital multimeter.

c. Verify that the measured DC voltage is less than ±2mV (0.2 divs).

RMS Noise

This procedure tests the RMS noise level of the AM 503B and AM 5030 Current Probe Amplifier. In this test you measure the RMS voltage of the amplifier output when the amplifier is set to the most sensitive setting and BW LIMIT is off. Refer to Figure 4 when making equipment connections.

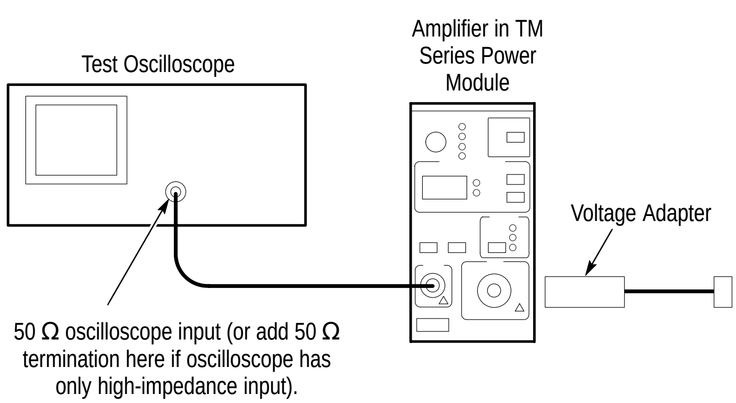

Figure 3: RMS Noise Test Setup for stand alone AM 503B/AM 5030

1. Using a 50 Ω BNC cable, connect the Amplifier **OUTPUT** to a 50 Ω oscilloscope input. If the input impedance of your oscilloscope is 1 MΩ, connect a 50 Ω feedthrough termination at the oscilloscope input. Do not connect the termination at the Amplifier output.
2. Connect the Voltage Adapter to the Amplifier **INPUT**.. The other end of the Voltage Adapter should not be connected to anything.
3. Make or verify the equipment settings in Table 9.

Table 9: Equipment Settings for RMS Noise Check

Oscilloscope	
Vertical input impedance	50 Ω
Vertical gain	10 mV/division
Time base	2 us/division
Record length	500
Coupling	DC
Offset	0 V (mid-scale)
Trigger type	Edge
Trigger mode	Auto
Trigger position	50%
Acquisition mode	Sample
Bandwidth	100 MHz
Measurement type	RMS
AM 503B and AM 5030	
Coupling	DC
BW Limit	Off (full bandwidth)
Current/division	1 mA/division

4. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.
5. Set the Oscilloscope couping to AC.
6. Using the RMS measurement capability of the oscilloscope, measure the RMS reading, and verify that it is less than 250 μA (2.5 mV).

Bandwidth

This procedure tests the bandwidth of the AM 503B and AM 5030. In this test you measure a signal at a relatively low frequency and again at the upper test frequency. The two measurements are compared to verify that the signal amplitude does not fall below a certain limit. Refer to Figure 4 when making equipment connections.

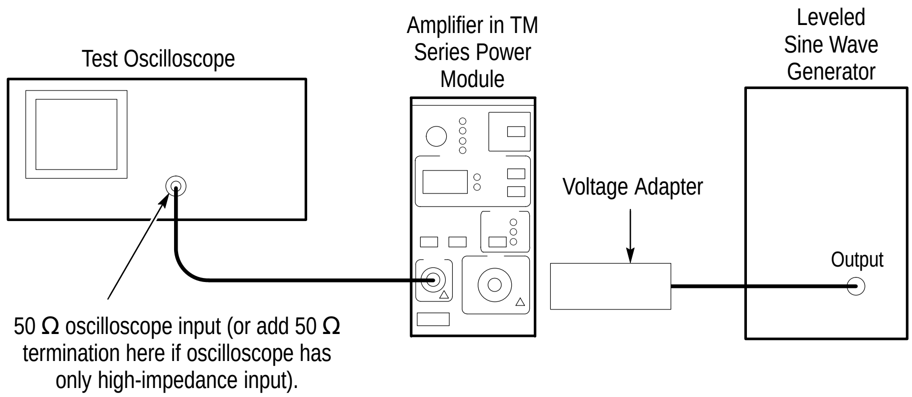

Figure 4: Bandwidth Test Setup

1. Using a 50 Ω BNC cable, connect the Amplifier **OUTPUT** to a 50 Ω oscilloscope input. If the input impedance of your oscilloscope is 1 MΩ, connect a 50 Ω feedthrough termination at the oscilloscope input. Do not connect the termination at the Amplifier output.
2. Connect the Voltage Adapter to the Amplifier **INPUT**.
3. Make or verify the equipment settings in Table 10:

Table 10: Equipment Settings for Bandwidth Check

Oscilloscope	
Vertical input impedance	50 Ω
Vertical gain	10 mV/division
Time base	100 ns/division
Record length	500
Coupling	DC
Offset	0 V (mid-scale)
Trigger type	Edge
Trigger mode	Auto
Trigger position	50%
Acquisition mode	Average

Table 10: Equipment Settings for Bandwidth Check (Cont.)

Oscilloscope	
Number of waveforms to average	16
Measurement type	Peak-to-Peak
Leveled Sine Wave Generator	
Frequency	3 MHz
Amplitude	3.0 V_{p-p}
AM 503B and AM 5030	
Coupling	DC
BW Limit	Off (full bandwidth)
Current/division	500 mA/division

4. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.

5. Connect the BNC cable from the output of the leveled sine wave generator to the BNC end of the Voltage Adapter.

6. Adjust the signal generator output so that the Amplifier output is approximately 60 mV_{p-p}, or six graticule divisions on the oscilloscope.

7. Using the peak-peak measurement capability of the oscilloscope, measure and record the peak-peak reading as M_1.

8. Set the oscilloscope time base to 5 ns/division. Increase the signal generator frequency to 100 MHz, the upper test frequency.

9. Using the peak-peak measurement capability of the oscilloscope, measure and record the peak-peak reading as M_2.

10. The system meets the bandwidth specification if the ratio of the signal amplitude at the warranted bandwidth is at least 70% of the signal amplitude at 3 MHz. Using the following calculation, verify system bandwidth:

$$\left(\frac{M_2}{M_1}\right) > 0.707$$

Degauss

This is only a functional test of the degauss operation. Refer to Figure 5.

1. Connect a current probe to the output of the AM 503B or AM 5030.
2. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the indicator light to turn off.
3. Verify that there are no error codes.

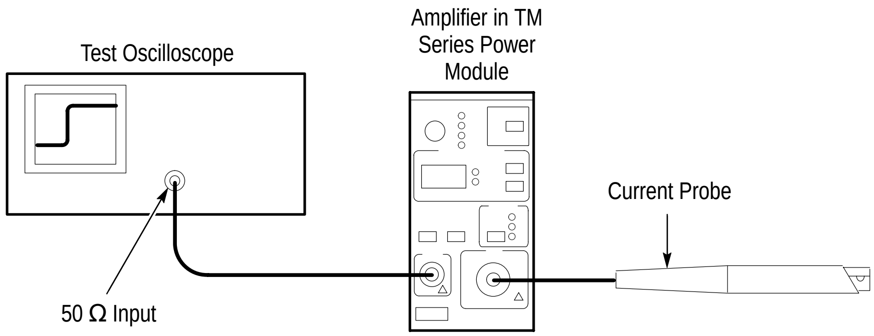

Figure 5: Setup for Degaussing the Current Probe

This completes the performance verification.

If the AM 503B or AM 5030 amplifier fails any of the verification tests, refer to the *AM 503B and AM 5030 Instruction Manual* for servicing information.

GPIB Installation

WARNING. *Instrument disassembly should only be performed by qualified service personnel.*

This section details how to assemble the GPIB test fixture and install it in the AM 503B Current Probe Amplifier prior to performing the adjustment procedure. The AM 503B amplifier requires the GPIB test fixture in order to set the internal calibration constants. After the adjustment procedure is complete, you must remove the test fixture.

The AM 5030 amplifier already contains a GPIB board. If you are calibrating an AM 5030 amplifier, disregard this section and proceed with the adjustment procedure on page 19.

CAUTION. *GPIB installation should only be performed by qualified service personnel.*

Assemble GPIB Test Fixture

Use the following procedure to assemble the GPIB test fixture. Once you assemble the fixture, you can use it to calibrate any number of AM 503B amplifiers.

1. Refer to Figure 6. Install the spacers (129-0425-00) onto the GPIB board with two screws (210-0408-00).
2. Install the ribbon cable (174-2314-00) onto the GPIB with the RED edge oriented as shown. (The tabbed end of the connector connects to the main board of the AM 503B amplifier.)
3. Install nut block (220-0729-00) onto the GPIB board with one screw (210-0408-00).

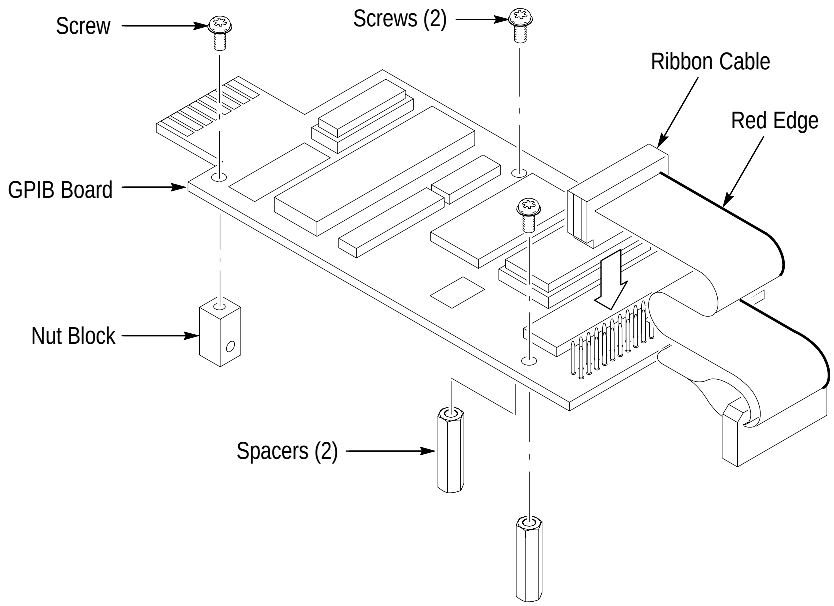

Figure 6: Assembling the GPIB Test Fixture

Remove Side Covers

Refer to Figure 7 and unlatch the securing screws with a flat-blade screwdriver. Remove both covers from the AM 503B and set them to one side.

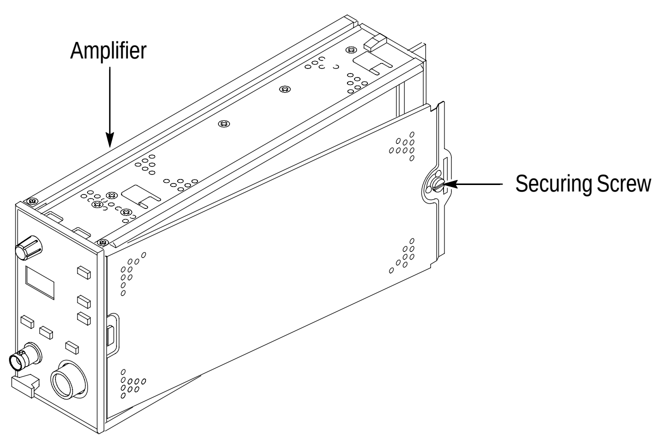

Figure 7: Removing the AM 503B Side Covers

Install GPIB Test Fixture

Refer to Figure 8 and install the GPIB test fixture on the AM 503B main board.

1. Install the tabbed end of the ribbon cable (174-2314-00) onto the main board keeping the RED edge towards rail.

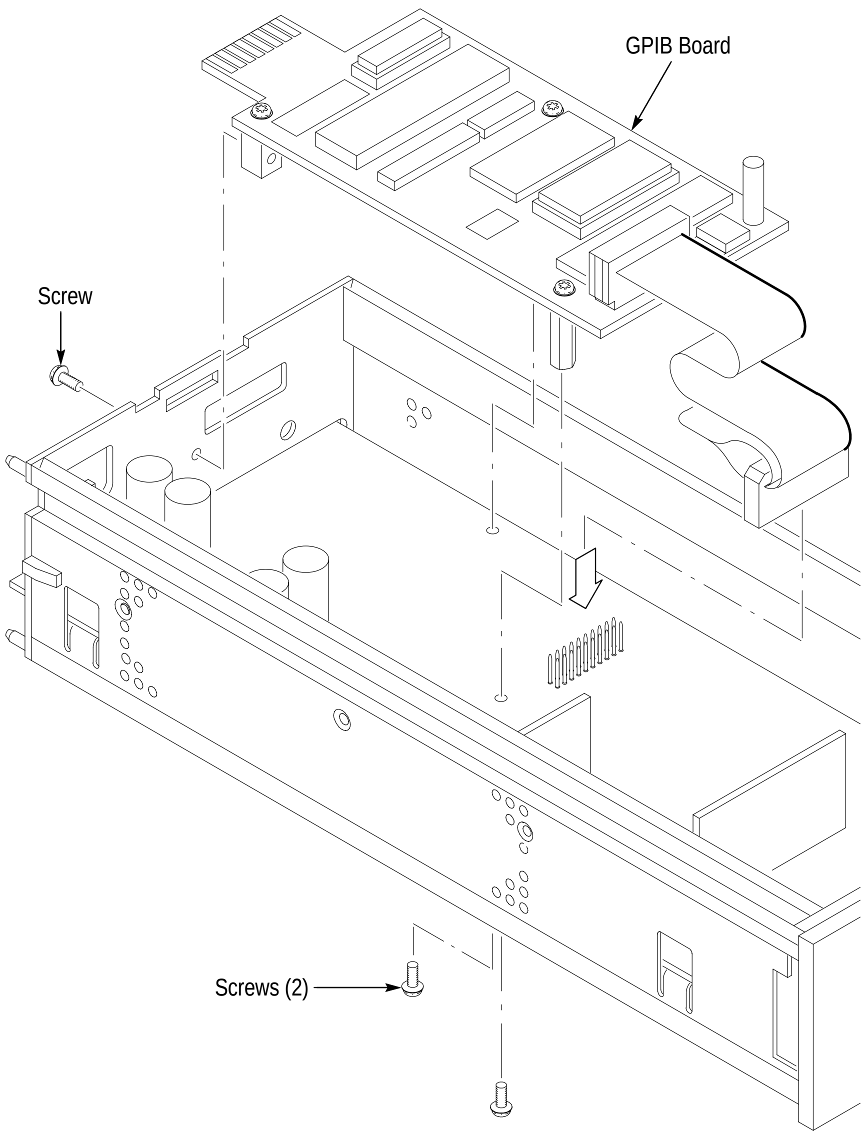

Figure 8: Installing the GPIB Test Fixture

CAUTION. *To avoid damaging the circuits, make sure the connectors are properly aligned with the pins. Check to be sure all pins are connected.*

2. Dress the excess ribbon cable back under the GPIB board and insert the end of the board with the gold contacts into the slot of the rear frame.

3. Align the spacers of the test fixture over the holes on the main circuit board.

  a. Install two screws (210-0408-00) through the main board to both spacers.

  b. Install one screw (210-0408-00) through the rear frame to the nut block on the GPIB board.

This completes the GPIB installation. Remove the GPIB test fixture and reinstall the side covers after the adjustment procedure is complete.

AM 503B and AM 5030 Adjustments

The adjustment procedure consists of a series of steps to determine and set the proper calibration constants of the AM 503B and AM 5030 Current Probe Amplifiers.

***NOTE**. To set the internal calibration constants of the AM 503B amplifier, you must install the GPIB test fixture. Refer to the procedure that begins on page 15.*

Amplifier Setup

Set up the AM 503B or AM 5030 amplifiers as follows:

1. Plug the AM 503B or AM 5030 into the TM 5000 mainframe.

2. Power the amplifier on and let it warm up at least 20 minutes. The amplifier must be calibrated at an ambient temperature between 25 ±5° C.

3. Enable the Cal Mode of the amplifier by sending the following command over the GPIB interface:

```
PASS "ATG"
```

***NOTE**. You must send the* `PASS "ATG"` *command in order to load the calibration constants.*

4. ***On the AM 5030 amplifier only***, send the `SERIAL?` query and verify that the serial number is correct.

If the serial number of the AM 5030 amplifier is not correct, perform the following steps:

a. Send the following command over the GPIB interface:

```
SERIAL<space><space><serial number>
```

Be sure to hit the space bar twice before entering the serial number (i.e. `SERIAL<space><space>B012345`).

b. Send the `SERIAL?` query again to verify that the serial number of the AM 5030 is now correct.

Calculate and Load New Calibration Constants

Use the following procedure to calculate and load new calibration (cal) constants for Rin1X, Rin10X and Rin100X.

NOTE. *Perform this procedure only if the amplifier fails the DC Gain Accuracy test on page 4.*

1. Query amplifier for existing Rin1X, Rin10X, and Rin100X Cal Constants (`CALC? 00`, `CALC? 01`, and `CALC? 02` respectively). Enter these values in Table 7 on page 8.
2. For each Existing Rin Cal Constant entered in Table 7 on page 8, calculate the New Rin Cal Constants using the following formulas:

   $$New\ Rin\ Cal\ Constant = \left(1 + \frac{\%Error}{100}\right) \times Existing\ Rin\ Cal\ Constant$$

   For example, having a %Error of +4.0% at 10 mA and an Existing Rin1X Cal Constant of 25500 would translate into a New Rin Cal Constant as follows:

   $$New\ Rin\ Cal\ Constant = \left(1 + \frac{+4.0}{100}\right) \times 25500 = 26520$$

NOTE. *The Rin Cal Constants must be five digit numbers.*

3. Enter the New Cal Constant for each of the three settings, Rin1X, Rin10X, and Rin100X in Table 7 on page 8.
4. Over the GPIB interface load the New Rin Cal Constants:
   - **a.** Send the command:

     ```
     CALC 00,<Rin1X Cal Constant>
     ```

     The parameter, `<Rin1X Cal Constant>`, is the Cal Constant for Rin 1X from Table 7.

     For example, using the New Rin1X calculated above of 26520, the GPIB command sent to the amplifier would be as follows:

     ```
     CALC 00,26520
     ```

     This will load the Rin1X with the new calibration constant to fine tune the DC gain accuracy of the amplifier.
   - **b.** Send the command:

     ```
     CALC 01,<Rin10X Cal Constant>
     ```

The parameter, `<Rin10X Cal Constant>`, is the New Cal Constant for Rin 10X from Table 7.

c. Over the GPIB interface send the following command to the amplifier:

```
CALC 02,<Rin100X Cal Constant>
```

The parameter, `<Rin100X Cal Constant>` is the New Cal Constant for Rin 100X from Table 7.

d. Verify the Cal Constants by sending the following commands:

```
CALC? 00
CALC? 01
CALC? 02
```

e. Connect a feed-thru adapter to the input of the amplifier and send the command:

```
DEGAuss 1
```

***NOTE**. It is important to use the feed-thru adapter and the DEGAuss 1 command; otherwise the gain check will not work*

5. Repeat the DC Gain Accuracy check on page 4.

GPIB Removal (AM 503B Only)

Remove the GPIB test fixture from the AM503B amplifier only. The GPIB board of the AM 5030 remains with the amplifier. Refer to Figure 8 on page 17 and use the following procedure:

1. Power the amplifier off and remove amplifier from the TM 5000 mainframe.

2. Remove the screw from the rear frame.

3. Remove the two screws from the bottom of the main board that connect to the spacers of the test fixture.

4. Remove the GPIB Test Fixture Board

5. Disconnect the tabbed end of the ribbon cable (174-2314-00) from the main board. Leave the cable attached to the GPIB board.

6. Reinstall the side covers on the amplifier.

7. Store the test fixture with standoffs and cable intact.

This completes the adjustment procedure.

Performance Verification Setup for Current Probes

The Performance Verification tests allow you to demonstrate that the A6300 Series Current Probe meets its specified levels of performance. The recommended calibration interval is one year.

An AM 503B or AM 5030 Current Probe Amplifier that meets the tolerances of the *AM 503B and AM 5030 Performance Verification Procedure* (page 3) can be used as a standard for calibrating the current probes. Since the amplifier and probe are designed as a system with known performance characteristics, it is not necessary for the amplifier to meet the 4:1 uncertainty ratio that is normally recommended for calibrations. To calibrate probes using an AM 503B or AM 5030 as a standard, follow the performance verification procedures in these instructions or in the *AM 503B and AM 5030 Instruction Manual*.

No probe or Amplifier adjustments are required during these test procedures. Should any test fail, refer to the troubleshooting section in the *AM 503B and AM 5030 Instruction Manual* for recommendations.

Tolerances that are specified in these procedures apply to the Amplifier and current probe and do not include test equipment error.

Test Procedure Conditions

These procedures are valid only under the following conditions:

- The system has been calibrated at an ambient temperature of 25°±5° C.
- The system is operating in an environment whose limits are described in Table 4 on page 3.
- 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.

Equipment Preparation

Before performing the verification tests, install all plug-in units into the power module and turn the power on. Turn any remaining equipment on and allow the entire system, including the 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 Amplifier PROBE DEGAUSS AUTOBALANCE button. The degauss/autobalance routine is complete when the indicator light turns off.*

*The Amplifier front panel will display an error code **266** during the degauss/autobalance routine if the Amplifier 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.*

Warranted Specifications

Warranted specifications, Table 11, are guaranteed performance specifications unless specifically designated as typical or nominal.

Table 11: Warranted AM 503B and AM 5030 Specifications

	Installed Probe					
Parameter	**A6312**	**A6302**	**A6303**	**A6302XL**	**A6303XL**	**A6304XL**
Bandwidth	DC to 100 MHz, –3 dB	DC to 50 MHz, –3 dB	DC to 15 MHz, –3 dB	DC to 17 MHz, –3 dB	DC to 10 MHz, –3 dB	DC to 2 MHz, –3 dB
Rise Time, 10% to 90%	≤ 3.5 ns	≤ 7 ns	≤ 23 ns	≤ 20 ns	≤ 35 ns	≤ 175 ns
DC Gain Accuracy	≤ 3%	≤ 3%	≤ 3%	≤ 3%	≤ 3%	≤ 3%

A6312 Performance Verification

The test procedures in this section verify proper performance of the A6312 current probe.

Read page 23 before starting these procedures. Also, read each procedure through completely before starting to ensure proper completion.

Required Test Equipment

To perform the acceptance tests in this section, you will need the test equipment listed in Table 12. The test equipment must meet or exceed the specifications listed. The test procedures may need to be modified if the recommended equipment is not used.

Table 12: Required Test Equipment

Qty	Item	Description	Recommended Equipment
1	Oscilloscope	500 MHz bandwidth	TDS 520B
1	Current Probe Amplifier		AM503B or AM5030
1	Leveled Sine Wave Generator	3 MHz to 100 MHz	Wavetek 9100 with Option 250 or SG 503 equivalent.
1	Calibration Generator	1 MHz square wave, rise time <1 ns, 1 $V_{p\text{-}p}$ into 50 Ω	Wavetek 9100 with Option 250 or PG 506A equivalent
1	Digital Multimeter	0.25% $3^1/_2$ digit resolution at ± 50 mV	DM2510/G or Fluke 850x/884x
1	Current Source	0.3% accuracy, 0 to ±2 A	Fluke 5700A or Wavetek 9100 with Option 250
1	Calibration Fixture	50 Ω, BNC Connector	015-0601-50
1	Current Loop	20 turns 27 AWG coated wire	Refer to page 40.
1	Termination	50 Ω, ±0.1%, 0.5 W	011-0129-00
1	BNC Cable	50 Ω, 1.05 m (42 in) long	012-0057-01
1	BNC to Dual Banana Adapter		103-0090-00

Bandwidth

This procedure tests the bandwidth of the A6312 Current Probe. In this test you measure a signal at a relatively low frequency and again at the rated bandwidth of the probe. The two measurements are compared to verify that the signal amplitude does not fall below –3 dB at the probe bandwidth. Refer to Figure 9 when making equipment connections.

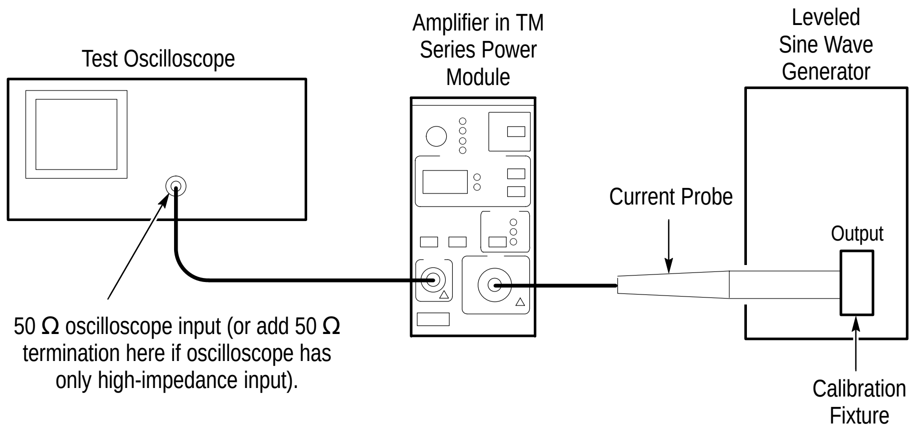

Figure 9: Bandwidth Test Setup for A6312

Equipment Connections

1. Using a 50 Ω BNC cable, connect the Amplifier **OUTPUT** to a 50 Ω oscilloscope input. If the input impedance of your oscilloscope is 1 MΩ, connect a 50 Ω feedthrough termination at the oscilloscope input. Do not connect the termination at the Amplifier output.
2. Connect the current probe to the Amplifier **INPUT**.
3. Connect the current loop calibration fixture to the output of the leveled sine wave generator.

Equipment Settings

Make or verify the equipment settings in Table 13.

Table 13: Equipment Settings for Bandwidth

Oscilloscope	
Vertical input impedance	50 Ω
Vertical gain	10 mV/division
Time base	200 ns/division
Record length	500
Coupling	DC
Offset	0 V (mid-scale)

Table 13: Equipment Settings for Bandwidth (Cont.)

Oscilloscope	
Trigger type	Edge
Trigger mode	Auto
Trigger position	50%
Acquisition mode	Average
Number of waveforms to average	8
Measurement type	Peak-to-Peak
Leveled Sine Wave Generator	
Frequency	3 MHz
Amplitude	3 V_{p-p}
AM 503B and AM 5030	
Coupling	DC
BW Limit	Off (full bandwidth)
Current/division	10 mA/division

Procedure

1. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.
2. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.
3. Clamp the current probe around the calibration fixture.
4. Adjust the signal generator output so that the Amplifier output is approximately 60 mV_{p-p}, or six graticule divisions on the oscilloscope.
5. Using the peak-peak measurement capability of the oscilloscope, measure and record the peak-peak reading as M_1.
6. Set the oscilloscope time base to 5 ns/division. Increase the signal generator frequency to the warranted bandwidth. Refer to Table 11 on page 24.
7. Using the peak-peak measurement capability of the oscilloscope, measure and record the peak-peak reading as M_2.

8. The probe meets the bandwidth specification if the ratio of the signal amplitude at the warranted bandwidth is at least 70.7% of the signal amplitude at 3 MHz. Using the following calculation, verify probe bandwidth:

$$\left(\frac{M_2}{M_1}\right) > 0.707$$

***NOTE**. The impedance of the calibration fixture used in this test changes between 3 MHz and 100 MHz. Typically the impedance changes from 50 Ω at 3 MHz to 59 Ω at 100 MHz. Thus you can substitute the following equation to make this test more accurate:*

$$(1.18)\left(\frac{M_2}{M_1}\right) > 0.707$$

Rise Time

This procedure measures the rise time of the A6312. In this test you directly measure the rise time of a step input. Refer to Figure 10 when making equipment connections.

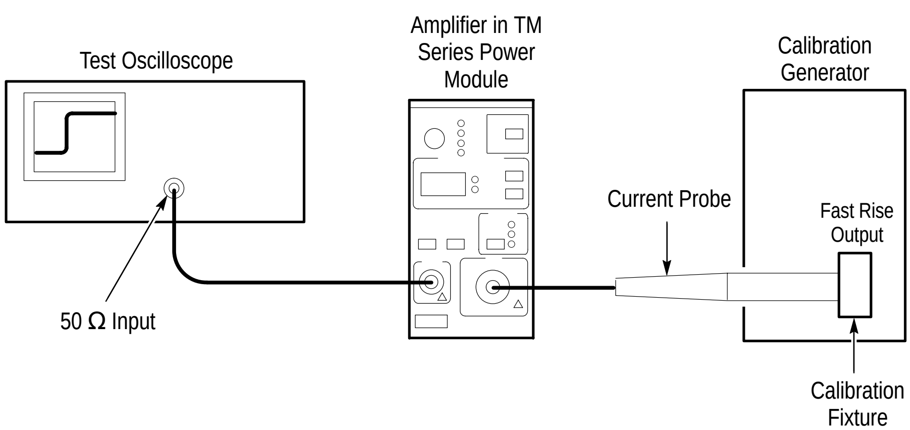

Figure 10: Rise Time Test Setup for A6312

Equipment Connections

1. Using a 50 Ω BNC cable, connect the Amplifier **OUTPUT** to a 50 Ω oscilloscope input. If the input impedance of your oscilloscope is 1 MΩ, connect a 50 Ω feedthrough termination at the oscilloscope input. Do not connect the termination at the Amplifier output.

2. Connect the current probe to the Amplifier **INPUT**.

3. Connect the current loop calibration fixture to the calibration generator 50 Ω 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 equipment settings in Table 14:

Table 14: Equipment Settings for Rise Time

Oscilloscope	
Vertical input impedance	50 Ω
Vertical gain	10 mV/division
Time base	2 ns/division
Record length	500
Coupling	DC
Offset	0 V (mid-scale)
Trigger type	Edge
Trigger mode	Auto
Trigger position	50%
Acquisition mode	Average
Number of waveforms to average	32
Measurement type	Rise Time
Calibration Generator	
Period	1 µs
Output	Fast rise
Amplitude	Maximum
AM 503B and AM 5030	
Coupling	DC
BW Limit	Off (full bandwidth)
Current/division	5 mA/division

Procedure

1. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.

2. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.

3. Clamp the current probe around the calibration fixture. Verify that the arrow-shaped indicator on the probe points away from the pulse source.

4. Using the measurement capability of the oscilloscope, measure the rise time of the displayed pulse from 10% to 90% amplitude.

5. Calculate the rise time of the probe (t_r *probe*) using the formula below:

$$t_r\ probe = \sqrt{t_r\ measured^2 - t_r\ system^2}$$

The measured rise time (t_r *measured*) is the value calculated in step 4.

The system rise time (t_r *system*) is the rise time of the displayed signal when output of the pulse generator is connected directly to the oscilloscope input. (The current probe and amplifier are excluded.)

6. Verify that the probe rise time is less than the warranted specification. Refer to Table 11 on page 24.

DC Gain Accuracy

This procedure tests the DC gain accuracy of the A6312 Current Probes. In this test you compare the voltage output of the Amplifier to a reference input.

Current Loop for DC Gain Accuracy Check

You will need to construct a simple current loop in order to complete the DC gain accuracy tests.

WARNING. *Magnetic fields are produced that may cause a malfunction in heart pacemakers, or damage to sensitive equipment.*

Construct the loop using a cylindrical form approximately 3 inches in diameter, wind *exactly* 20 turns of #27 coated wire.

NOTE. *Ensure that the current loop has exactly 20 turns. A significant error will result for each turn variance from 20 turns.*

Equipment Connections

1. Using a BNC cable, connect the Amplifier **OUTPUT** to the 50 Ω feed-through 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.

2. Connect the current loop to the current source as shown in Figure 11.

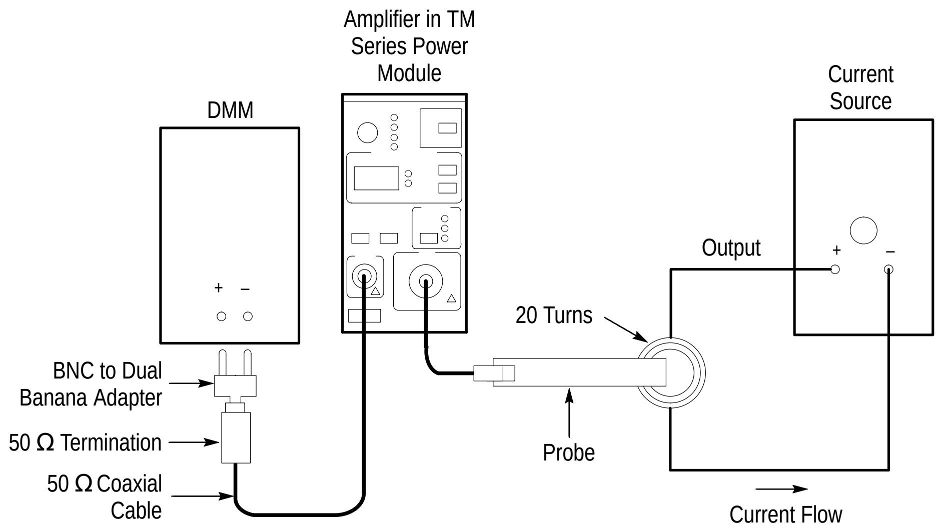

Figure 11: DC Gain Accuracy Test Setup for A6312

Equipment Settings

Make or verify the equipment settings in Table 15:

Table 15: Equipment Settings for DC Gain Accuracy

Digital Multimeter	
Measurement Type	DC volts
Range	Autoranging
Current Source	
Output	Off
AM 503B and AM 5030	
Coupling	DC
BW Limit	On (20 MHz)
Current/division	1 mA/division
Probe Trim	000

Procedure

1. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.
2. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.
3. Clamp the current probe around the 20 turn current loop, as shown in Figure 14 on page 41. Verify that the arrow-shaped indicator on the probe points away from the current source.

4. For each of the Amplifier current/division settings in Table 16, perform the following steps:

a. Set the Amplifier to the desired current/division setting from Table 16.

b. Set the current source to the correct positive test current using Table 16.

c. Turn on the current source.

d. Record the exact measurement of the digital multimeter as M_1. (You can copy Table 17 on page 34 to record the results of your measurements.)

e. Set the current source for the correct negative test current using Table 16.

Table 16: DC Gain Accuracy Test for A6312

Turns of Current Loop Passing Through Probe	AM 503B and AM 5030 Current/Division	Current Source Output	Test Current I_t
20	1 mA	±250 µA	10 mA
20	2 mA	±500 µA	20 mA
20	5 mA	±1.25 mA	50 mA
20	10 mA	±2.5 mA	100 mA
20	20 mA	±5 mA	200 mA
20	50 mA	±12.5 mA	500 mA
20	100 mA	±25 mA	1 A
20	200 mA	±50 mA	2 A
20	500 mA	±125 mA	5 A
20	1 A	±250 mA	10 A
20	2 A	±500 mA	20 A
20	5 A	±1 A	40 A

f. Record the digital multimeter reading as M_2.

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

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

For example, you might have obtained values of 50 mV for M_1 and 48 mV for M_2. If you are using an Amplifier setting of 10 mA/division, you can compute I_m as:

$$I_m = \frac{(50.0x10^{-3}) - (-48x10^{-3})}{0.01} \times (10x10^{-3}) = 98\ mA$$

h. Verify that the measured current (I_m) is within ±3% of the test current (I_t) by computing *%Error* as follows:

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

For example, using a test current I_t of 100 mA and a measured current I_m of 98 mA, the *%Error* would be:

$$\%Error = \frac{98 - 100}{100} \times 100 = -2\%$$

Table 17: DC Gain Accuracy Test Worksheet for A6312

Turns of Current Loop Passing Through Probe	AM 503B and AM 5030 Current/Division	Current Source Output	Test Current I_t	M_1	M_2	I_m (Note A)	*%Error* (Note B)
20	1 mA	±250 µA	10 mA				
20	2 mA	±500 µA	20 mA				
20	5 mA	±1.25 mA	50 mA				
20	10 mA	±2.5 mA	100 mA				
20	20 mA	±5 mA	200 mA				
20	50 mA	±12.5 mA	500 mA				
20	100 mA	±25 mA	1 A				
20	200 mA	±50 mA	2 A				
20	500 mA	±125 mA	5 A				
20	1 A	±250 mA	10 A				
20	2 A	±500 mA	20 A				
20	5 A	±1 A	40 A				

Note A

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

Note B

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

A6302 and A6302XL Performance Verification

The test procedures in this section verify proper performance of the A6302 and A6302XL current probes.

Read page 23 before starting these procedures. Also, read each procedure through completely before starting to ensure proper completion.

Required Test Equipment

To perform the acceptance tests in this section, you will need the test equipment listed in Table 18. The test equipment must meet or exceed the specifications listed. The test procedures may need to be modified if the recommended equipment is not used.

Table 18: Required Test Equipment

Qty	Item	Description	Recommended Equipment
1	Oscilloscope	350 MHz bandwidth	TDS 520B
1	Current Probe Amplifier		AM503B or AM5030
1	Leveled Sine Wave Generator	3 MHz to 50 MHz	Wavetek 9100 with Option 250 or SG 503 equivalent
1	Calibration Generator	1 MHz square wave, rise time <1 ns, 1 V_{p-p} into 50 Ω	Wavetek 9100 with Option 250 or PG 506A equivalent
1	Digital Multimeter	0.25% $3^1/_2$ digit resolution at ± 50 mV	DM2510/G or Fluke 850x/884x
1	Current Source	0.3% accuracy, 0 to ±2 A	Fluke 5700A or Wavetek 9100 with Option 250
1	Calibration Fixture	50 Ω, BNC Connector	015-0601-50
1	Current Loop	20 turns 27 AWG coated wire	Refer to page 40.
1	Termination	50 Ω, ±0.1%, 0.5 W	011-0129-00
1	BNC Cable	50 Ω, 1.05 m (42 in) long	012-0057-01
1	BNC to Dual Banana Adapter		103-0090-00

Bandwidth

This procedure tests the bandwidth of the A6302 and A6302XL Current Probes. In this test you measure a signal at a relatively low frequency and again at the rated bandwidth of the probe. The two measurements are compared to verify that the signal amplitude does not fall below –3 dB at the probe bandwidth. Refer to Figure 12 when making equipment connections.

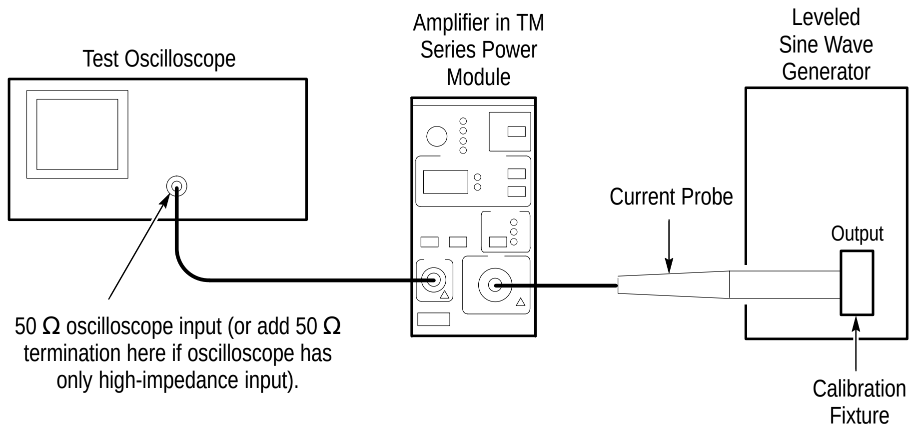

Figure 12: Bandwidth Test Setup for A6302

Equipment Connections

1. Using a 50 Ω BNC cable, connect the Amplifier **OUTPUT** to a 50 Ω oscilloscope input. If the input impedance of your oscilloscope is 1 MΩ, connect a 50 Ω feedthrough termination at the oscilloscope input. Do not connect the termination at the Amplifier output.
2. Connect the current probe to the Amplifier **INPUT**.
3. Connect the current loop calibration fixture to the output of the leveled sine wave generator.

Equipment Settings

Make or verify the equipment settings in Table 19.

Table 19: Equipment Settings for Bandwidth

Oscilloscope	
Vertical input impedance	50 Ω
Vertical gain	10 mV/division
Time base	200 ns/division
Record length	500
Coupling	DC
Offset	0 V (mid-scale)

Table 19: Equipment Settings for Bandwidth (Cont.)

Oscilloscope	
Trigger type	Edge
Trigger mode	Auto
Trigger position	50%
Acquisition mode	Average
Number of waveforms to average	8
Measurement type	Peak-to-Peak
Leveled Sine Wave Generator	
Frequency	3 MHz
Amplitude	3 V_{p-p}
AM 503B and AM 5030	
Coupling	DC
BW Limit	Off (full bandwidth)
Current/division	10 mA/division

Procedure

1. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.
2. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.
3. Clamp the current probe around the calibration fixture.
4. Adjust the signal generator output so that the Amplifier output is approximately 60 mV_{p-p}, or six graticule divisions on the oscilloscope.
5. Using the peak-peak measurement capability of the oscilloscope, measure and record the peak-peak reading as M_1.
6. Set the oscilloscope time base to 10 ns/division. Increase the signal generator frequency to the warranted bandwidth. Refer to Table 11 on page 24.
7. Using the peak-peak measurement capability of the oscilloscope, measure and record the peak-peak reading as M_2**.**
8. The probe meets the bandwidth specification if the ratio of the signal amplitude at the warranted bandwidth is at least 70.7% of the signal amplitude at 3 MHz. Using the following calculation, verify probe bandwidth:

$$\left(\frac{M_2}{M_1}\right) > 0.707$$

NOTE. *The impedance of the calibration fixture 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 make this test more accurate:*

$$(1.06)\left(\frac{M_2}{M_1}\right) > 0.707$$

Rise Time

This procedure measures the rise time of the A6302 and A6302XL. In this test you directly measure the rise time of a step input. Refer to Figure 13 when making equipment connections.

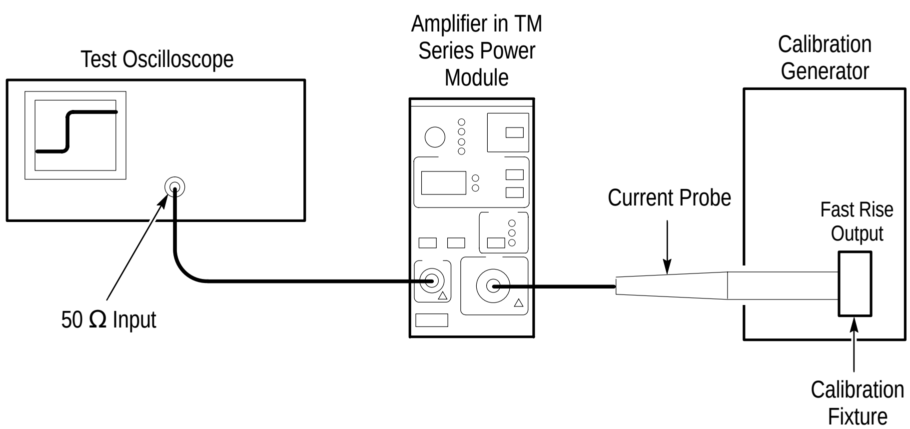

Figure 13: Rise Time Test Setup for A6302/A6302XL

Equipment Connections

1. Using a 50 Ω BNC cable, connect the Amplifier **OUTPUT** to a 50 Ω oscilloscope input. If the input impedance of your oscilloscope is 1 MΩ, connect a 50 Ω feedthrough termination at the oscilloscope input. Do not connect the termination at the Amplifier output.
2. Connect the current probe to the Amplifier **INPUT**.
3. Connect the current loop calibration fixture to the calibration generator 50 Ω 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 equipment settings in Table 20:

Table 20: Equipment Settings for Rise Time

Oscilloscope	
Vertical input impedance	50 Ω
Vertical gain	10 mV/division
Time base	2 ns/division
Record length	500
Coupling	DC
Offset	0 V (mid-scale)
Trigger type	Edge
Trigger mode	Auto
Trigger position	50%
Acquisition mode	Average
Number of waveforms to average	8
Measurement type	Rise Time
Calibration Generator	
Period	1 μs
Output	Fast rise
Amplitude	Maximum
AM 503B and AM 5030	
Coupling	DC
BW Limit	Off (full bandwidth)
Current/division	5 mA/division

Procedure

1. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.
2. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.
3. Clamp the current probe around the calibration fixture. Verify that the arrow-shaped indicator on the probe points away from the pulse source.
4. Using the measurement capability of the oscilloscope, measure the rise time of the displayed pulse from 10% to 90% amplitude.

5. Verify that the rise time is less than the warranted specification. Refer to Table 11 on page 24.

DC Gain Accuracy

This procedure tests the DC gain accuracy of the A6302 and A6302XL Current Probes. In this test you compare the voltage output of the Amplifier to a reference input.

Current Loop for DC Gain Accuracy Check

You will need to construct a simple current loop in order to complete the DC gain accuracy tests.

WARNING. *Magnetic fields are produced that may cause a malfunction in heart pacemakers, or damage to sensitive equipment.*

Construct the loop using a cylindrical form approximately 3 inches in diameter, wind *exactly* 20 turns of #27 coated wire.

NOTE. *Ensure that the current loop has exactly 20 turns. A significant error will result for each turn variance from 20 turns.*

Equipment Connections

1. Using a BNC cable, connect the Amplifier **OUTPUT** to the 50 Ω feed-through 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.
2. Connect the current loop to the current source as shown in Figure 14.

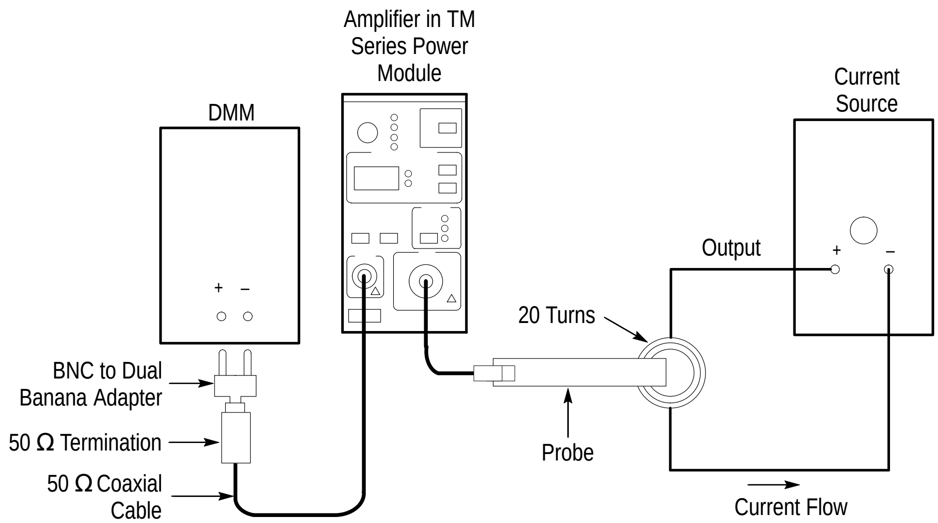

Figure 14: DC Gain Accuracy Test Setup for A6302/A6302XL

Equipment Settings

Make or verify the equipment settings in Table 21:

Table 21: Equipment Settings for DC Gain Accuracy

Digital Multimeter		
	Measurement Type	DC volts
	Range	Autoranging
Current Source		
	Output	Off
AM 503B and AM 5030		
	Coupling	DC
	BW Limit	On (20 MHz)
	Current/division	1 mA/division
	Probe trim	000

Procedure

1. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.
2. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.
3. Clamp the current probe around the 20 turn current loop, as shown in Figure 14 on page 41. Verify that the arrow-shaped indicator on the probe points away from the current source.

4. For each of the Amplifier current/division settings in Table 22 on page 42, perform the following steps:

a. Set the Amplifier to the desired current/division setting from Table 22.

b. Set the current source to the correct positive test current using Table 22.

c. Turn on the current source.

d. Record the exact measurement of the digital multimeter as M_1. (You can copy Table 23 on page 44 to record the results of your measurements.)

e. Set the current source for the correct negative test current using Table 22.

Table 22: DC Gain Accuracy Test for A6302/A6302XL

Turns of Current Loop Passing Through Probe	AM 503B and AM 5030 Current/Division	Current Source Output	Test Current I_t
20	1 mA	±250 µA	10 mA
20	2 mA	±500 µA	20 mA
20	5 mA	±1.25 mA	50 mA
20	10 mA	±2.5 mA	100 mA
20	20 mA	±5 mA	200 mA
20	50 mA	±12.5 mA	500 mA
20	100 mA	±25 mA	1 A
20	200 mA	±50 mA	2 A
20	500 mA	±125 mA	5 A
20	1 A	±250 mA	10 A
20	2 A	±500 mA	20 A
20	5 A	±1 A	40 A

f. Record the digital multimeter reading as M_2.

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

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

For example, you might have obtained values of 50 mV for M_1 and 48 mV for M_2. If you are using an Amplifier setting of 10 mA/division, you can compute I_m as:

$$I_m = \frac{(50.0x10^{-3}) - (-48x10^{-3})}{0.01} \times (10x10^{-3}) = 98\ mA$$

h. Verify that the measured current (I_m) is within ±3% of the test current (I_t) by computing *%Error* as follows:

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

For example, using a test current I_t of 100 mA and a measured current I_m of 98 mA, the *%Error* would be:

$$\%Error = \frac{98 - 100}{100} \times 100 = -2\%$$

Table 23: DC Gain Accuracy Test Worksheet for A6302/A6302XL

Turns of Current Loop Passing Through Probe	AM 503B and AM 5030 Current/Division	Current Source Output	Test Current I_t	M_1	M_2	I_m (Note A)	*%Error* (Note B)
20	1 mA	±250 µA	10 mA				
20	2 mA	±500 µA	20 mA				
20	5 mA	±1.25 mA	50 mA				
20	10 mA	±2.5 mA	100 mA				
20	20 mA	±5 mA	200 mA				
20	50 mA	±12.5 mA	500 mA				
20	100 mA	±25 mA	1 A				
20	200 mA	±50 mA	2 A				
20	500 mA	±125 mA	5 A				
20	1 A	±250 mA	10 A				
20	2 A	±500 mA	20 A				
20	5 A	±1 A	40 A				

Note A

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

Note B

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

A6303 and A6303XL Performance Verification

The test procedures in this section check for proper performance of the A6303 and A6303XL current probes.

Read page 23 before starting these procedures. Also, read each procedure through completely before starting to ensure proper completion.

Required Test Equipment

To perform the acceptance tests in this section, you will need the test equipment listed in Table 24. The test equipment must meet or exceed the specifications listed. The test procedures may need to be modified if the recommended equipment is not used.

Table 24: Required Test Equipment

Qty	Item	Description	Recommended Equipment
1	Oscilloscope	350 MHz bandwidth	TDS 520B
1	Current Probe Amplifier		AM503B or AM5030
1	Leveled Sine Wave Generator	3 MHz to 15 MHz	Wavetek 9100 with Option 250 or SG 503 equivalent
1	Calibration Generator	1 MHz square wave, rise time <1 ns, 1 V_{p-p} into 50 Ω	Wavetek 9100 with Option 250 or PG 506A equivalent
1	Digital Multimeter	0.25% $3^1/_2$ digit resolution at ± 50 mV	DM2510/G
1	Current Source	0.3% accuracy, 0 to ±2 A	Fluke 5700A or Wavetek 9100
1	Calibration Fixture	50 Ω, BNC Connector	015-0601-50
1	Current Loop	50 turns 21 AWG coated wire	Refer to page 50.
1	Termination	50 Ω, ±0.1%, 0.5 W	011-0129-00
1	BNC Cable	50 Ω, 1.05 m (42 in) long	012-0057-01
1	BNC to Dual Banana Adapter		103-0090-00

Bandwidth

This procedure tests the bandwidth of the A6303 and A6303XL Current Probes. In this test you measure a signal at a relatively low frequency and again at the rated bandwidth of the probe. The two measurements are compared to check that the signal amplitude does not fall below –3 dB at the probe bandwidth. Refer to Figure 15 when making equipment connections.

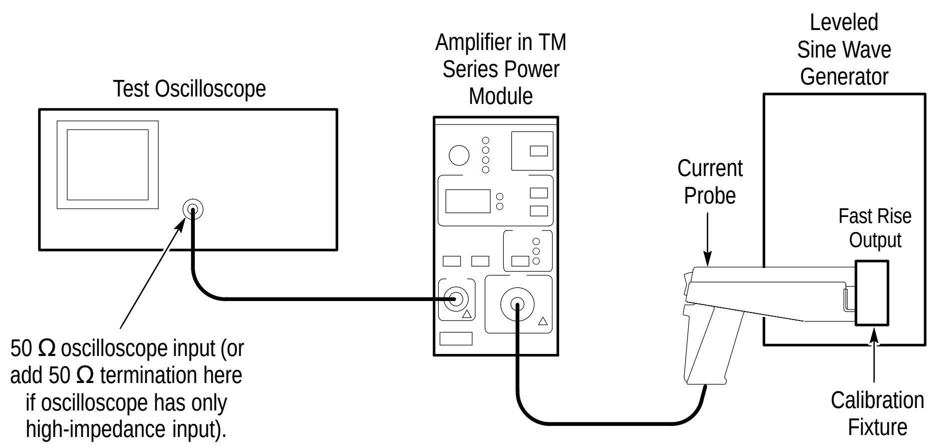

Figure 15: Bandwidth Test Setup for an A6303 or A6303XL

Equipment Connections

1. Using a 50 Ω BNC cable, connect the Amplifier **OUTPUT** to a 50 Ω oscilloscope input. If the input impedance of your oscilloscope is 1 MΩ, connect a 50 Ω feedthrough termination at the oscilloscope input. Do not connect the termination at the Amplifier output.
2. Connect the current probe to the Amplifier **INPUT**.
3. Connect the current loop calibration fixture to the output of the leveled sine wave generator.

Equipment Settings

Make or check the equipment settings in Table 25:

Table 25: Equipment Settings for Bandwidth

Oscilloscope	
Vertical input impedance	50 Ω
Vertical gain	10 mV/division
Time base	200 ns/division
Record length	500
Coupling	DC
Offset	0 V (mid-scale)

Table 25: Equipment Settings for Bandwidth (Cont.)

Oscilloscope	
Trigger type	Edge
Trigger mode	Auto
Trigger position	50%
Acquisition mode	Average
Number of waveforms to average	8
Measurement type	Peak-to-Peak
Leveled Sine Wave Generator	
Frequency	3 MHz
Amplitude	3 V_{p-p}
AM 503B and AM 5030	
Coupling	DC
BW Limit	Off
Current/division	10 mA/division

Procedure

1. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.
2. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.
3. Clamp the current probe around the current loop calibration fixture.
4. Adjust the signal generator output so that the Amplifier output is ≈ 60 mV_{p-p}, or six graticule divisions on the oscilloscope.
5. Using the peak-peak measurement capability of the oscilloscope, measure and record the peak-peak reading as M_1.
6. Set the oscilloscope time base to 50 ns/division. Increase the signal generator frequency to the warranted bandwidth. Refer to Table 11 on page 24.
7. Using the peak-peak measurement capability of the oscilloscope, measure and record the peak-peak reading as M_2.

8. The probe meets the bandwidth specification if the ratio of the signal amplitude at the warranted bandwidth is at least 0.707 of the signal amplitude at 3 MHz. Use the following formula to check probe bandwidth:

$$\left(\frac{M_2}{M_1}\right) > 0.707$$

Rise Time

This procedure measures the rise time of the A6303 and A6303XL. In this test you directly measure the rise time of a step input. Refer to Figure 16 when making equipment connections.

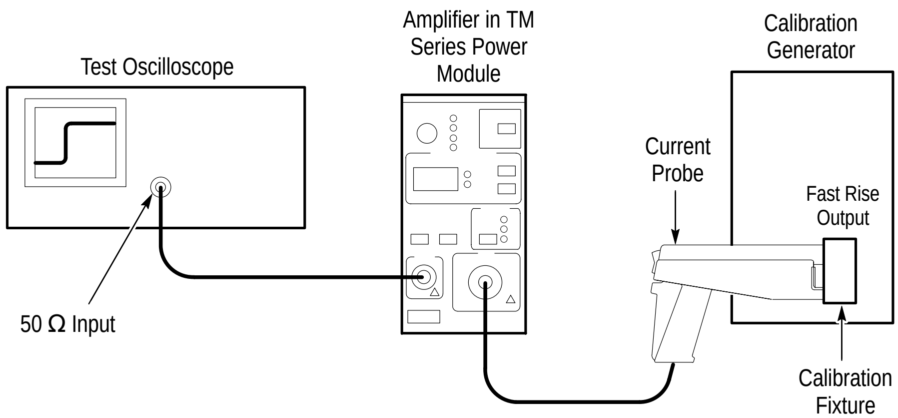

Figure 16: Rise Time Test Setup for A6303 or A6303XL

Equipment Connections

1. Using a BNC cable, connect the Amplifier **OUTPUT** to a 50 Ω oscilloscope input. If the input impedance of your oscilloscope is 1 MΩ, connect a 50 Ω feedthrough termination at the oscilloscope input. Do not connect the termination at the Amplifier output.

2. Connect the probe to the Amplifier.

3. Connect the current loop calibration fixture to the calibration generator 50 Ω 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 check the equipment settings in Table 26.

Table 26: Equipment Settings for Rise Time

Oscilloscope	
Vertical input impedance	50 Ω
Vertical gain	5 mV/division
Time base	10 ns/division
Record length	500
Coupling	DC
Offset	0 V (mid-scale)
Trigger type	Edge
Trigger mode	Auto
Trigger position	50%
Acquisition mode	Average
Number of waveforms to average	8
Measurement type	Rise Time
Calibration Generator	
Period	1 µs
Output	Fast Rise
Amplitude	Maximum
AM 503B and AM 5030	
Coupling	DC
BW Limit	Off
Current/division	5 mA/division

NOTE*. This is the only test where the oscilloscope vertical gain should be set at other than 10 mV/division. Reset the vertical gain to 10 mV/division when the rise time check is complete.*

Procedure

1. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.
2. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.
3. Clamp the current probe around the current loop calibration fixture. Check that the arrow-shaped indicator on the probe points away from the source.
4. Using the measurement capability of the oscilloscope, measure the rise time of the displayed pulse from 10% to 90% amplitude.
5. Check that the rise time is less than the warranted specification. Refer to Table 11 on page 24.
6. Reset the oscilloscope vertical gain to 10 mV/division.

DC Gain Accuracy

WARNING. *This test produces intense magnetic fields that may cause malfunctions in a normally operating heart pacemaker or damage sensitive equipment. Personnel fitted with pacemakers should not perform this test, and should stay at least 10 feet from the current loop while the test is being conducted.*

This procedure tests the DC gain accuracy of the A6303 and A6303XL. In this test you compare the voltage output of the Amplifier to a reference input.

Current Loop for DC Gain Accuracy Check

You will need to construct a simple current loop in order to complete the DC gain accuracy tests. Construct the loop as follows using a cylindrical form approximately 3 inches in diameter, wind *exactly* 50 turns of #21 coated wire.

NOTE. *Ensure that the current loop has exactly 50 turns. A significant error will result for each turn variance from 50 turns.*

Equipment Settings

Make or check the equipment settings in Table 27.

Table 27: Equipment Settings for DC Gain Accuracy

Digital Multimeter	
Measurement Type	DC volts
Range	Autoranging
Current Source	
Output	Off
AM 503B and AM 5030	
Coupling	DC
BW Limit	On
Current/division	5 mA/division

Equipment Connections

1. Using a BNC cable, connect the Amplifier **OUTPUT** to a 50 Ω feedthrough termination. Attach the termination to a BNC-to-dual banana adapter. Taking care to observe the adapter polarity, insert the dual banana adapter into the digital multimeter DC voltage input.

2. Connect the current loop to the current source as shown in Figure 17.

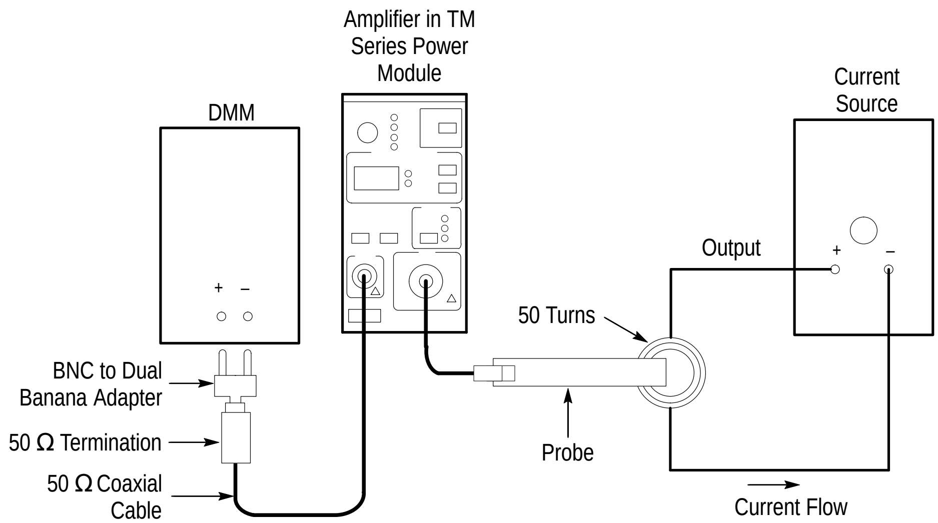

Figure 17: DC Gain Accuracy Test Setup for A6303/A6303XL

WARNING. *This test produces intense magnetic fields that may cause malfunctions in a normally operating heart pacemaker or damage sensitive equipment. Personnel fitted with pacemakers should not perform this test, and should stay at least 10 feet from the current loop while the test is being conducted.*

Procedure

1. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.
2. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.
3. Clamp the current probe around the one conductor of the current loop. (See Figure 17 on page 51.) Check that the arrow-shaped indicator on the probe points away from the current source.
4. For each of the Amplifier current/division settings in Table 28 on page 52, perform the following steps:
   a. Set the Amplifier to the desired current/division setting from Table 28.
   b. Set the current source to the correct positive test current using Table 28.
   c. Turn on the current source.
   d. Record the exact measurement of the digital multimeter as M_1. (You can copy Table 29 on page 53 to record the results of your measurements.)
   e. Set the current source for the correct negative test current using Table 28.

Table 28: DC Gain Accuracy Test for A6303/A6303XL

Turns of Current Loop Passing Through Probe	AM 503B and AM 5030 Current/Division	Current Source Output	Test Current I_t
50	5 mA	±500 µA	50 mA
50	10 mA	±1 mA	100 mA
50	20 mA	±2 mA	200 mA
50	50 mA	±5 mA	500 mA
50	100 mA	±10 mA	1 A
50	200 mA	±20 mA	2 A
50	500 mA	±50 mA	5 A
50	1 A	±100 mA	10 A
50	2 A	±200 mA	20 A
50	5 A	±500 mA	50 A
50	10 A	±1 A	100 A
50	20 A	±2 A	200 A
50	50 A	±2 A	200 A

f. Record the digital multimeter reading as M_2.

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

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

For example, you might have obtained values of 50 mV for M_1 and 48 mV for M_2. If you are using an Amplifier setting of 10 mA/division, you can compute I_m as:

$$I_m = \frac{(50.0x10^{-3}) - (-48x10^{-3})}{0.01} \times (10x10^{-3}) = 98\ mA$$

h. Verify that the measured current (I_m) is within ±3% of the test current (I_t) by computing *%Error* as follows:

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

For example, using a test current I_t of 100 mA and a measured current I_m of 98 mA, the *%Error* would be:

$$\%Error = \frac{98 - 100}{100} \times 100 = -2\%$$

Table 29: DC Gain Accuracy Test Work Sheet for A6303/A6303XL

Turns of Current Loop Passing Through Probe	AM 503B and AM 5030 Current/Division	Current Source Output	Test Current I_t	M_1	M_2	I_m (Note A)	*%Error* (Note B)
50	5 mA	±500 µA	50 mA				
50	10 mA	±1 mA	100 mA				
50	20 mA	±2 mA	200 mA				
50	50 mA	±5 mA	500 mA				
50	100 mA	±10 mA	1 A				
50	200 mA	±20 mA	2 A				
50	500 mA	±50 mA	5 A				
50	1 A	±100 mA	10 A				
50	2 A	±200 mA	20 A				
50	5 A	±500 mA	50 A				
50	10 A	±1 A	100 A				
50	20 A	±2 A	200 A				
50	50 A	±2 A	200 A				

Note A

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

Note B

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

A6304XL Performance Verification

The test procedures in this section check for proper performance of the A6304XL current probe.

Read page 23 before starting these procedures. Also, read each procedure through completely before starting to ensure proper completion.

Required Test Equipment

To perform the acceptance tests in this section, you will need the test equipment listed in Table 30. The test equipment must meet or exceed the specifications listed. The test procedures may need to be modified if the recommended equipment is not used.

Table 30: Required Test Equipment

Qty	Item	Description	Recommended Equipment
1	Oscilloscope	20 MHz bandwidth	Tektronix TDS 520B
1	Digital Multimeter	0.25%, $3^1/_2$ digit resolution at ± 50 mV	DM2510/G or Fluke 850x/884x
1	Current Source	0.3% accuracy, 0 to ±2 A	Fluke 5700A or Wavetek 9100 with Option 250
1	Calibration Generator	Square wave with a rise time <35 ns, 5 A into 50 Ω	AVTECH[1] AVR-3-PW-C-P-TEK2
1	Current Loop	250 turns	067-0240-00
1	Termination	50 Ω, ±0.1%, 0.5 W	011-0129-00
2	BNC Cable	50 Ω, 1.05 m (42 in) long	012-0057-01
3	BNC to Dual Banana Adapter		103-0090-00

[1] **AVTECH Electrosystems Ltd.**
P.O. Box 265, Ogdensburg NY 13669-0265
(315) 472-5270 or (800) 265-6681

Rise Time

This procedure measures the rise time of the A6304XL. In this test you directly measure the rise time of a step input. Refer to Figure 18 when making equipment connections.

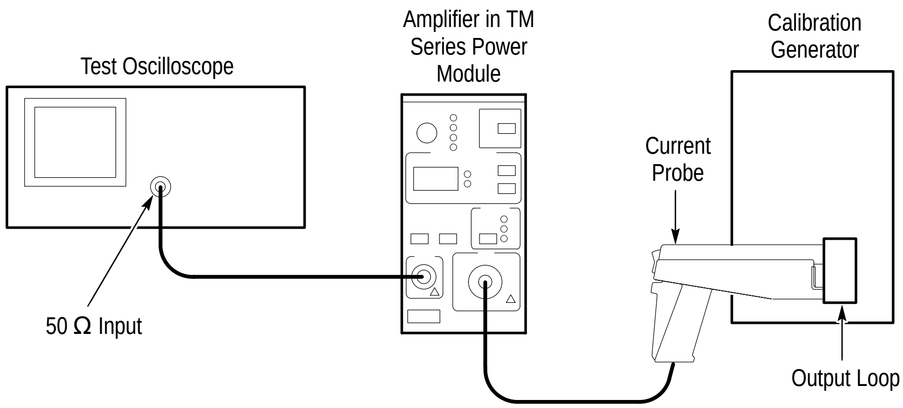

Figure 18: Rise Time Test Setup for the A6304XL

Equipment Connections

1. Using a BNC cable, connect the Amplifier **OUTPUT** to a 50 Ω oscilloscope input. If the input impedance of your oscilloscope is 1 MΩ, connect a 50 Ω feedthrough termination at the oscilloscope input. Do not connect the termination at the Amplifier output.
2. Connect the probe to the Amplifier.
3. Connect the current loop calibration fixture to the calibration generator 50 Ω 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 check the equipment settings in Table 31:

Table 31: Equipment Settings for Rise Time

Oscilloscope	
Vertical input impedance	50 Ω
Vertical gain	10 mV/division
Time base	50 ns/division
Record length	500
Coupling	DC
Offset	0 V (mid-scale)
Trigger type	Edge
Trigger mode	Auto
Trigger position	50%
Acquisition mode	Average
Number of waveforms to average	8
Measurement type	Rise Time
Calibration Generator	
Pulse width	250 µs
Pulse repetition frequency	25 Hz
Amplitude	5 A peak
AM 503B and AM 5030	
Coupling	DC
BW Limit	Off
Current/division	1 A/division

Procedure

1. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.
2. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.
3. Clamp the current probe around the current loop calibration fixture. Check that the arrow-shaped indicator on the probe points away from the source.
4. Using the measurement capability of the oscilloscope, measure the rise time of the displayed pulse from 10% to 90% amplitude.
5. Check that the rise time is less than the warranted specification. Refer to Table 11 on page 24.

Bandwidth

The bandwidth of the probe is derived as a function of its rise time. The rise time (t_r) is measured in nanoseconds between the 10% and 90% points of the leading edge of the pulse. (Refer to the procedure on page 56.) To calculate the probe bandwidth, use the following formula:

$$\left(\frac{0.35}{t_r}\right) = Bandwidth$$

For example, a rise time of 175 ns would result in the following solution:

$$\left(\frac{0.35}{175 \times 10^{-9}\ seconds}\right) = 2.0 \times 10^{6}\ Hertz$$

DC Gain Accuracy

WARNING. *This test produces intense magnetic fields that may cause malfunctions in a normally operating heart pacemaker or damage sensitive equipment. Personnel fitted with pacemakers should not perform this test, and should stay at least 10 feet from the current loop while the test is being conducted.*

This procedure tests the DC gain accuracy of the A6304XL. In this test you compare the voltage output of the Amplifier to a reference input.

Equipment Connections

1. Using a BNC cable, connect the Amplifier **OUTPUT** to a 50 Ω feedthrough termination. Attach the termination to a BNC-to-dual banana adapter. Taking care to observe the adapter polarity, insert the dual banana adapter into the digital multimeter DC voltage input.

2. Connect the current loop to the current source as shown in Figure 19.

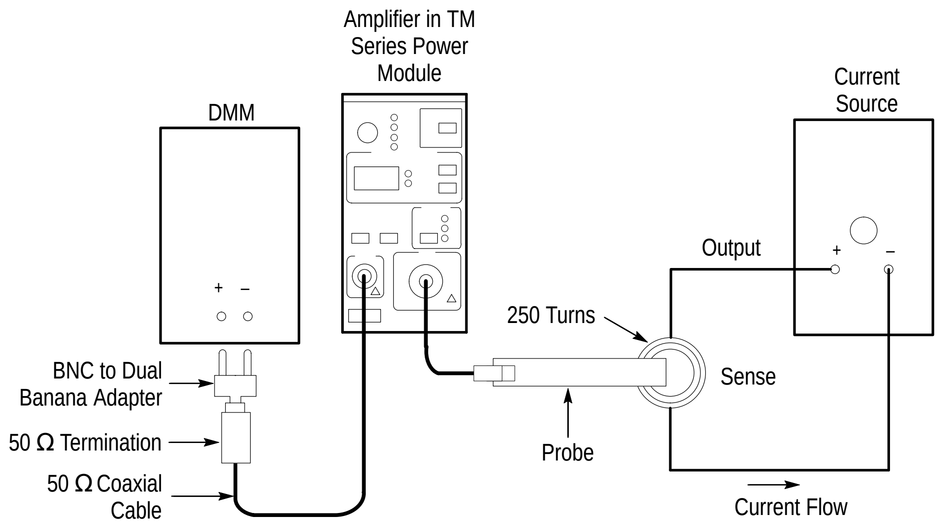

Figure 19: DC Gain Accuracy Test Setup for the A6304XL

Equipment Settings

Make or check the equipment settings in Table 32.

Table 32: Equipment Settings for DC Gain Accuracy

Digital Multimeter	
Measurement	DC volts
Current Source	
Output	Off
AM 503B and AM 5030	
Coupling	DC
BW Limit	On
Current/division	500 mA/division
Probe trim	000

WARNING. *This test produces intense magnetic fields that may cause malfunctions in a normally operating heart pacemaker or damage sensitive equipment. Personnel fitted with pacemakers should not perform this test, and should stay at least 10 feet from the current loop while the test is being conducted.*

Procedure

1. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.

2. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.

3. Clamp the current probe around the current loop. Check that the arrow-shaped indicator on the probe points away from the current source. (See Figure 19 on page 59.)

4. For each of the Amplifier current/division settings in Table 33 on page 61, perform the following steps:

   a. Set the Amplifier to the desired current/division setting from Table 33.

   b. Set the current source to the correct positive test current using Table 33.

   c. Turn on the current source.

   d. Record the exact measurement of the digital multimeter as M_1. (You can copy Table 34 on page 62 to record the results of your measurements.)

   e. Set the current source for the correct negative test current using Table 33.

   f. Record the digital multimeter reading as M_2.

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

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

   For example, you might have obtained values of 50 mV for M_1 and 48 mV for M_2. If you are using an Amplifier setting of 1 A/division, you can compute I_m as:

   $$I_m = \frac{(50.0x10^{-3}) - (-48x10^{-3})}{0.01} \times 1 = 9.80\,A$$

   h. Verify that the measured current (I_m) is within ±3% of the test current (I_t) by computing *%Error* as follows:

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

   For example, using a test current I_t of 10 A and a measured current I_m of 9.80 A, the *%Error* would be:

   $$\%Error = \frac{9.80 - 10.0}{10.0} \times 100 = -2\%$$

Table 33: DC Gain Accuracy Test for the A6304XL

Turns of Current Loop Passing Through Probe	AM 503B and AM 5030 Current/Division	Current Source Output	Test Current I_t
250	500 mA	±10 mA	5 A
250	1 A	±20 mA	10 A
250	2 A	±40 mA	20 A
250	5 A	±100 mA	50 A
250	10 A	±200 mA	100 A
250	20 A	±400 mA	200 A
250	50 A	±1 A	500 A
250	100 A	±2 A	1000 A
250	200 A	±2 A	1000 A

Table 34: DC Gain Accuracy Test Work Sheet for the A6304XL

Turns of Current Loop Passing Through Probe	AM 503B and AM 5030 Current/Division	Current Source Output	Test Current I_t	M_1	M_2	I_m (Note A)	*%Error* (Note B)
250	500 mA	±10 mA	5 A				
250	1 A	±20 mA	10 A				
250	2 A	±40 mA	20 A				
250	5 A	±100 mA	50 A				
250	10 A	±200 mA	100 A				
250	20 A	±400 mA	200 A				
250	50 A	±1 A	500 A				
250	100 A	±2 A	1000 A				
250	200 A	±2 A	1000 A				

Note A

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

Note B

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

Adjustment Procedures for Current Probes

Before performing the adjustment procedures, perform the following steps:

1. Install all plug-in units into the power modules.
2. Attach the current probe to be adjusted.
3. Turn the power on and allow the entire system to warm up for a minimum of 20 minutes. Also warm up any other test equipment used.

A6312, A6302 and A6302XL Adjustment

The following adjustment procedure describes how to adjust the DC offset of the A6312, A6302 and A6302XL. Tolerances that are specified in these procedures apply to the current probes and do not include test equipment error.

Required Test Equipment

To perform the adjustment procedure in this section, you will need the test equipment listed in Table 35. The test equipment must meet or exceed the specifications listed. The test procedure may need to be changed if the recommended equipment is not used.

Table 35: Required Test Equipment

Qty	Item	Description	Recommended Equipment
1	Oscilloscope	150 MHz bandwidth	TDS 520B
1	Current Probe Amplifier		AM 503B or AM 5030
1	Termination	50 Ω, BNC connector, feedthrough	011-0129-00
1	BNC Cable	50 Ω, 1.05 m (42 in) long	012-0057-01

A6312, A6302 and A6302XL DC Offset Adjustment

Figure 20 shows the location of the DC offset adjustment in the lower probe half.

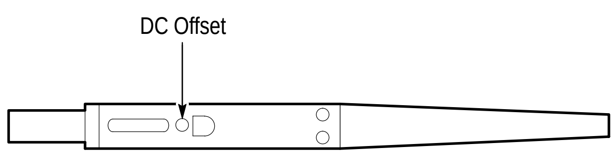

Figure 20: A6312, A6302 and A6302XL DC Offset Adjustment Location

Equipment Connections

1. Connect the Amplifier **OUTPUT** to a 50 Ω oscilloscope input using a 50 Ω BNC cable. 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 at the Amplifier output.

2. Connect the current probe to the Amplifier **INPUT** connector.

3. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.

Equipment Settings

Make or verify the equipment settings in Table 36:

Table 36: Settings for DC Offset Adjustment

AM 503B and AM 5030	
Coupling	DC
BW Limit	On (20 MHz bandwidth limit)
Current/division	10 mA/division
Oscilloscope	
Vertical Gain	10 mV/division
Time Base	1 ms/division, Auto triggered
Input Coupling	Ground

Procedure

1. Move the oscilloscope trace to the center horizontal graticule line using the vertical position control.
2. Set the oscilloscope input coupling to DC.
3. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.
4. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.

NOTE. *The Amplifier front panel will display error code 266 after the degauss/autobalance routine completes if the Amplifier is not properly terminated into 50 Ω. Verify that the oscilloscope input is 50 Ω and set to DC coupling. If necessary, use a 50 Ω termination at the oscilloscope input.*

5. If no error codes are displayed after the degauss/autobalance routine completes, no offset adjustment is necessary. If any of the error codes listed in Table 37 are displayed, continue with the procedure.

Table 37: Error Codes Requiring DC Offset Adjustment

Error Code	Meaning
580	Unable to complete negative offset adjustment
581	Unable to complete positive offset adjustment

6. Press and hold the **20 MHz BW LIMIT** button, and while holding it, press the **PROBE DEGAUSS AUTOBALANCE** button. This sets the front panel display to –00 and puts the AM 503B and AM 5030 into an internal test mode.

7. Press the **CURRENT/DIVISION** ⇩ button until the front panel display reads **–52**.

8. Press and release the **20 MHz BW LIMIT** button. The Amplifier will degauss itself; wait until the DEGAUSS light goes out.

9. Adjust the DC Offset control so that the oscilloscope trace is on the center graticule line (zero offset), ±1 division.

10. Press and release the **20 MHz BW LIMIT** button, then press and release the **COUPLING** button. This exits the AM 503B and AM 5030 test mode.

A6303 and A6303XL Adjustments

Each of the following adjustment procedures describes how to adjust specific performance characteristics of the A6303 and the A6303XL. Tolerances that are specified in these procedures apply to the current probes and do not include test equipment error.

Required Test Equipment

To perform the adjustment procedures in this section, you will need the test equipment listed in Table 38. The test equipment must meet or exceed the specifications listed. The test procedures may need to be changed if the recommended equipment is not used.

Table 38: Required Test Equipment

Qty	Item	Description	Recommended Equipment
1	Oscilloscope	150 MHz bandwidth	TDS 520B
1	Current Probe Amplifier		AM 503B or AM 5030
1	Calibration Generator	DC or 1 kHz square wave, 5 V_{p-p} into 50 Ω, 0.5% vertical accuracy	PG 506A
1	Current Loop	50 Ω	015-0601-50
1	Termination	50 Ω, BNC connector, feedthrough	011-0129-00
2	BNC Cables	50 Ω, 1.05 m (42 in) long	012-0057-01
1	BNC T-adapter	50 Ω	103-0030-00

A6303 and A6303XL DC Offset Adjustment

This procedure describes how to adjust the DC offset of the A6303 and A6303XL using the DC Offset adjustment. Refer to Figure 21 when performing this procedure.

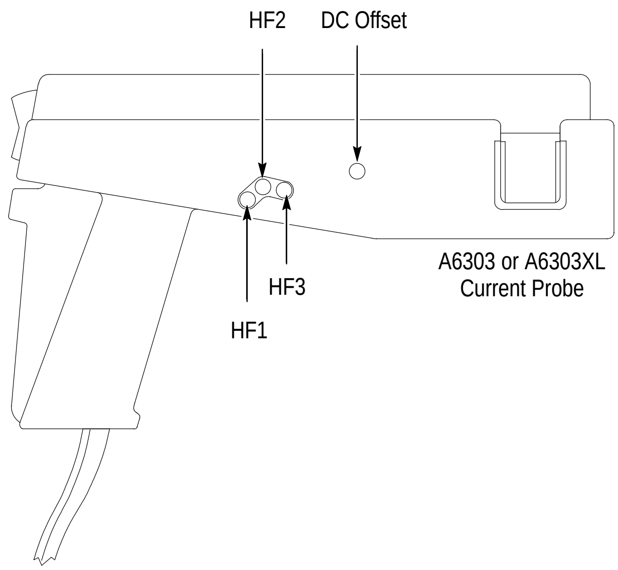

Figure 21: A6303 and A6303XL Adjustment Locations

Equipment Connections

1. Connect the Amplifier **OUTPUT** to a 50 Ω oscilloscope input using a 50 Ω BNC cable. 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 at the Amplifier output.
2. Connect the current probe to the Amplifier **INPUT** connector.
3. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.

Equipment Settings

Make or verify the equipment settings in Table 39:

Table 39: Settings for DC Offset Adjustment

AM 503B and AM 5030	
Coupling	DC
BW Limit	Off (full bandwidth)
Current/division	10 mA/division
Oscilloscope	
Vertical Gain	10 mV/division
Time Base	1 ms/division, Auto triggered
Input Coupling	Ground

Procedure

1. Move the oscilloscope trace to the center horizontal graticule line using the vertical position control.
2. Change the oscilloscope input coupling to DC.
3. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.
4. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.

NOTE. *The Amplifier front panel will display error code 266 after the degauss/autobalance routine completes if the Amplifier is not properly terminated into 50 Ω. Verify that the oscilloscope input is 50 Ω and set to DC coupling. If necessary, use a 50 Ω termination at the oscilloscope input.*

5. If no error codes are displayed after the degauss/autobalance routine completes, no offset adjustment is necessary. If any of the error codes listed in Table 40 are displayed, continue with the procedure.

Table 40: Error Codes Requiring DC Offset Adjustment

Error Code	Meaning
580	Unable to complete negative offset adjustment
581	Unable to complete positive offset adjustment

6. Remove the probe access plug for the DC Offset adjust (see Figure 21).

7. Press and hold the **20 MHz BW LIMIT** button, and while holding it, press the **PROBE DEGAUSS AUTOBALANCE** button. This sets the front panel display to –00 and puts the AM 503B and AM 5030 into an internal test mode.
8. Press the **CURRENT/DIVISION** ⇩ button until the front panel display reads **–52**.
9. Press and release the **20 MHz BW LIMIT** button. The Amplifier will degauss itself; wait until the DEGAUSS light goes out.
10. Adjust the DC Offset control so that the oscilloscope trace is on the center graticule line (zero offset), ±1 division.
11. Press and release the **20MHz BW LIMIT** button, then press and release the **COUPLING** button. This exits the AM 503B and AM 5030 test mode.

A6303 and A6303XL Transient Response and Gain Adjustment

This procedure describes how to optimize the transient response and gain of the A6303 and A6303XL using adjustments HF1, HF2, and HF3. Refer to figures 21 and 22 when performing this procedure.

***NOTE**. The A6303XL has only a single adjustment located at the HF2 position.*

Equipment Connections

1. Connect the calibration generator output to a 50 Ω oscilloscope input using a 50 Ω BNC cable. 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.
2. Connect the current probe to the Amplifier **INPUT** connector.

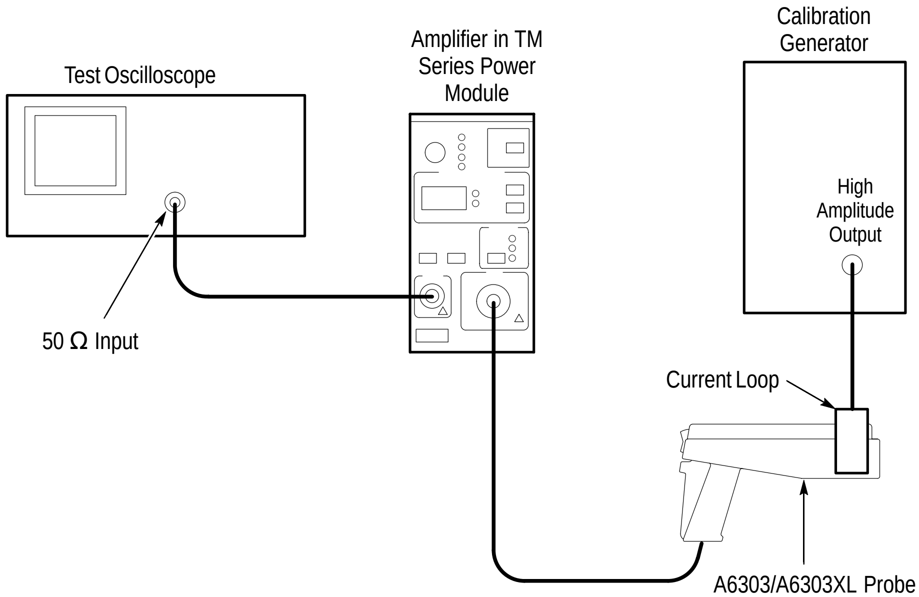

Figure 22: A6303 and A6303XL Adjustment Setup

Equipment Settings

Make or verify the equipment settings in Table 41:

Table 41: Settings for Transient Response and Gain Adjustments

AM 503B and AM 5030	
Coupling	DC
BW Limit	Off (full bandwidth)
Current/division	20 mA/division
Oscilloscope	
Vertical Gain	1 V/division
Time Base	100 μs/division, Auto triggered
Input Coupling	Ground
Calibration Generator	
Period	0.1 ms
Function	High amplitude

Procedure

1. Move the oscilloscope trace up one graticule line from the bottom of the screen.
2. Change the oscilloscope input coupling to DC.
3. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.

4. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.

***NOTE**. The Amplifier front panel will display error code **266** after the degauss/autobalance routine completes if the Amplifier is not properly terminated into 50 Ω. Verify that the oscilloscope input is 50 Ω and set to DC coupling. If necessary, use a 50 Ω termination at the oscilloscope input.*

5. Adjust the calibration generator to produce an amplitude of five graticule divisions (5 volts).

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

6. Disconnect the BNC cable from the calibration generator and attach it to the Amplifier **OUTPUT** connector (see Figure 22 on page 73).

7. Attach the current loop to the probe and lock the probe.

8. Connect the current loop to the calibration generator output using another coaxial cable.

9. Reset the vertical gain of the oscilloscope to 10 mV/division and the time base to 100 μs/division.

10. Reset the period of the calibration generator to 1 ms.

11. Remove the probe access plugs for HF1, HF2, and HF3. Remove the HF2 plug only for the A6303 (see Figure 21 on page 70).

12. Adjust the probe for optimum performance:

- A6303: Adjust HF1, HF2, and HF3 for an oscilloscope display of five divisions and optimum transient response.
- A6303XL: Adjust only HF2 for an oscilloscope display of five divisions and optimum transient response. The A6303XL does not have controls in the HF1 and HF3 positions.

***NOTE**. The HF1, HF2, and HF3 adjustments on the A6303 interact. Adjusting them can be a repetitive process. You may need to balance between transient response and gain in order to meet both specifications at once.*

A6304XL Adjustments

Each of the following adjustment procedures describes how to adjust specific performance characteristics of the A6304XL. Tolerances that are specified in these procedures apply to the current probe and do not include test equipment error.

Required Test Equipment

To perform the adjustment procedures in this section, you will need the test equipment listed in Table 42. The test equipment must meet or exceed the specifications listed. The test procedures may need to be changed if Tektronix equipment is not used.

Perform the steps on page 63 before starting these procedures. Also, read each procedure through completely before starting to ensure proper completion.

Table 42: Required Test Equipment

Qty	Item	Description	Recommended Example
1	Oscilloscope	20 MHz bandwidth	Tektronix TDS 520B
1	Current Probe Amplifier		AM 503B or AM 5030
1	Calibration Generator	Square wave with a rise time <35 ns, 5 A into 50 Ω	AVTECH[1] AVR-3-PW-C-P-TEK2
1	Digital Multimeter	0.25% $3^1/_2$ digit resolution at ± 50 mV	DM2510/G or Fluke 850x/884x
1	Current Source	0.3% accuracy, 0 to ±2 A	Fluke 5700A or Wavetek 9100 with Option 250
1	Current Loop	250 turns	067-0240-00
1	Termination	50 Ω, ±0.1%, 0.5 W	011-0129-00
3	BNC Cables	50 Ω, 1.05 m (42 in) long	012-0057-01
1	BNC to Dual Banana Adapter		103-0090-00

[1] **AVTECH Electrosystems Ltd.**
P.O. Box 265, Ogdensburg NY 13669-0265
(315) 472-5270 or (800) 265-6681

A6304XL DC Offset Adjustment

This procedure details how to adjust the A6304XL offset.

Equipment Connections

1. Connect the Amplifier **OUTPUT** to a 50 Ω oscilloscope input using a 50 Ω BNC cable. 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 at the Amplifier output.
2. Connect the current probe to the Amplifier **INPUT** connector.
3. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.

Equipment Settings

Make or verify the equipment settings in Table 43:

Table 43: Settings for DC Offset Adjustment

AM 503B and AM 5030		
	Coupling	DC
	BW Limit	Off (full bandwidth)
	Current/division	1 A/division
Oscilloscope		
	Vertical Gain	10 mV/division
	Time Base	1 ms/division, Auto triggered
	Input Coupling	Ground

Procedure

1. Move the oscilloscope trace to the center horizontal graticule line using the vertical position control.
2. Change the oscilloscope input coupling to DC.
3. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.
4. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.

***NOTE**. The Amplifier front panel will display error code 266 after the degauss/ autobalance routine completes if the Amplifier is not properly terminated into 50 Ω. Verify that the oscilloscope input is 50 Ω and set to DC coupling. If necessary, use a 50 Ω termination at the oscilloscope input.*

5. If no error codes are displayed after the degauss/autobalance routine completes, no offset adjustment is necessary. Go to the *DC Gain Adjustment* on page 78.

6. If either of the error codes in Table 44 are displayed, continue with this procedure.

Table 44: Error Codes Requiring DC Offset Adjustment

Error Code	Meaning
580	Unable to complete negative offset adjustment
581	Unable to complete positive offset adjustment

7. Remove the probe access plug for the DC Offset adjust (see Figure 23).

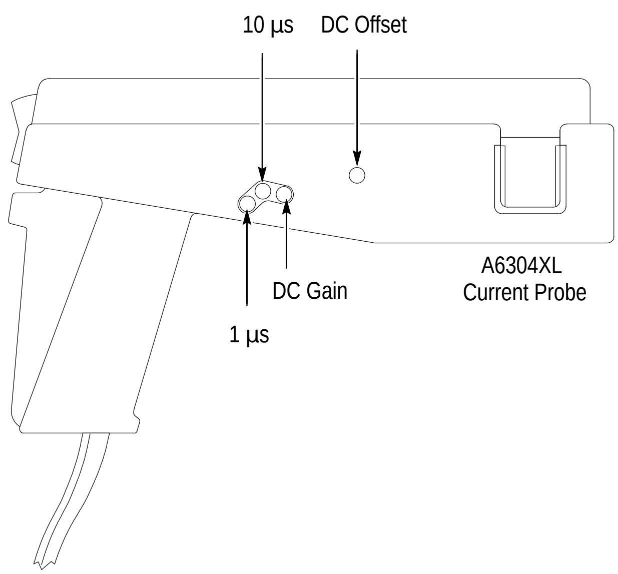

Figure 23: A6304XL Adjustment Locations

8. Press and hold the **20 MHz BW LIMIT** button, and while holding it, press the **PROBE DEGAUSS AUTOBALANCE** button. This sets the front panel display to –00 and puts the AM 503B and AM 5030 into an internal test mode.

9. Press the **CURRENT/DIVISION ⇩** button until the front panel display reads **–52**.

10. Press and release the **20 MHz BW LIMIT** button. The Amplifier will degauss the probe; wait until the DEGAUSS light goes out.

11. Adjust the DC Offset control so that the oscilloscope trace is on the center graticule line (zero offset), ±1 division.

12. Press and release the **20MHz BW LIMIT** button, then press and release the **COUPLING** button. This exits the AM 503B and AM 5030 test mode.

DC Gain Adjustment

This procedure adjusts the DC gain accuracy of the A6304XL probe.

CAUTION. *This test produces magnetic fields that may cause a malfunction in normally operating heart pacemakers or damage sensitive equipment. Personnel fitted with pacemakers should not perform this test and should stay at least 10 feet from the current loop while the test is being conducted.*

Equipment Settings

Make or check the equipment settings in Table 45:

Table 45: Equipment Settings for DC Gain Accuracy

Digital Multimeter	
Measurement Type	DC volts
Current Source	
Output	Off
AM 503B and AM 5030	
Coupling	DC
BW Limit	On
Current/division	10 A/division
Probe trim	000

Equipment Connections

1. Using a BNC cable, connect the Amplifier **OUTPUT** to a 50 Ω feedthrough termination. Attach the termination to a BNC-to-dual banana adapter. Taking care to observe the adapter polarity, insert the dual banana adapter into the digital multimeter DC voltage input.

2. Connect the current loop to the current source as shown in Figure 24.

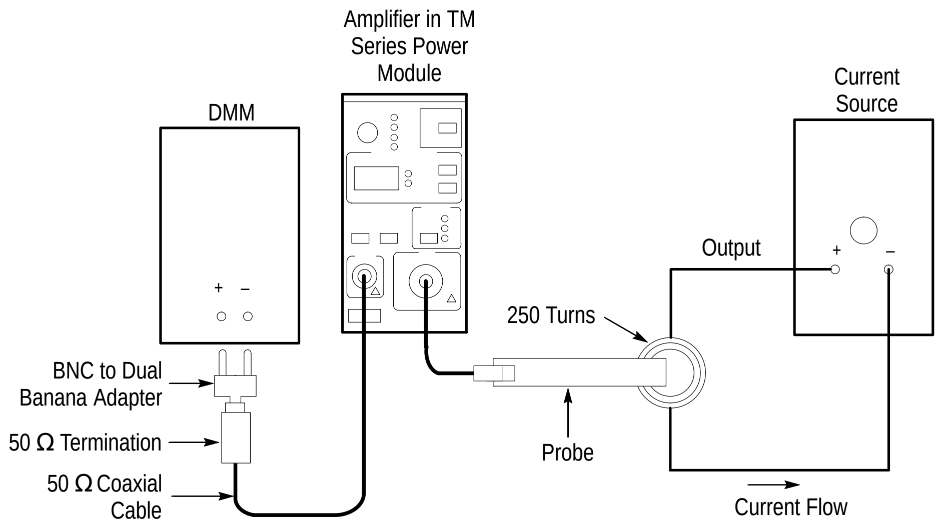

Figure 24: DC Gain Accuracy Adjustment Setup

Procedure

1. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.
2. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.
3. If necessary, adjust **DC LEVEL** on the amplifier for a zero reading on the DMM.
4. Clamp the current probe around the current loop. (See Figure 24.) Check that the arrow-shaped indicator on the probe points away from the current source.
5. Adjust the current output of the power supply to 200 mA.
6. The DMM reading should be 50 mV. If you could not set your current source to exactly 200 mA, use the formula below:

$$\text{DMM voltage reading} = \frac{\text{current source reading} \times 250 \text{ turns}}{10 \text{ Amps/division}} \times 10 \text{ mV/division}$$

7. If the reading is not correct, adjust **DC GAIN** on the A6304XL for a correct reading on the DMM. See Figure 23 on page 77.

A6304XL Transient Response Adjustment

This procedure describes how to optimize the transient response of the A6304XL using the 10 μs and 1 μs adjustments. Refer to figures 23 and 25 when performing this procedure.

Equipment Connections

1. Connect the Amplifier output to a 50 Ω oscilloscope input using a 50 Ω BNC cable. If the input impedance of your oscilloscope is 1 MΩ, connect a 50 Ω feedthrough termination to the oscilloscope input.
2. Connect the current probe to the Amplifier **INPUT** connector.

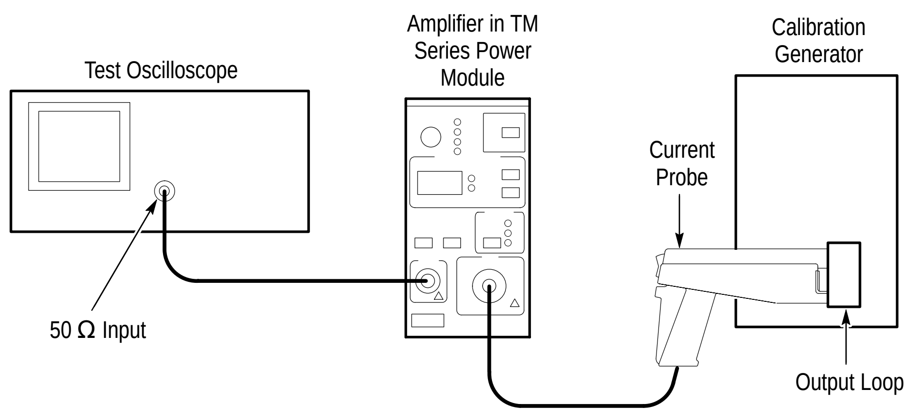

Figure 25: A6304XL Adjustment Setup

Equipment Settings

Make or verify the equipment settings in Table 46:

Table 46: Equipment Settings for Transient Response

Oscilloscope	
Vertical input impedance	50 Ω
Vertical gain	10 mV/division
Time base	100 μs/division
Record length	500
Coupling	DC
Offset	0 V (mid-scale)
Trigger type	Edge
Trigger mode	Normal
Trigger position	50%
Acquisition mode	Average
Number of waveforms to average	8
Measurement type	Rise Time

Table 46: Equipment Settings for Transient Response (Cont.)

Calibration Generator	
Pulse Width	250 µs
Pulse Repetition Frequency	20 Hz
Pulse Amplitude	5 A peak
AM 503B and AM 5030	
Coupling	DC
BW Limit	Off
Current/division	1 A/division

Procedure

1. Move the oscilloscope trace to one graticule line from the bottom of the screen.
2. Set the oscilloscope input coupling to DC.
3. Do not clamp the current probe around any conductor, but make sure the jaws are locked shut.
4. Remove the probe access plugs for 1 µs, 10 µs, and DC Gain.
5. Press the Amplifier **PROBE DEGAUSS AUTOBALANCE** button. Wait for the degauss/autobalance routine to complete before proceeding. The routine is complete when the indicator light turns off.

***NOTE**. The Amplifier front panel will display error code **266** after the degauss/autobalance routine completes if the Amplifier is not properly terminated into 50 Ω. Verify that the oscilloscope input is 50 Ω and set to DC coupling. If necessary, use a 50 Ω termination at the oscilloscope input.*

6. Lock the jaws of the probe around the calibrator current loop.
7. Adjust the oscilloscope to view the 100 µs portion of the pulse.
8. Adjust the calibration generator to produce an amplitude of five graticule divisions (5 amps) at the 100 µs portion of the pulse.

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

9. Adjust the **10 µs** control for a flat waveform to match the level at the 100 µs point.
10. Adjust the oscilloscope sweep to 1 µs/div.

11. Adjust the **1 µs** control to flatten the front end of the pulse.

NOTE. *The 10 µs and 1 µs adjustments on the A6304XL interact. Adjusting them can be a repetitive process. You may need to balance between short and long term response in order to meet both specifications at once.*

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12. Disconnect the probe from the calibration generator current loop.

13. Verify the DC Gain Accuracy using the procedure on page 78.