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Instructions

Tektronix

A6312
100 MHz AC/DC Current Probe

070-9603-02

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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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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.

Injury Precautions

Avoid Electric Overload. To avoid electric shock or fire hazard, do not apply a voltage to a terminal that is outside the range specified for that terminal.

Avoid Electric Shock. To avoid injury or loss of life, do not connect or disconnect probes or test leads while they are connected to a voltage source.

Ground the Product. This product is indirectly grounded through the grounding conductor of the mainframe 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 in Wet/Damp Conditions. To avoid electric shock, do not operate this product in wet or damp conditions.

Do Not Operate in an Explosive Atmosphere. To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.

Product Damage Precautions

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Immerse in Liquids. Clean the probe using only a damp cloth. Refer to cleaning instructions.

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Symbols and Terms

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.*

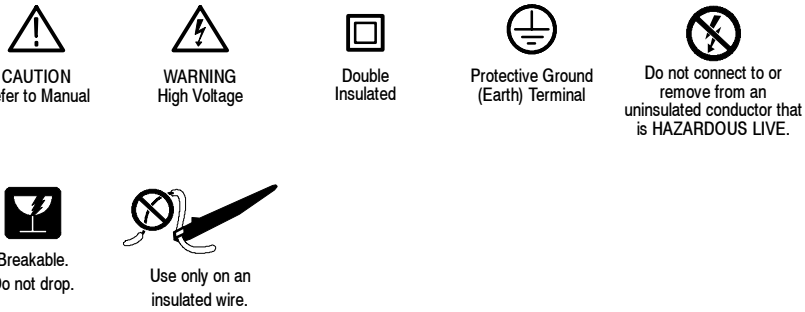
Terms on the Product. These terms may appear on the product:

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:



Certifications and Compliances

Refer to the specifications section for a listing of certifications and compliances that apply to this product.

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Preface

This instruction manual supports the operation and maintenance of the A6312 Current Probe with any of the AM503 series current probe amplifiers.

You can find additional documentation supporting the operation and maintenance of the AM 503 series amplifiers in the following manuals:

- *AM503 Instruction Manual* (070-2052-XX)
- *AM503S (AM503A) User Manual* (070-8170-XX)
- *AM503S (AM503A) Service Manual* (070-8174-XX)
- *AM503B & AM5030 Instruction Manual* (070-8766-XX)

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Sales support	1-800-833-9200, select option 1*
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Technical support	Email: techsupport@tektronix.com 1-800-833-9200, select option 3* 6:00 a.m. - 5:00 p.m. Pacific time

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Getting Started

The A6312 is a DC to 100 MHz current probe designed for use with the AM503 series current probe amplifiers. With the AM503A amplifier, you can measure frequencies up to 80 MHz. With the AM503, AM503B, and AM5030 amplifiers, you can measure frequencies up to 100 MHz. The A6312 current probe can measure currents to 20 A (DC + peak AC), and up to 50 A peak current (while not exceeding the amp-second rating).

This section explains how to install and operate the A6312 current probe.

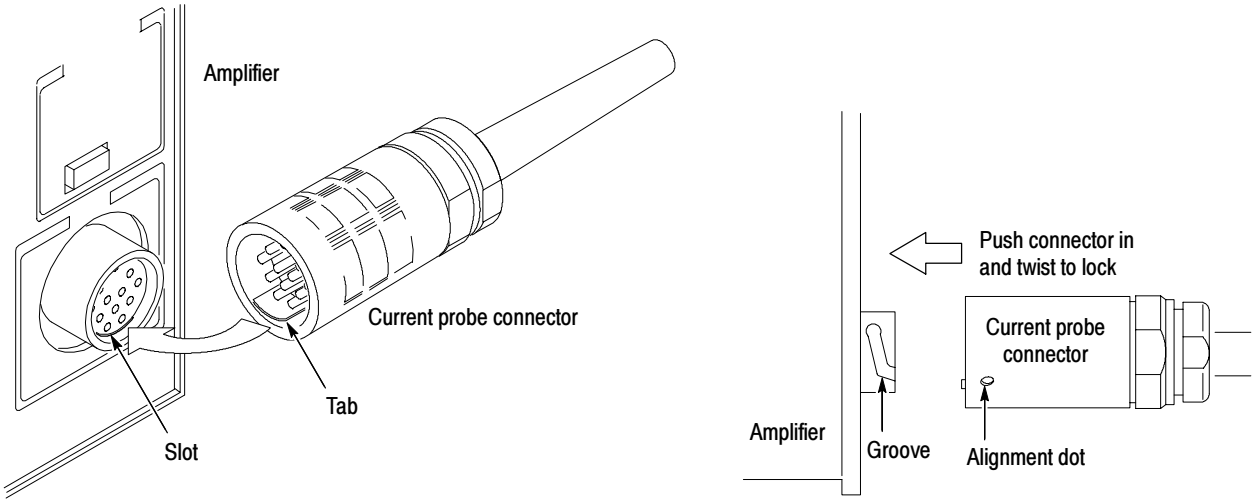
Probe Installation

To connect the current probe to the amplifier input connector, align the tab of the probe connector with the slot in the amplifier input connector as shown in Figure 1(a). Align the dot on the probe connector with the groove opening of the input connector as shown in Figure 1(b). Push the probe connector in while twisting the barrel clockwise to lock the connector.



CAUTION. *Handle the current probe with care. Do not drop the probe or subject it to impact, or the core may crack. Do not connect or disconnect the current probe while the probe is clamped around a live conductor or while the amplifier is powered on, or the probe may suffer electrical damage.*

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(a) Align the tab with the connector slot

(b) Insert the connector into the amplifier

Figure 1: Connecting a current probe to the current probe amplifier

Operating the Current Probe Slide

The current probe has a slide mechanism that opens and closes the probe jaw. This allows you to clamp the probe around a conductor under test. The slide must be locked to accurately measure current or to degauss the probe. If a probe is unlocked, the PROBE OPEN indicator on the amplifier lights.



WARNING. *When the probe slides are open, the exposed ferrite core pieces are not insulated. To avoid injury or equipment damage, remove power from an uninsulated wire before clamping the current probe around it. Also, never disconnect the probe from the amplifier when the probe is connected to a live conductor.*

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

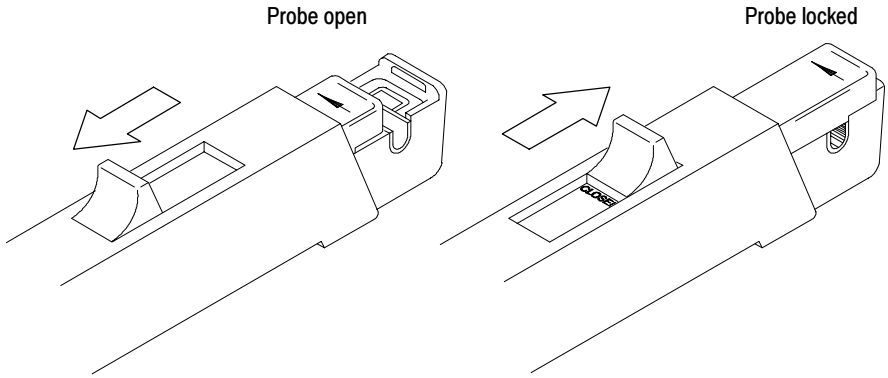


Figure 2: Operating the probe slide

Degaussing and Autobalancing the Current Probe

Degaussing the probe removes any residual magnetization from the probe core. Such residual magnetization can induce measurement error. Autobalancing removes unwanted DC offsets in the amplifier circuitry.

Failure to degauss the probe is a leading cause of measurement errors. To maintain measurement accuracy, degauss your probe in each of these cases:

- After turning on the amplifier and allowing a 20-minute warm-up period
- Before connecting the probe to a conductor, or changing conductors under test
- Whenever an overload condition occurs
- Whenever the probe is subjected to a strong external magnetic field
- Periodically during normal use

Degauss and autobalance the current probe as follows

1. Verify that the current probe is connected to the amplifier.
2. Remove the current probe from the conductor under test.
3. Lock the probe slide closed (see Figure 2).
4. Press the amplifier **PROBE DEGAUSS AUTOBALANCE** button.

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***NOTE**. The degauss procedure will fail if the amplifier is not properly connected to a 50 Ω termination impedance.*

After you have completed the oscilloscope adjustments and the degauss/autobalance procedure, your system is ready to measure current.

Maximum Current Limits

Current probes have three maximum current ratings: continuous, pulsed, and Ampere-second product. Exceeding any of these ratings can saturate the probe core and cause measurement errors. The section titled *Specifications* on page 7 lists the maximum current ratings of the probe.

- Maximum Continuous Current refers to the maximum current that can be continuously measured at DC or at a specified AC frequency. The maximum continuous current value is derated with frequency; as the frequency increases, the maximum continuous current rating decreases.
- Maximum Pulsed Current refers to the maximum peak value of pulsed current the probe can accurately measure, regardless of how short (within bandwidth limitations) the pulse duration.
- Ampere-Second Product defines the maximum width of pulsed current that you can measure when the pulse amplitude is between the maximum continuous and maximum pulsed current specifications. The maximum continuous specification itself varies by frequency.

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

To determine if your measurement exceeds the Ampere-second product, perform either Procedure A or Procedure B:

Procedure A

To determine the maximum allowable pulse width, measure the peak current of the pulse (see Figure 3a). Divide the Ampere-second (or Ampere-microsecond) specification of your probe by the measured peak current of the pulse. The quotient is the maximum allowable pulse width; the pulse width at the 50% point of the measured signal must be less than this value.

For example, the A6312 current probe has a maximum Ampere-second product of 100 A · µs. If a pulse measured with an A6312 has a peak current of 40 A, the maximum allowable pulse width would be 100 A · µs divided by 40 A, or 2.5 µs.

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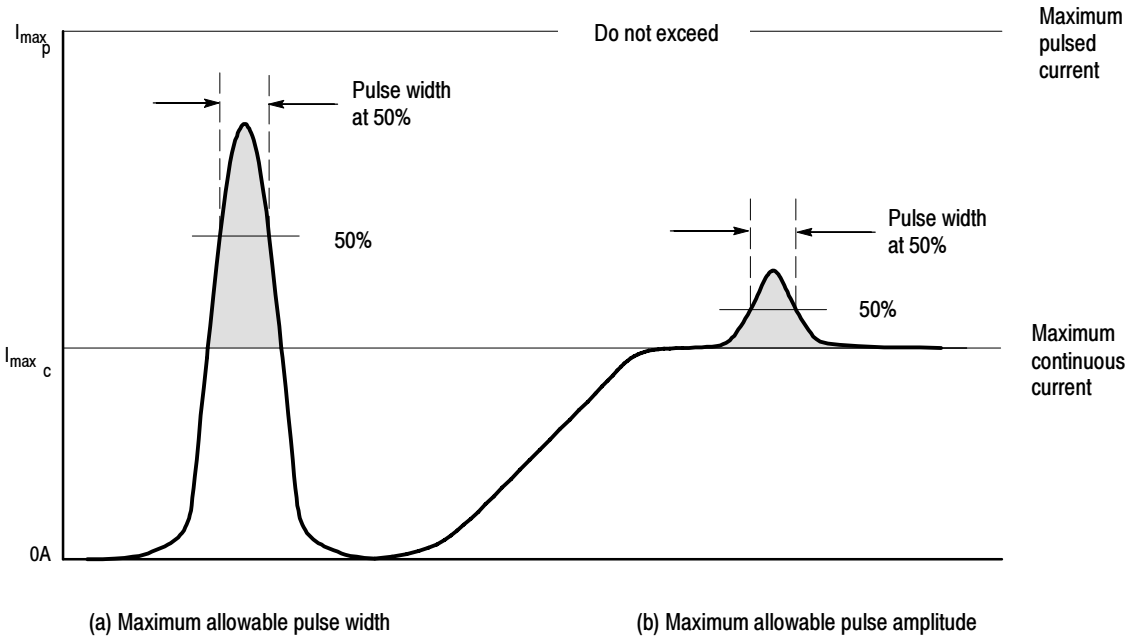


Figure 3: Applying the amp-second product rule

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Procedure B To determine the maximum allowable pulse amplitude, measure the pulse width at the 50% points (see Figure 3b). Divide the Ampere-second (or Ampere-microsecond) specification of your probe by the pulse width. The quotient is the maximum allowable current; the peak amplitude of the measured pulse must be less than this value.

For example, the A6312 current probe has a maximum Ampere-second product of 100 A · µs. If a pulse measured with an A6312 probe has a width of 3 µs, the maximum allowable peak current would be 100 A · µs divided by 3 µs, or 33.3 A.

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Specifications

This section lists the specifications, characteristics, certifications, and compliances for the A6312 current probe.

Warranted specifications, Table 1, are guaranteed performance specifications unless specifically designated as typical or nominal.

Table 1: Warranted A6312 specifications

	Installed amplifier		
Parameter	**AM503**	**AM503A**	**AM503B/AM5030**
Bandwidth	DC to 100 MHz, -3 dB	DC to 80 MHz, -3 dB	DC to 100 MHz, -3 dB
Rise time, 10% to 90%	≤3.5 ns[1]	≤4.4 ns	≤3.5 ns
Aberrations (typical)	$7\%_{P\text{-}P}$[1]	$7\%_{P\text{-}P}$	$7\%_{P\text{-}P}$
DC gain accuracy	≤3%	≤3%	≤3% (<1.5% typical)[2]
System noise (typical)	≤250 μA_{RMS}[3]	≤250 μA_{RMS}[3]	≤250 μA_{RMS}[3]

1 **You can optimize the pulse response by adjusting R364 (HF COMP) located inside the AM503 amplifier. Refer to the AM503 Instruction Manual (070-2052-XX) for instructions on how to access this adjustment.**

2 **On the AM503B and AM5030, the DC gain accuracy is correctable to < 0.2% when using the AM503B and AM5030 probe trim procedure described on page 22.**

3 **The bandwidth of the measurement instrument must be ≤ 500 MHz.**

Mechanical, electrical, and environmental characteristics for the A6312 current probe are listed in Tables 2 through 4 and Figures 4 through 7.

Table 2: Electrical characteristics

Frequency derating	2 A at 20 MHz
Maximum bare wire working voltage	300 V_{RMS}
Maximum continuous current	20 A (DC + peak AC)
Maximum pulsed current	50A
Amp · second product	1×10^{-4} A · s (100 A · μs)
Insertion impedance	0.1 Ω at 1 MHz 0.5 Ω at 50 MHz 1 Ω at 100 MHz

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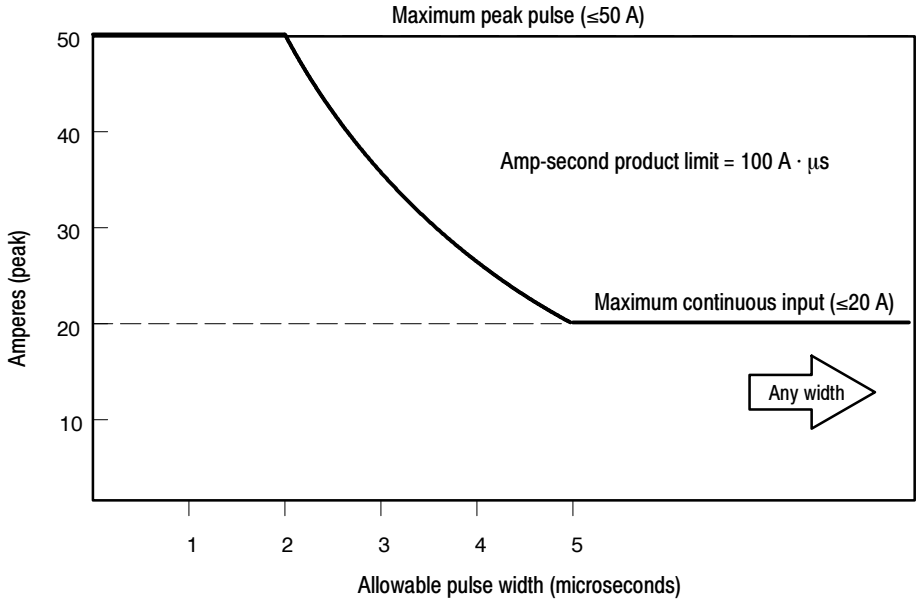


Figure 4: A6312 specified operating area

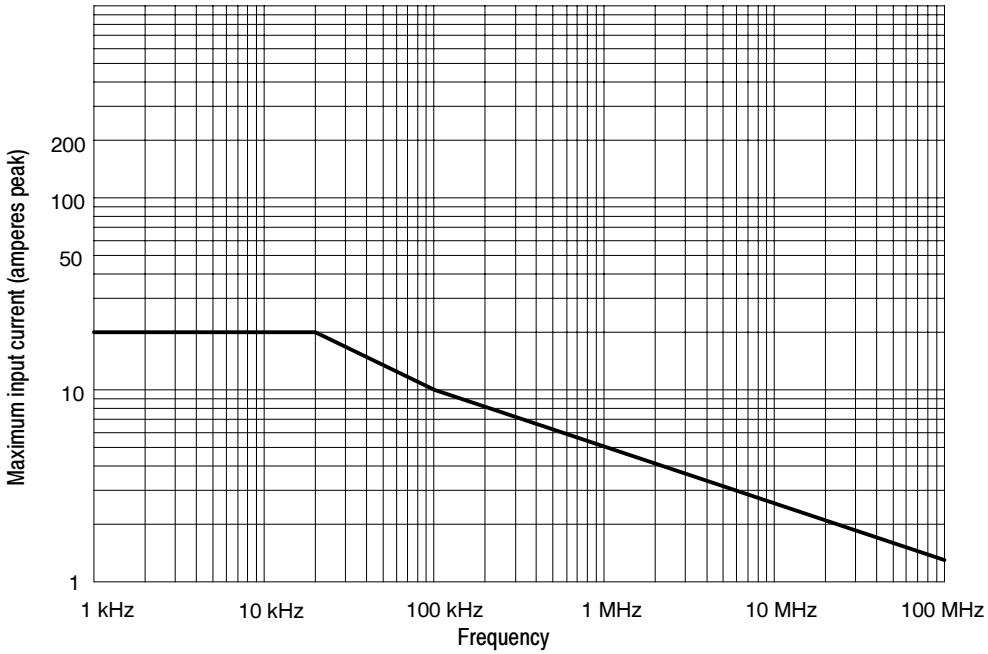


Figure 5: A6312 frequency derating curve for maximum input current

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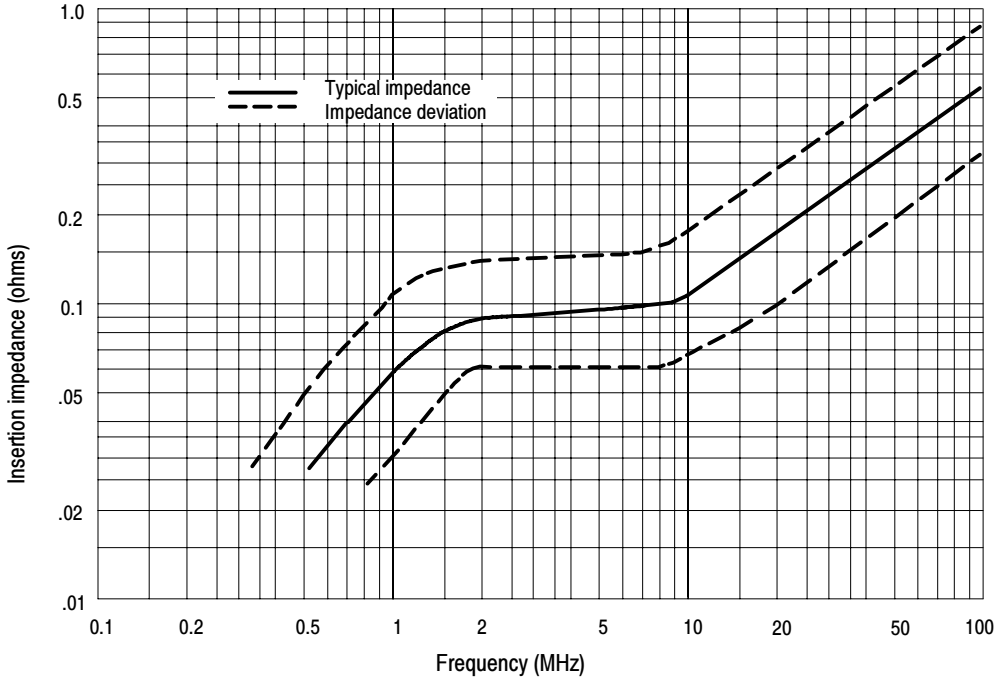


Figure 6: A6312 insertion impedance curve

Table 3: Mechanical characteristics

Probe dimensions	Length: Width: Height:	20 cm (7.77 inches) 1.6 cm (0.625 inches) 3.2 cm (1.25 inches)
Cable length	2 m (6.6 feet)	
Weight	255 g (0.56 lbs)	

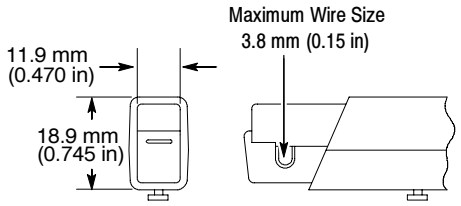


Figure 7: A6312 Probe jaw dimensions (nominal)

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Table 4: Environmental characteristics

Operating temperature	0° C to 50° C
Storage temperature	-40° C to 75° C
Humidity	
Nonoperating	30° C to 60° C at 90 to 95% RH
Operating	30° C to 50° C at 90 to 95% RH
Transportation	Qualifies under National Safe Transit Procedure 1A, category II, 36 in. drop
Mechanical shock	500 g. Half sine. Three shocks on three axes of the probe for 1 ms duration. Total of 9 shocks
Vibration	0.025 in. pk-pk displacement. 10 - 50 Hz in 1min. cycles. Hold 9 min. at any major resonance, or if none, at 55 Hz. Total time, 54 min
Random vibration	
Operating	0.31 g_{RMS}, 5 to 500 Hz, 10 minutes on each axis Tektronix Std. 062-2858-00, Rev. B, Class 3

Table 5 lists the product certifications and compliances.

Table 5: Certifications and compliances

EC Declaration of Conformity	Meets intent of Low Voltage Directive 73/23/EEC for Product Safety. Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities: Low Voltage Directive 73/23/EEC as amended by 93/68/EEC: EN 61010-1 EN 61010-2-032:1994	 Safety requirements for electrical equipment for measurement, control, and laboratory use Particular requirements for hand-held current clamps for electrical measurement and test
Certifications	Underwriters Laboratories certified to Standard UL3111-1 and CSA/CAN C22.2 No. 1010.1 for Electrical and Electronic Measuring and Testing Equipment. Underwriters Laboratories certified to Standard IEC1010-2-032, Particular requirements for hand-held current clamps for electrical measurement and test.	
Overvoltage category	Category: CAT III CAT II CAT I	Examples of Products in this Category: Distribution-level mains, fixed installation Local-level mains, appliances, portable equipment Signal levels in special equipment or parts of equipment, telecommunications, electronics
Pollution degree 2	Do not operate in environments where conductive pollutants may be present.	

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Performance Verification

The Performance Verification tests allow you to demonstrate that the A6312 current probe meets its specified levels of performance.

Tolerances that are specified in these procedures apply to the AM503 series current probe amplifiers and the A6312 current probe and do not include test equipment error.

The recommended calibration interval is one year.

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 on page 10.
- 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.

Before starting these procedures, read completely through each procedure to ensure proper completion.

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.

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***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 displays 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.*

Required Test Equipment

To perform the acceptance tests in this section, you will need the test equipment listed in Table 6. 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 6: Required test equipment

Qty	Item	Description	Recommended Equipment
1	Oscilloscope	500 MHz bandwidth	TDS520B
1	Current probe amplifier	AM503 series	Select the amplifier as noted on page 13.
1	Leveled sine wave generator	3 MHz to 100 MHz, ±4% flatness	Wavetek 9100 with Option 250 or SG503 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 PG506A 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 19.
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

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Performance and interchangeability of the A6312 probe depends upon the type of amplifier you select to verify the probe. When selecting one of the AM503 series amplifiers, please note the following:

- If you select the AM503B or AM5030 amplifier, the procedures verify the A6312 probe to 100 MHz and the probe is then interchangeable between either amplifier.
- If you select the AM503 amplifier, you must verify the probe and AM503 as a system. The procedures verify the A6312 probe to 100 MHz and the probe is *not* interchangeable with any other amplifier or system.
- If you select the AM503A amplifier, you must verify the probe and AM503A as a system. The procedures verify the A6312 probe to 80 MHz and the probe is *not* interchangeable with any other amplifier or system.

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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 8 when making equipment connections.

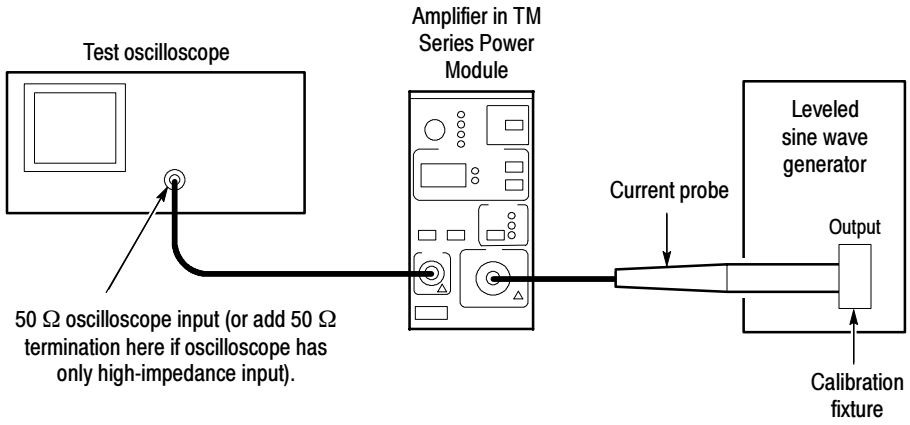


Figure 8: Bandwidth test setup for the A6312 current probe

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 7.

Table 7: 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)

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Table 7: 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}
Current probe amplifier	
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 1 on page 7.
7. Using the peak-peak measurement capability of the oscilloscope, measure and record the peak-peak reading as M_2.

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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:*

At 100 MHz,

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

For the AM503A at 80 MHz,

$$(1.12)\left(\frac{M_2}{M_1}\right) > 0.707$$

9. Verify that the bandwidth is greater than the warranted specification. Refer to Table 1 on page 7.

Rise Time

This procedure measures the rise time of the A6312 current probe. In this test you directly measure the rise time of a step input. Refer to Figure 9 when making equipment connections.

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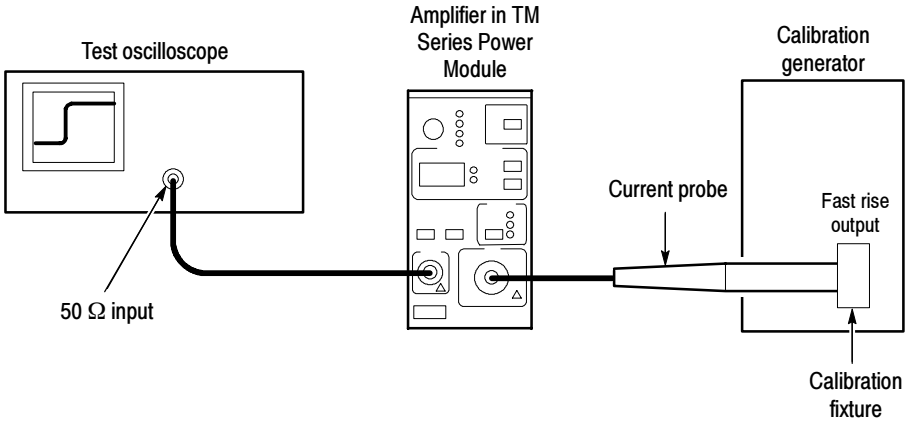


Figure 9: Rise time test setup for A6312

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 8:

Table 8: 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

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Table 8: Equipment settings for rise time (Cont.)

Oscilloscope	
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
Current probe amplifier	
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.)

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6. Verify that the probe rise time is less than the warranted specification. Refer to Table 1 on page 7.

***NOTE**. When using the A6312 on an AM503, you can optimize the pulse response by adjusting R364 (HF COMP) located inside the AM503 amplifier. Refer to the AM503 Instruction Manual (070-2052-XX) for instructions on how to access this adjustment. This information is in the service section of the manual and the adjustment should be performed by qualified service personnel only.*

DC Gain Accuracy

This procedure tests the DC gain accuracy of the A6312 current probe. 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 feedthrough termination. Attach the termination to a BNC-to-dual banana adapter. Taking care to observe and maintain polarity, insert the dual banana adapter into the digital multimeter DC voltage input.
2. Connect the current loop to the current source as shown in Figure 10.

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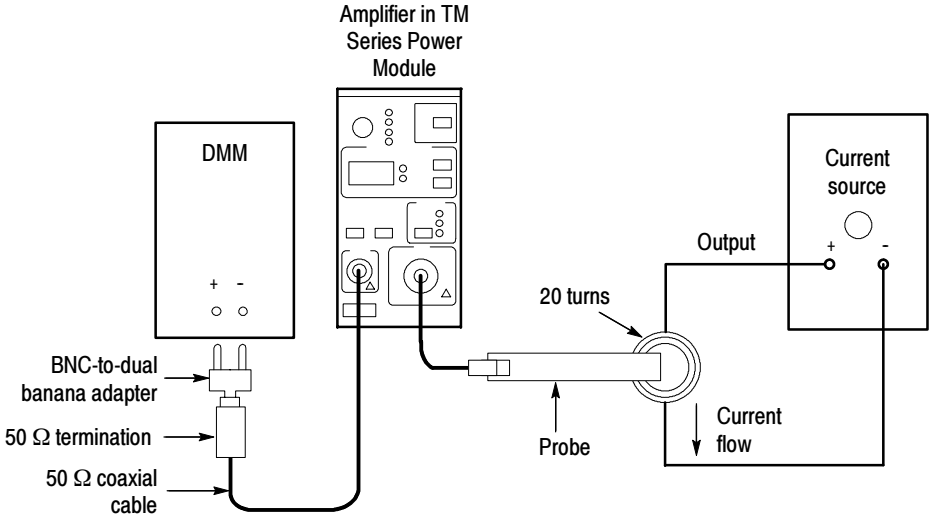


Figure 10: DC gain accuracy test setup for A6312

Equipment Settings

Make or verify the equipment settings in Table 9:

Table 9: Equipment settings for DC gain accuracy

Digital multimeter	
Measurement type	DC volts
Range	Autoranging
Current source	
Output	Off
Current probe amplifier	
Coupling	DC
BW limit	On
Current/division	1 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 20 turn current loop, as shown in Figure 10. Verify that the arrow-shaped indicator on the probe points away from the current source.

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4. For each of the amplifier current/division settings in Table 10, perform the following steps:

   a. Set the Amplifier to the desired current/division setting from Table 10.

   b. Set the current source to the correct positive test current using Table 10.

   c. Turn on the current source.

   d. Record the exact measurement of the digital multimeter as M_1. (You can copy Table 11 on page 23 to record the results of your measurements.)

   e. Set the current source for the correct negative test current using Table 10.

Table 10: DC gain accuracy test for A6312

Turns of current loop passing through probe	Current probe amplifier 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:

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

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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:

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

Probe Trim Adjust for Gain Accuracy (AM503B and AM5030 Only)

After the PROBE DEGAUSS AUTOBALANCE routine has been run, the probe and amplifier system will meet all published specifications; however, if you want to improve the tolerance of the system gain accuracy, or to intentionally offset the gain accuracy to make up for total system errors, the probe trim adjust routine may be performed.

Probe trim adjust is a multiplicative factor that you can use to adjust the gain of the current amplifier system. You can set this multiplier in increments of 0.001 from 0.750 through 1.250. Probe trim adjust is used for an optional calibration of some current probes. If you are not performing such an adjustment, leave probe trim adjust to the factory-default of unity gain (1.000).

To set probe trim adjust, press and hold the 20MHz BW LIMIT button while pressing and releasing the COUPLING button. Use the ⇧ and ⇩ buttons to adjust the setting that is displayed in the CURRENT/DIVISION display. When finished, press either the 20MHz BW LIMIT or COUPLING button to restore normal operation.

The display shows the last three significant digits of the display adjust setting; the leading 0. or 1. are omitted. If the first digit displayed is 7, 8, or 9, then the leading digit must be 0. If the first digit displayed is 0, 1, or 2, then the leading digit must be 1.

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Table 11: DC gain accuracy test work sheet for A6312

Turns of current loop passing through probe	Current probe amplifier current/division	Current source output	Test current I_t	M_1	M_2	I_m [1]	%Error [2]
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				

1 $$I_m = \frac{M_1 - M_2}{0.01} \times (current/division)$$

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

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DC Offset Adjustment

The following adjustment procedures describe how to adjust the DC offset of the A6312 using the AM503, AM503A, AM503B or AM5030 amplifiers. Tolerances that are specified in these procedures apply to the current probes and do not include test equipment error.

Refer to Figure 11 for the location of the DC offset adjustment.

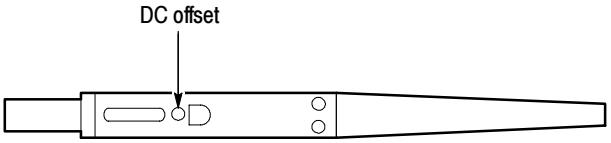


Figure 11: A6312 DC offset adjustment location

Required Test Equipment

To perform the adjustment procedures 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 procedure may need to be changed if the recommended equipment is not used.

Table 12: Required test equipment

Qty	Item	Description	Recommended equipment
1	Oscilloscope	150 MHz bandwidth	TDS460
1	Termination[1]	50 Ω, BNC connector, feedthrough	011-0049-01
3	BNC cable[1]	50 Ω, 1.05 m (42 in) long	012-0057-01

[1] **Provided as a standard accessory with the AM503 series amplifiers.**

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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, first 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 a conductor, but make sure the jaws are locked shut.

AM503B or AM5030

Use the following procedure to adjust the DC offset of the A6312 current probe when using an AM503B or AM5030 current probe amplifier.

Equipment Settings

Make or verify the equipment settings in Table 13:

Table 13: AM503B/AM 5030 settings for DC offset adjustment

AM503B and AM5030	
Coupling	DC
BW Limit	On (20 MHz bandwidth limit)
Current/division	10 mA/division
Oscilloscope	
Vertical Gain	10 mV/division
Time Base	Auto triggered 1 ms/division,
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 a 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.

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***NOTE**. If the amplifier is not properly terminated into 50 Ω, the amplifier front panel displays error code 266 after the degauss/autobalance routine completes. 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 14 are displayed, continue with the procedure:

Table 14: AM 503B/AM 5030 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 AM503B and AM5030 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 degausses 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), ± 2 divisions.
10. Press and release the **20 MHz BW LIMIT** button, then press and release the **COUPLING** button. This exits the AM503B and AM5030 test mode.

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AM503A

Use the following procedure to adjust the DC offset of the A6312 current probe when using an AM503A current probe amplifier.

Equipment Settings

Make or verify the equipment settings in Table 15:

Table 15: AM503A settings for DC offset adjustment

AM503A	
Coupling	DC
BW limit	On (20 MHz bandwidth limit)
Current/division	10 mA/division
Oscilloscope	
Vertical gain	10 mV/division
Time base	Auto triggered 1 ms/division,
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 a conductor, but make sure the jaws are locked shut.
4. Press the AM503A **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**. If the AM503A is not properly terminated into 50 Ω, the AM503A front panel displays error code 54 after the degauss/autobalance routine completes. 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 in Table 16 are displayed, continue with the rest of this procedure.

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Table 16: AM503A error codes requiring DC offset adjustment

Error code	Meaning
46	Unable to complete positive coarse offset adjustment
47	Unable to complete negative coarse offset adjustment
48	Unable to complete positive fine offset adjustment
49	Unable to complete negative fine 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 AM503A into an internal test mode.
7. Rotate the **CURRENT/DIVISION** knob until the front panel display reads **21**.
8. Press and release the **20 MHz BW LIMIT** button. This sets the AM503A internal offsets to zero.
9. Adjust the A6312 DC Offset control so that the oscilloscope trace is on the center graticule line (zero offset), ± 2 divisions.
10. Press and release the **20MHz BW LIMIT** button, then press and release the DC COUPLING button. This exits the AM503A test mode.

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AM503

Use the following procedure to adjust the DC offset of the A6312 current probe when using an AM503 current probe amplifier.

Equipment Settings

Make or verify the equipment settings in Table 17:

Table 17: AM 503 settings for DC offset adjustment

AM503	
Coupling	CAL DC LEVEL
BW limit	On (5 MHz bandwidth limit)
Current/division	10 mA/division
Oscilloscope	
Vertical gain	10 mV/division
Time base	Auto triggered 1 ms/division
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. Move the oscilloscope trace to the center horizontal graticule line using the AM503 DC LEVEL control.
4. Do not clamp the current probe around a conductor, but make sure the jaws are locked shut.
5. Press and release the DEGAUSS button.
6. Set the AM503 input coupling to DC.
7. Set the AM503 BALANCE adjustment to mid-position.
8. Adjust the A6312 DC Offset control so that the oscilloscope trace is on the center graticule line (zero offset), ± 2 divisions.
9. Press and release the DEGAUSS button.
10. If necessary, readjust the A6312 DC Offset control so that the oscilloscope trace is on the center graticule line (zero offset), ± 2 divisions.

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Maintenance

This section explains how to clean the A6312 current probe and, if necessary, disassemble the probe for maintenance or repair. Also included are instructions for preparing the probe for shipment.



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

Cleaning

To clean the probe body, use a soft cloth dampened in a solution of mild detergent and water. To clean the core, open the jaw and clean the exposed core surfaces with a cotton swap dampened with isopropyl alcohol (isopropanol) or ethyl alcohol (fotocol or ethanol).

Do not lubricate the jaws mating surfaces. Any lubricant between the core pieces should be removed with a recommended solvent.

Do not use chemicals containing benzine, benzene, toluene, xylene, acetone, or similar solvents.

Do not use a petroleum based lubricant on the plastic. If the plastic slide assembly requires lubrication, use a silicone based grease sparingly.

Do not immerse the probe in liquids or use abrasive cleaners.

Disassembly Instructions



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

1. Remove the two screws from the bottom of the probe and pull the strain relief boot back as shown in Figure 12.

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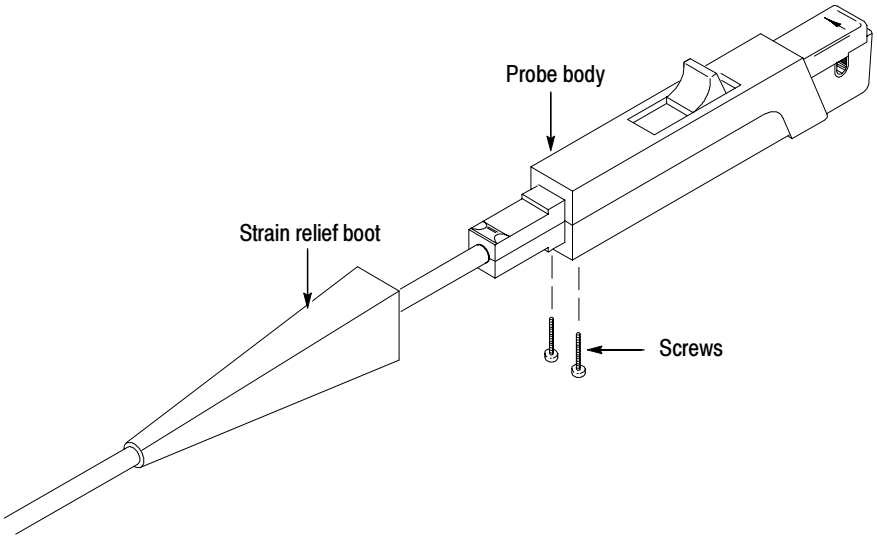


Figure 12: Removing the strain relief boot

2. Move the probe slide assembly to the open position.

***NOTE**. The probe slide contains a tiny metal ball. In step 3, be careful not to lose the ball by accidentally letting it fall out.*

3. Hold the probe in a top-up horizontal position and slide the top half of the probe body off as shown in Figure 13.
4. Remove the metal ball.
5. Turn the probe upside down, push the slide back slightly, and remove the slide (see Figure 14).

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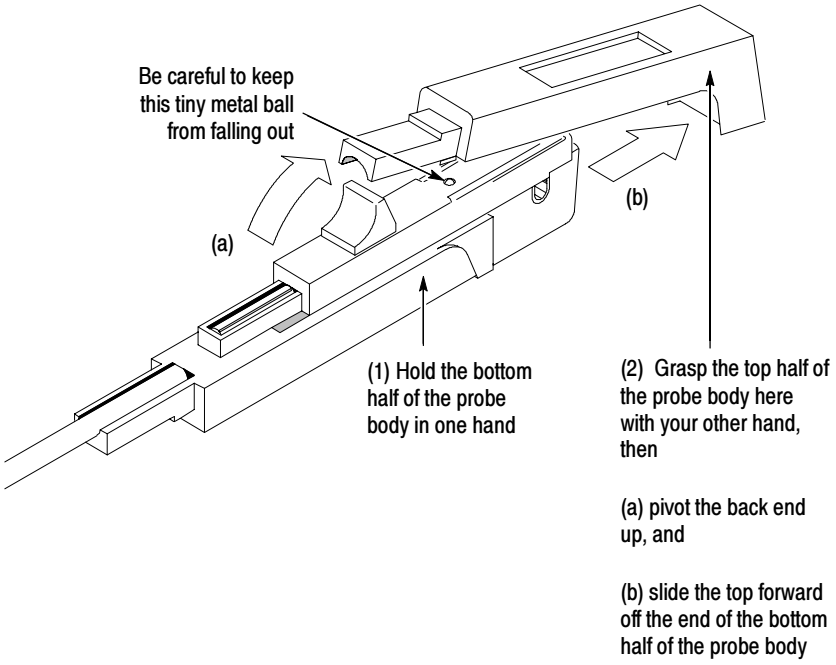


Figure 13: Removing the top half of the probe

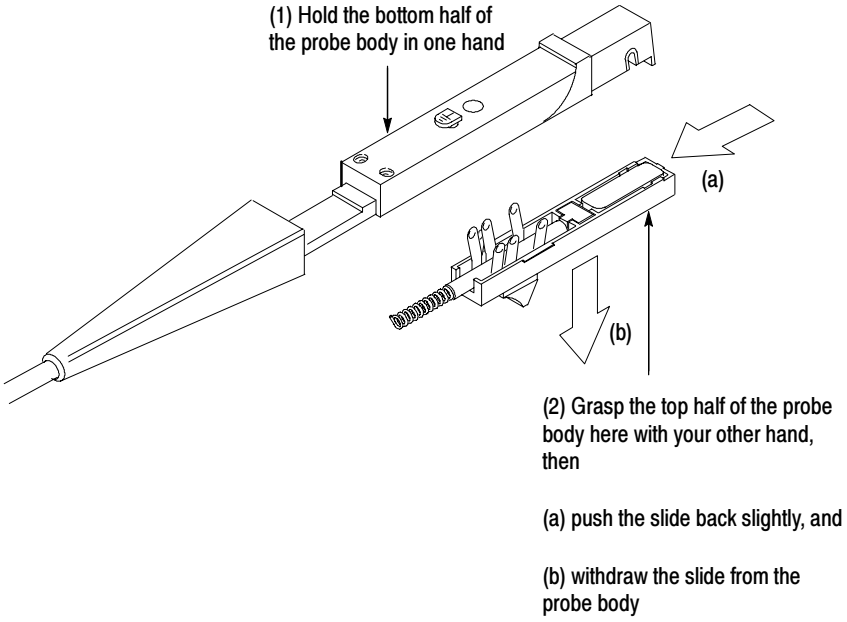


Figure 14: Removing the probe slide

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6. If you want to replace the current transformer, lift the front edge of the circuit board and transformer out of the probe and then pull the transformer out of the circuit board socket.

7. To remove the circuit board, unsolder the two connections then lift the strain relief and circuit board from the body half. Refer to Figure 15.

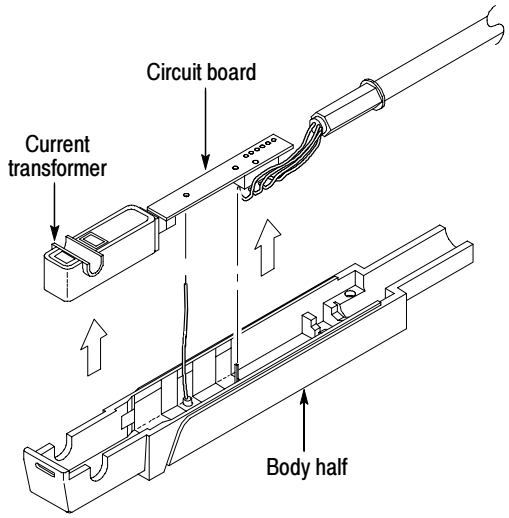


Figure 15: Removing the current transformer

8. Before reassembling the probe, be sure that the gap between the stationary and moveable core pieces is clean. If necessary, use isopropyl alcohol or a similar cleaning agent to clean the pieces. Also, clean the contacts of the slide switch, if necessary. Should the plastic slide assembly require lubrication, sparingly apply silicone-based grease to the parts.

   Probe reassembly is the reverse of steps 1 through 7.

***NOTE**. Exercise care when fitting the slide back into the probe body; aligning the switch contacts can require patience.*

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Obtaining Replacement Parts

Replacement parts may be obtained through your local Tektronix field office or representative. Refer to the Replaceable Parts List on page 35 for more information.

Preparation for Shipment

If you must ship your Tektronix product, please use the original packaging if possible. If the original packaging is unfit for use or not available, use the following packaging guidelines:

1. Use a corrugated cardboard shipping carton having inside dimensions at least one inch greater than the probe dimensions. The box should have a carton test strength of at least 200 pounds.
2. Put the probe into a plastic bag or wrap to protect it from dampness.
3. Place the probe into the box and stabilize it with light packing material.
4. Seal the carton with shipping tape.

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Replaceable Parts

This section contains a list of the components that are replaceable for the Current Probe. As described below, use these lists to identify and order replacement parts.

Parts Ordering Information

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

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

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

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

Using the Replaceable Parts List

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

Item Names

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

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Indentation System

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

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
(END ATTACHING PARTS)

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

Parts of Detail Part
Attaching parts for Parts of Detail Part
(END ATTACHING PARTS)

Attaching parts always appear at the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. Attaching parts must be purchased separately, unless otherwise specified.

Abbreviations

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

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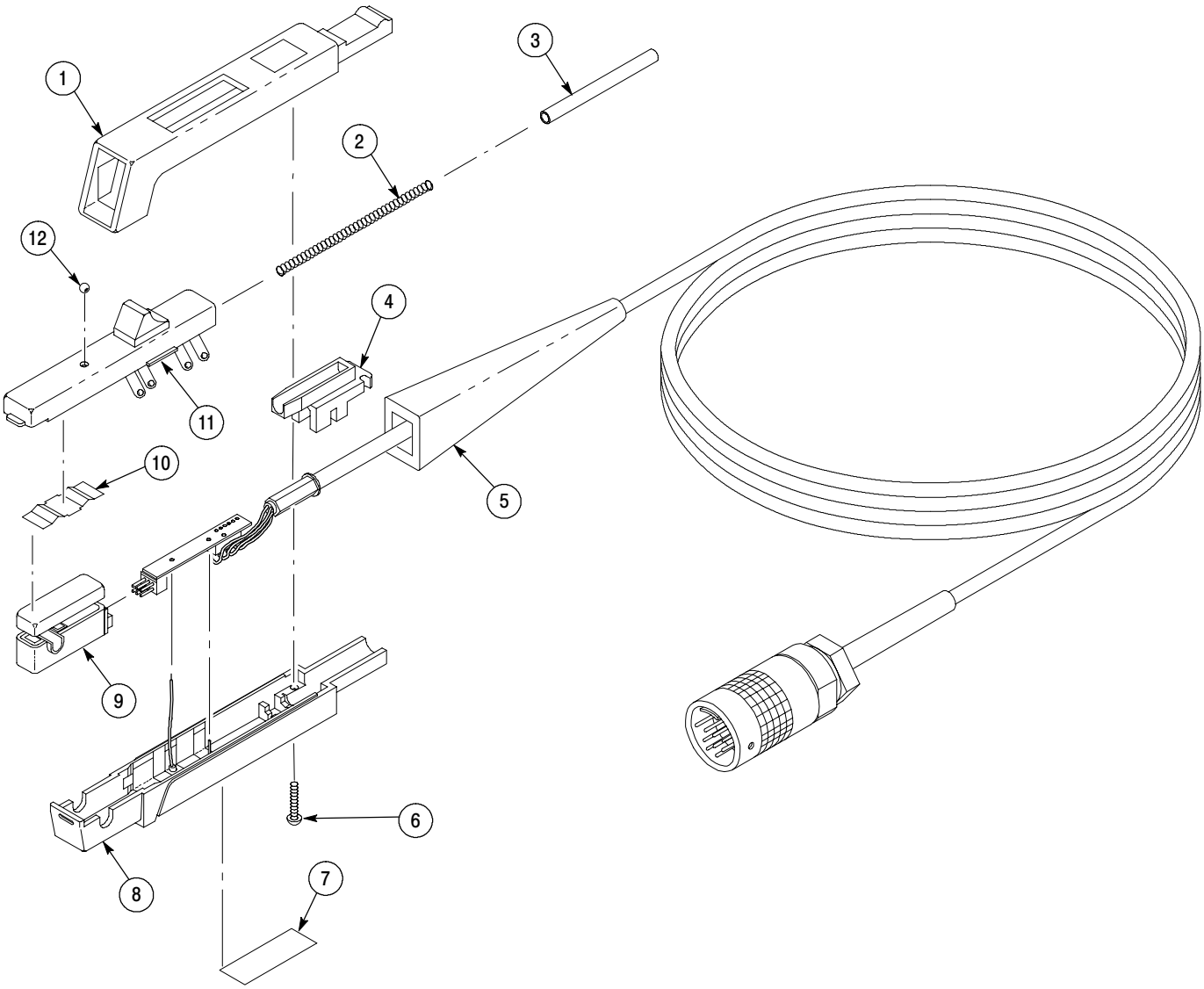


Figure 16: A6312 exploded view

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Replaceable parts list

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
16-	----------			1	PROBE, CURRENT:A6312		
-1	204-0288-03			1	BODY HALF,PROBE:UPPER BODY HALF,BLACK,POLY,A6302,	80009	204-0288-03
-2	214-0835-00			1	SPRING,HLCPS:0.127 OD X 2.65 L,SST	91260	ORDER BY DESCRIPTION
-3	214-0849-00			1	RTNR RETURN SPR:BRS CD PL P6042	80009	214-0849-00
-4	352-0106-00			1	HOLDER,SPR RTNR:DELRIN P6042	TK2565	352-0106-00
-5	650-3496-00			1	CABLE W/BD ASSY:CABLE W/A6312 PROBE CIRCUIT BOARD,A6312	80009	650-3496-00
-6	213-0087-00			2	SCREW,TPG,TC:2-32 X 0.5,TYPE BT,PANHEAD,STEEL,CADIUM PLATED,POZIDRIVE	3M099	ORDER BY DESCRIPTION
-7	334-8976-00			1	MARKER,IDENT:PROBE IDENT LABEL,A6312,	80009	334-8976-00
-8	204-0714-06			1	BODY,HALF:LOWER BODY HALF W/CONTACTS,A6302,	80009	204-0714-06
-9	120-1988-00			1	XFMR SUBASSY:UPPER & LOWER TRANSFORMER SUBASSY,A6312	80009	120-1988-00
-10	214-0854-00			1	CONTACT,ELEC:UPPER SHELF,CU BE	TK1947	214-0854-00
-11	351-0121-01			1	CONT ASSY,ELEC:PROBE SLIDE ASSY,A6302,	80009	351-0121-01
-12	214-0997-00			1	BALL,BEARING:0.094,SST	05469	ORDER BY DESCRIPTION
					Standard Accessories		
	020-0167-01			1	ACCESSORY PKG:ACCESSORY PACKAGE,P6021	80009	020-0167-01
	070-9603-XX			1	MANUAL,TECH:INSTRUCTIONS,A6312,DP	80009	070-9603-XX

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Manufacturers cross index

Mfr. Code	Manufacturer	Address	City, State, Zip Code
05469	BEARINGS INC	3634 EUCLID PO BOX 6925	CLEVELAND, OH 44101
3M099	PORTLAND SCREW COMPANY	6520 N BASIN AVE	PORTLAND, OR 97217
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON, OR 97077-0001
91260	CONNOR FORMED METAL PRODUCTS	1729 JUNCTION AVENUE	SAN JOSE, CA 95112
TK1947	NORTHWEST ETCH TECHNOLOGY	2601 S HOOD ST PO BOX 110610	TACOMA, WA 98411-0610
TK2565	VISION PLASTICS INC	26000 SW PARKWAY CENTER DRIVE	WILSONVILLE, OR 97070

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