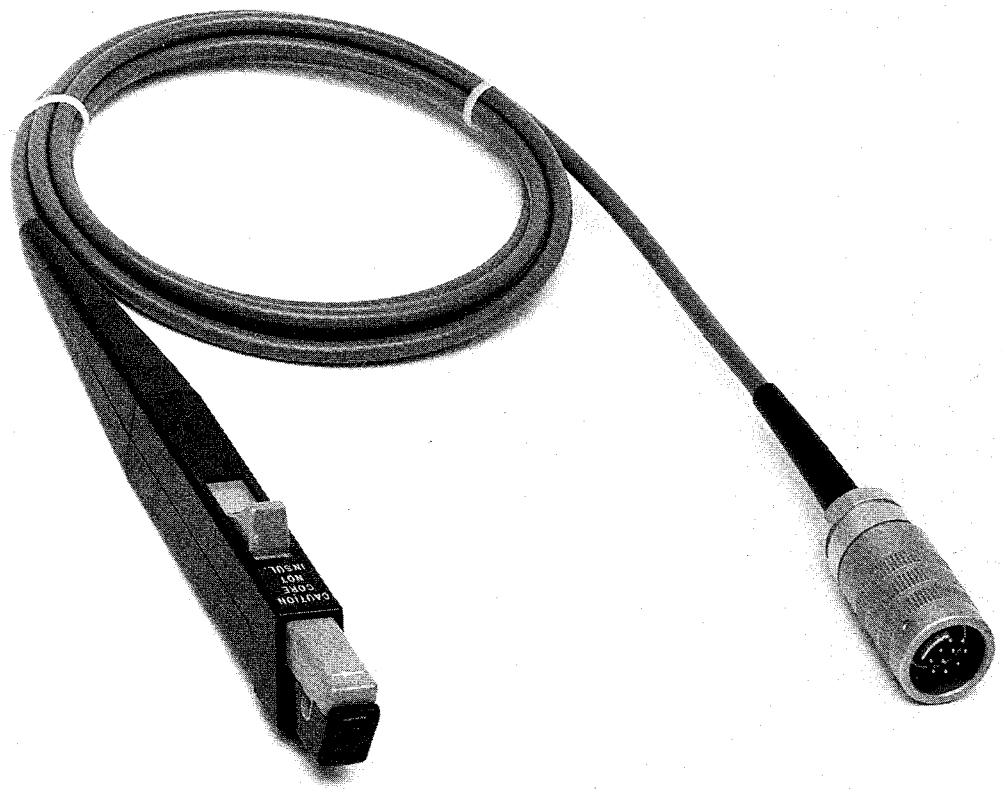
Tektronix®
COMMITTED TO EXCELLENCE

Instructions

A6302 Current Probe



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Product Group 60

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OPERATORS SAFETY SUMMARY

The general safety information in this part of the summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

Terms In This Manual

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

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

Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

Do Not Remove Covers or Panels

To avoid personal injury, do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.

SERVICING SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY

Refer also to the preceding Operators Safety Summary.

Do Not Service Alone

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

Use Care When Servicing With Power On

Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections or components while power is on.

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

DESCRIPTION

The A6302 is a dc to 50 MHz probe capable of measuring currents to 20 A dc (dc plus peak ac), and up to 50 A peak current, not to exceed the amp-second rating. The A6302 is designed for use with a Current Probe Amplifier.

A Hall generator device is used in the probe to provide dc and low-frequency current information. Low-frequency (from the Hall device) and high-frequency information (from the current transformer) are combined in the current probe amplifier to produce an accurate representation of the current being measured.

A spring-loaded slide permits the current transformer core to open and close around a conductor. The slide is pushed forward into the CLOSED position to measure the current in a conductor. A multi-pin connector is provided to permit connection of the probe to a current probe amplifier.

SPECIFICATION

The following instrument specification applies over an ambient temperature range of 0°C to +50°C, providing the instruments were calibrated in an ambient temperature range between +20°C and +30°C. The amplifier and probe must operate for at least 20 minutes before making measurements.

Table 1
ELECTRICAL CHARACTERISTICS

Characteristics	Performance Characteristics	Supplemental Information
Bandwidth	Dc to at least 50 MHz	
Risetime	7 ns or less	
Aberrations		
First 100 ns	≤±5%, total not to exceed 7% p-p; on 100 MHz oscilloscope system	
After 100 ns	≤±3%, total not to exceed 4% p-p; on 100 MHz oscilloscope system	
Noise	≤0.3 mA tangentially measured	Probe Amplifier Bandwidth at 100 MHz, sensitivity 1 mA
Maximum Input Current		
Dc + peak ac		20 A maximum (ac current not to exceed derating curve for continuous operation); see derating curve, Fig. 1
Peak Pulse		50 A maximum not to exceed Dynamic Range of AM 503
Maximum Voltage on bare conductor being tested		500 V (dc + peak ac)
External Voltage Feedthrough Susceptibility		250 μA/V or less at 50 MHz

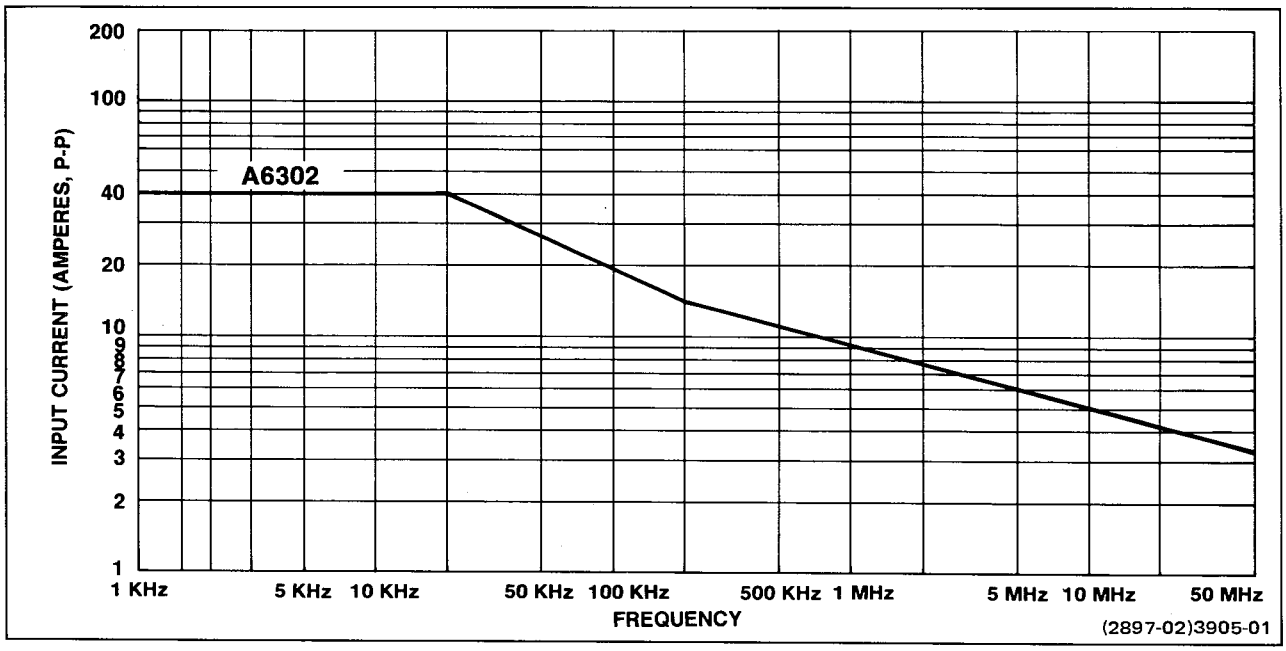


Fig. 1. Maximuim input current derating curve.

Table 2
ENVIRONMENTAL CHARACTERISTICS

Characteristic	Information
Temperature	
Non-Operating (Storage)	−55°C to +75°C
Operating	0°C to +50°C
Altitude	
Non-Operating	50,000 feet
Operating	15,000 feet

Table 3
PHYSICAL CHARACTERISTICS

Characteristic	Information
Dimensions, Probe Head	
Length	7.875 inches
Height	1.25 inches
Width	0.4375 inch
Jaw Size	0.15 inch

OPERATING CONSIDERATIONS

Ground Clip Leads

Two ground-clip leads are supplied with each probe. These leads are provided to ground the probe shield at the probe head to reduce high-frequency electrostatic voltages that could be coupled to the current transformer. Normally, the ground lead is not used in the 1, 2, and 10 mA sensitivities of the current probe amplifier due to undesirable currents that may appear in these more sensitive positions. When observing high-frequency signals, use the short ground lead.

Insertion Impedance

The insertion impedance of the current probe is the equivalent circuit that is placed in the circuit under test when the probe is clamped around a conductor. When observing fast-rise signals, consider the insertion impedance.

Figure 2 shows the relationship of frequency to insertion impedance for A6302 Current Probes.

Circuit Loading

To minimize loading of critical circuits, clamp the probe at the low or ground end of a component lead whenever possible.

NOTE

The A6302 Current Probe measures magnetic flux around a conductor, caused by current in the conductor. Keep this in mind when reading dc current in ferrous leads (such as transistor leads) that may be magnetized. This lead flux causes erroneous readings in the more sensitive current probe amplifier settings.

Direction of Current Flow

To display correct polarity, the probe should be clamped around a conductor with the probe arrow pointing in the direction of conventional current flow (positive to negative).

CAUTION

Do not let the probe transformer core touch the base conductor being tested. The core is not insulated.

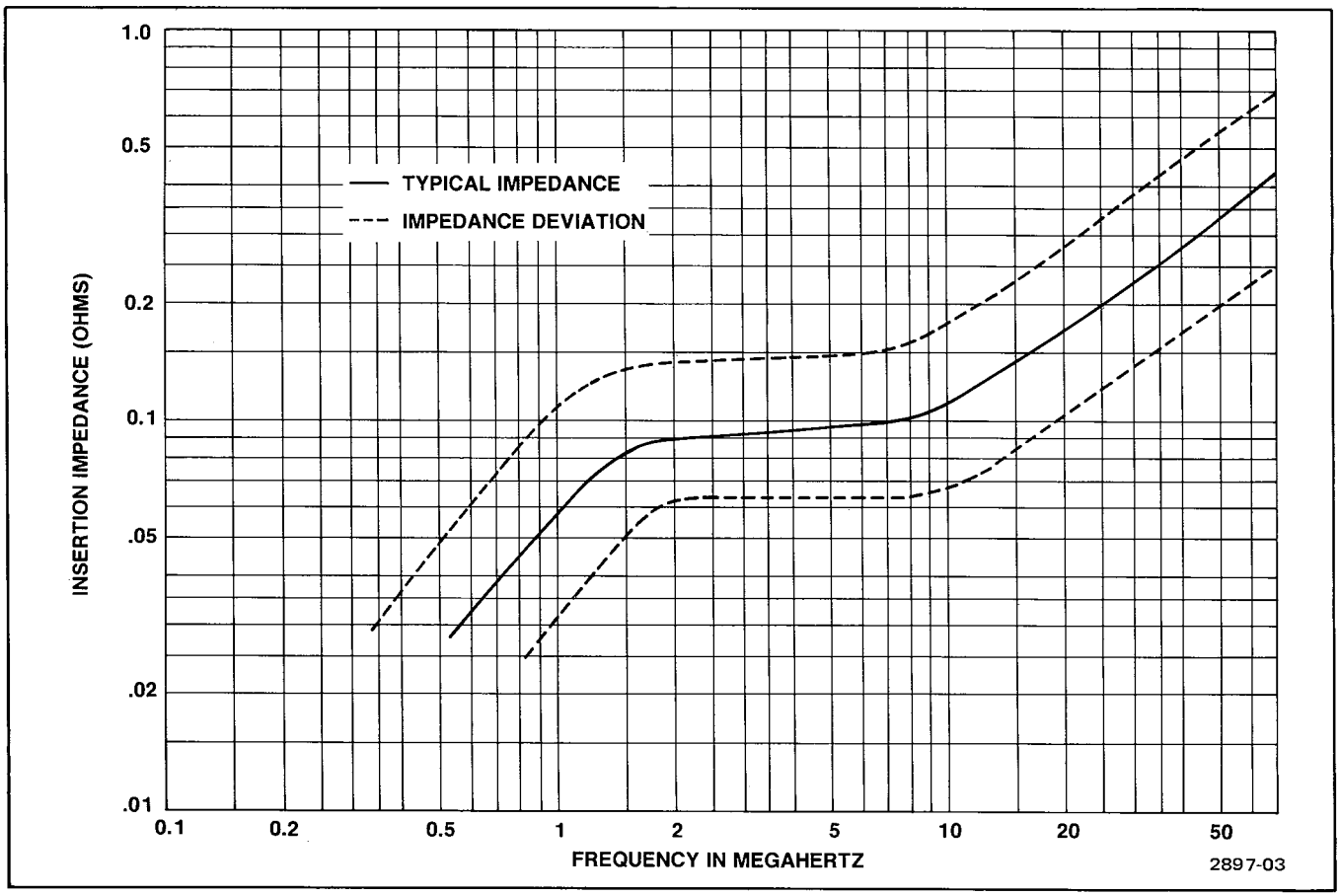


Fig. 2. Insertion impedance versus frequency in megahertz.

PERFORMANCE CHECK PROCEDURE

Introduction

This procedure checks the electrical characteristics that appear in the Specification portion of this manual. If the instrument fails to meet the requirements given in this performance check, an adjustment procedure should be performed. This procedure can also be used by an incoming inspection facility to determine acceptability of performance.

The electrical characteristics are valid only if the current probe amplifier is calibrated at an ambient temperature of +20°C to +30°C and operated at an ambient temperature of 0°C to +50°C. Forced air circulation is required for ambient temperature above +40°C.

Tolerances that are specified in this performance check procedure apply to the instrument under test and do not include test equipment error.

Test Equipment Required

The following test equipment, or equivalent, is required to perform the performance check. Test equipment characteristics listed are the minimum required to verify the performance of the equipment under test. Substitute equipment must meet or exceed the stated requirements. All test equipment is assumed to be operating within tolerances.

Modification of the test procedure may be required if alternate test equipment is substituted.

Special test devices are used where necessary to facilitate the procedure. Most of these are available from Tektronix, Inc. and can be ordered through your local Tektronix Field Office or representative.

Table 4
TEST EQUIPMENT REQUIRED

Description	Performance Requirements	Application	Examples
Test Oscilloscope	Bandwidth, 150 MHz; vertical deflection, 5 mV/Div; time/div, 2 ms	All measurements	TEKTRONIX 7704A with 7A16A Amplifier and 7B80 Time Base
Calibration Generator	Fast rise output; period 0.1 ms; duty cycle, approx. 50%; amplitude, 200 mV p-p, into 50 Ω	Risetime measurement	TEKTRONIX PG 506[a] Pulse Generator
Constant Amplitude Sine Wave Generator	Frequency range, at least 100 MHz with 50 kHz reference frequency; amplitude range, to 5.5 V p-p; impedance, 50 Ω; amplitude acuracy (50 kHz reference), within 3% of indicated amplitude on 5 V range, into 1% termination; flatness, output amplitude does not vary more than 3% from actual amplitude of 50 kHz reference.	Bandwidth checks	TEKTRONIX SG 503[a] Leveled Sine Wave
Current Probe Amplifier	Bandwidth, 100 MHz; current/div accuracy, within 3%	All measurements	TEKTRONIX AM 503[a] current probe amplifier
Cable	Impedance, 50 Ω; length, 42 inches; connectors, bnc	Amplifier output to test oscilloscope	Tektronix Part No. 012-0057-01
Termination	Impedance, 50 Ω; connector, bnc	Amplifier output to test oscilloscope	Tektronix Part No. 011-0049-01
10X Attenuator (2 required)	Attenuation accuracy, ±2%	Noise check	Tektronix Part No. 011-0059-02
Calibration Fixture (Current Loop)	Impedance, 50 Ω	Bandwidth, risetime, aberrations	Tektronix Part No. 067-0559-00

[a]**Requires TM 500-Series Power Module.**

Preliminary Procedure

1. Ensure that all power switches are off.

2. Ensure that all test equipment and the power module into which the current probe amplifier will be installed are suitably adapted to the line voltage to be applied.

3. Install the current probe amplifier into the power module and connect the A6302 current probe. Install all other applicable TM 500-Series test equipment into the power module.

4. Connect the power module(s) and test equipment to a suitable line voltage source. Turn all equipment on and allow at least 20 minutes for the equipment to warm up and stabilize.

NOTE

All steps in the Performance Check require the following setup. (See Fig. 3.) With each of the more complex steps, an equipment setup illustration is provided. Titles for front-panel controls and connectors are initial capitals in this procedure (e.g., Current/Div, Balance, etc.).

5. Set test oscilloscope vertical sensitivity for 10 mV/div.

6. With the test oscilloscope input coupling switch at ground, position the trace vertically to graticule center. Switch input coupling to dc.

7. Set the current probe amplifier function to adjust the dc level for zero output (trace centered on the test oscilloscope graticule).

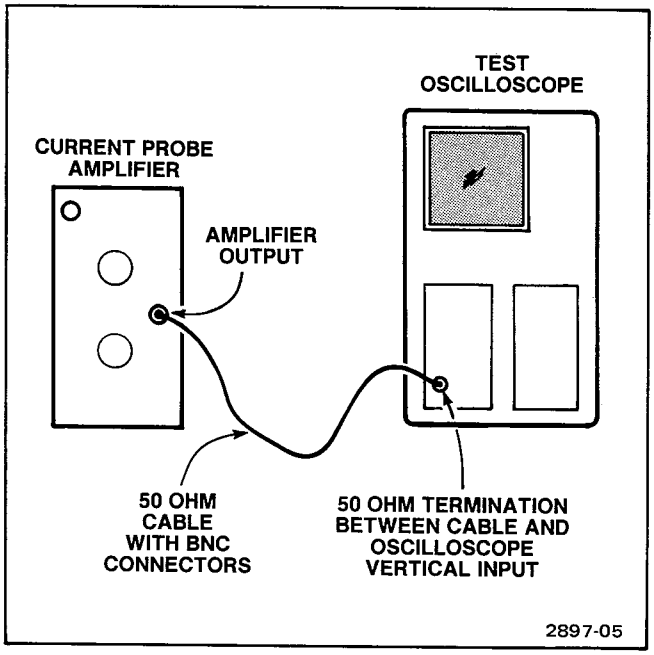


Fig. 3. Setup for preliminary procedure.

8. Set amplifier sensitivity for 1 mA/div.

9. Momentarily apply degaussing voltage to the probe.

10. Set current probe amplifier coupling to dc.

11. Set dc balance for zero output (trace centered on test oscilloscope graticule).

1. Risetime Check

See Fig. 4 for test setup.

Set Controls:

Current Probe Amplifier

Bandwidth	Full
Current/Div	2 mA

Calibration Generator

Period	1 μs
Function	Fast Rise

Test Oscilloscope

Volts/Div	10 mV
Input Coupling	dc
Time/Div	20 ns

a. Adjust calibration generator output for five-division vertical display on test oscilloscope.

b. Switch test oscilloscope Time/Div to 2 ns.

c. Measure risetime between 10% and 90% amplitude points.

d. CHECK—for 7 ns, maximum risetime.

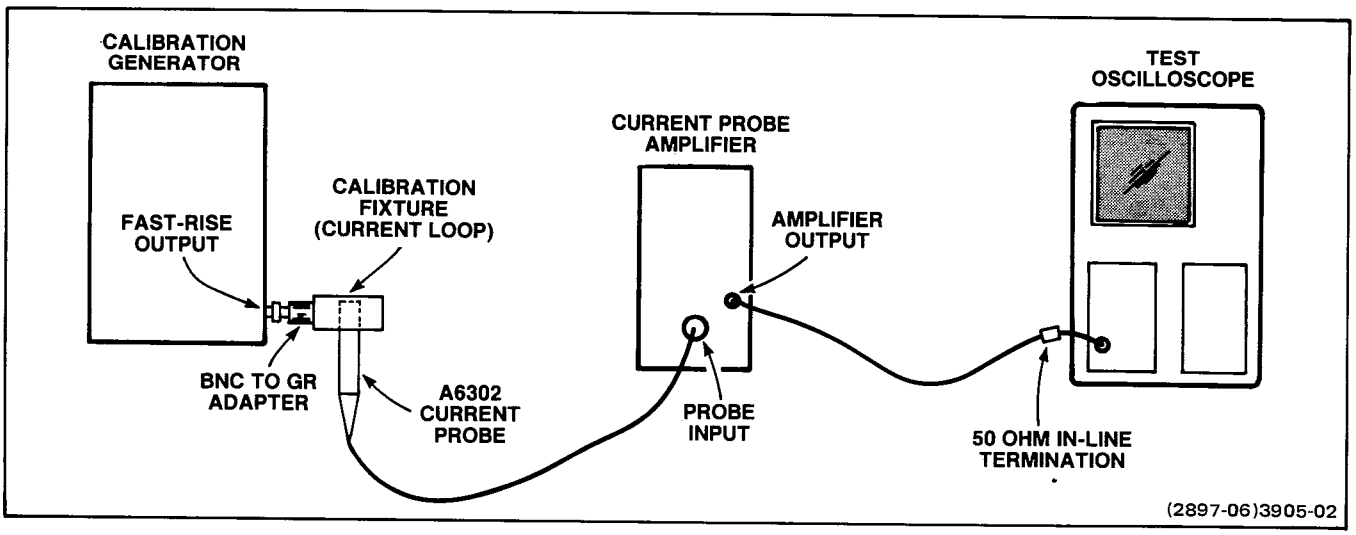


Fig. 4. Test setup for risetime check.

2. Aberrations Check

See Fig. 5 for test setup.

Set Controls:

Oscilloscope

Vertical	10 mV
Coupling	dc
Time/Div	50 ns

Current Probe Amplifier

Bandwidth	Full
Current/Div	5 mA

Calibration Generator

Function	Fast Rise

a. Set calibration generator for 4 div output, period 1 μs.

b. Adjust test oscilloscope vertical sensitivity for a five-division display (uncalibrated).

c. CHECK—display on test oscilloscope. ($\pm$5%, total not to exceed 7% p-p for the first 100 ns. After the first 100 ns $\pm$3%, total not to exceed 4% p-p.)

3. Noise Check

See Fig. 6 for test setup.

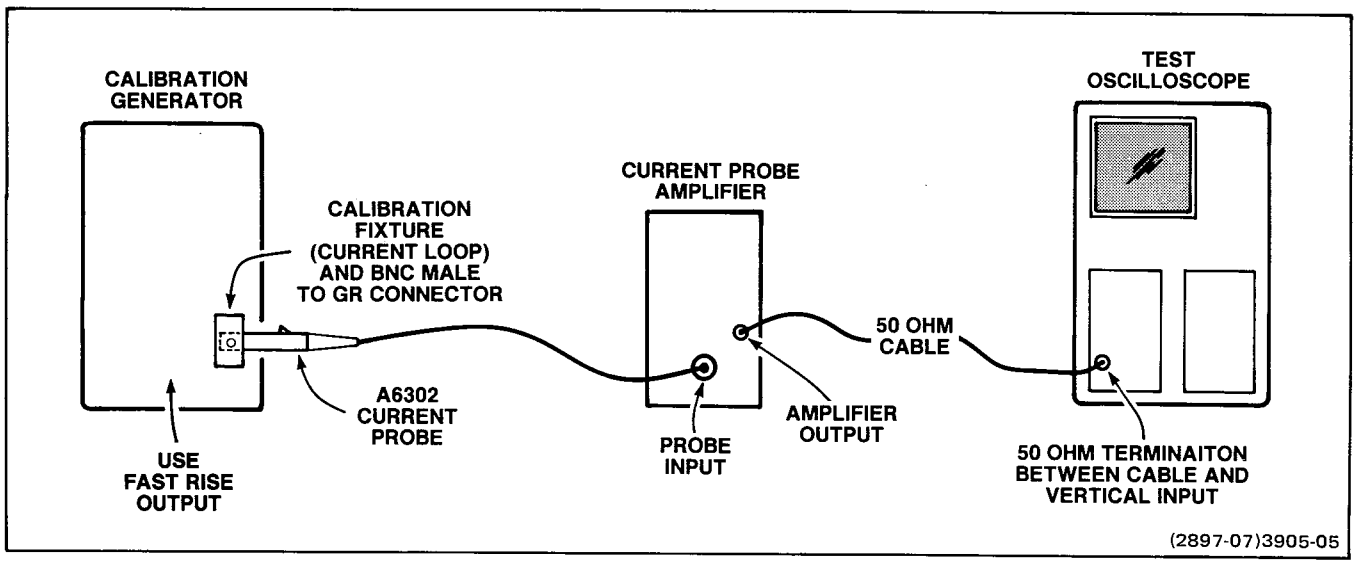


Fig. 5. Test setup for aberrations check.

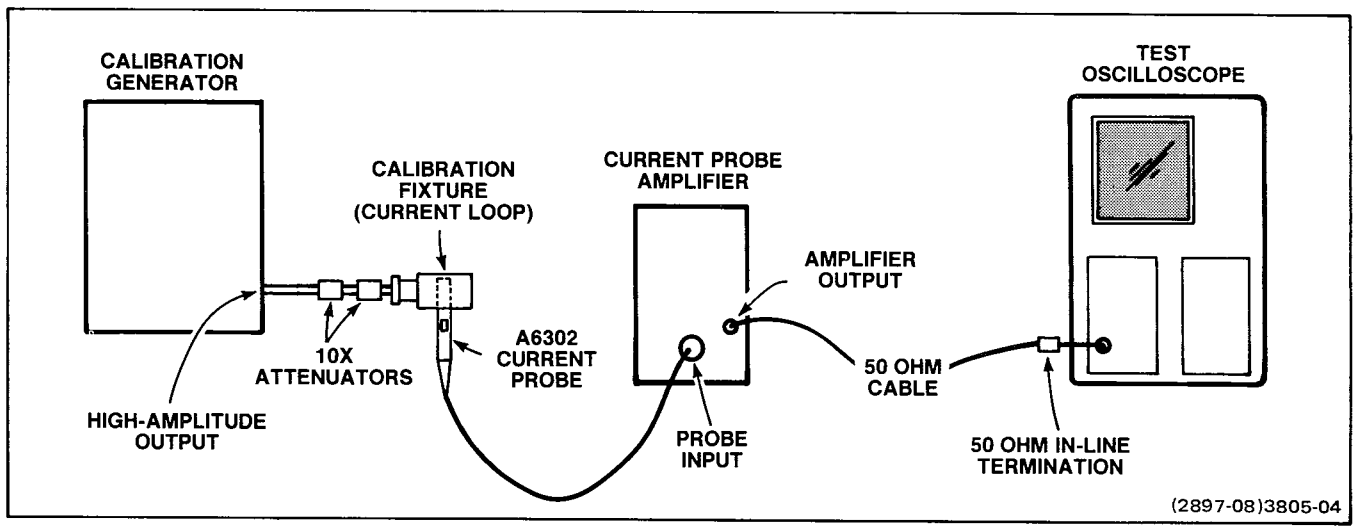


Fig. 6. Test setup for noise check.

Set Controls:

Current Probe Amplifier

Current/Div	1 mA
Bandwidth	Full

Test Oscilloscope

Time/Div	100 μs
Volts/Div	10 mV

Calibration Generator

Frequency	1 kHz
Function	High Amp

a. Adjust calibration generator amplitude until two free-running traces just merge (no dark area between traces). See Fig. 7.

b. Remove one 10X attenuator.

c. Measure the display amplitude on the test oscilloscope. Divide display amplitude by 10.

Example: two divisions of display at 10 mV/Div = 20 mV (equivalent to 2 mA), divided by 10=0.2 mA of noise, measured tangentially.

d. CHECK—for ≤0.3 mA maximum noise, measured tangentially.

4. Bandwidth Check

See Fig. 8 for test setup.

Set controls:

Current Probe Amplifier

Bandwidth	Full
Current/Div	5 mA

Test Oscilloscope

Volts/Div	10 mV

Sine Wave Generator

Frequency	50 kHz reference

a. Set constant amplitude sine-wave generator amplitude for six-division display on test oscilloscope.

b. Increase constant amplitude sine-wave generator frequency until test oscilloscope vertical display amplitude decreases to 4.2 divisions.

c. CHECK—that constant amplitude sine-wave generator frequency is 50 MHz or greater.

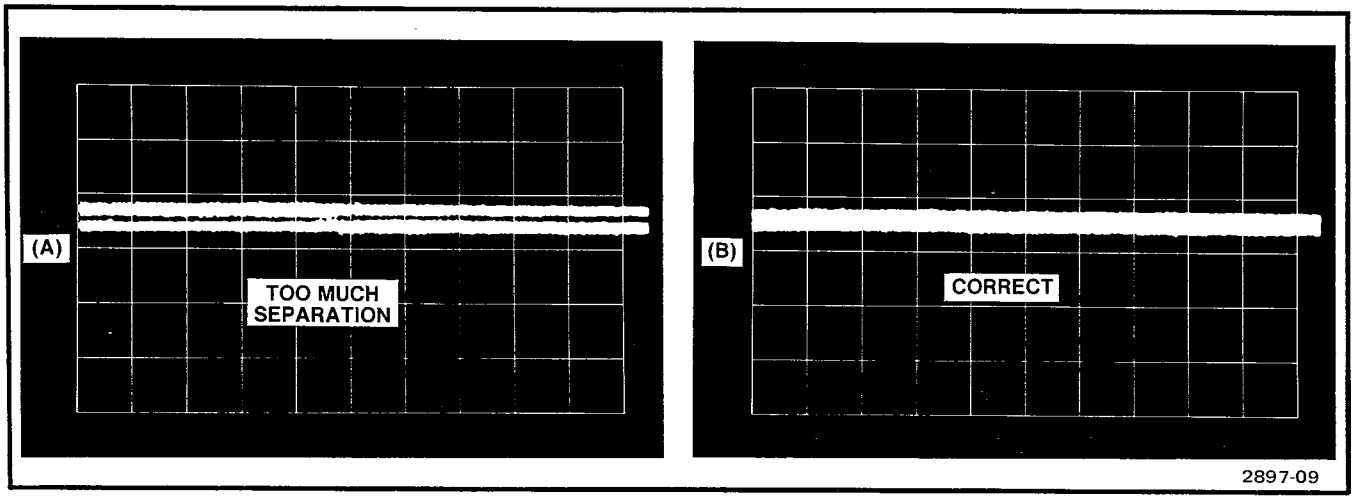


Fig. 7. Display of tangentially-measured noise (A) incorrect; dark area showing between traces, (B) correct display.

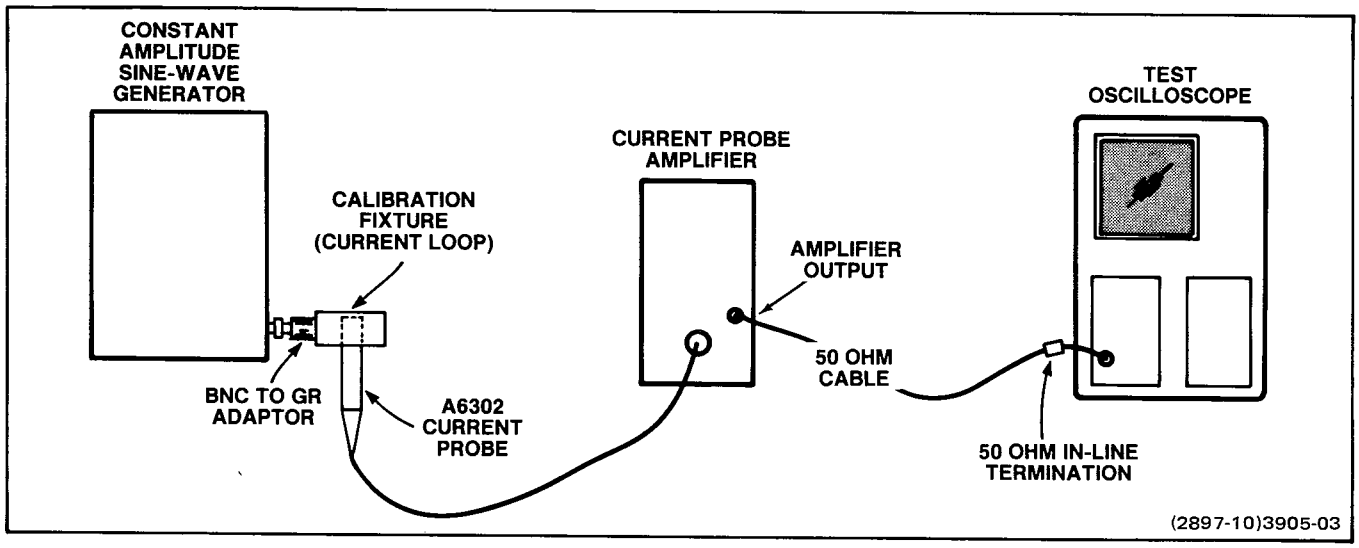


Fig. 8. Test setup for bandwidth check.

MAINTENANCE

CLEANING

Dirt that accumulates on the probe head can be removed with a soft cloth dampened in a mild detergent and water solution. Abrasive cleaners should not be used.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. In particular, avoid chemicals which contain benzene, toluene, xylene, acetone, or similar solvents.

Recommended cleaning agents are isopropyl alcohol (Isopropanol) or ethyl alcohol (Fotocol or Ethanol).

SERVICING

The following servicing instructions are for use by qualified personnel only.To avoid personal injury, do not perform any servicing other than that contained in operating instructions unless you are qualified to do so.

The A6302 Current Probe is designed to withstand normal operation and handling. However, if the probe fails or breaks, replacement parts are available.

Obtaining Replacement Parts

Most electrical and mechanical parts can be obtained through your local Tektronix field office or representative. However, you should be able to obtain many of the standard electronic components from a local commercial source in your area. Before you purchase or order a part from a source other than Tektronix, inc., please check the Replaceable Electrical Parts list for the proper value, rating, tolerance, and description.

Lubrication

Do not lubricate the gap between the stationary and movable transformer core pieces. Any lubricant between the core pieces should be removed with a recommended cleaning agent.

Slide Switch. This switch is lubricated before leaving the factory. Should the switch become noisy, clean and lubricate with switch cleaning lubricant.

Movable Plastic Parts. Should the plastic slide assembly require lubrication, apply silicone-based grease sparingly to the plastic.

Probe Disassembly (see Fig. 9)

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

2. Remove the two screws from the bottom of the probe body and pull the strain relief boot back on the cable.

3. While holding the probe in a horizontal position with the slide assembly up, lift the top half of the body and slide the top half off the end of the probe.

NOTE

Do not let the metal ball, in the top of the slide assembly, fall out. The ball may be easily lost.

4. Remove the metal ball.

5. Lift the spring retainer and spring out of the spring holder. Remove the spring and retainer (lift the back of the slide assembly).

6. Lay the probe on its side and remove the slide assembly. When removing the movable portion of the transformer core and the contact spring for the slide asembly, note the position of the contact spring. Switch contacts are not removable from the slide assembly.

7. Remove the spring holder from the bottom half of the probe body.

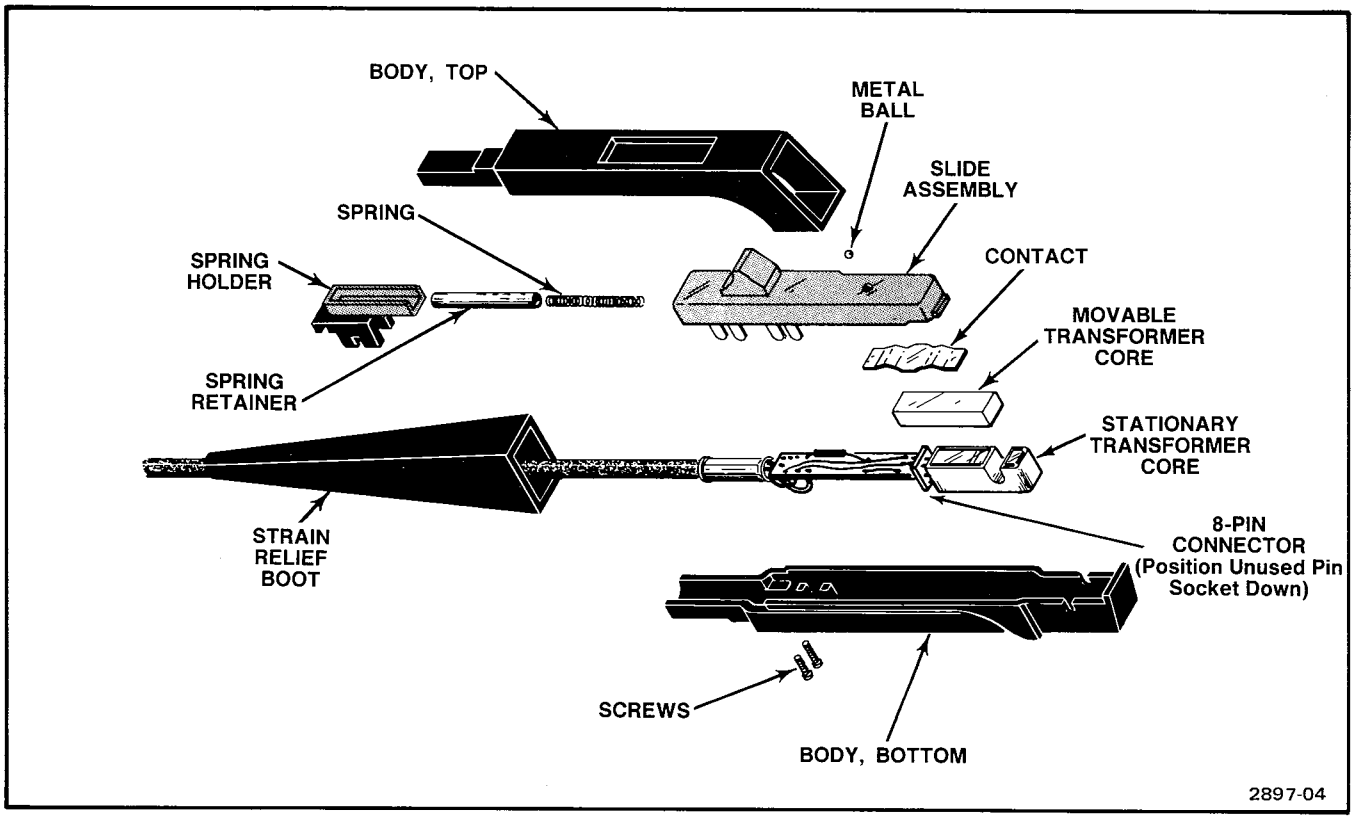


Fig. 9. Probe assembly exploded view.

8. To remove the stationary transformer core, first lift out the transformer-circuit board assembly, then carefully grip the stationary transformer core and pull it out of its socket. If necessary, unsolder the cable connection to the bottom half of the probe body.

Probe Assembly (see Fig. 9)

1. If unsoldered, resolder the cable connections (2) to the bottom half of the probe body.

2. Plug the stationary transformer core into the eight-pin connector.

3. Place the circuit board and transformer core into the bottom half of the probe body and replace the spring holder.

4. Replace the contact spring and movable core in the slide assembly. Place the spring and spring retainer in the spring guide on the slide assembly.

5. With both halves of the probe body held upside down, insert the slide assembly tip into the slot at the front of the probe body and bring the two pieces together. Be sure that the slide assembly switch contacts go on the inside (toward the center) of the stationary contacts. As the two pieces are brought together, push the spring retainer into the spring holder.

6. Hold the probe with the slide assembly up and place the metal ball into the hole in the slide assembly.

7. Replace the top half of the probe body, the strain relief boot, and the two screws.

8. The transformer assembly, when ordered, comes with an offset resistor (R18). The polarity marking (+ or −) on the tape attached to the transformer indicates which Hall Bias resistor it will be tied to (R16 is +, R17 is −).

REPLACEABLE PARTS

PARTS ORDERING INFORMATION

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

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

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

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

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

ITEM NAME

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

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

REPLACEABLE ELECTRICAL PARTS

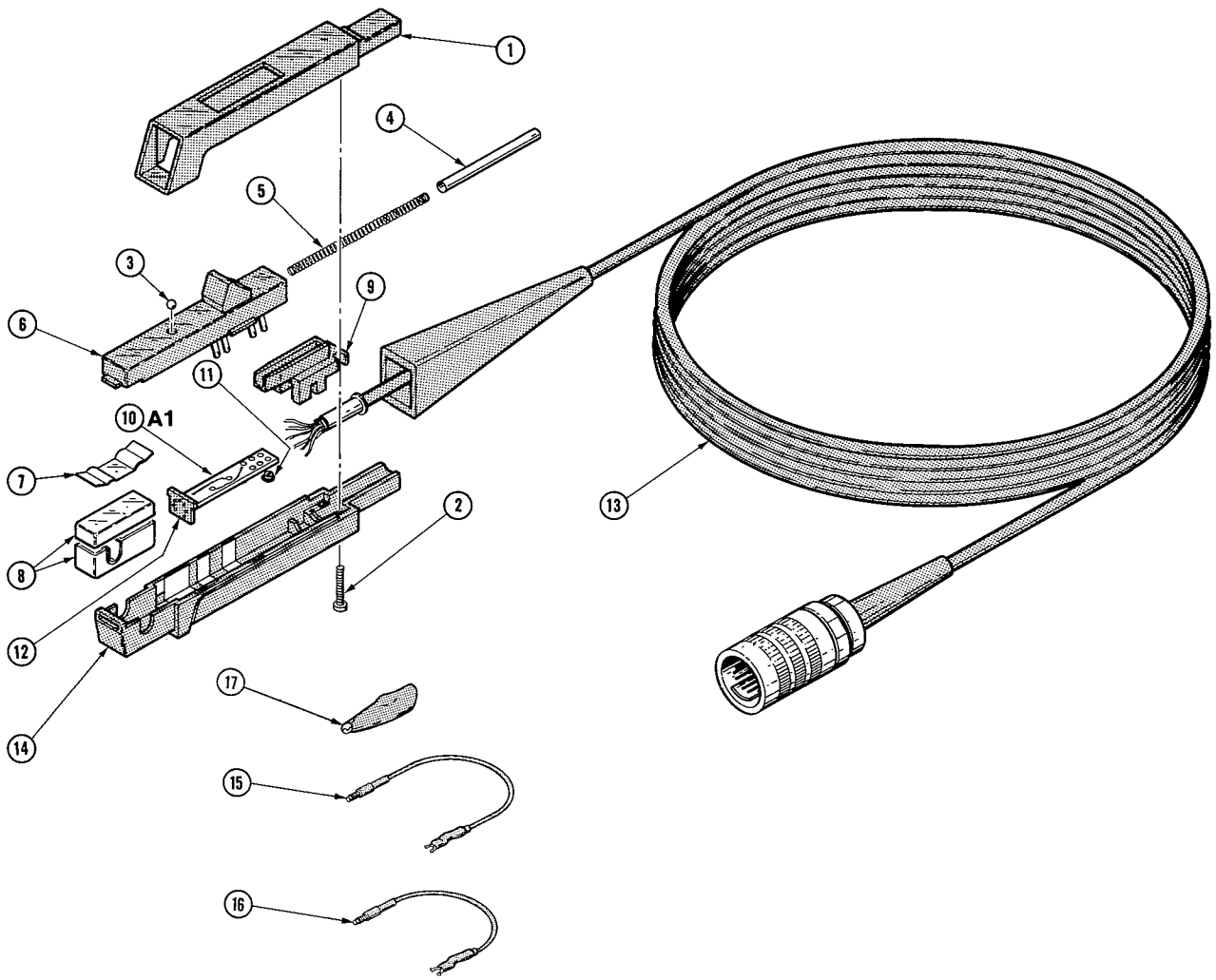
Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-4647-00			CKT BOARD ASSY:PROBE	80009	670-4647-00
LR15	108-0330-00			COIL,RF:FIXED,395NH	80009	108-0330-00
R14	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R16	317-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.125W	01121	BB2705
R17	317-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.125W	01121	BB2205
R18	SELECTED					
T5	120-0464-02			TRANSFORMER,CUR:UPPER AND LOWER	80009	120-0464-02
	----- -----			(SELECTED WITH R18)		
T15	120-0741-00			XFMR,TOROID:8 TURNS	80009	129-0741-00

REPLACEABLE MECHANICAL PARTS

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-	A6302			1		PROBE,CURRENT:	80009	A6302
-1	204-0288-00			1		. . BODY HALF,PROBE:TOP	80009	204-0288-00
						(ATTACHING PARTS)		
-2	213-0087-00			2		. . SCR,TPG,THD CTG:2-32 X 0.500 L,PNH STL	83385	OBD
						- - - * - - -		
-3	214-0997-00			1		. . BALL BEARING:0.094 OD,SST	27545	OBD
-4	214-0849-00			1		. . RTNR,RTN SPR:0.132 ID X 0.160 OD X 1.77 L	80009	214-0849-00
-5	214-0835-00			1		. . SPRING,HLCPS:0.12 OD X 2.65 L	80009	214-0835-00
-6	351-0121-00			1		. . CONT ASSY,ELEC:PROBE SLIDE ASSY	80009	351-0121-00
-7	214-0854-00			1		. . CONTACT,ELEC:0.340 W X 1.0 L	80009	214-0854-00
-8	----- -----			1		. . TRANSFORMER,CUR:(SEE T5 REPL)		
	----- -----			-		. . (SELECTED WITH R18)		
-9	352-0106-00			1		. . HOLDER,SPR RTNR:BLACK,ACETAL RESIN	80009	352-0106-00
	175-1836-01			1		. . CA ASSY,SP,ELEC:W/CIRCUIT BOARD	80009	175-1836-01
-10	----- -----			1		. . . CKT BOARD ASSY:PROBE(SEE A1 REPL)		
-11	136-0252-00			7		. . . SOCKET,PIN TERM:0.145 INCH LONG	00779	2-330808-7
-12	352-0287-00			1		. . . HOLDER,CKT BOARD:	80009	352-0287-00
-13	175-1836-00			1		. . . CA ASSY,SP,ELEC:6.30 AWG/2.50 OHM COAX,P	80009	175-1836-00
-14	204-0714-01			1		. . BODY HALF,PROBE:BOTTOM W/CONTACTS	80009	204-0714-01
						STANDARD ACCESSORIES		
	070-3905-01			1		SHEET,TECHNICAL:INSTR,A6302	80009	070-3905-01
-15	175-0124-01			1		LEAD,ELECTRICAL:PROBE GND,5 INCHES LONG	80009	175-0124-01
-16	175-0263-01			1		LEAD,ELECTRICAL:PROBE GND,3 INCHES LONG	80009	175-0263-01
-17	344-0046-00			2		CLIP,ELECTRICAL:ALLIGATOR	80009	344-0046-00

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
27545	HARTFORD-UNIVERSAL CO.	951 WEST STREET	ROCKY HILL, CT 06067
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153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DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

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

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

Resistors = Ohms (Ω).

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

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The overline on a signal name indicates that the signal performs its intended function when it goes to the low state.

Abbreviations are based on ANSI Y1.1-1972.

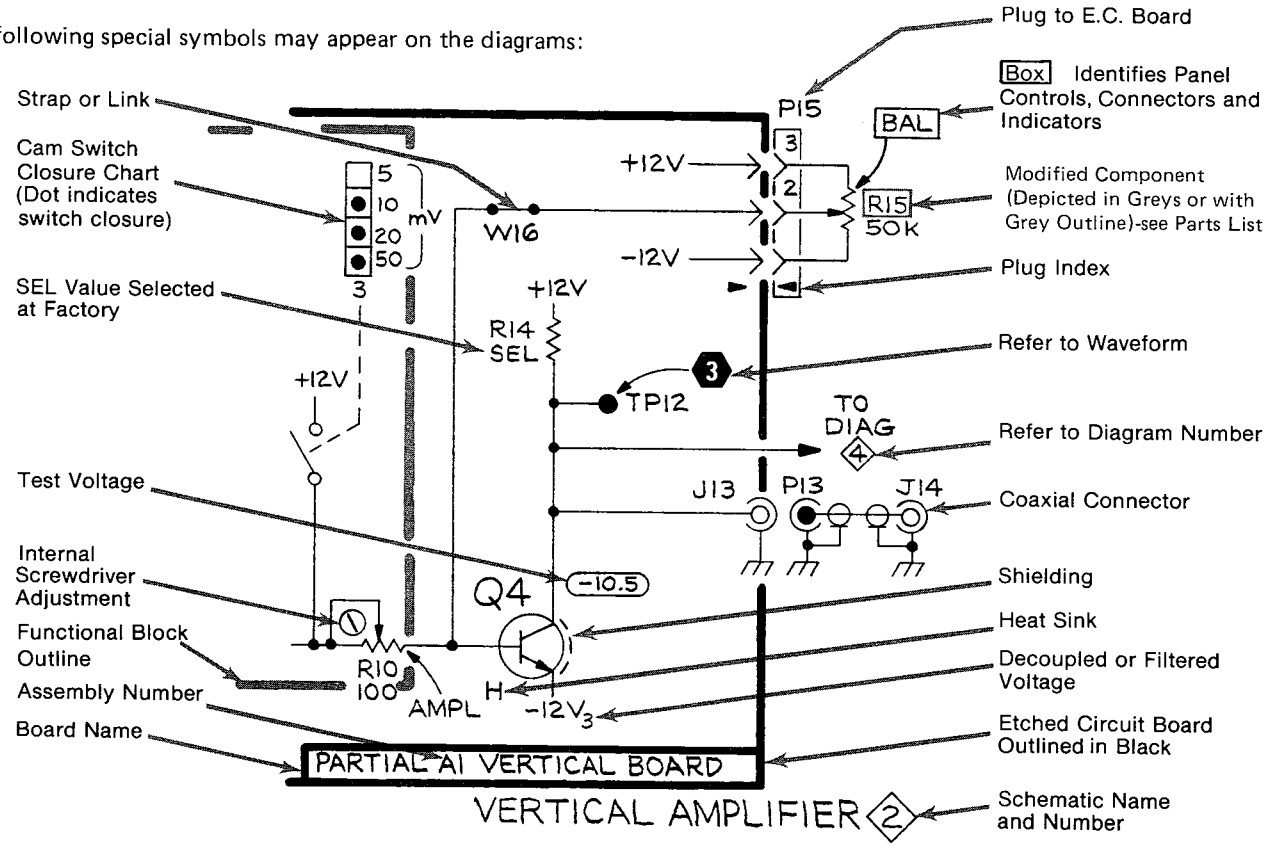
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

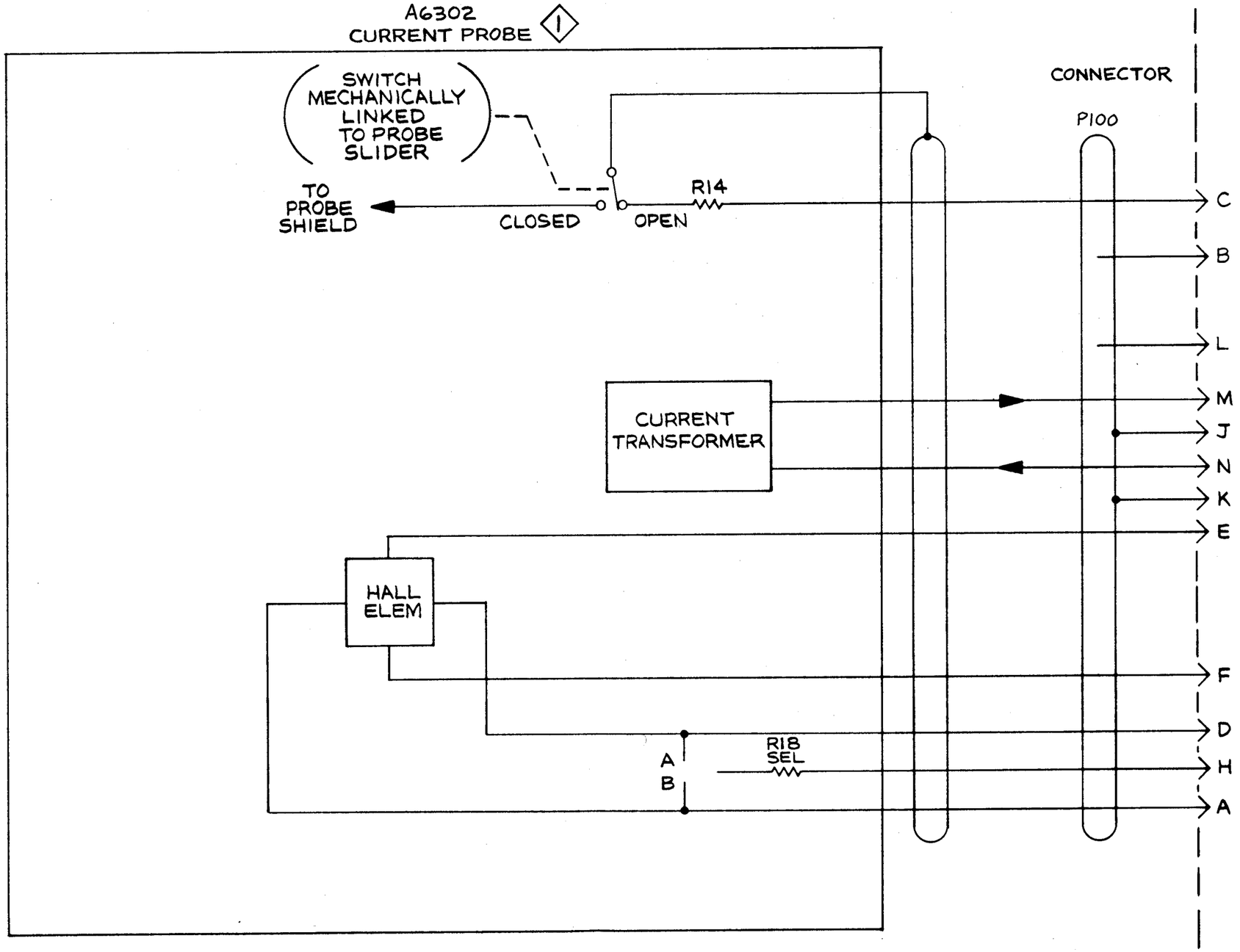
Y14.15, 1966	Drafting Practices.
Y14.2, 1973	Line Conventions and Lettering.
Y10.5, 1968	Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc)	H	Heat dissipating device (heat sink, heat radiator, etc)	S	Switch or contactor
AT	Attenuator, fixed or variable	HR	Heater	T	Transformer
B	Motor	HY	Hybrid circuit	TC	Thermocouple
BT	Battery	J	Connector, stationary portion	TP	Test point
C	Capacitor, fixed or variable	K	Relay	U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
CB	Circuit breaker	L	Inductor, fixed or variable	V	Electron tube
CR	Diode, signal or rectifier	M	Meter	VR	Voltage regulator (zener diode, etc.)
DL	Delay line	P	Connector, movable portion	W	Wirestrap or cable
DS	Indicating device (lamp)	Q	Transistor or silicon-controlled rectifier	Y	Crystal
E	Spark Gap, Ferrite bead	R	Resistor, fixed or variable	Z	Phase shifter
F	Fuse	RT	Thermistor		
FL	Filter				

The following special symbols may appear on the diagrams:





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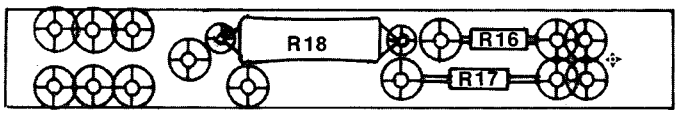
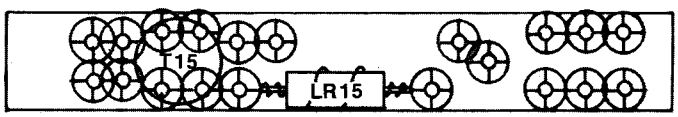
BLOCK DIAGRAM

FRONT



BACK



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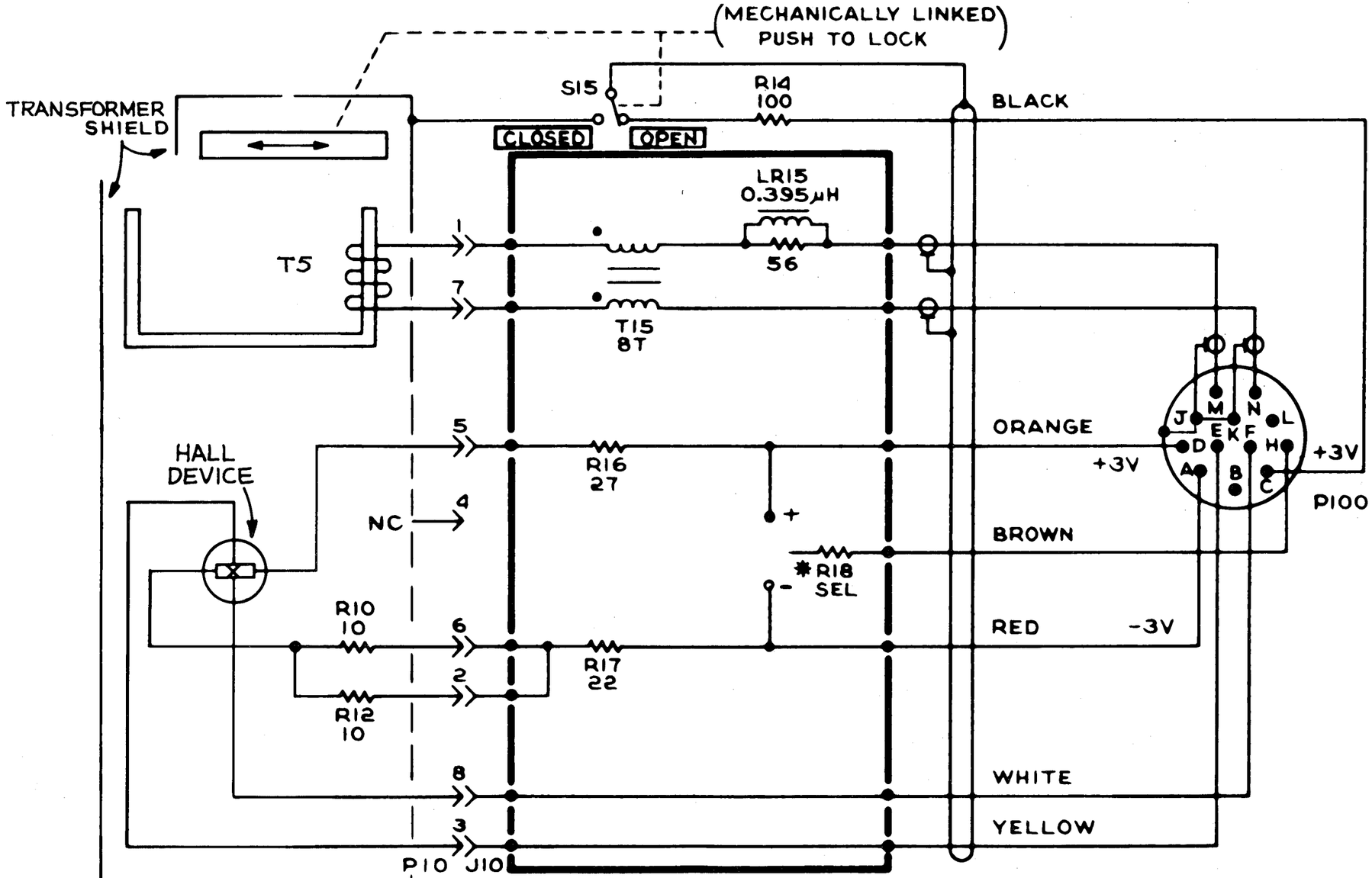
Location of components on Probe Board.



NOTES:

1. * R18 IS CONNECTED EITHER TO THE ORANGE OR RED LEAD.
2. P10 IS COUNTED IN A CW DIRECTION STARTING AT THE KEY.

P10 

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PROBE ◇1

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.