INSTRUCTION MANUAL

MODEL 9200B
RF MILLIVOLTMETER

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SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation and maintenance of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Boonton Electronics assumes no liability for the customer's failure to comply with these requirements.

THE INSTRUMENT MUST BE GROUNDED

To minimize shock hazard the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three conductor, three prong a.c. power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to a two-contact adapter with the (green) grounding wire firmly connected to an electrical ground at the power outlet.

DO NOT OPERATE THE INSTRUMENT IN AN EXPLOSIVE ATMOSPHERE.

Do not operate the instrument in the presence of flammable gases or fumes.

KEEP AWAY FROM LIVE CIRCUITS.

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by quailfied maintenance personnel. Do not replace components with the power cable connected. Under certain conditions dangerous voltages may exist even though the power cable was removed, therefore; always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE.

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

Do not install substitute parts or perform any unauthorized modification of the insturment. Return the instrument to Boonton Electronics for repair to ensure that the safety features are maintained.

SAFETY SYMBOLS.

This safety requirement symbol (located on the rear panel) has been adopted by the International Electrotechnical Commission, Document 66 (Central Office) 3, Paragraph 5.3, which directs that and instrument be so labeled if, for the correct use of the instrument, it is necessary to refer to the instruction manual. In this case it is recommended that reference be made to the instruction manual when connecting the instrument to the proper power source. Verify that the correct fuse is installed for the power available, and that the switch on the rear panel is set to the applicable operating voltage.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operation procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the equipment. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

WARNING

The WARNING sign denotes a hazard. It calls attention to an operation procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

Indicates dangerous voltages.

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Figure 1-1. Model 9200B RF Millivoltmeter.

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

This instruction manual provides general information, installation and operating instructions, theory of operation, maintenance instructions, and parts list for the Model 9200B RF Millivoltmeter.

1-2. DESCRIPTION

The Model 9200B is a microprocessor-based RF Millivoltmeter that is capable of measuring RF voltage levels from 200 microvolts to 3 volts over a frequency range from 10 kHz to 1.2 GHz.

The measured RF levels can be displayed directly in mV, dBV, dBmV, dBm (dB relative to 1 mW across any impedance between 5 Ω and 2506 Ω) or dBw (dB relative to 1W across any impedance between 20 Ω and 2000 Ω).

1-3. The instrument design features are:

a. Wide Frequency Range. The calibrated frequency range of the instrument is determined by the probe used with the instrument. The 952001A RF Probe supplied with the instrument provides calibrated indications from 10 kHz to 1.2 GHz, with uncalibrated response to beyond 8 GHz. An optional 952009 RF Sensor provides calibrated, 50 Ω terminated indications from 100 kHz to 2.5 GHz. The optional 952016 RF probe provides calibrated response from 10 Hz to 100 MHz.

b. Sensitivity and range linearization data for the probe supplied with the instrument is stored in non-volatile memory. If another probe is used with the instrument, data for this probe must be entered into non-volatile memory before using the probe. Data entry is a simple procedure, requiring only operation of an internal switch and entry of data through the front panel keys. No further calibration is necessary.

c. Voltage Range. The instrument has eight voltage measurement ranges from 1 mV to 3 volts full scale, arranged in a 1-3-10 sequence. In the dB measurement modes, it covers a range of 80 dB in 8 ranges, with 0.01 dB resolution. The measurement capability of the instrument can be extended to 300 volts at frequencies up to 700 MHz when the optional 952005 100:1 Voltage Divider is used and 300 volts for frequencies between 10 Hz and 20 MHz when the optional 952058 100:1 Voltage Divider is used.

d. True RMS Response. Waveform response of the instrument probe is true RMS for inputs below 30 mV, allowing accurate voltage measurements with all types of waveforms. Probe waveform response changes gradually as the input voltage is raised above 30 mV approaching peak-to-peak at the higher levels. The instrument shapes the response digitally to indicate RMS voltage, provided that the input is reasonably sinusoidal, as with CW or FM input signals.

e. Low Noise. The instrument has been designed and constructed to minimize noise from all sources. The probe cable is of a special low noise design; vigorous flexing causes only momentary, minor deflections on the most sensitive range of the instrument. The probes are insensitive to shock and vibration; even sharp tapping on the probe barrel causes no visible deflection on any range. Internal signal amplification occurs at approximately 94 Hz, thereby reducing susceptibility to 50 or 60 Hz fields. A low noise solid-state chopper is used.

f. Key Selection of Measurement Modes. A choice of measurement modes is available to the operator. Measurements in terms of mV, dBV, dBmV, dBm (dB relative to 1 mW across any impedance between 5 Ωs and 2500 Ωs) or dBw (dB relative to 1W across any impedance between 20 Ωs and 2000 Ωs) can be selected by merely pressing the appropriate front panel key. The keyboard also allows entry of dB reference levels and impedance values for these measurement modes.

g. Measured values are displayed on a 4 digit LED type readout with decimal points and minus sign. Annunciators associated with the display indicate the units of measurement. The result is clear, direct, unambiguous readout that minimizes the possibility of misinterpretation. The display is also used to show data being entered into non-volatile memory and to display data recalled from non-volatile memory. The display and annunciators blink on and off during data entry and recall to indicate that displayed values are not measured values.

h. A front panel meter provides relative RF level indications for peaking or nulling applications. A rear panel DC output supplies 10 volts full scale that is linear with voltage in the mV mode, or linear in dB over the entire 80 dB range in any of the dB modes.

i. Autoranging under control of the microprocessor eliminates the need for manual ranging by the operator. Alternately, a measurement range can be retained for measurements, if desired, by selecting a range hold mode through the IEEE-488 Bus when the instrument is so equipped. Application of input levels beyond the measurement capability of the instrument in the autorange mode or outside the selected range in the range hold mode results in an error indication on the display.

j. An automatic zeroing circuit eliminates the need for tedious, often inaccurate manual zeroing. With zero input to the probe, pressing the front panel ZERO key causes the microprocessor to compute and store zero corrections for each range, which are applied to subsequent readings. A logic transition is available at a rear panel connector for automatic turn off of a source during the automatic zeroing sequence.

k. Sensitivity and range linearization data for up to eight probes may be stored in the instrument non-volatile memory. Probe data is written into memory at the factory for probes ordered with the instrument. Probe data may also be written into memory quickly and easily in the field. A hard copy of stored data is provided under the top cover of the instrument. The microprocessor corrects measurements automatically in accordance with the stored probe data.

l. High/Low dB Limits. High and low dB limits can be entered through the IEEE-488 Bus when the instrument is so equipped. Rear panel TTL outputs provide remote indications of out-of-limit conditions.

m. Solid-state Chopper. Signal amplification in the instrument occurs at approximately 94 Hz. Input signals from the probe are converted into 94 Hz signals by a solid-state, low-level input modulator (chopper).

n. The instrument is designed for easy maintenance. Accessibility to all printed circuit boards is excellent. Connection facilities for signature analysis are incorporated and special diagnostic ROMs are available. Digital circuit troubles can be localized rapidly and accurately using the signature-analysis maintenance technique, thereby reducing instrument downtime.

o. GPIB Option. A full function GPIB can be installed in the 9200B. This interface allows remote operation of all front panel controls, except the line switch. Individual voltage and dB ranges may be selected and selectively zeroed. Listen/talk address and message termination characters are set by a rear panel bit switch.

p. MATE Option. An internal TMA is available that allows the 9200B to respond to CIIL commands.

1-4. APPLICATION

1-5. The instrument can be used for the following applications:

a. Measurement of transistor parameters.

b. SWR and return loss measurements with directional couplers, reflection coefficient bridges and slotted lines.

c. Gain and loss measurements of wide-band amplifiers.

d. Adjustment of tuned circuits in narrow-band amplifiers.

e. Adjustment, performance measurements and parameter evaluation of RF filters.

f. Measurement of SWR, return loss and attenuation of RF attenuators.

g. Measurement of output levels of signal generators, adjustment of baluns, harmonic distortion measurements of RF signals and adjustment of RF circuits for minimum voltage (null) or maximum voltage (peak).

1-6. ACCESSORIES

1-7. The following accessories are supplied with the instrument:

a. 41-2A Sensor/Probe Interconnecting Cable (5 ft.) (M/M).

b. 952001A RF Probe. Probe with low-noise cable and connector assembly for measurements from 10 kHz to 1.2 GHz. Refer to Table 1-1 for input resistance and capacitance.

c. 952002 50 Ω BNC Adapter. Used for measurements up to 1.2 GHz in a 50 Ω system.

d. 952004 Probe Tip. Removable probe tip with grounding-clip lead; for use up to approximately 100 MHz.

e. 952005 100:1 Voltage Divider. Attenuates input signal by a factor of 100 $\pm$ (1 + f_{MHz}/200)%, permitting measurements up to 300 V, and extending the rms measuring range to 3 V; also increases input resistance by a factor of 1000 to 3000, depending upon input level. Operates from 50 kHz to 700 MHz. Maximum input potential, 1000 VDC plus peak AC.

1-8. The following accessories are optional and may be ordered:

a. 41-2A/10 Sensor/Probe Interconnecting Cable (10 ft.) (M/M).

b. 41-2A/20 Sensor/Probe Interconnecting Cable (20 ft.) (M/M).

c. 41-2A/50 Sensor/Probe Interconnecting Cable (50 ft.) (M/M).

d. 41-2A/100 Sensor/Probe Interconnecting Cable (100 ft.) (M/M).

e. 950000 Rack Mtg. Kit, Single. Mounts one unit left or right of blank panel in 19 inch rack. 5.25 inches high.

f. 950001 Rack Mtg. Kit, Dual. Mounts two units side by side in 19 inch rack. 5.25 inches high.

g. 950002 Single Rack Mounting Kit. Kit for mounting one 9200B as one-half of a module in a standard 19-inch rack.

h. 950029 Transit Case.

i. 952003 50 Ω Tee Adapter. Type N Tee connector used with 952014 termination, it permits connection into a 50 ohm line.

j. 952006 75 Ω BNC Adapter. Used for measurements up to 500 MHz in a 75 ohm system.

k. 952007 75 Ω Tee Adapter. Type-N Tee connector; used with 952015 termination it permits connection into a 75 ohm line.

l. 952008 Unterminated BNC Adapter (Female). Used for coaxial connection up to approximately 100 MHz, or to 400 MHz when fed from a 50 ohm source in an electrically short system.

1-8. (Continued)

m. 952009 50 Ω Sensor. 50 Ω terminated sensor for voltage and power measurements, 100 kHz to 2.5 GHz.

n. 952011-2 50 Ω Accessory Kit. For Model 952001A Probe. Consist of Models 952003, 952005, 952008, 952013, and Model 952014 50 Ω Type N Male Termination.

o. 952012-2 75 Ω Accessory Kit. For Model 952000 Probe. Consist of Models 952005, 952007, 952008, 952013, and Model 952015 75 Ω Type N Male Termination.

p. 952013 Accessory Case. For use with the 952001A probe and accessories.

q. 952016 Low Frequency Probe. 10 Hz to 100 MHz. Overload protection, 10 VAC and 50 VDC.

r. 952058 100:1 Divider. For use with 952016 Low Frequency Probe; frequency range 10 Hz to 20 MHz.

1-9. OPTIONS

1-10. The following options are available:

a. -01B IEEE 488 Bus Interface. Duplicates all front panel functions except on/off power switch. In addition individual voltage and dB ranges may be selected and selectively zeroed.

b. -03 Input Channel 2. Allows display of either channel 1 or channel 2, or channel 3 which is channel 1 minus channel 2, expressed in dB. Includes second 952004 Probe Tip and 952002 50 Ω BNC Adapter.

c. -06 MATE. Internal TMA. Requires -01B Option.

d. -11 Low Frequency Version. Includes the 952016 Low frequency Probe, 952002 50 Ω BNC Adapter, 952008 Unterminated BNC Adapter, and the 952058 100:1 Divider.

e. -12 Dual Channel Low Frequency Version. Includes two 952016 Low frequency Probes, two 952002 50 Ω BNC Adapters, two 952008 Unterminated BNC Adapters, and two 952058 100:1 Dividers.

1-11. SPECIFICATIONS

1-12. Specifications are listed in Table 1-1.

TABLE 1-1. SPECIFICATIONS

VOLTAGE RANGE: 200 µV to 3V in 8 ranges (300 V to 700 MHz with Divider). Indications down to 50 µV.

VOLTAGE DISPLAY: 1.000, 3.000, 10.00, 30.00, 100.0, 300.0, 1000 and 3000 mV fs.

dB RANGE: 80 dB in 8 ranges, 0.01 dB resolution.

dB DISPLAY: dBmV (0 dB equivalent to 1 mV), dBV (0 dB equivalent to 1 V), dBm (0 dB equivalent to voltage drop generated when 1 mW is dissipated in selectable Z_o reference), dBr (0 dB equivalent to any desired dB reference level) or dBw (dB relative to 1W across any impedance between 20 Ω and 2000 Ω).

Z_o Impedance: Any value from 20 to 2000 Ω.

Reference dB Offset: Any offset can be keyboard selected to 0.01 dB resolution provided that the available display range of ±99.99 dB is not exceeded.

RANGING: Autoranging, plus hold-on-range. Individual ranges may be commanded via bus interface option.

FREQUENCY RANGE: 10 kHz to 1.2 GHz, Model 952001A Probe; 100 kHz to 2.5 GHz, optional Model 952009 Sensor. 10 Hz to 100 MHz when the optional Model 952016 Probe is used.

WAVEFORM RESPONSE: RMS to 30 mV, calibrated in rms of a sinewave above 30 mV (RMS to 3 V and 700 MHz with Divider).

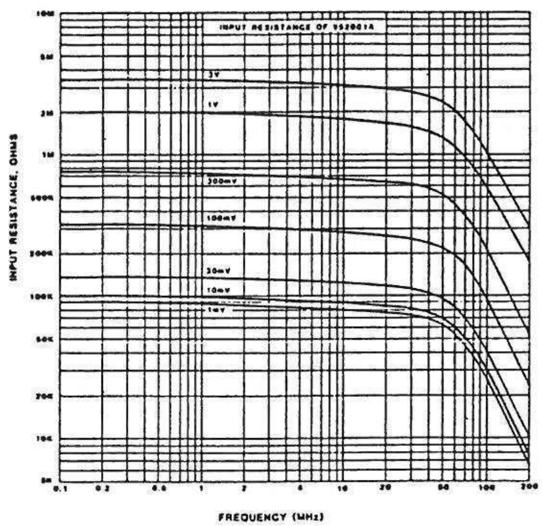
CREST FACTOR:

Direct Input:	Level	300 µV	1 mV	3 mV	10 mV	30 mV
	C.F.	140	42	14	4.2	1.4
With Divider:	Level	30 mV	100 mV	300 mV	1 V	3 V
	C.F.	140	42	14	4.2	1.4

INPUT CONFIGURATION:

Probe: Model 952001A, button center conductor, 1/2-20 threaded ground shell (supplied).

Probe Tip: For Model 952001A, probe, needle tip, ground clip lead, Model 952004 (supplied).



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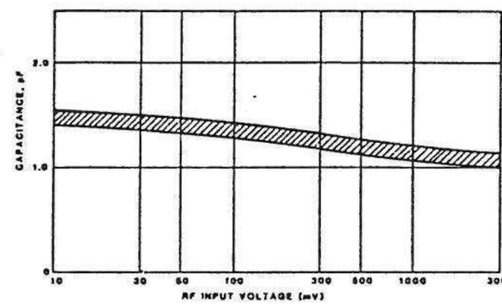
INPUT RESISTANCE VS, FREQUENCY, MODEL 952001A



INPUT CAPACITANCE VS, INPUT VOLTAGE, MODEL 952001A RF PROBE

Adapter: Model 952002 50 Ω terminated BNC female, for use with the Model 952001A Probe. (Supplied).

Input Impedance: Refer to the graphs.

MAXIMUM AC INPUT: 10 V, all frequencies and ranges.

MAXIMUM DC INPUT: 200 V, all ranges.

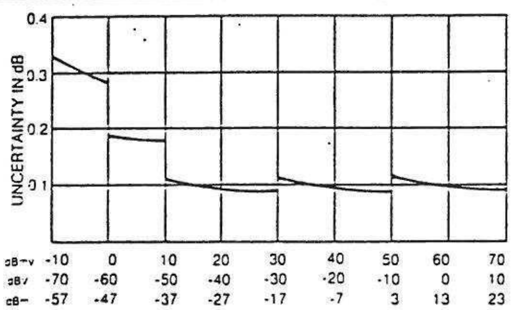
RECORDER OUTPUT: 10 V fs proportional to indicated voltage (voltage mode) over each range; 8 V equivalent to 0 dBm regardless of Z_o (dB modes) with a sensitivity of 1 V per 10 dB change over the entire range.

ACCURACY: The maximum uncertainty is the sum of the uncertainties listed in sections A, B and C.

TABLE 1-1. SPECIFICATIONS (CONT.)

A. Basic Uncertainty:

Voltage Level	mV	dBV, dBmV, dBm
3 mV - 3000 mV 1 mV - 3 mV 0.2 mV - 1 mV	1% rdg ± 1 count 2% rdg ± 2 counts 3% rdg ± 3 counts	see curve



MODEL 9200B UNCERTAINTY VS. INPUT LEVEL FOR dBV, dBmV, AND dBm.

B. Frequency Effect:

Model 952001A Probe with Model 952002 50 Ω BNC Adapter or Model 952003 Tee Adapter.

Frequency	mV	dBV dBmV, dBm
1 MHz (cal freq)	0	0
10 kHz - 100 MHz	1% rdg	0.09 dB
100 MHz - 1 GHz	3% rdg	0.27 dB
1 GHz - 1.2 GHz	7% rdg	0.63 dB

Model 952003 Tee Adapter
1.2 GHz - 2.0 GHz 7% ±.01%/mV

SWR: 1.05 to 300 MHz, 1.10 to 1 GHz, 1.15 to 1.2 GHz

Model 952009 Terminated Voltage Sensor.

Frequency	mV	dBV dBmV, dBm
1 MHz (cal freq)	0	0
100 kHz - 1 GHz	1% rdg	0.09 dB
1 GHz - 2 GHz	3% rdg	0.27 dB
2 GHz - 2.5 GHz	5% rdg	0.45 dB

SWR: 1.05 to 2 GHz, 1.10 to 2.5 GHz,

Model 952016 Low Frequency Probe with Model 952002 BNC Adapter.

Frequency	mV	dBV, dBmV, dBm
1 MHz (cal freq)	0	0
50 Hz - 20 MHz	1% rdg	0.09 dB
20 Hz - 50 Hz	2% rdg	0.17 dB
10 Hz - 100 MHz	5% rdg	0.45 dB

SWR: 1.05 to 100 MHz.

Model 952016 Low Frequency Probe with Model 952058 100:1 Divider.

Frequency	mV	dBV, dBmV, dBm
1 MHz (cal freq)	0	0
1 MHz - 20 MHz	5%	0.45 dB
50 Hz - 1 MHz	3.5% rdg	0.31 dB
20 Hz - 50 Hz	4.5% rdg	0.40 dB
10 Hz - 20 Hz	7.5% rdg	0.68 dB

Model 952001A Probe with Model 952006 75 Ω BNC Adapter.

Frequency	mV	dBV, dBmV, dBm
1 MHz (cal freq)	0	0
10 kHz - 100 MHz	1% rdg	0.09 dB
100 MHz - 300 MHz	3% rdg	0.27 dB
300 MHz - 500 MHz	6% rdg	0.54 dB

SWR: 1.05 to 150 MHz, 1.10 to 300 MHz, 1.20 to 500 MHz

Model 952001A Probe with Model 952007 75 Ω Tee Adapter.

Frequency	mV	dBV dBmV, dBm
1 MHz (cal freq)	0	0
10 kHz - 100 MHz	1% rdg	0.09 dB
100 MHz - 700 MHz	3% rdg	0.27 dB
700 MHz - 1 GHz	7% rdg	0.63 dB

SWR: 1.05 to 150 MHz, 1.10 to 750 MHz, 1.25 to 1 GHz

TABLE 1-1. SPECIFICATIONS (CONT.)

C. Temperature Effect:
Model 952001A Probe or Model 952009 Sensor at 10 kHz to 1.2 GHz.

	mV		dBV, dBmV, dBm	
Temp	Inst	Probe/ Sensor	Inst	Probe/ Sensor
21°C - 25°C	0	0	0	0
18°C - 30°C	0	1% rdg	0	0.09 dB
10°C - 40°C	1% rdg	3% rdg	0.09 dB	0.26 dB
0°C - 55°C	2% rdg	7% rdg	0.18 dB	0.63 dB

LINE STABILITY: Less than 0.2% rdg with ±10% line voltage change at reference line conditions of 115 to 120 V, 50 to 400 Hz. Usable after 5 min. warmup.

ZERO: Automatic, operated by panel key switch.

DISPLAY: 4 digit LED display of voltage or dB. Auxiliary analog display, uncalibrated, proportional to voltage (voltage mode) or dB (dB modes).

ANNUNCIATORS: LEDs indicate V, mV, dBV, dBmV, dBm, dBw, dBr and X100. Also shows use of channel 1 (CH1), channel 2 (CH2) or channel 3 (CH3) with option -03 where CH3=CH1-CH2 in dB. Indicate IEEE-488 bus activity (LSN, ATN, REM and TLK) with option -01B.

ENVIRONMENTAL PERFORMANCE:
Operating Temperature: 0° C to +55° C.

Storage Temperature: -55° C to +75° C.

Classification: Conforms to the requirements of Mil-T28800C for Type II, Class 5, Style E equipment.

POWER: 100, 120, 220, 240 V ±10%, 50-400 Hz; 24 VA.

WEIGHT: 10 lbs. (4.54 kg) approx.

DIMENSIONS: 5.85 in (14.9 cm) high, 8.3 in (21.1 cm) wide, and 12.27 in (30.1 cm) deep.

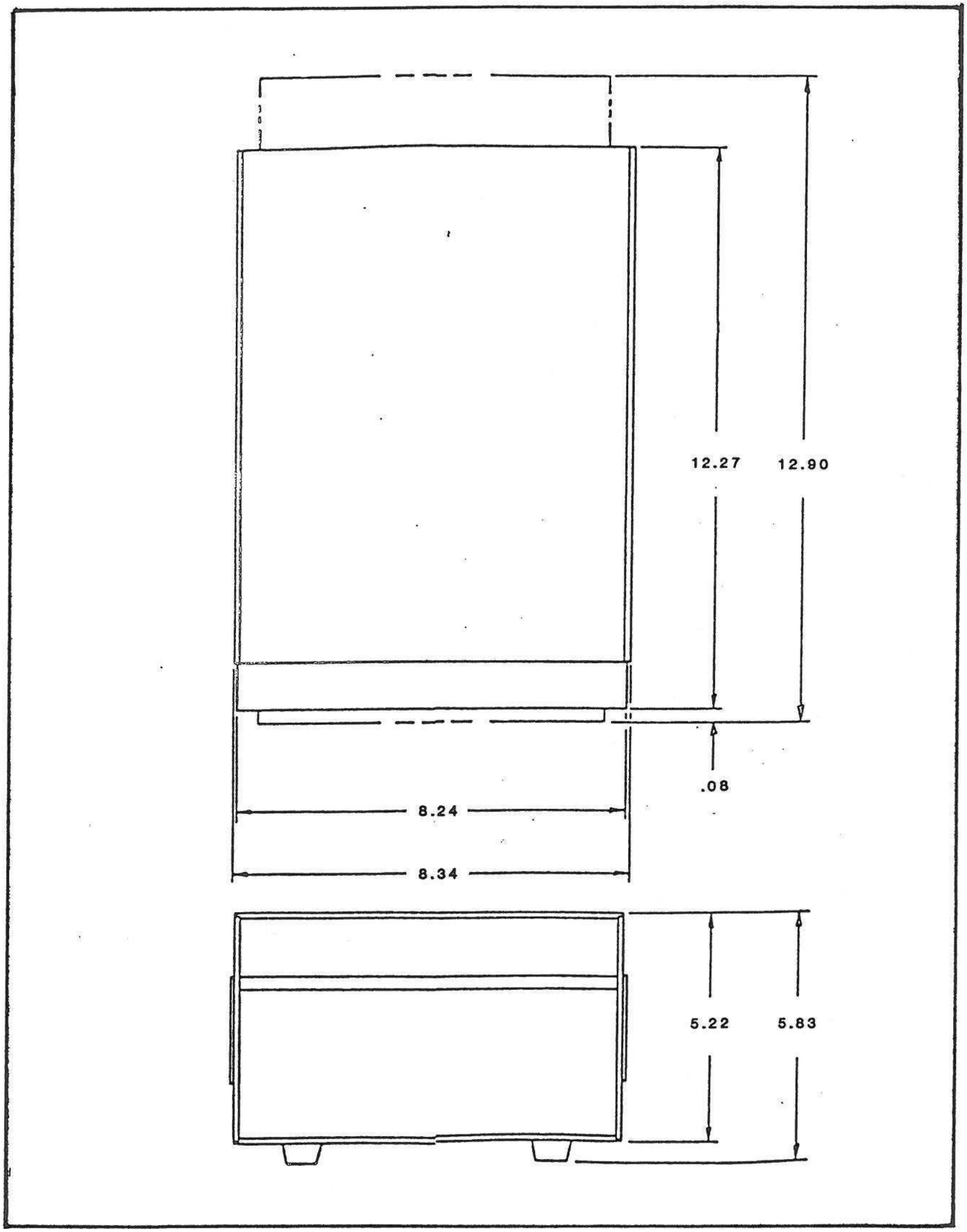


Figure 1-2. Outline Dimensions.

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section contains the installation instructions for the Model 9200B RF Millivoltmeter and includes the unpacking, mounting, power requirements, power fail protection, cable connections, and the preliminary checkout procedure.

2-3. UNPACKING

2-4. The instrument is shipped complete and is ready to use upon receipt. Unpack the instrument from its shipping container and inspect it for damage that may have occurred during shipment. Refer to Figure 2-1.

NOTE

Save the packing material and container for possible use in reshipment of the instrument.

2-5. MOUNTING

2-6. For bench mounting, choose a clean, sturdy, uncluttered mounting surface. For rack mounting, an accessory kit is provided with the instrument that provides mounting ears and rear supports. The rack mounting kit contains the required hardware and instructions.

2-7. POWER REQUIREMENTS

2-8. The instrument has a tapped power transformer and two line voltage selection switches which permit operation from 100, 120, 220 and 240 volt ±10%, 50 to 60 Hz, single phase AC power sources. Power consumption is approximately 100 VA.

CAUTION

Always make certain that the line voltage selector switches are set to the correct positions most nearly corresponding to the voltage of the available AC power source, and that a fuse of the correct rating is installed in the fuse holder before connecting the instrument to any AC power source.

2-9. Set the line voltage selector switches, located on the rear panel to the appropriate positions as indicated on the LINE VOLTAGE SELECT chart located next to the switches. Check that the line fuse is correct for the selected power source.

VOLTAGE	FUSE
100/120 V	0.3 A MDL (SB)
220/240 V	0.2 A MDL (SB)

2-10. CABLE CONNECTIONS

2-11. Cable connections required depend on the use and what options are installed. A line cord and voltage probe are supplied with the instrument, a second voltage probe is supplied with option 9200B-03. Any other cables required must be supplied by the user.

2-12. Cable connections that may be required are as follows:

a. PROBE CHNL 1 input. Front panel connector that provides a means for connecting probe to the instrument channel 1 input.

b. J1 IEEE-488 Bus connector. Rear panel connector that provides a means for connecting to the IEEE-488 Bus interconnection when the 9200B-01B option is installed.

c. P3 Status Output connector. Rear panel connector that provides signal outputs for input disconnect during zeroing operations and high and low dB limit signals. Pin connections are as follows:

Connector Pin	Signal
1	Common
2	Not used
3	Logic high indicates zeroing operation.
4	Logic low if measured value is within dB limits; logic high if measured value is above high dB limit.
5	Logic low if measured value is within dB limits; logic high if measured value is below low dB limit.

d. RECORDER Output connector. Rear panel RECORDER connector (type BNC) provides an analog DC voltage that is linear with voltage over each decade range in the mV measurement mode, or linear in dB over the entire 80 dB range in any of the dB modes. Output impedance is approximately 9000 ohms. Maximum current capability is 1 milliampere into 1000 ohms. Full scale DC voltage for each range in the mV mode is 10 volts. Output voltage in all dB modes is as follows:

Measured dBV	Output Voltage
+10	10 volts
0	9 volts
-10	8 volts
-20	7 volts
-30	6 volts
-40	5 volts
-50	4 volts
-60	3 volts
-70	2 volts

e. CHNL1 and CHNL 2 input connectors. Rear panel connectors that provide a means for connecting probes to instrument CHNL 1 or CHNL 2, when the 9200B-03 or 9200B-12 options are installed.

2-13. PRELIMINARY CHECKOUT PROCEDURE

2-14. The preliminary check verifies that the instrument is operational and should be performed before the instrument is placed into use. Refer to Section V for the Performance Tests.

2-15. Perform the preliminary checkout as follows:

a. Connect the power cord to the instrument and the desired power source. Refer to paragraph 2-7 for proper power application.

b. Set the LINE switch to ON.

c. Check operation of the LED display and the numerical keys by pressing the following keys in the sequence indicated and noting the LED display:

Press	Display	Press	Display
CLR	0000	5	0045
●	0000.	6	0456
0	000.0	7	4567
1	00.01	CLR	0000
2	0.012	8	0008
3	0123	9	0089
CLR	0000	CHS	-0089
4	0004		

d. Connect the probe that is marked Channel 1 to the front panel PROBE CHNL 1 input connector.

e. Enter measurement parameters by pressing the following keys:

1 SELECT CHNL
0 REF LEVEL dB
MODE dBm
50 SELECT Z_o

f. Check to see that the dBm and CH1 annunciators are lighted.

g. With zero input to the probe, press the ZERO key. The instrument will go through an automatic zeroing cycle. During the zeroing cycle the display will show cccc; in approximately 18 seconds, the display will return and show cc 3, indicating that zeroing is complete and the input level is underrange.

NOTE

The 9200B will display eight error codes, as follows:

cc 1	Entry too small
cc 2	Entry too large
cc 3	Measurement underrange
cc 4	Measurement overrange
cc 5	Zero acquisition out of range - excessive negative offset (hardware malfunction, e.g., input connector polarity reversed, or negative chopper offset).
cc 6	Zero acquisition out of range - excessive positive offset (input too large).
cc 7	Channel 3 over/underrange
cc 8	Probe (sensor) serial number is not in instrument's memory.

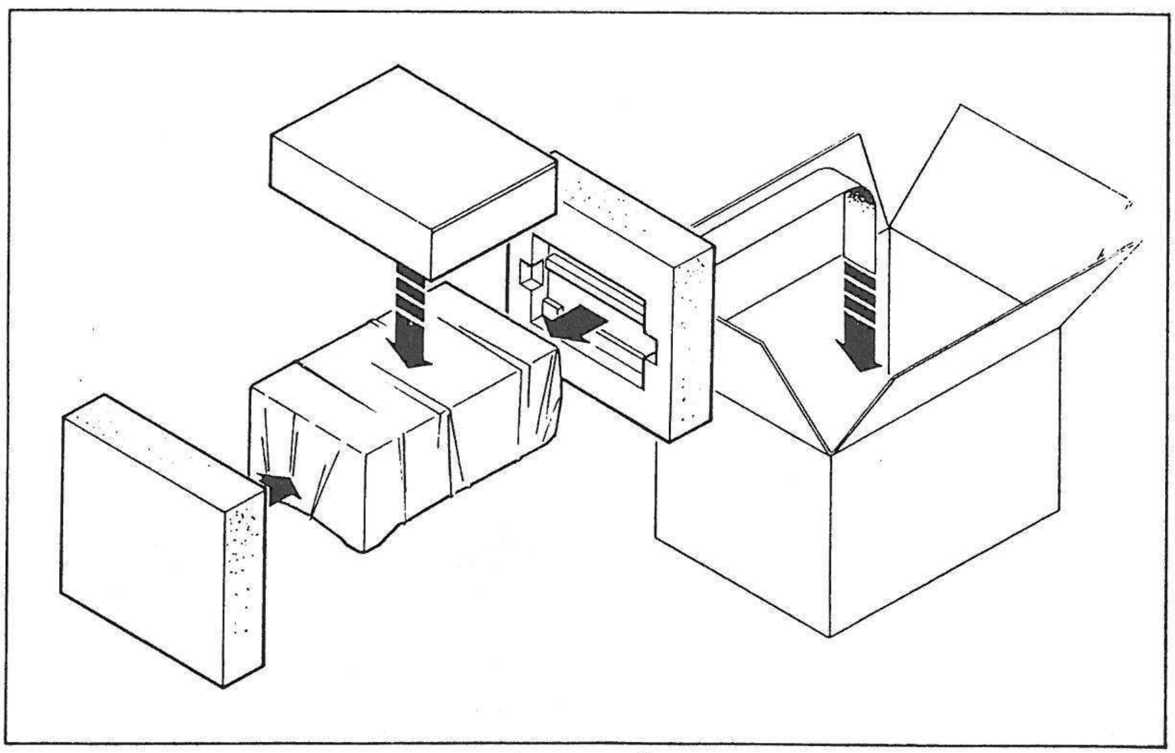


Figure 2-1. Packing and Unpacking Diagram.

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. Section III contains the operating controls, indicators, and connectors descriptions and functions, initial conditions, and operating instructions for the instrument.

3-3. OPERATING CONTROLS, INDICATORS, AND CONNECTORS

3-4. The controls, indicators, and connectors used during operation of the instrument are listed in Table 3-1 and shown in Figures 3-1 and 3-2.

3-5. OPERATING INSTRUCTIONS

3-6. The operating instructions for the instrument are as follows:

a. Initial conditions.

b. Programming Measurement Parameters.

c. Zeroing the Instrument .

d. Making Measurements.

e. Recall and Entry of Instrument Non-Volatile Memory Data Operations.

f. Application Notes.

3-7. Initial Conditions.

3-8. Initialize the instrument as follows:

a. Connect the power cord to the instrument and the desired power source. Refer to paragraph 2-7 for proper power application.

b. Set the LINE ON power switch to ON.

c. Wait several seconds then depress the INIT key.

3-9. Programming Measurement Parameters.

3-10. Measurement parameters for each channel of the instrument are entered into the microprocessor through the front panel keyboard. To eliminate the need for repeated reprogramming, parameters entered through the keyboard are stored in non-volatile memory, and the stored parameters are unaffected by instrument turn OFF and turn ON. It is important to remember that the last used parameters are stored in the instrument because these stored parameters could cause what appear to be erroneous indications when subsequent measurements that require different parameters are made. Measurement parameters may be changed at any time. The following keys may be used to recall the last entered value for the corresponding functions: AVERAGE SEL, SELECT PROBE SELECT Z_o, SELECT CHNL, and REF LEVEL dB.

NOTE

Entered measurement parameters apply only to the channel in use at the time that the parameter entries were made. If the instrument is equipped with the second channel option (option 9200B-03), different measurement parameters may be entered for channel 1 and channel 2. When either channel is selected thereafter, measurement parameters that had been entered for that channel are invoked automatically by the microprocessor.

3-11. When the instrument is in store or recall mode, the LED display and annunciators blink on and off to alert the operator to the fact that the displayed value is not a measured value, but a value that has been recalled from instrument memory or that is to be entered into memory.

3-12. Probe Selection.

3-13. The Model 9200B is supplied with either the Model 952001A high impedance probe or the Model 952009 50 Ω sensor as ordered for channel 1 (and channel 2, option 9200B-03 if ordered).

3-14. Use of Numerical Keys.

3-15. The numerical keys are used to enter values for SELECT, PROBE SELECT, AVERAGING CONSTANT, Z_o and REF LEVEL dB functions. When any numerical key is pressed, the microprocessor interrupts the measurement operation to accept new data. Numerical values are entered in normal sequence and keyed-in values enter the instrument display from right to left. Up to four digits, plus decimal point and minus sign, can be entered; entries exceeding four digits are ignored. Pressing the decimal point key places a decimal point after the right most digit in the instrument display. Pressing the CHS key changes the sign of the entry (plus becomes minus, or minus becomes plus); the plus sign is not displayed. If an error is made during entry of numerical values, press the CLR key and repeat the data entry process. When the instrument display shows the desired numerical value, pressing the applicable SELECT or dB REF LEVEL key will cause the microprocessor to store the keyed-in value and return automatically to the measurement cycle.

3-16. CLEAR key.

3-17. If an error is made in keying in a numeric entry pressing the CLEAR key will clear the display to all zeros and the value may be re-keyed. Additionally, the CLEAR key may be used to clear to zero the value stored for dB reference by pressing the CLEAR key followed by the REF LVL dB key. During IEEE-488 Bus operations, the CLEAR key is used as the Return to Local key, whereby pressing it returns control of the instrument to the front panel.

3-18. SELECT Keys.

3-19. The SELECT keys are used by the operator to specify the number of the measurement channel and the probe.

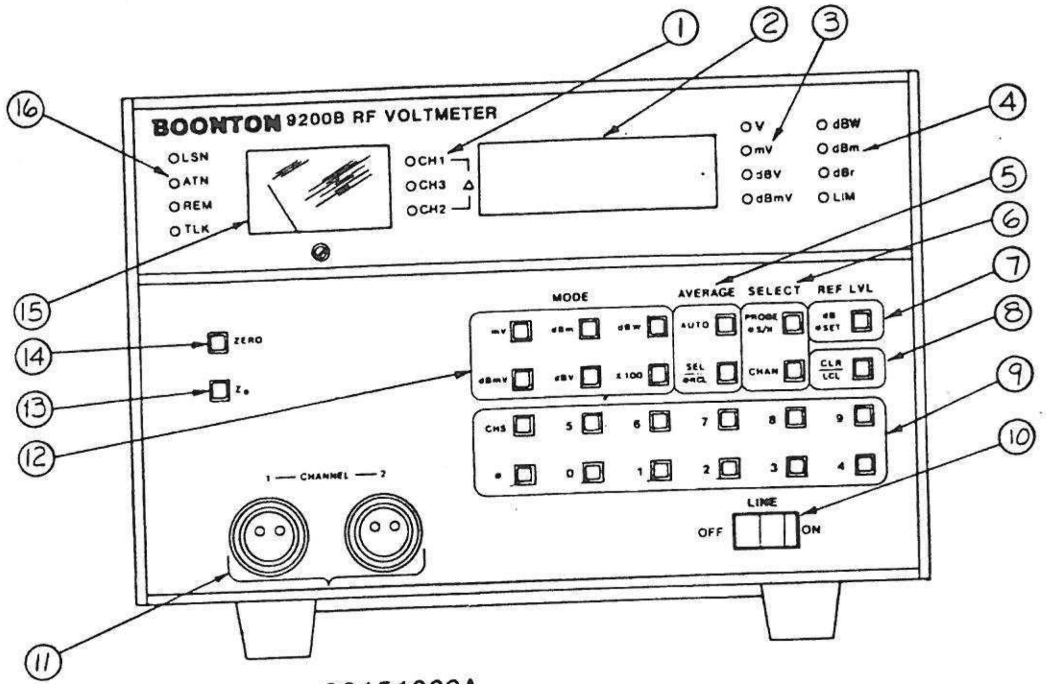


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Figure 3-1. Model 9200B, Front View.

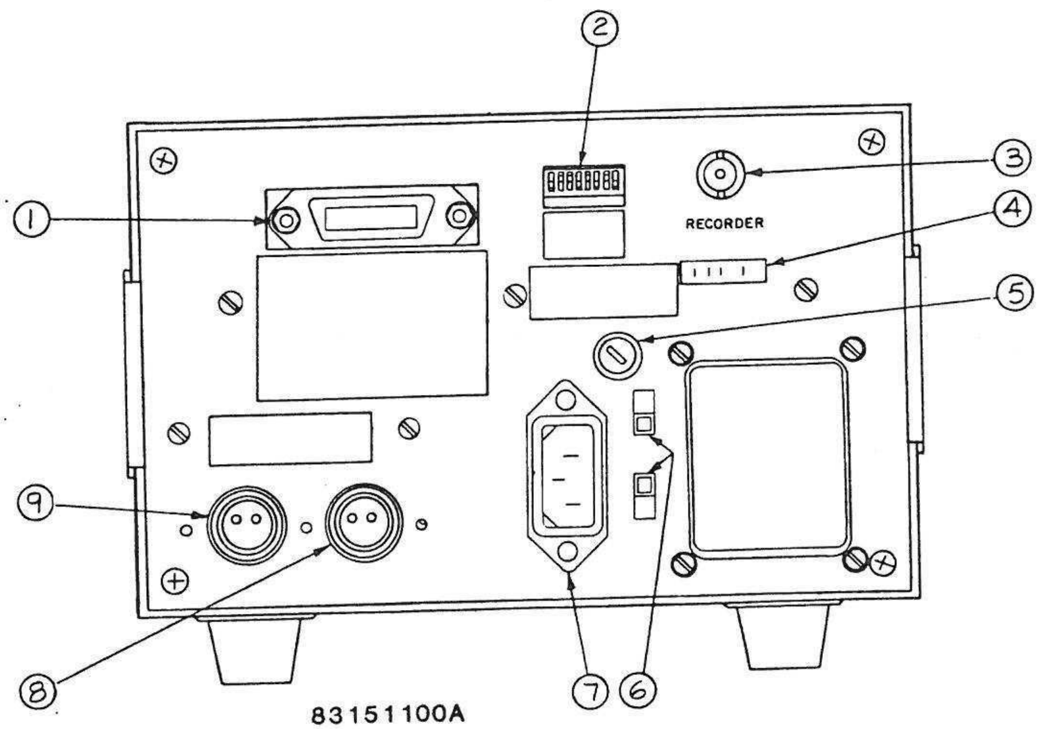

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Figure 3-2. Model 9200B, Rear View.

TABLE 3-1. OPERATING CONTROLS, INDICATORS, AND CONNECTORS

Control, Indicator, or Connector	Figure and Index No.	Function
CH1, CH3 and CH2 annunciators	3-1, 1	Indicates which channel has been selected for use.
LED display	3-1, 2	Four digit LED display with minus sign and decimal point; provides numeric indication of measured voltage or dB level, or data entered or recalled through keyboard, or error messages.
V, mV, dBV and dBmV annunciators	3-1, 3	Indicate measurement units.
dBm, dBw, dBr, and LIM annunciators	3-1, 4	Indicate whether displayed measurement values in dB modes are absolute (dBm) or relative (dBr) values.
AVERAGE keys	3-1, 5	
AUTO		Selects automatic averaging operation.
SEL / ●RCL		Provides means for entering or recalling range averaging constant.
SELECT keys	3-1, 6	
PROBE ●S/N		Provide means for entering or recalling probe number or serial number.
CHAN		Provides means for entering or recalling channel number (CHNL).
REF LEVEL key	3-1, 7	Provides means for entering or recalling a dB reference level.
dB ●SET		
CLR / LCL Key	3-1, 8	Provides means for clearing incorrect digit(s) entry, clearing dB calibration factor and dB Ref level to zero, and returns to local under bus operation provided local lockout (LLO) is not active.
Numeric, decimal point and CHS keys	3-1, 9	Provide means for entering signed numeric data.
LINE switch	3-1, 10	Controls application of AC line power to instrument.
PROBE connectors	3-1, 11	Provides means for connecting probes to input channels of instrument.
MODE keys	3-1, 12	Provide means for selecting display indication mode (mV, dBm, dBmV, dBV, dBw or X100).
Z_0 key	3-1, 13	Provides means for entering or recalling reference impedance for dB mode measurements.
ZERO key	3-1, 14	Provides means for automatic acquisition and storage of zero corrections for each range.
Meter	3-1, 15	Provides relative indication of voltage or dB for peaking and nulling operations.
LSN, ATN, REM and TLK annunciators	3-1, 16	Provide indication of activity when IEEE 488 bus interface option 9200B-01B is in use.

TABLE 3-1. OPERATING CONTROLS, INDICATORS, AND CONNECTORS (Continued)

Control, Indicator, or Connector	Figure and Index No.	Function
J1 connector	3-2, 1	Option: provides IEEE 488 bus connections when option 9200B-01B is installed.
S1 switch	3-2, 2	Option: used to set address of instrument and termination characters when IEEE 488 bus option 9200B-01B is installed.
RECORDER connector	3-2, 3	Provides analog DC output, which is proportional to measured voltage or dB level, for application to recorder.
P3 connector	3-2,4	Provides logic signal outputs for input disconnect during zeroing, high dB limit and low dB limit.
Fuseholder	3-2, 5	AC line fuseholder.
Line Voltage Selector Switches	3-2, 6	Selects the desired operating voltage.
AC power connector	3-2, 7	AC power connector.
REAR CHNL 2 connectors	3-2, 8	Provides means for rear connection to input channel 2.
REAR CHNL 1 connectors	3-2, 9	Provides means for rear connection to input channel 1.

3-19. (Continued).

NOTE

Selecting a channel also selects probe data and measurement parameters that had been entered into non-volatile memory for that channel and PROBE (SENS).

a. The basic instrument contains only one measurement channel. This channel is designated channel 1 and the front and rear panel CHANNEL connector provides the input to this channel. An option is available for the addition of a second measurement channel. When this option (option 9200B-03) is included, the additional measurement channel is designated channel 2.

b. To further enhance the usefulness of the instrument, a channel 3 operation may be exercised if the instrument is equipped with option 9200B-03. The indication in channel 3 mode is, the Display equals:

Channel 1		Channel 2
[dBmV or dBV or (dBm - REF LVL dB) or (dBw - REF LVL dB)]	-	[dBmV or dBV or (dBm - REF LVL dB) or (dBw - REF LVL dB)]

The dB mode operative for each channel in channel 3 operation is the last dB mode chosen for that channel prior to selection of channel 3 operation. This is true even if the mV mode is chosen prior to channel 3 selection. Mixed modes are also possible, that is, either channel may be operating in any of its modes (mV, dBmV, dBV dB or dBw). If either or both channels are operating in the dB mode, the REF LEVEL dB function is also operative. Examples of channel 3 operation are listed in Table 3-2.

c. Channel 1 measurements, channel 2 measurements or the channel 3 function can be selected using the numerical keys and the SELECT CHNL key.

Example: To select the channel 1 input for measurement:

Press	Display
1	0001
SELECT CHNL	Reverts to measurement.

Example: To select a reference impedance of 50 ohms:

Press	Display
5	0005
0	0050
SELECT Z_O	Reverts to measurement.

TABLE 3-2. EXAMPLES OF CHANNEL 3 MEASUREMENTS

Channel 1

Meas. No.	Input	Mode	Z_o	REF LEVEL dB	Display
1	1000 mV	mV	–	0	1000 mV
2		dBmV	–	0	60.00 dBmV
3		dBV	–	0	00.00 dB
4		dBm	50	0	13.01 dBm
5		dBm	50	5	8.01 dBr
6		dB	50	5	8.01 dBr
7		mV	50	5	1000 mV
8		mV	50	5	1000 mV

Channel 2

Meas. No.	Input	Mode	Z_o	REF LEVEL dB	Display	Channel 3 Display
1	1000 mV	mV	–	0	1000 mV	(See Note)
2		dBmV	–	0	60.00 dBmV	00.00 dBr
3		dBmV	–	0	60.00 dBmV	-60.00 dBr
4		dBm	50	0	13.01 dB	00.00 dBr
5		dBm	50	0	13.01 dB	-05.00 dBr
6		dBmV	50	0	60.00 dBmV	-51.99 dBr
7		dBmV	50	0	60.00 dBmV	-51.99 dBr
8		mV	50	0	1000 mV	-51.99 dBr

NOTES:

For No. 1 measurement, the channel 3 indication is a function of previously selected dB modes, unknown at this time.

For No. 2 measurement, the channel 3 indication = 60 dBmV - 60 dBmV = 0 dBr.

For No. 3 measurement, the channel 3 indication = 0 dBV - 60 dBmV = -60 dBr.

For No. 4 measurement, the channel 3 indication = 13.01 dBm -13.01 dBm = 0 dBr.

For No. 5 measurement, the channel 3 indication = (13.01 dBm - 5 dB) dBr - 13.01 dBm = -5 dBr.

For No. 6 measurement, the channel 3 indication = (13.01 dBm - 5 dB) dBr - 60 dBmV = -51.99 dBr.

For No. 7 and No. 8 measurements, the channel 3 indication is the same as for the No. 6 measurement because if the mV mode was chosen for channel 1 and/or channel 2 prior to channel 3 selection, that channel will revert to the dB mode used prior to selection of the mV mode.

3-20. Probe (Sensor) Select.

3-21. The Model 9200B can accommodate data storage for up to eight probes or sensors. The desired probe is selected by pressing N (N: digit 1 thru 8) and SELECT PROBE keys. The data for N Probe (if previously stored see Section 4-33) will now be used in the measurement process. The probe number for data in effect can be recalled by pressing the SELECT PROBE key. The display will show the probe number. The serial number of each probe (sensor) is also stored in the instrument's memory and can be recalled by pressing the ●, SELECT PROBE keys. This is helpful in assuring that the correct probe has been installed and selected. If the probe (sensor) number is not known, the correct data can be recalled by entering the last four digits of the probe (sensor) serial number followed by pressing the ●, SELECT PROBE keys. The correct data and probe number will now be matched to the probe in use.

3-22. If a particular probe (sensor) is desired with a particular channel this is obtained by selecting the channel first followed by the probe selection (e.g. 1 CHNL, 1 PROBE). Whenever Channel 1 is now selected Probe 1 is also selected.

3-23. PROBE (SENS) Serial Number Recall.

3-24. To recall the serial number of a probe, first select the probe (N, PROBE), then press ●, PROBE keys. The display will now show the serial number for the probe selected. PROBE (SENS) serial number entry is covered in Section 4-33.

3-25. MODE Selection.

3-26. The MODE keys enable the operator to select the desired measurement mode. When the MODE mV key is pressed, measurement values are displayed in millivolts. When the MODE dBmV key is pressed, measured levels are displayed in dB referred to 1 millivolt. When the MODE dBV key is pressed, measured levels are displayed in dB referred to 1 volt. When the MODE dBm key is pressed (and a 0 dB reference level has been entered), measured levels are displayed in dB referred to the voltage that produces 1 milliwatt in the selected Z_o reference impedance (the Z_o value must be entered through the keyboard). When the MODE dBw key is pressed (and a 0 dB reference level has been entered), measured levels are displayed in dB referred to the voltage that produces 1 watt in the selected Z_o. The displayed numerical values may be expressed as follows:

$$dB = 20 \log \frac{e_{measured}}{e_{reference}}$$

For dBm, $e_{reference} = (Z_o \times 10^{-3})^{1/2}$

For dBw, $e_{reference} = (Z_o)^{1/2}$

3-27. In the dB mode, entering a dB reference level other than 0 causes lighting of the dBr annunciator and displayed dB mode measurement values represent dB with respect to the selected reference level. Resolution of the instrument in any dB mode is 0.01 dB.

3-28. REF LEVELS dB Selection.

3-29. The following standard reference levels are operative in the dB modes:

Mode	Level (0 dB)	Annunciator
dBmV	1 mV	dBmV
dBV	1 V	dBV
$dB(Z_o)$	$dB(Z_o \times 10^{-3})^{1/2}$	dBm
$dBw(Z_o)$	$dB(Z_o)^{1/2}$	dBw

3-30. Entering a number other than 0 into the REF LEVEL dB results in this number becoming the reference level for the dB mode. The display will indicate reference level and the dBr annunciator will be activated. The dB reference level affects the dB mode only. The dB reference level may be entered while any mode is being used, but the result of the entry will be apparent only when returning to the dB mode.

3-31. It is possible to select the present dB level as the dB reference level by pressing the ● and REFERENCE LEVEL dB keys.

a. To display dBr to a reference level of -15.3 dB:

Press	Display	Annunciators dBm	dBr
MODE dBm	Measurement	ON	OFF
CLR	0000	ON	OFF
REF LEVEL dB	dB Measurement	ON	OFF
1	0001	ON	OFF
5	0015	ON	OFF
●	0015.	ON	OFF
3	015.3	ON	OFF
CHS	-015.3	ON	OFF
REF LEVEL dB	dB Measurement	ON	ON

NOTE

Maximum display capability for dBr is ±99.99 dB.

b. To return to a dBm measurement:

Press	Display	Annunciators dBm	dBr
0 or CLR	0000	ON	ON
dB REF LEVEL	dB Measurement	ON	OFF

3-32. Select Z_o.

3-33. The SELECT Z_o key enables the operator to enter a desired reference impedance for dB mode measurements. (When the MODE dBm key is pressed, measured input levels are displayed in dBm referred to the voltage that produces 1 milliwatt of power in the selected reference impedance.) Valid Z_o values are 5 through 2500 ohms.

Example: To select a reference impedance of 50 ohms:

Press	Display
5	0005
0	0050
SELECT Z_o	Reverts to measurement.

3-34. AVERAGE Function Selection.

3-35. To reduce the effects of noise, spurious components, etc. at lower levels, the Model 9200B employs signal averaging. The amount of averaging is a function of signal level, being highest on the lowest ranges and least on the highest ranges. When the instrument is first turned on a set of default values is assigned as follows:

fs LEVEL	RANGE	CONSTANT
3000 mV	7	1
1000 mV	6	1
300 mV	5	1
100 mV	4	1
30 mV	3	2
10 mV	2	4
3 mV	1	20
1 mV	0	80

3-36. Increasing or decreasing these values may be accomplished by pressing N (N=1 to 127) and then the AVERAGE SELECT key. This new constant will now be in effect on all ranges and will remain in effect until changed by entering a different value, or until the AVERAGE AUTO key is pressed or the instrument is turned OFF/ON after which the default values will again be in effect. The value of the constant in effect can be recalled by pressing the ●, AVERAGE SEL keys. The default values when in the AUTO mode cannot be recalled.

NOTE

Some early production models allow the average to be set on individual ranges. If a new average is selected it will be in effect only on the range that the instrument was on when it was selected, all other operations remain the same. To test for this operation press the ●, AVERAGE SEL keys. If the constant listed for that range (refer to paragraph 3-35) is returned on the display, the instrument has the older software. If 0 is returned on the display, the instrument has the updated software.

3-37. X100 Key.

3-38. The X100 key is used with the 952005 100:1 Voltage Divider. By pressing the X100 key when the 952005 Divider is installed on a probe, the display is corrected to read the true voltage or dB and is active in all voltage and dB modes. This saves the operator from making a mental correction or recalculating dB by hand. The X100 function can be used independently on both channels and the X100 annunciator will light to inform the operator that the channel selected is in the X100 mode. To return to the X1 mode, press the X100 key.

3-39. Zeroing the Instrument.

3-40. For greatest accuracy, especially on the more sensitive ranges, the instrument must be zeroed. To eliminate the need for tedious and often inaccurate manual zeroing, the instrument incorporates an automatic zeroing capability. When automatic zeroing is initiated, the microprocessor reads, averages and stores zero corrections for each measurement range of the instrument and applies the proper zero correction for the range in use for all subsequent measurements. Zero corrections are most important on the more sensitive ranges of the instrument. During instrument warmup periods and during use in environments with varying ambient temperatures, the instrument should be zeroed frequently if measurements are being made on the lower ranges. To zero the instrument, proceed as follows:

CAUTION

Never press the ZERO key with a signal applied to the probe. To do so will result in erroneous zero corrections and inaccurate subsequent measurements. If the input exceeds normal zero offsets, error flag cc 6 will be displayed when automatic zeroing is initiated; remove the input signal and re-zero the instrument.

a. Remove all input signal to the probe. This can be done by unscrewing the probe tip until the tip just breaks contact with the internal connection, leaving the metal shell engaged with the probe body threads. Alternatively, the probe tip can be removed and a Model 952002 50 Ω adapter connected in its place.

b. Press the ZERO key. The automatic zeroing cycle takes approximately 18 seconds; the microprocessor computes and stores zero corrections during this this period. When the ZERO key is pressed, a logic signal is activated at rear panel connector J3; this signal can be used to initiate turn-off of the device to which the instrument probe is connected if such operation is desired. When zeroing is complete, the instrument display shows cc 3 in all dB modes, indicating input underrange. In the mV mode, the underrange indication does not appear; the instrument display shows the "zero condition". This is composed of residual noise and offsets and, ideally, should show + and - excursions of similar amplitude less than 100 counts.

3-41. Making Measurements.

3-42. Once the instrument has been programmed and zeroed, it is ready for voltage or dB level measurements. Merely connect the probe to the source whose voltage or dB level is to be measured; the measured level will be displayed directly.

3-43. Recall and Entry of Non-Volatile Memory Data Operation.

NOTE

Factory entered data is shown on a hard copy stored under the top cover of the instrument.

3-44. Instrument and probe data is entered in to the instrument non-volatile memory depending on what options and probes are ordered with the instrument. Field entry of data is not required unless the stored data is destroyed, data accuracy becomes questionable, or if another probe is to be used with the instrument.

3-45. Recall and Entry of Instrument Gain Data.

3-46. Instrument Gain Data. The front end of the instrument input module is a balanced-input DC amplifier with seven decade ranges with nominal full-scale inputs of 20 microvolts to 20 volts. The output is an unbalanced DC with a 2.5 volt full-scale value for each range; the DC is converted into a proportional digital value. One manual gain adjustment, potentiometer R44, adjusts the gain of all ranges by the same amount; this adjustment is factory set during instrument calibration. Individual range adjustments are accomplished through software correction or adjustment, which is also determined during instrument calibration. The software corrections are stored in the instrument non-volatile memory. A gain factor associated with the recorder DC output is also stored in memory.

3-47. Gain Factor Recall. Recall the instrument gain factors stored for each channel of the instrument as follows:

a. Set the control board bit switch to mode 1. Refer to Figure 5-1.

b. Using the instrument keyboard, select the channel for which gain factors are to be recalled. For example: to select channel 1, press the 1 and SELECT CHNL keys.

c. Press the MODE dBw key. The instrument display will show approximately 1185; this is the recorder output gain factor.

d. Using the keyboard keys, select the range to be checked. For example: to select range 0, press the 0 and MODE dBV keys.

e. Press the REF LEVEL dB key. The instrument display will indicate the gain factor stored for the selected channel and range; this value should be in the vicinity of 1000.

f. Repeat steps c and e for each of the remaining ranges to be checked.

g. After all desired gain factors have been recalled, reset the control board bit switch to mode 0.

3-48. Instrument Gain Factor Entry. Correct or reintroduce an instrument gain factor as follows:

a. Set the control board bit switch to mode 1.

b. Using the keyboard keys, select the channel for which gain factor correction or reintroduction is required. For example: to select channel 2, press the 2 and SELECT CHNL keys.

c. Using the keyboard keys, select the range for which the gain factor is to be corrected or reintroduced. For example: to select range 2, press the 2 and MODE dBV keys.

d. Using the keyboard keys, enter the desired gain factor as a REF LEVEL dB value. For example: to enter a gain factor of 1023, press the 1, 0, 2 and 3 numeric keys, then press the REF LEVEL dB key.

e. Press the REF LEVEL dB key a second time. The instrument display will indicate the entered gain factor value.

f. Repeat steps c through e for each of the remaining ranges for which entry of a gain factor is desired.

g. Upon completion of gain factor entries, reset the control board bit switch to mode 0.

3-49. Recall and Entry of Probe Data.

3-50. Probe (SENS) Serial Number Entry. Enter the probe serial number as follows:

a. Set the control board bit switch to MODE 2. Refer to Figure 5-2.

b. Select the probe (SENS) number (1 through 8) with N, PROBE keys.

c. Enter the probe (SENS) serial number with digit keys N, N, N, N and depress the AVERAGE AUTO key.

d. Set the control board bit switch to MODE 0 (OPERATE MODE).

e. The probe (SENS) serial number can be recalled by pressing the ●, PROBE keys.

3-51. Probe Data Recall. Recall stored probe data as follows:

a. Set the control board bit switch to mode 0.

b. Using the keyboard keys, select the probe for which stored probe data is to be recalled. For example: if stored data for the 1 probe is to be recalled, press the 1 and SELECT PROBE keys.

c. Set the control board bit switch to mode 2.

d. Using the keyboard keys, select the range for which the probe gain factor is desired. For example: if the gain factor for range 0 is to be recalled, press the 0 and MODE dBV keys.

e. Press the REF LEVEL dB key. The instrument display will show the stored gain factor (approximately 5000) for the selected range.

f. Press the MODE dBw key. The instrument display will show a down-scale correction (generally 0 on range 0).

g. Repeat steps d through f for each of the other ranges for which the stored gain factor is to be recalled.

h. Set the control board bit switch to mode 0.

3-52. Probe Gain Factor and Gain Correction Entry.

3-53. Probe (sensor) data cannot be entered for a probe (SENS) number which is not accommodated by the control board bit switch setting for N PROBE (SENS) capability. If this is attempted, the instrument will display an error message. If the instrument was originally supplied with 2 probes and it is desired to enter data (or calibrate) for a third, bit switches 4, 5 and 6 will have to be set for 3 probe capability with the new data entered for probe 3. Refer to Figure 5-4 for the bit switch settings for 1 through 8 probe (sensor) capabilities. Proceed as follows:

a. Using the keyboard keys, select the probe for which the data is to be entered. For example: if the data to be entered applies to probe 1, press the 1 and PROBE (SENS), SELECT PROBE keys.

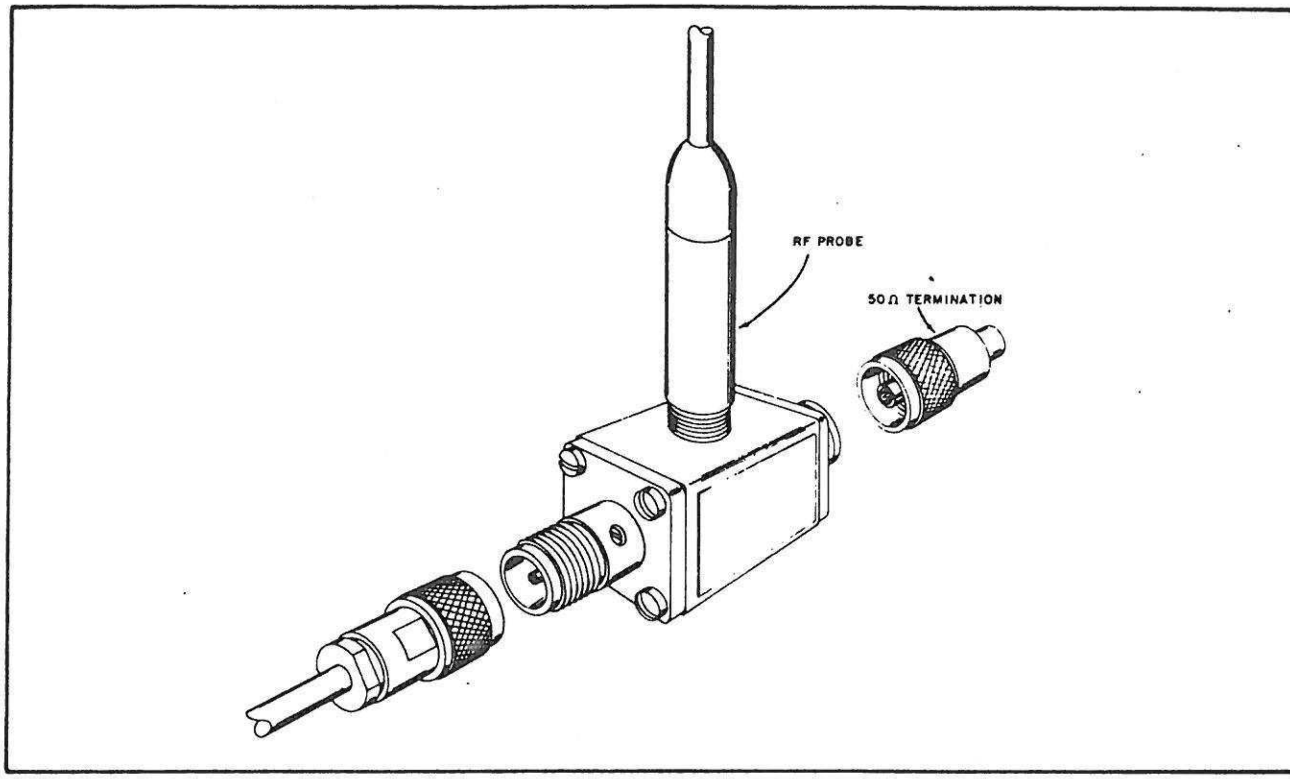


Figure 3-3. Attachment of Model 952003 50 Ohm N Tee Adapter to Model 952001A Probe and Model 952014 50 Ohm Termination.

3-53. (Continued).

b. Set the control board bit switch to mode 2.

c. Using the keyboard keys, select the range for which a probe gain factor entry is to be made. For example: If the probe gain factor for range 0 is to be entered, press the 0 and MODE dBV keys.

d. Using the numerical keys, enter the probe gain factor for the selected range; then, press the REF LEVEL dB key. For confirmation of correct probe gain factor entry, press the REF LEVEL dB key a second time; the stored probe gain factor for the selected range will appear on the instrument display.

e. Repeat steps c and d for each of the other instrument ranges for which probe gain factors are to be entered.

f. Select the instrument range for which the probe gain correction is to be entered. For example: If the probe gain correction for range 2 is to be entered, press the 2 and MODE dBV keys.

g. Using the numerical keys, enter the probe gain correction for the selected range, then press the MODE X100 key. For confirmation of correct probe gain correction entry, press the MODE X100 key a second time; the stored gain correction for the selected range will appear on the instrument display.

h. Repeat steps f and g for each of the other instrument ranges for which probe gain corrections are to be entered.

i. Upon completion of data entry, reset the control board bit switch to mode 0.

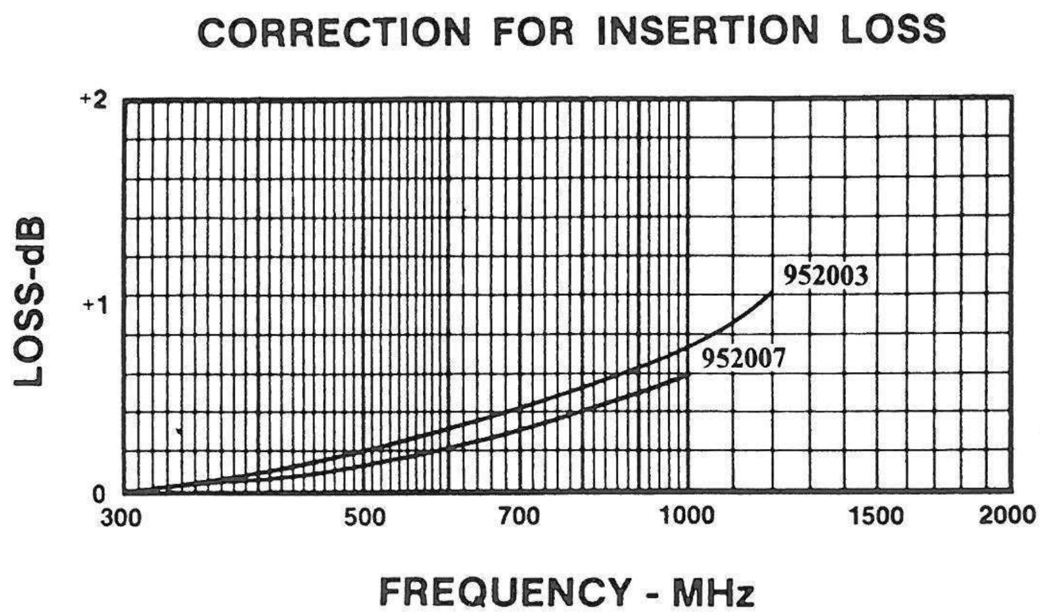
3-54. Application Notes.

3-55. Overload Limits.

a. The Model 952001A RF Probe supplied with the instrument is overload protected to 10 volts AC and 400 volts DC. Exceeding these limits may result in permanent damage.

b. The Model 952002 50 Ω BNC Adapter supplied with the instrument should not be subjected to continuous overload of more than 10 volts (DC + RMS AC) in order to avoid excessive heating of the terminating resistor.

c. Where voltages above the specified overload limits are likely to be encountered, use the Model 952005 100:1 Voltage Divider. Maximum rating of the voltage divider is 1000 volts (DC + peak AC).



NOTES

Attenuation shown is between the input and output ports of the tee. The instrument measures the input voltage of the tee.

Subtract the correction from the value indicated on the instrument if the output voltage of the tee is to be measured.

Do not use the correction if terminated measurements are required (Model 91-15A termination installed on the output port.

Figure 3-4. Correction Curves for Models 952003 and 952007 Type N Tee Adapters.

3-55. (Continued).

d. The terminated Model 952009 RF Probe is overload protected to 4 volts AC and 400 volts DC. Exceeding these limits may result in permanent damage.

3-56. Connection Recommendations.

a. The Model 952001A probe is equipped with a detachable tip and ground lead. For measurement of signals below approximately 100 MHz, this tip provides a convenient means for making both signal and ground connections.

b. For frequencies above 100 MHz, the probe tip should not be used because the series impedances of the connection will affect the voltage level at the probe and cause an error in measurement. For high impedance voltage measurements, connection should be made directly to the center contact of the RF probe, with the ground connection kept as short as possible. For matched impedance measurements, one of the various terminated adapters, tee adapter or Model 952009 Probe should be used Refer to Figure 3-3.

3-57. Low Level Measurements.

a. The instrument will provide reliable, reproducible measurements of signal levels as low as 200 microvolts. Useful indications extend down to 50 µV. Zeroing of the instrument is essential when using the lower ranges in order to achieve the specified accuracy. Zeroing is also strongly recommended for all ranges up to 30 millivolts. Refer to paragraph 3-39 for the zeroing procedure.

3-58. Temperature Effects.

a. The accuracy specifications for the instrument apply over a temperature range of 0°C to 50°C. Outside these limits, operation of the instrument is possible, but appreciable inaccuracies can be expected; however, no permanent change in probe characteristics will result from any reasonably high or low temperature exposure.

b. It should be noted that inaccuracies of measurement resulting from temperature effects may occur shortly after soldering to the RF probe tip, or measuring with the probe in the vicinity of heat sources such as resistors, heat sinks and so forth.

3-58. (Continued).

c. When making low level measurements (below approximately 2 millivolts), it is important to make sure that the probe has attained a uniform temperature throughout its body. A temperature gradient between the inside and outside of the probe can generate a small thermal voltage that may add to the DC output of the detector diodes.

3-59. Hum, Noise and Spurious Pickup.

a. When measuring low level signals, precautions should always be taken to avoid the possibility of measurement errors resulting from hum, noise or stray RF pickup. Although all low frequency hum and noise are attenuated at the input, unwanted high level signals could still possibly cause errors. In some cases it may be necessary to provide extra shielding around the probe connection to reduce stray pickup. Some typical sources of spurious radiation are induction or dielectric heating units, diathermy machines and local radio transmitters.

3-60. Recorder Output.

a. The DC output provided at the rear panel RECORDER connector may be used to drive an XY recorder for swept measurements, or a strip chart recorder for monitoring applications. Refer to Section II, paragraph 2-12.

3-61. Correction Curve for Model 952003 50 Ω N Tee Adapter.

a. When using the optional Model 952003 50 Ω N Tee Adapter, the input voltage to the adapter is indicated directly on the instrument. To obtain the correct output voltage from the adapter, subtract the correction shown in Figure 3-4 from the input voltage, in dB, indicated on the instrument. Corrections are not required if the Model 952003 is terminated in 50 Ω.

3-62. Correction Curve for Model 952007 75 Ω N Tee Adapter.

a. When using the optional Model 952007 75 Ω N Tee Adapter, the input voltage to the adapter is indicated directly on the instrument. To obtain the correct output voltage from the adapter, subtract the correction shown in Figure 3-4 from the input voltage, in dB, indicated on the instrument. Corrections are not required if the Model 952007 is terminated in 75 Ω.