

ADDENDUM 92A-S2

GENERAL

The 92A is provided with ranges up to 3 volts, used without the voltage divider on the rf probe input. Calibration of the meter is in rms on all ranges; however, the instrument's response is true rms only up to 30 mV. Above this range the response changes gradually to peak-to-peak.

The 92A-S2, used with the voltage divider, provides true rms measurements over the complete range of measurement. The range-selection push-buttons are grouped and identified for this mode of operation.

RANGE SELECTION

1. Normal Measurements

Select the desired voltage or dBm range as marked to the left or the right of the range push-buttons.

2. True RMS Measurements

a. Inputs of 30 mV and below:

The 100:1 voltage divider is not used. Select voltage ranges of 1, 3, 10 or 30 mV as marked to the left of the lowest four range push-buttons.

b. Inputs above 30 mV, up to 3 volts:

Install the 100:1 voltage divider on the rf probe input. Select voltage ranges of 100, 300, 1000 or 3000 mV as marked directly on the lowest four range push-buttons.

NOTE: Only the four lowest pushbuttons are used when measuring true rms. These are bracketed and labelled: "TRUE RMS."

DBM CONVERSION

For 600-ohm dBm readings, add 10.8 dBm to the dBm scale reading.

For 1000-ohm dBm readings, add 13.0 dBm to the dBm scale reading.

dBm Conversion Chart

Ref. Level			dBm					
			0	2	4	6	8	10
1 mW	50Ω	volts	0.224	0.282	0.354	0.446	0.561	0.707
1 mW	600Ω	volts	0.775	0.976	1.23	1.55	1.95	2.45
1 mW	1000Ω	volts	1.00	1.26	1.59	2.00	2.51	3.16

CHAPTER I
SPECIFICATIONS

Voltage Range: 100 μ V to 3V (300V up to 700 MHz with accessory
100:1 Voltage Divider) (see Table 1)

Full Scale
Voltage Ranges: 1, 3, 10, 30, 100, 300, 1000, and 3000 mV.

dBm Range: -60 to +23 dBm (+63 dBm up to 700 MHz with optional accessory,
Model 91-7C 100:1 Voltage Divider)

Frequency Range: 10 kHz to 1.2 GHz (uncalibrated response to approximately 8 GHz).

Accuracy:

	1 mV to 3V			
	1% fs plus			
300 mV to 3V	1% rdg			10% rdg
100 μ V to 300 mV*	2% rdg	1% rdg	3% rdg	7% rdg
	10 kHz	50 kHz	150 MHz	700 MHz 1.2GHz

*Below 1 mV, add 1% f.s.; below 200 μ V, use correction curve.

Meter: 4-1/2-inch taut-band
Two linear voltage scales
0 to 3; 0.05 per division
0 to 10; 0.1 per division
One logarithmic dBm scale
-10 to +3; 0.2 per division max.

Meter
Unrest:
(1 mV fs range
only)

Indicated Voltage	Unrest
Above 600 μ V	< 1% fs
300 μ V to 600 μ V	< 2% fs
100 μ V to 300 μ V	< 5% fs

Power: 115 or 230 V \pm 10%, 50 to 400 Hz, 8 W.

RFI: There is no detectable radiated or conducted leakage from
instrument or probe.

SPECIFICATIONS (Cont'd)

Temperature: In accordance with ANSI (ASA) Spec. 39.7

Temperature Range	Temperature	Influence
	Instrument	RF Probe
Ref. 21° C to 25° C	0	0
Normal, 18° C to 30° C	0	± 1% rdg
Severe, 10° C to 40° C	± 1% rdg	± 4% rdg

Waveform Response: True rms response for input levels up to 30 mV (3V to 700 MHz with 100:1 Voltage Divider), with transition to peak-to-peak (calibrated in rms) at higher levels.

Crest Factor: 420 to 1.4 depending upon input level (see Table II).

Input Impedance: See Figures 1 and 2.

VSWR: Less than 1.15 to 1.2 GHz (Return Loss greater than 23 dB). See Figures 3 and 4.

Power Sensitivity: 200 pW, minimum detectable power in 50 ohms.

DC Output: 0 to 10 V proportional to rf input voltage. Source resistance 9 kΩ. Will deliver 1 mA into 1 kΩ load. Full scale input step function response time; less than 100 ms on 30 mV fs to 3 V fs ranges increasing to 1 sec. on the 1 mV fs range.

Dimensions: 5.2" H (without rubber feet), 8.3" W (1/2 of standard 19 inch rack module) 11.5" D (132 x 211 x 292 mm)

Weight: Net 7 lbs. (3.2 kg) (with standard accessories)
Shipping - 8 1/2 lbs. (3.8 kg)

Accessories Furnished: Model 91-12F, RF Probe. RF Probe with low-noise cable and connector assembly for measurements from 10 kHz to 1.2 GHz; see Figures 1 and 2 for input resistance and capacitance.

Model 91-13B, Probe Tip. Removable Probe Tip with grounding clip lead; for use up to approximately 100 MHz.

**OTHER
ACCESSORIES
(OPTIONAL)
AVAILABLE:**

Model 91-6C-1, Unterminated Adapter, BNC. Coaxial adapter to allow probe to be connected to female BNC connectors.

Model 91-14A, Tee Adapter. Type N coaxial adapter to permit in-line measurements.

Model 91-7C, 100:1 voltage divider.

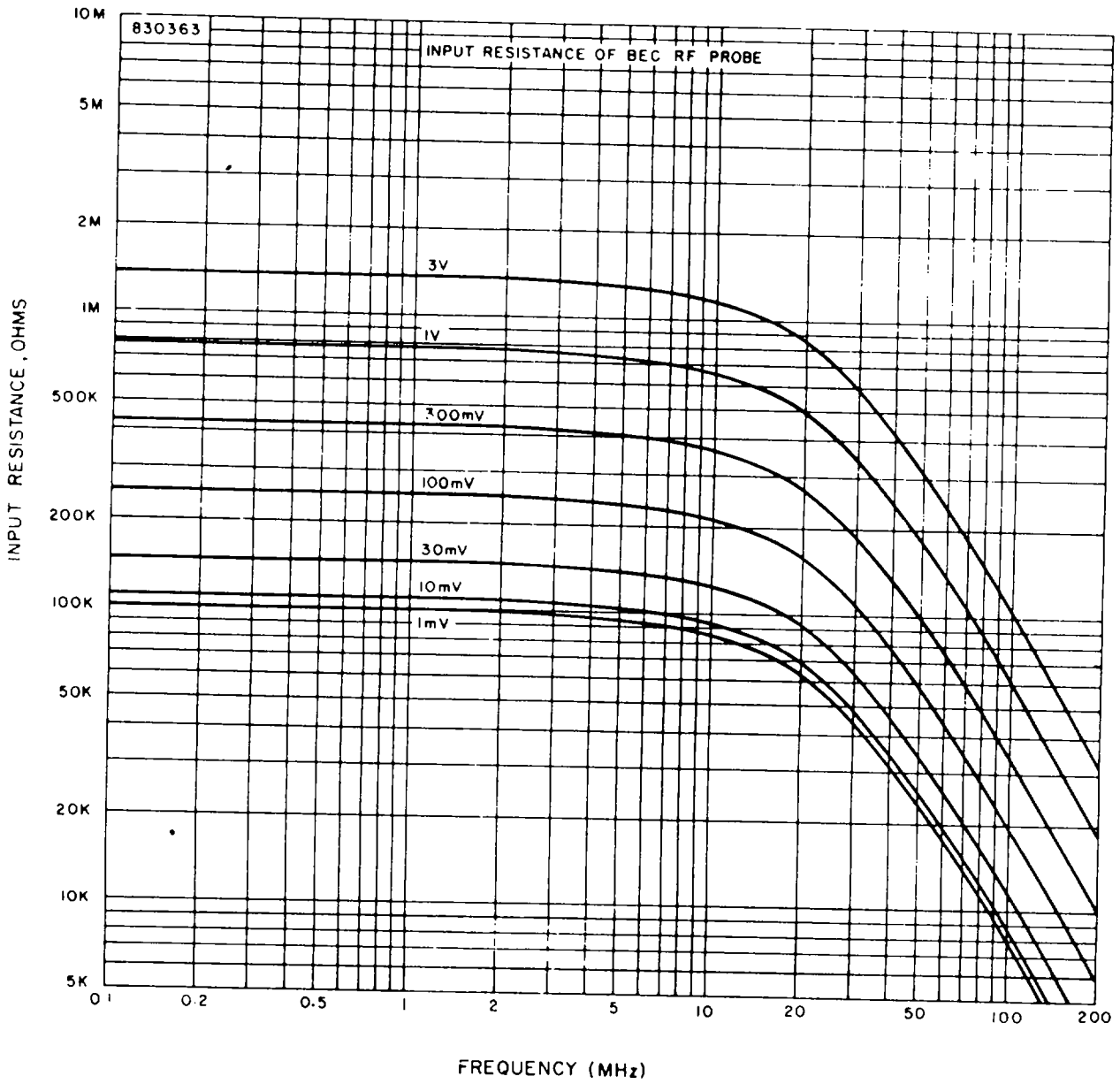


Figure 1. Input Resistance of RF Probe as a Function of Input Level and Frequency

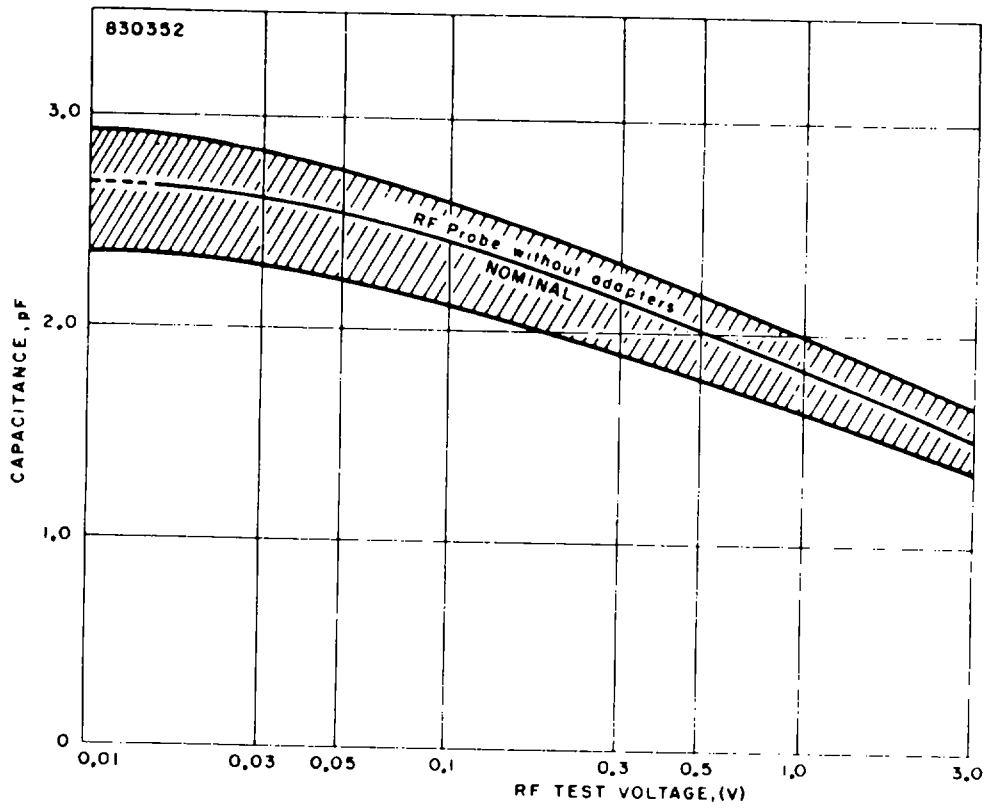


Figure 2. Input Capacitance vs. Input Level of Model 91-12F Probe (Measured at 10 MHz)

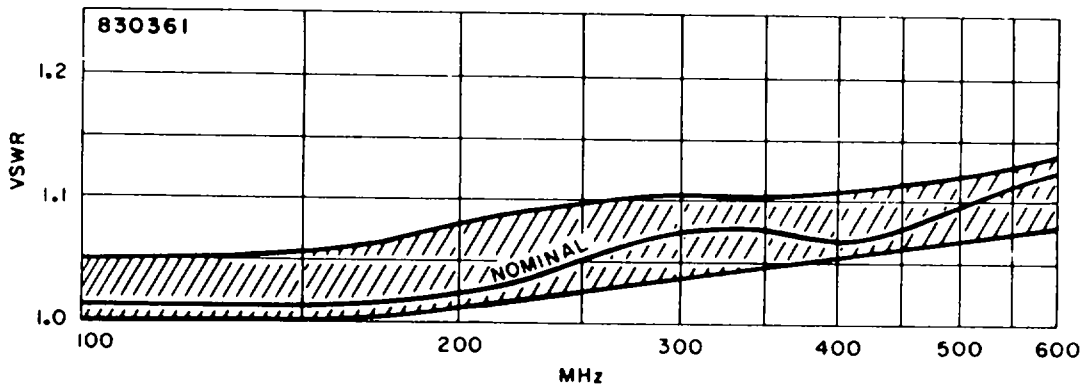


Figure 3. Typical VSWR of Model 91-12F RF Probe with Model 91-8B 50Ω BNC Adapter

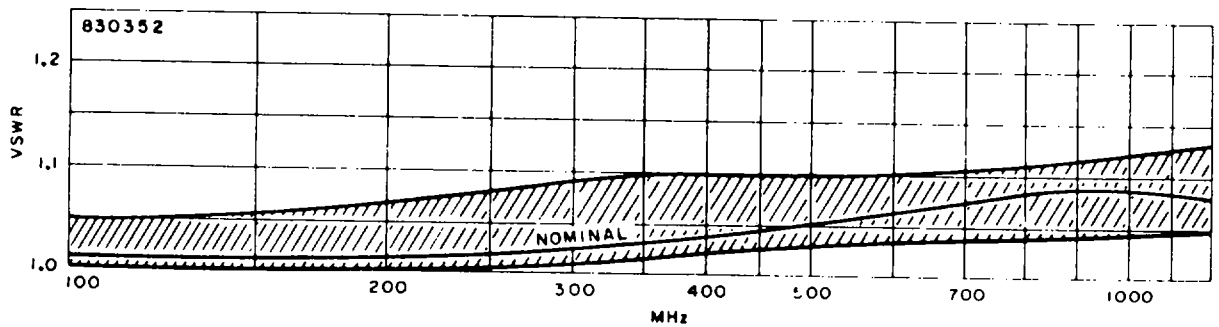


Figure 4. Typical VSWR of Model 91-12F RF Probe with Model 91-14A Type N Tee Adapter and Model 91-15A 50Ω Termination

SPECIFICATIONS (Cont'd)

- Accessory Kit
(Optional)
Model 91-24A: Model 91-6C, Unterminated BNC Adapter. 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.
- Model 91-7C, 100:1 Voltage Divider. Attenuates input signal by a factor of 100 ($\pm 1\%$), permitting measurements up to 300 volts and extending the rms measuring range to 3 volts; increases input resistance by a factor of 1000; operates from 50 kHz to 700 MHz. Maximum input potential, 1000 volts, dc plus peak ac.
- Model 91-14A, 50 Ω Tee Adapter. Type N Tee Connector; with Model 91-15A termination (see below) permits connecting into 50-ohm line; required for measurements above approximately 100 MHz; for VSWR see curve of Figure 4.
- Model 91-15A, 50 Ω Termination. Type N 50-ohm termination for use with Model 91-14A Tee Connector.
- Model 91-18A, Storage Case. Case for protecting and storing Model 92A accessories.
- Other
Accessories
(Optional)
Available: Model 91-4C, Special 1 kHz to 250 MHz RF Probe. Low-frequency probe for measurements ranging from 1 kHz to 250 MHz; input resistance essentially the same as that of Model 91-12F, RF Probe.
- Model 91-16A, Unterminated Type N Adapter. May be used with all probes, except Model 91-23A. 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.
- Model 91-25A, Rack Mounting Kit. Kit for mounting Model 92A as one-half of a module in a standard 19 inch rack.
- Standard Equipment Options
- Model 92A-52: Option adapted for logic-level programming, with 8-line logic level input, TTL/DTL compatible. Two linear voltage scales and one logarithmic dBm scale.
- Model 92A-53: dBV: same as Model 92A except that dB scale is referred to 1 volt.
- Model 92A-54: dBV: same as Model 92A except that the dB scale, referred to 1 volt, is read out as the top scale on the instrument's meter.

Standard Equipment Options (Cont'd)

- Model 92A-55: 75 Ω dBm: same as 92A except that the dBm scale is referred to 75 ohms.
- Model 92A-56: 75 Ω dBm: same as Model 92A except that the dBm scale, referred to 75 ohms, is read out as the top scale on the instrument's meter.
- Model 92A-57: 50 Ω dBm: same as Model 92A except that dBm, referred to 50 ohms, is read out as the top scale on the instrument's meter.
- Model 92A-58: Rear probe connection: same as Model 92A except that an additional jack for the probe connection is provided on the rear of the cabinet.

Special Equipment Option

- Models 92A-S1 to S49: Furnished to customer's specifications.

SPECIFICATIONS (Cont'd)

IMPORTANT NOTE:

To exploit fully the capabilities of this instrument, the accessories listed below are required for the indicated ranges of operation.

Table 1. Required Accessories

MEASURING RANGE	REQUIRED ACCESSORY	REMARKS
100 MHz to 600 MHz	Model 91-8B 50Ω Adapter for shielded connection to 50-ohm line; other impedances available on request.	Supplied as standard equipment with the Model 92 Series.
Above 600 MHz	Model 91-14A Tee Connector and 91-15A 50 Ω Termination for connection into 50-ohm line.	Available separately.
1 kHz to 250 kHz	Model 91-4C RF Probe	Available separately.
Input levels up to 300V; rms response with levels to 3V.	Model 91-7C 100:1 Voltage Divider; operates over frequency range from 50 kHz to 700 MHz	Available separately.

For details on the availability of these and other Boonton Electronics Accessories for RF Voltmeters, call on your local Boonton Electronics Sales Engineering Representative, or write directly to the factory at the address on the title page of this instruction book.

Table 2. Crest Factors

VOLTAGE RANGES (mV) AND CREST FACTORS								
VOLTAGE RANGE (mV)	1	3	10	30	100*	300*	1000*	3000*
CREST FACTOR**	420 to 42	70 to 14	21 to 4.2	7 to 1.4	420 to 42	70 to 14	21 to 4.2	7 to 1.4

* With accessory 100:1 Voltage Divider (see Table 1)

**Maximum permissible ratio of peak to rms value of voltage

CHAPTER II

GENERAL DESCRIPTION

2.1 GENERAL. The Model 92 Series RF Millivoltmeter is a programmable, solid state, sensitive, rf millivoltmeter used for measurements from the low radio frequencies to the gigacycle region, and over a voltage range from 100 microvolts to 3 volts. In the following paragraphs, a reference to the Model 92 Series means that the general information is applicable to all configurations and options. Specific references applicable only to one configuration are so noted.

The Model 92 Series provides true rms response for input signals up to 30 millivolts, gradually approaching peak-to-peak response calibrated on the meter scale in rms above this level. It is characterized by high input impedance (see Figures 1 and 2), excellent stability, and low noise.

A linear dc output is provided whose level is proportional to the rf input voltage. This output is suitable for application to recorders, digital voltmeters, plotters, voltage comparators, or other external equipment.

The Model 92 Series is particularly suitable for production and laboratory applications and, with specific options, can be integrated into test consoles, computer-controlled test systems, automatic test systems, and other equipment.

The instrument offers a convenient and accurate means for making a wide variety of measurements. Among the typical uses of the Model 92 Series are the following:

In transistor testing the instrument may be used to measure β , f_t , and other transistor parameters.

VSWR and return loss measurement using the Model 92 Series with bridge methods, directional couplers, and adjustable or slotted lines.

Gain and loss measurements in wide-band amplifiers, including such design characteristics as stage gain, flatness of the pass band, upper cut-off or corner frequency, negative feedback factors, and other parameters.

Proper adjustment of tuned circuits in narrow-band amplifiers.

The adjustment, measurement of performance, and evaluation of parameters of rf filters.

Measurement of vswr or return loss and attenuation of rf attenuators.

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

The Model 92 Series is available in various configurations with a basic accuracy of 1% rdg. + 1% fs. The standard features of the instrument are as follows:

- Measures 100 μ V to 3V* from 10 kHz to 1.2 GHz
- True rms response to 30 mV**
- Convenient push-button ranging and half-rack packaging
- Fast, high-level dc output
- High input resistance, low input capacitance
- Overload protection to 400 Vdc, 10 Vac.
- VSWR less than 1.15 up to 1.2 GHz
- * To 300 V, up to 700 MHz with accessory 100:1 divider.
- ** To 3V, up to 700 MHz with accessory 100:1 divider.

The characteristics of the instrument include: high reliability, fast warm-up, lengthy intervals between calibrations, plug-in PC boards for ease in servicing, light weight, and all other advantages of solid state design.

2.2 EQUIPMENT DESCRIPTION. The Model 92 Series is basically a programmable analog instrument with linear dc output. The instrument is available with a full range of options as described in Chapter 1. Input range programming by external contact closure or PNP transistors to ground is standard on all models.

The instrument is sensitive, accurate, sturdily constructed, and protected against overloads. It will perform over extended periods of time without failure or need for re-calibration. It is packaged as a compact (half-rack) bench instrument that can be easily mounted in a standard 19-inch rack using an inexpensive hardware kit.

Important input and accuracy specifications are stipulated on a reference plate fastened to the exterior top cover of the instrument. Clips for holding out-of-use accessories are provided at the rear of the instrument. Calibration instructions are reproduced on the underside of the top cover of the instrument.

The standard accessories furnished with the Model 92 Series include the following: A Model 91-12F RF Probe with a low-noise cable and connector assembly; a Model 91-8B 50-ohm BNC Adapter, and a Model 91-13B Probe Tip (removable) with a grounding clip lead.

A complete kit of probe accessories is available as optional equipment, including a storage case with space for the Model 91-12F RF Probe and the other standard accessories.

2.2.1 Model 92A Version. The Model 92A analog readout configuration of the instrument has a large 4-1/2-inch mirrored-scale panel meter, with linear 0-3 and 0-10 voltage scales divided into 1/20ths and 1/10ths for precise readings. A dBm scale referred to 1 mW in 50 ohms is also standard on the panel meter. The instrument's range push-buttons are marked in mV and dBm.

As options, panel meters may be ordered with the dB scales referred to 1 mW in 75 ohms or referred to 1V. All dB scales may be specified as being uppermost if desired.

2.2.2 Wide Frequency Range. The calibrated frequency range of the Model 92 Series extends from 10 kHz to 1.2 GHz, with uncalibrated response to beyond 8 GHz. Relative accuracy above 1.2 GHz is typically ± 0.5 dB.

A Model 91-8B 50-ohm BNC Adapter is supplied as a standard accessory with the instrument for 50-ohm voltage measurements up to 600 MHz. For measurements above this frequency and for thru-line voltage measurements, the optional accessory, Model 91-14A Tee Adapter, is recommended. It is designed to compensate for the rf probe capacitance and to present a good vswr (better than 1.15) up to 1.2 GHz. It may be used in conjunction with the Model 91-15A 50-ohm load for terminated voltage measurements. In a coaxial line its insertion loss is low; however, a chart is supplied showing loss vs. frequency.

An optional accessory, the Model 91-4C RF Probe, has a frequency range of 1 kHz to 250 MHz for lower frequency applications.

2.2.3 Wide Voltage Range. The Model 92 Series has eight ranges, from 1 millivolt full scale to 3 volts full scale, arranged in 1-3-10 sequence. No attenuator attachments are required for measurements up to 3 volts. While this range is ample for most rf voltage measurements, the capability of the instrument can be increased to 300 volts (up to 700 MHz) by using the optional accessory, Model 91-7C 100:1 Voltage Divider. Use of the 100:1 Voltage Divider also increases the input resistance of the Model 91-4C RF Probe by a factor of greater than 100.

2.2.4 True RMS Response. The Model 92 Series provides true rms response for signal inputs below approximately 30 millivolts (below 3 volts, up to 700 MHz, with the Model 91-7C 100:1 Voltage Divider). As the input level increases, the waveform response gradually approaches peak-to-peak, calibrated on the meter scale in rms. Thus, in addition to making precise sinusoidal voltage measurements at all levels, the instrument measures non-sinusoidal or asymmetrical signals within the rms region without loss of accuracy.

2.2.5 Low Noise. The Model 92 Series has been designed and constructed to hold noise from all sources to a minimum.

The probe cable is of special low-noise design; a vigorous flexing causes only momentary, minor deflections on the most sensitive range. The Model 91-12F Probe is not sensitive to shock or vibration; even sharp tapping on the probe barrel causes no visible deflection on any range.

Amplification takes place at 94 Hz, reducing susceptibility to any 50 or 60 Hz line-frequency-related fields. A unique circuit reduces the low-level noise originating from the mechanical chopper and renders the instrument immune to changes in chopper performance that could occur with the passage of time.

2.2.6 Minimal Zero Adjustment. Zero adjustment is not required on the upper five sensitivity ranges of the Model 92 Series. For measurements on the lower three ranges, the ZERO control is set on the most sensitive range before operation. This control balances out small thermal voltages in the probe elements and, once adjusted, requires only infrequent checking during the course of subsequent measurements.

2.2.7 DC Output. The Model 92 Series produces a dc output whose current capability (1 mA into 1000 ohms) is extremely stable and linear. When used as part of an automatic test system, the fast response of the instrument's dc output to an input step function allows more tests per unit time.