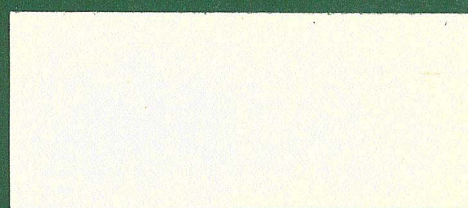
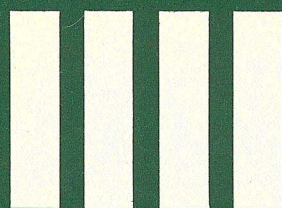


BOONTON
ELECTRONICS
CORPORATION



MODEL 92A/92AB

PROGRAMMABLE RF MILLIVOLTMETER

d-1172

MODEL 92A/92AB

PROGRAMMABLE RF MILLIVOLTMETER

d-1172

BOONTON
ELECTRONICS
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MODEL 92A

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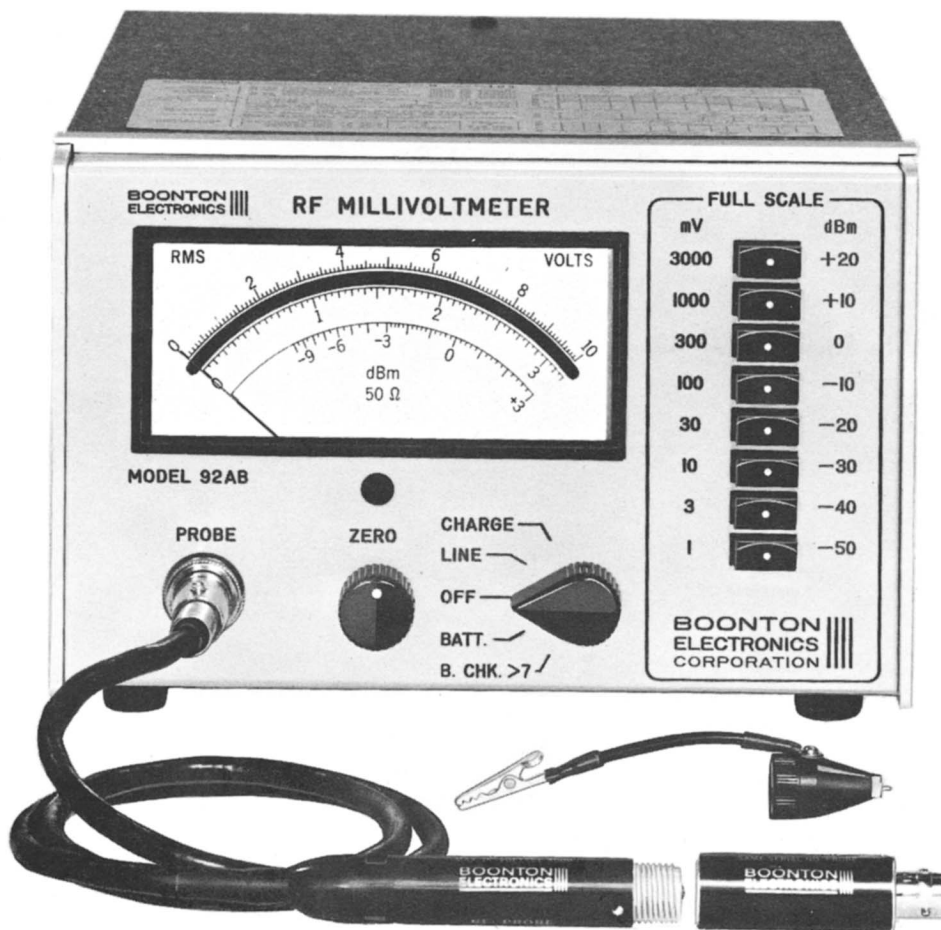
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PL 1

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Endfold



MODEL 92AB

BATTERY OPERATED RF MILLIVOLTMETER

92A/AB
α-371

A

CHAPTER I

INTRODUCTION

1.1 GENERAL

The Model 92 Series RF Millivoltmeter provides an accurate readout of measurements from the low radio frequencies to the gigahertz region, over a voltage range of 200 μ V to 3 volts. It is a programmable, solid-state instrument of high sensitivity and accuracy, characterized by high input impedance (see Figs. 1 and 2), excellent stability, and low noise.

The Model 92 exhibits true rms response for input signals up to 30 millivolts, gradually approaching peak-to-peak above this level. The meter, however, is calibrated in rms above this region.

Input and output connections for external control and readout are provided by a 22-pin card-edge connector at the rear of the instrument.

A linear dc output, whose level is proportional to the rf input voltage, is also provided at a rear connector. This may be used to drive a recorder, remote indicator, or other analog devices.

The 92 offers a convenient and accurate means for making a wide variety of measurements. Typical uses of this instrument include:

- 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 rf filter parameters.

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 is available in several optional configurations with a basic accuracy of 1% rdg. + 1% fs. The standard features of the instrument are:

Remote programmability

Measures from 200 μ V to 3V* from 10 kHz to 1.2 GHz.

True rms response to 30 mV**

Convenient push-button ranging.

DC analog output.

High input resistance, low input capacitance.

Overload protection to 400 Vdc and 10 Vac.

VSWR less than 1.15 up to 1.2 GHz.

* To 300V, 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 (1 minute), long intervals between calibrations, plug-in PC boards for ease in servicing or modifying, light weight, and other advantages of solid-stage design.

1.2 EQUIPMENT DESCRIPTION

The Model 92 is basically a programmable analog instrument with linear dc output. It is available with a full range of options and accessories as described in Chapter II. Input range programming by external contact closure or PNP transistors to ground is standard.

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

Important input and accuracy specifications are reproduced 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.

Standard accessories supplied with the Model 92 Series include one each of the following:

- Model 91-12F RF Probe with low-noise cable and connector.
- Model 91-8B 50-ohm BNC adapter.
- Model 91-13B Probe Tip (removeable) with 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.

1.2.1 Frequency Capability

The calibrated frequency range of the Model 92 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. A correction curve (Figure 8A) is included for frequencies above 50 MHz. For higher-frequency measurements and for through-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 (Figure 8B) is supplied showing loss vs. frequency. See Figure 4 for typical vswr.

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

1.2.2 Voltage Capability

The Model 92 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 greater than 100.

1.2.3 True RMS Response

The Model 92 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 indicator 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.

1.2.4 Low Noise

The Model 92 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.

1.2.5 Minimal Zero Adjustment

Zero adjustment is not required on the upper five sensitivity ranges of the Model 92. 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.

1.2.6 DC Output

The 92 provides a linear dc output whose current capability of 1 mA into 1000 ohms is extremely stable. 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.

For system or external requirements, all input and output connections for the 92 are made at the card-edge connector on the rear of the instrument. (See Figure 11 for receptacle connections.)

CHAPTER II

SPECIFICATIONS

Voltage Range: 200 μ V to 3V (300V up to 700 MHz with accessory 100:1 voltage divider). Voltage sensitivity is 100 μ V.

Full Scale Voltage Range: 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% fs plus				
300 mV to 3V	1% rdg	1% rdg	3% rdg	10% rdg
200 μ V to 300mV*	2% rdg			7% rdg
	10 kHz	50 kHz	150 MHz	700 MHz
				1.2 GHz

*Below 1 mV, add 1% fs

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: 92A: 115 or 230 V $\pm 10\%$, 50 to 400 Hz.
92AB: 115 or 230 V $\pm 10\%$, 50 to 400 Hz, and two 18-volt re-chargeable batteries

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

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	$\pm 1\%$ rdg
Severe, 10° C to 40° C	$\pm 1\%$ rdg	$\pm 4\%$ 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 Vdc proportional to rf input voltage. Source resistance of 9 k Ω ; will deliver 1 mA into 1 k Ω load. Full scale input step function response time less than 100ms on 30mV fs to 3Vfs 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: 92A: Net 7 lbs. (3.2 kg)
92AB: Net 10 lbs. (4.54 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.

Model 91-8B, 50 Ω BNC Adapter. Used for measurements up to 600 MHz with a 50-ohm system; for VSWR see curve of Figure 3.

Warm-Up:

Warm-up period, 1 min. Adjust zero on 1 mV range when measuring below 30 mV.

Accessory Kit
(Optional)
Model 91-24A:

Model 91-6C, Underterminated 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.

Other
Accessories
(Optional)
Available:
(cont'd)

Model 91-16A, Underterminated 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 92-1A, Single Rack Mounting Kit. Kit for mounting one 92A/AB as one-half of a module in a standard 19-inch rack.

Model 92-1B, Double Rack Mounting Kit. Kit for mounting two 92A/AB's side-by-side in a standard 19-inch rack.

Standard
Equipment
Options:

Model 92AB-02. Logic-level programming, with 8-line logic level input, TTL/DTL compatible.

Model 92AB-03. dBV option, dB scale, referred to 1 volt.

Model 92AB-04. dBV option, dB scale, referred to 1 volt, is read out at top scale on meter.

Model 92AB-05. 75 Ω dBm option; dBm scale, referred to 75 Ω .

Model 92AB-06. 75 Ω dBm option; dBm scale, referred to 75 Ω , read out on top scale on meter.

Model 92AB-07. 50 Ω dBm option; dBm scale, referred to 50 Ω , read out on top scale on meter.

Model 92AB-08. Rear signal-input option.

SPECIFICATIONS (Cont'd)

IMPORTANT NOTE:

Fully to exploit 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 50 Ω 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 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 I)

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

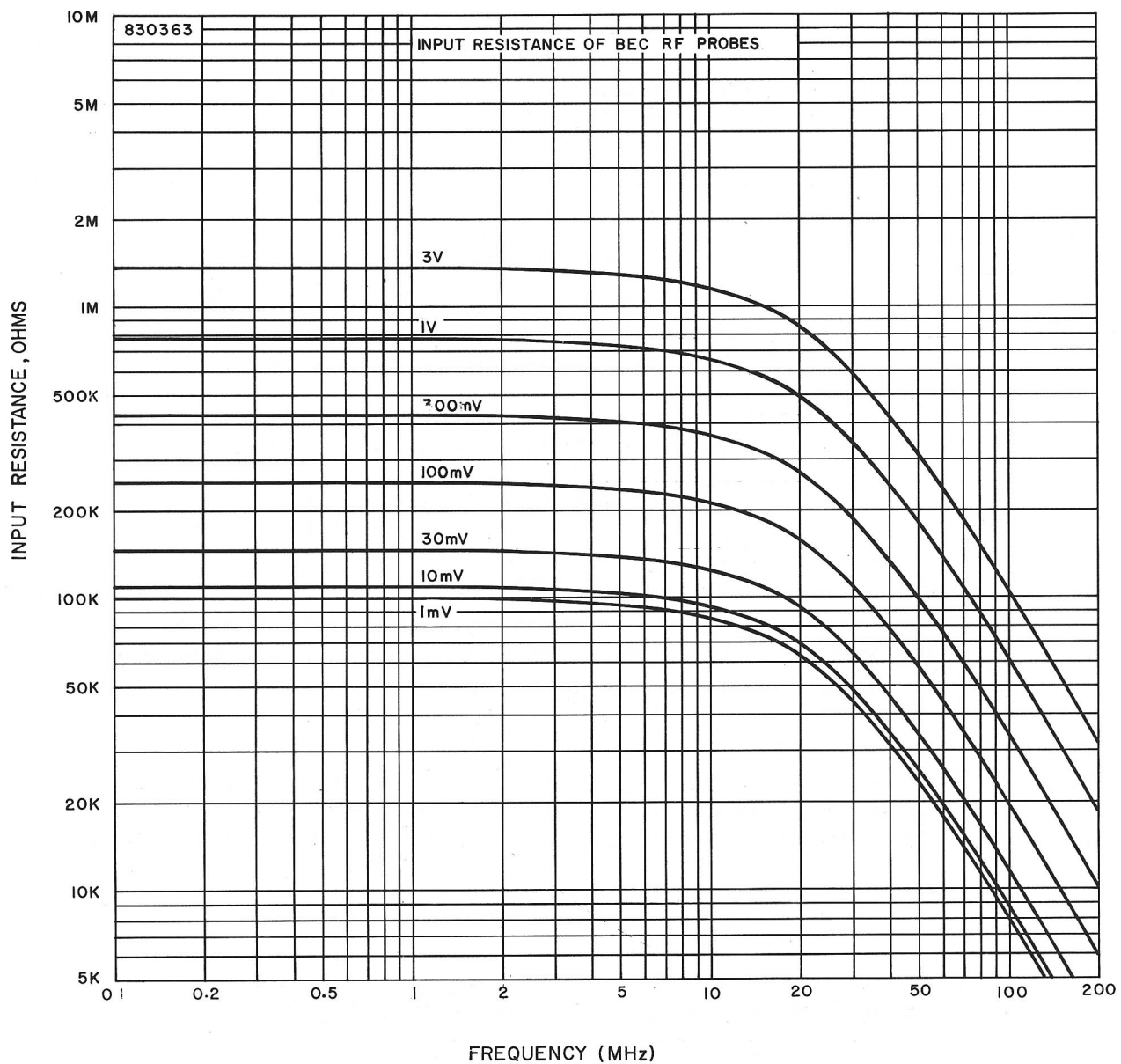


Figure 1. Input Resistance of RF Probe as a Function of Input Level and Frequency

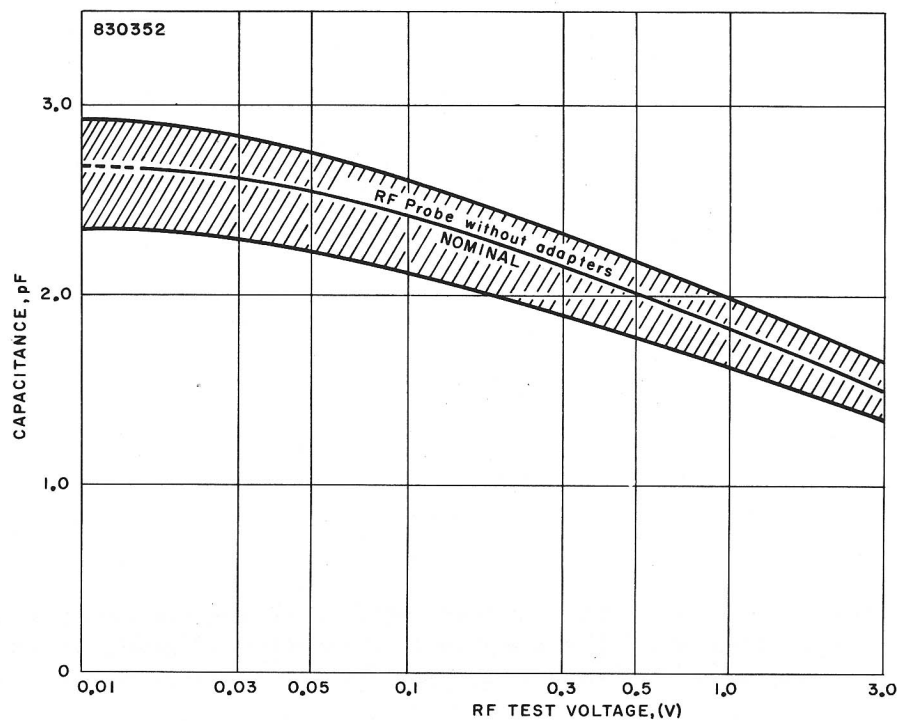


Figure 2. Input Capacitance vs. Input Level of Model 91-12F Probe (Measured at 10 MHz)

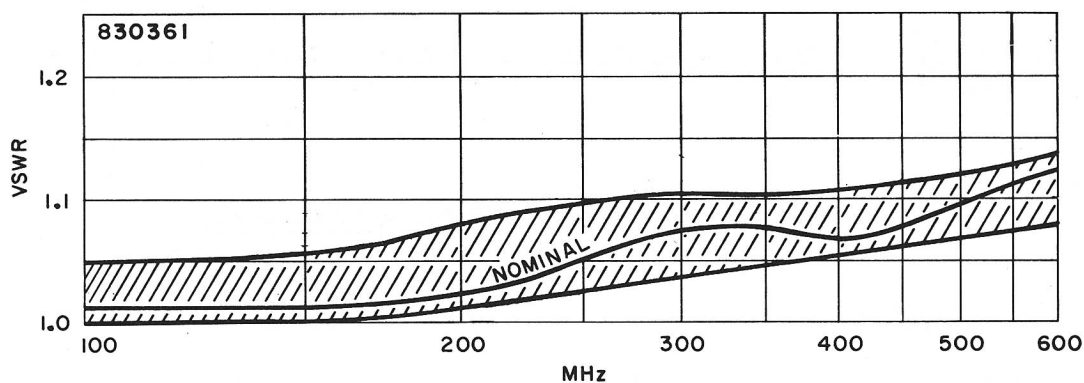


Figure 3. Typical VSWR of Model 91-12F RF Probe with Model 91-8B 50Ω BNC Adapter

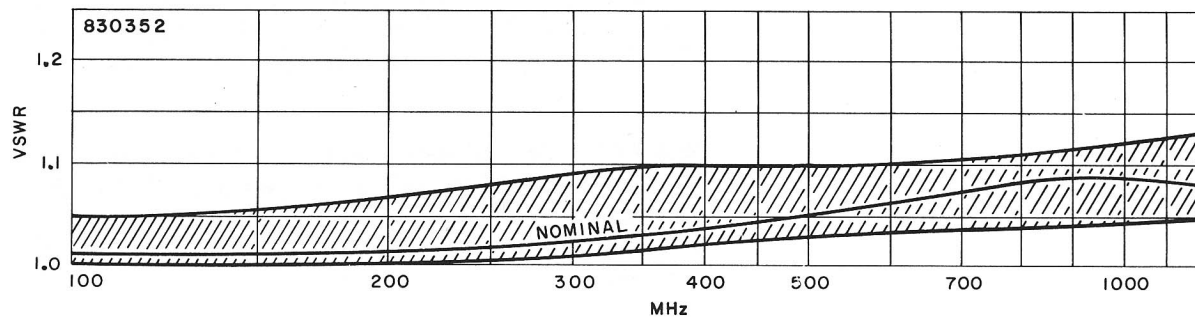


Figure 4. Typical VSWR of Model 91-12F RF Probe with Model 91-14A Type N Tee Adapter and Model 91-15A 50Ω Termination

CHAPTER III

OPERATION

3.1 INSTALLATION

The Model 92 has been inspected and tested at the factory before packing, and is shipped ready for operation. If there is any indication of shipping damage, immediately notify the carrier before attempting to put the instrument into operation.

3.1.1 Operating Controls and Indicators

The controls and indicators of the 92A are shown in Table 3A, and those of the 92AB in Table 3B.

Table 3A. Model 92A Controls and Indicators

<u>ITEM</u>	<u>FUNCTION</u>
PWR ON	This switch turns on the instrument power.
FULL SCALE	These range pushbuttons, (1, 3, 10, 30, 100, 300, 1000, and 3000 mV) and (-50, -40, -30, -20, -10, 0, +10, and +20) select the operating range.
Meter	A 4 1/2-inch taut-band meter with two linear voltage scales reading out 0 to 3 with 0.05 per division and 0-10 with 0.1 per division; and one logarithmic dBm scale reading out -10 to +3 with 0.2 per division maximum.

Table 3A. Model 92A Controls and Indicators (Con't)

<u>ITEM</u>	<u>FUNCTION</u>
PROBE (Jack)	The probe cable connects to the instrument through this PROBE jack. Always be sure that the knurled ferrule nut of the probe cable connection is tightened when in use.
ZERO (Control)	This control is used to zero the instrument.
The following items are on the rear panel:	
Fuse Holder and Fuse	A fuse holder is located on the rear panel for installing either a 0.15 ampere, 115 V, or a 0.1 ampere, 220 V, Bussman MDL SLO-BLO fuse.
Slide Switch	Switch which is set to 115 V or 230 V, according to the available power source. Be sure that the proper fuse is located in the fuse holder.
Recorder Output Terminals	A DC voltage proportional to the indicator reading is available at these terminals. F.S. output = $\pm 10V$ Output Impedance = $9\text{ k}\Omega$
Component Holders (Clips)	Three component holders or component clips are located at the rear panel for securing accessories which are not in use.
REMOTE CONNECTIONS (Use with an Amphenol 225-2221-101 connector or equivalent)	A card edge connector is mounted at the rear of the instrument. See Figure 10 for the pin designations.

Table 3A. Model 92A Controls and Indicators (Con't)

<u>ITEM</u>	<u>FUNCTION</u>
 (Symbol on Rear Panel)	This safety requirement symbol has been adopted by the International Electrotechnical Commission, Document 66 (Central Office) 3, paragraph 5.3 which directs that an 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 right fuse is installed for the power available and that the switch on the rear panel 0.15 A and 0.10 A, 50-400 Hz, is set to the applicable operating voltage of 115 V or 230 V. Within a brief time, the use of this symbol will be acted upon by ANSI (ASA).

Table 3B. Model 92AB Controls and Indicators

<u>ITEM</u>	<u>FUNCTION</u>
Power Switch	This is a rotary switch controlling the operating condition of the instrument. CHARGE. In this position, the instrument is off, but the charging circuits are connected to the power line. Charging time in this mode is 14 hours from zero to full charge. LINE. This position connects the instrument to the ac power line and turns it on. OFF. In this position, both charging circuits and instrument are off. BATT. This position connects the instrument to the internal battery power supply and turns it on. B. CHK. This position connects the meter across the batteries, through a series calibrating resistance. A reading of 7 or higher indicates that the batteries are sufficiently charged for reliable operation.

Table 3B. Model 92AB Controls and Indicators (Cont'd)

<u>ITEM</u>	<u>FUNCTION</u>
FULL SCALE	These range pushbuttons, (1, 3, 10, 30, 100, 300, 1000, and 3000 mV) and (-50, -40, -30, -20, -10, 0, +10, and +20) select the operating range.
METER	A 4 1/2-inch taut-band meter with two linear voltage scales reading out 0 to 3 with 0.05 per division and 0-10 with 0.1 per division; and one logarithmic dBm scale reading out -10 to +3 with 0.2 per division maximum.
PROBE (Jack)	The probe cable connects to the instrument through this PROBE jack. Always be sure that the knurled ferrule nut of the probe cable connection is tightened when in use.
ZERO (Control)	This control is used to zero the instrument.

The following items are on the rear panel:

Fuse Holder and Fuse	A fuse holder is located on the rear panel for installing either a 0.15 ampere, 115 V, or a 0.1 ampere, 220 V, Bussman MDL SLO-BLO fuse.
Slide Switch	Switch which is set to 115 V or 230 V, according to the available power source. Be sure that the proper fuse is located in the fuse holder.
Recorder Output Terminals	A DC voltage proportional to the indicator reading is available at these terminals. F.S. output = +10 V Output Impedance = 9 k Ω

Table 3B. Model 92AB Controls and Indicators (Cont'd)

<u>ITEM</u>	<u>FUNCTION</u>
Component Holders (Clips)	Three component holders or component clips are located at the rear panel for securing accessories which are not in use.
REMOTE CONNECTIONS (Use with an Amphenol 225-2221-103 connector or equivalent)	A card edge connector is mounted at the rear of the instrument. See Figure 10 for the pin designations.
 (Symbol on Rear Panel)	This safety requirement symbol has been adopted by the International Electrotechnical Commission, Document 66 (Central Office) 3, paragraph 5.3 which directs that an 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 right fuse is installed for the power available and that the switch on the rear panel 0.15A and 0.10A, 50-400 Hz, is set to the applicable operating voltage of 115V or 230 V. Within a brief time, the use of this symbol will be acted upon by ANSI (ASA).

3.2 OPERATING PROCEDURES

In the following paragraphs, the initial operating procedure for the 92 is described, as well as operating notes and recommended connection methods.

3.2.1 Initial Operating Procedure

- a. Be sure that the serial number of the probe to be used is the same as that of the Model 92. (Each instrument is calibrated for its particular rf probe). Use of a probe other than that for which the instrument was calibrated may result in measurement errors.
- b. Connect the probe cable to the PROBE jack on the front panel.
- c. Check the setting of the power switch on the rear panel to be sure that it is set to the proper position for the line voltage available.
- d. Plug the instrument's power cable into a power receptacle.
92A: Push PWR ON switch button.
92AB: Turn Power Switch to LINE. (or BATT.)
- e. Press the 1 mV range button; the panel meter pointer should rest on zero. If it does not, use the ZERO control to set the meter to zero. (This adjustment will hold for the other ranges.) The instrument is now ready for use. (See 3.3.5)

3.3 OPERATING NOTES

While using the Model 92 is a direct and straightforward process, there are certain precautions and procedures which **MUST** be observed to obtain satisfactory results.

3.3.1 Overload Limits

The Model 91-12F RF Probe supplied with the Model 92 is overload-protected to 10 volts, ac, and to 400 volts, dc. EXCEEDING THESE LIMITS MAY RESULT IN PERMANENT DAMAGE TO THE PROBE.

The Model 91-8B 50-ohm Adapter should not be subjected to continuous overload of more than 10 volts (dc + rms ac) to avoid excessive heating of the terminating resistor.

Where voltages above these limits are likely to be encountered, the Model 91-7C 100:1 Voltage Divider is required. Maximum rating of the Voltage Divider is 1000 volts, dc + peak ac.

3.3.2 Connection for Measurements Below 100 MHz

The RF Probe supplied with the Model 92 is equipped with a detachable tip and ground lead. For measurements of signals below approximately 100 MHz, this tip provides a convenient means for both signal and ground connection.

3.3.3 Connection for Measurements Above 100 MHz

For frequencies above 100 MHz, the probe tip should NOT be used with the Model 92. Connection should be made directly to the center contact of the probe with the ground connection kept as short as possible (see Figure 5).

The connection recommendations outlined in Table 4 below should be followed to maintain specified accuracy.

Table 4. Connection Recommendations

FREQUENCY	SIGNAL CONNECTION
Up to 100 MHz	Probe with tip and grounding lead, or with Model 91-8B (supplied). Probe with Model 91-14A/15A (optional).
100 to 250 MHz	Probe without tip (see Fig. 5), or probe with Model 91-8B (supplied). Probe with Model 91-14A/15A (optional).
250 to 600 MHz	Probe with Model 91-8B (supplied). Probe with Model 91-14A/15A (optional).
600 MHz to 1.2 GHz	Probe with Model 91-14A and Model 91-15A (see Figure 6) (optional).

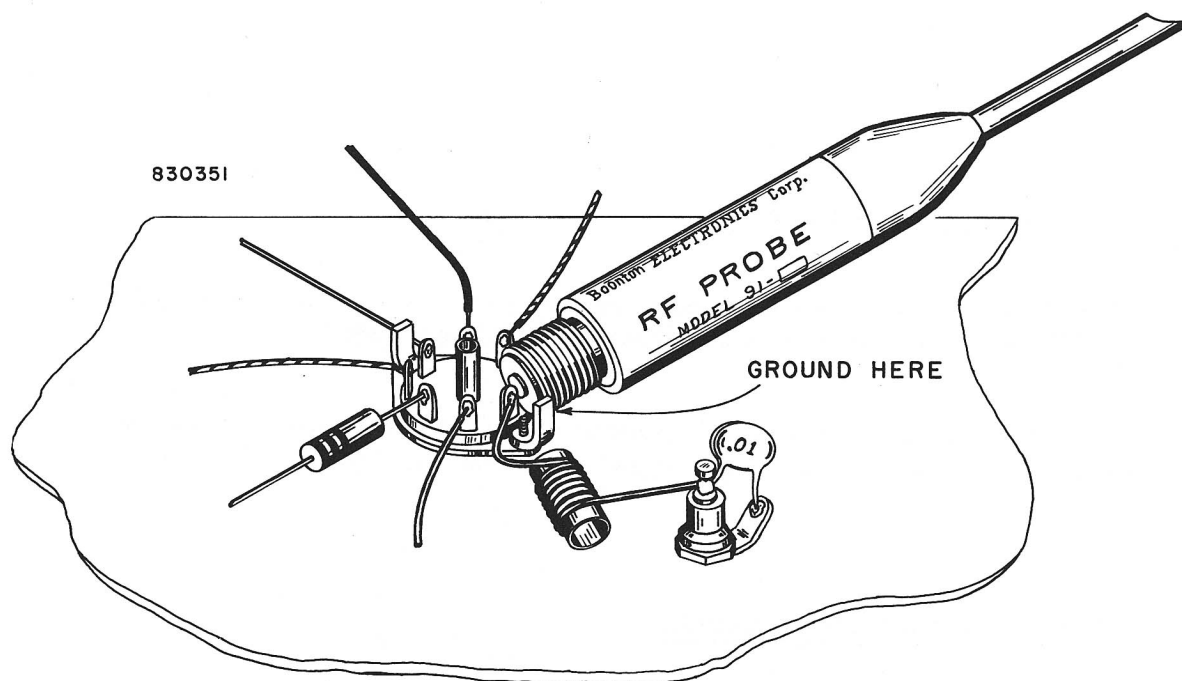


Figure 5. Method for making low-inductance connections to test signal point directly using the RF Probe. (Use for in-circuit measurements when lowest capacitance loading is required or when ground lead inductance of probe tip cannot be tolerated).

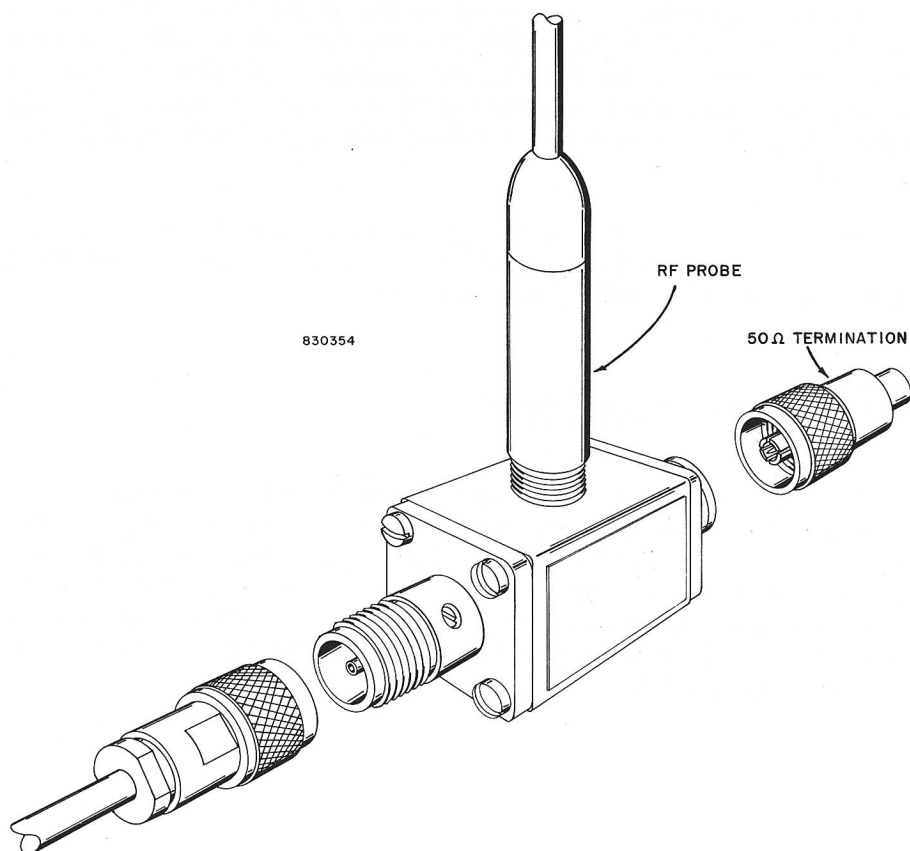


Figure 6. Assembly of Model 91-14A Type N Tee Adapter

3.3.4 Low-Level Measurements

The Model 92 will provide reliable, reproducible measurements of signal levels as low as 200 microvolts, and has a sensitivity of 100 microvolts.

Preliminary zero adjustment is essential when using the lowest range scale to achieve the specified accuracy, and is strongly recommended for all ranges up to 30 millivolts.

3.3.5 Making the Zero Adjustment

When the instrument is to be used on the 1 mV range, the following zero adjustment procedure should be followed:

- a. Set the FULL SCALE range selector to the 1 mV position.
- b. Be sure that no voltage is applied to the probe, and that it is adequately shielded from local fields. This can be done by partially unscrewing the probe cap until the tip just breaks contact with the internal connector, leaving the metal shell engaged with the body threads. Alternately, the probe tip can be removed and the 50-ohm termination (Model 91-8B) mounted in its place.
- c. Adjust the ZERO control to bring the meter reading to zero. Noise will cause the reading to fluctuate up to $\pm 5\%$ of full scale. Adjust the ZERO control so that the reading averages zero.

3.3.6 Signal Overload on 1 mV Range

On the most sensitive (1 mV) range, application of a large ac signal overloads the amplifier and a short time is required for the high-impedance input circuit to discharge. This effect is significant for signals above approximately 100 millivolts. Typically, application of a 1 volt signal will require a recovery time of about thirty-seconds before subsequent measurements should be made. It should be noted, however, that such overloads cause no damage to the equipment as long as they are within the limits outlined in paragraph 3.3.1.

3.3.7 Temperature Effects

The accuracy specifications for the Model 92 apply over temperatures from 50°F to 104°F. Outside of these limits operation of the equipment is possible but appreciable inaccuracies can be expected. However, no permanent change in probe characteristics will result from any reasonable high or low temperature exposure.

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

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 contribute to the dc output of the detector diodes.

3.3.8 Hum, Noise, and Spurious Pick-up

When measuring low-level signals, precautions should always be taken to avoid the possibility of errors of measurement resulting from hum, noise, or stray rf pick-up. Although all low-frequency hum and noise are attenuated at the input, it is still possible for unwanted high-level signals to cause errors. In some cases it may be necessary to provide extra shielding around the probe connections to reduce stray pick-up. Typical sources of spurious radiation are: induction or dielectric heating units, diathermy machines, local radio transmitters and grip dip meters.

3.4 DC OUTPUT

The dc output provided at the rear panel binding posts is a linear function (typically within 1%) of the input level, as long as the input signal is greater than 20% of full scale. For inputs less than 20% of full scale the output is NOT linear, but may be corrected by referring to paragraph 3.6 and Figure 7. Polarity of the dc output is positive with respect to the instrument ground the negative dc output terminal being at ground potential. Output resistance is 9 k Ω .

3.5 LOW-FREQUENCY MEASUREMENTS

The Model 91-12F RF Probe supplied with the Model 92 provides measurements within the specified accuracy from 10 kHz to 1.2 GHz. For measurements at lower frequencies the Model 91-4C RF Probe is available. It operates over a frequency range from 1 kHz to 250 MHz.

Important Note: After installing the Model 91-4C RF Probe, the Model 92 must be checked for accuracy of calibration, and recalibrated if re-quired (see Paragraphs 5.3 and 5.4).

3.6 CORRECTION CURVES FOR ACTUAL VOLTAGE vs METER READING

Use the curves of Figure 7 to correct for non-linearity below 20% of full scale on each range.

3.7 LOSS vs FREQUENCY CORRECTION FOR MODEL 91-8B

Use the curve of Figure 8A to make corrections for high-frequency roll-off when using the Model 91-8B 50Ω Adapter.

3.8 LOSS vs FREQUENCY CORRECTION CURVE FOR MODEL 91-14A

Use the curve of Figure 8B to make corrections for transmission loss when using the Model 91-14A Type N Tee Adapter.

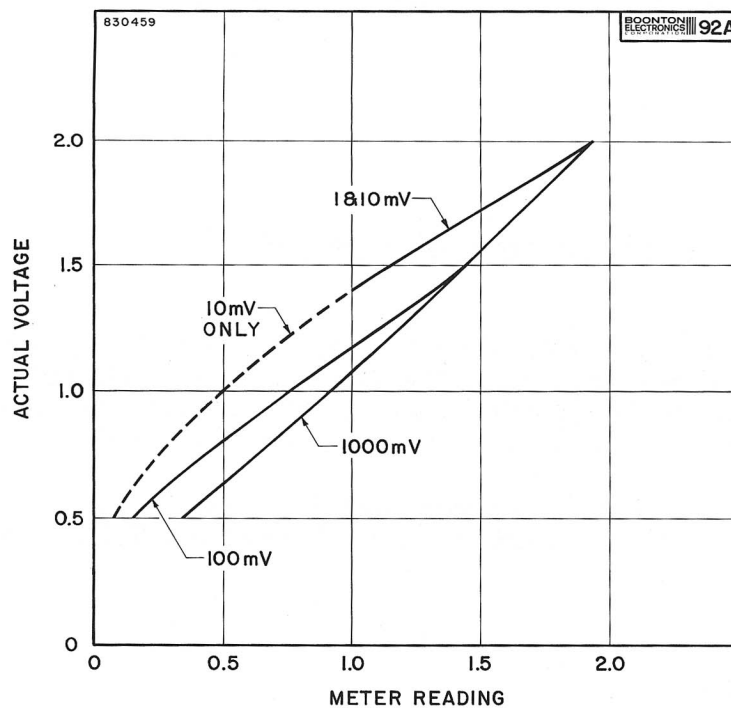
3.9 BATTERY OPERATION

When the instrument is operating on the ac power line the batteries are kept charged automatically. When the instrument is not in use the switch can be left in the LINE position to maintain the batteries at full charge. To test the battery condition, turn the switch to the B. CHK position. The meter should read at least 7 for batteries near full charge. To charge the batteries quickly, turn the switch to the CHARGE position, which charges at double the rate of the LINE position. Approximately 14 hours are required to bring them from discharged to full charge condition.

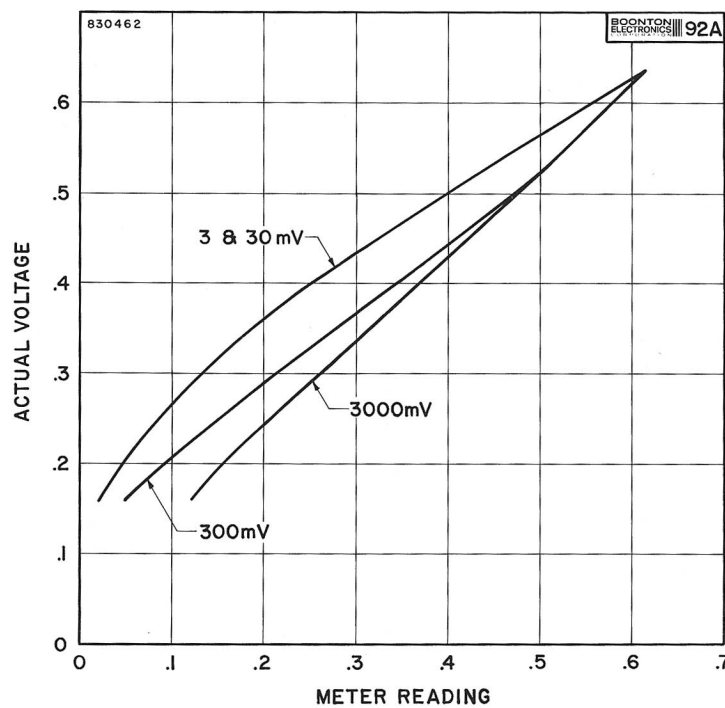
3.10 MODEL 92A/AB-02 (LOGIC LEVEL) OPTION

The additional circuitry required for the Logic Level option is contained in an enclosure mounted on the rear panel of the instrument. The external connector, in this case, will mount on the top of the Logic-Level enclosure. See Schematic diagram 830490 in the back of this manual for the external connections.

Ranging and other functions are controlled by remote logic inputs; logic 1 = +3.0 V or more, and logic 0 = +0.3 V or less. The system is TTL compatible.



Down-Scale Correction (0 to 10 scale)



Down-Scale Correction (0 to 3 scale)

Figure 7. Correction Curves, Actual Voltage vs. Meter Reading (for use with the Model 92A and Model 92A Option Instruments)

CORRECTION FOR ADAPTER LOSS

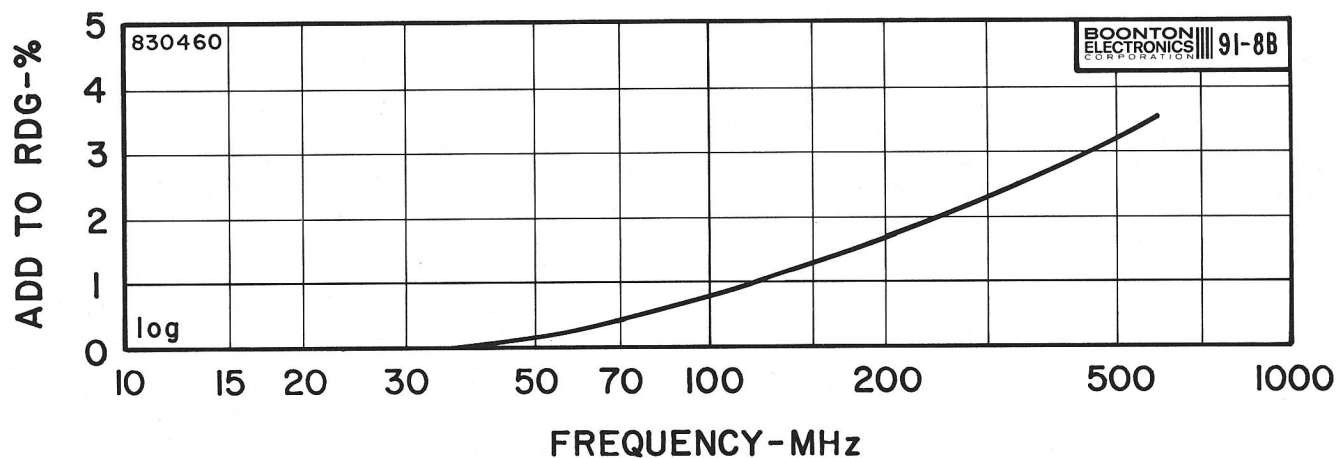


Figure 8A. Model 91-8B 50Ω BNC Adapter Correction Curve. (Add to meter readings)

CORRECTION FOR INSERTION LOSS

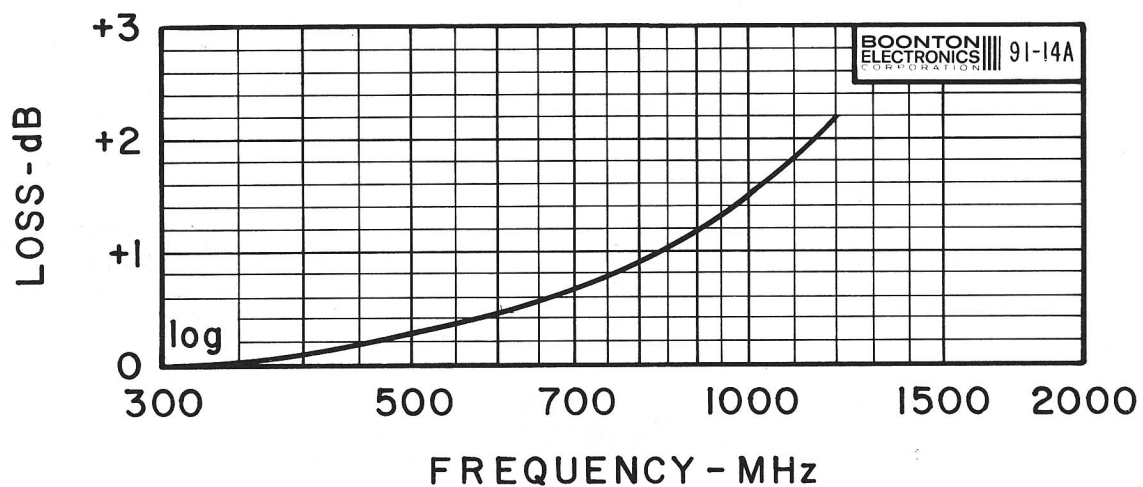


Figure 8B. Model 91-14A Type N Tee Adapter Correction Curve. (Input voltage to tee adapter is indicated by voltmeter. Subtract the correction from the indicated value, in dB, to obtain output voltage of tee)

CHAPTER IV

THEORY OF OPERATION

4.1 GENERAL

The operating principles of the Model 92 are shown in the following block diagram. (Figure 9) The essential elements of the instruments are the probe, chopper driver, chopper, attenuator, preamplifier, amplifier, pulse generator, sync detector, shaping amplifier, panel meter, power supply, and battery charger (92AB only).

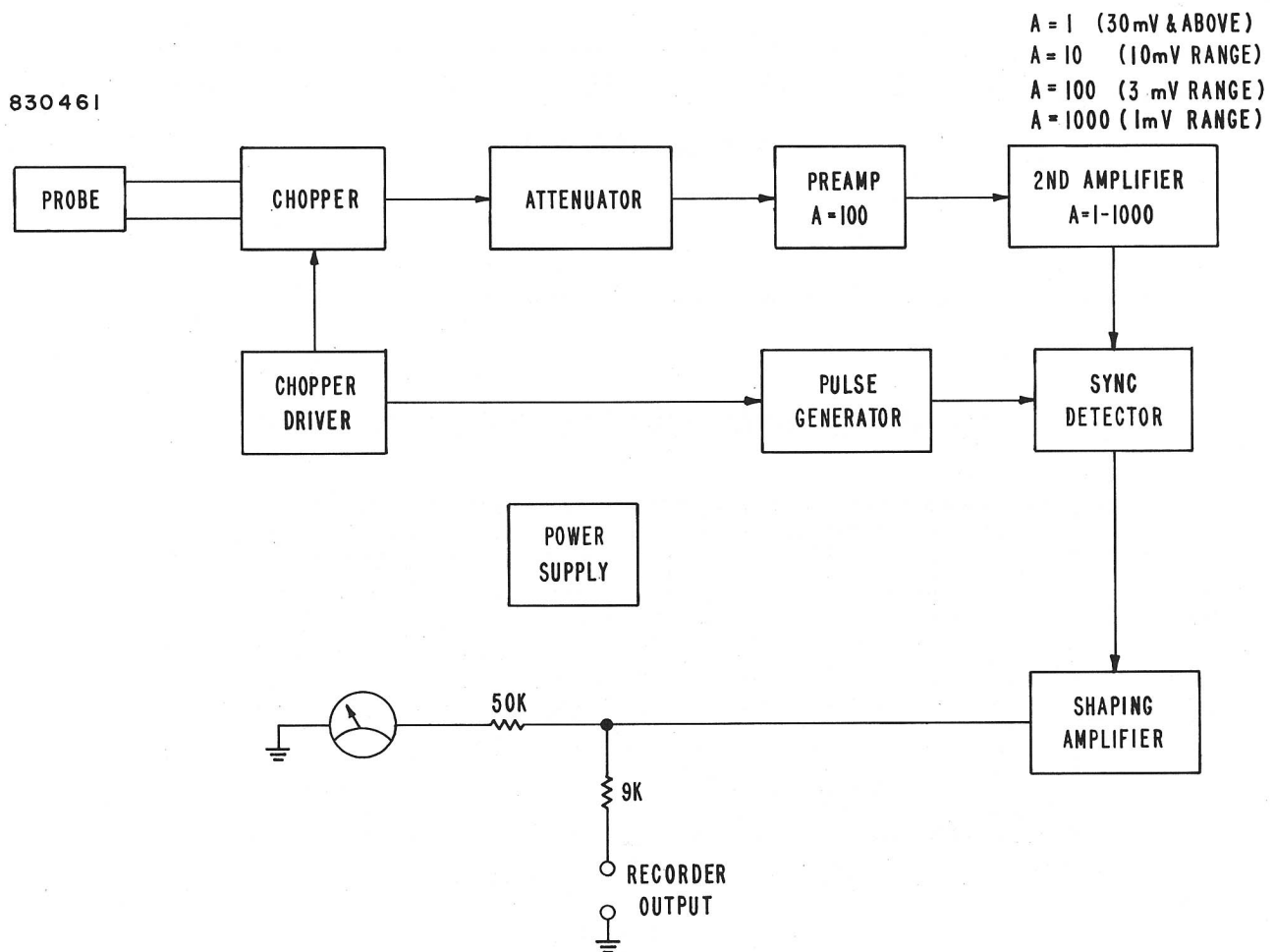


Figure 9. Model 92 Block Diagram

4.1.1 RF Probe

The RF Probe contains a full-wave diode detector which rectifies the signal under study to a dc voltage whose level is a function of the input level. While operating in the square-law region (below approximately 30 millivolts) the detector provides true rms response. As the input level increases beyond 30 millivolts, waveform response gradually approaches peak-to-peak, calibrated on the scale in rms.

In addition to increasing efficiency, use of full-wave rectification in the detector probe permits measurement of signals having highly asymmetrical waveforms without errors stemming from turn-over effect.

The diodes used in the RF Probe have been carefully selected for specific characteristics. The user is urged NOT to attempt their replacement with any off-the-shelf types. In case of damage to probe components, call your local Boonton Electronics Sales Engineering Representative or the factory for instructions.

4.1.2 Attenuator and Amplifiers

The dc output of the probe is converted to ac by the mechanical chopper. The resultant ac signal is applied to the attenuator and amplifier sections. For each range the output voltage from the 2nd amplifier is approximately 3V peak-to-peak. This is accomplished by ranging both the attenuation and the gain of the 2nd amplifier in the following manner:

RANGE	$\frac{1}{\text{ATTN}}$	GAIN 2nd AMP.
1 mV	1	1000
3	1	100
10	1	10
30	1	1
100	0.15	1
300	0.04	1
1000	0.01	1
3000	0.004	1

The preamplifier has a constant gain of X100, and is designed for very low input noise. Both amplifiers have moderately wide bandwidths and are stabilized by large amounts of negative feedback.

4.1.3 Synchronous Detector

The amplified ac signal from the 2nd amplifier is converted to dc by the synchronous detector. The peak-to-peak amplitude is derived from a shunt-series capacitor storage circuit using JFET switches. The synchronous detector is driven by pulses in the chopper-driver circuit, thus assuring exact synchronization. The characteristics of the detector determine the effective bandwidth of the amplifier-detector combination and allow modification of the bandwidth for different range conditions. The detector also provides conversion without offset, with excellent linearity.

4.1.4 Shaping Amplifier

The conversion of rf to dc in the probe is non-linear, the response being virtually square-law for the lowest ranges and gradually becoming quasi-linear for the 3V range. The shaping amplifier converts the non-linear output of the phase detector to a linear output by using a segmental approximation to the exact correction. The shaping amplifier is actually an operational amplifier so connected that, as the signal increases at its output, its gain is reduced by successively paralleling resistors across the feedback resistors. The number of segments required to adequately linearize the response varies from 6 for the "square-law" ranges down to 2 for the 3V range. The output of the shaping amplifier is +10V which drives the panel meter and is applied to the recorder terminals through a 9 k Ω resistor.

4.1.5 Chopper-Driver Circuits

The chopper-driver block provides all of the drive signals required by the instrument. The chopper frequency is obtained by dividing the output of a unijunction oscillator by two. The oscillator also generates the switching pulse for the synchronous detector. Diode gating feeds the pulse to the proper JFET depending upon chopper phase.

4.1.6 Power Supply

a. 92A

The power supply converts the ac input power to regulated +15V and -15V outputs. Each supply is protected by current limiting against accidental short circuits. The +15V supply is a zener-biased follower, and no adjustment is provided. The -15V supply is referred to a 6.2V zener, and the voltage is adjustable to -14.9V, ± 0.1 V.

4.1.6 Power Supply (cont'd)

b. 92AB

In addition to the ac power supply, the 92AB also contains two Nicad 18-volt batteries and appropriate charging circuits. The batteries are automatically charged when the 92AB is running on ac power. The instrument can operate for 16 hours with fully charged batteries; charging time is 14 hours on CHARGE or 28 hours on LINE.

4.1.7 Programming

The instrument is organized around an eight-line ranging system. In each functional subcircuit the switching is accomplished by solid-state devices, generally JFET's, which are actuated by the appropriate range line. The front panel range switch simply connects to the eight range lines to allow range selection. The range lines are extended to the rear of the instrument and terminate in a card edge connector. The instrument may be externally ranged by grounding the appropriate line after grounding the 'manual disable' line. (It is recommended that an Amphenol connector, or equivalent, be used for remote programming connection.)

CHAPTER V

MAINTENANCE

5.1 PERIODIC CALIBRATION

The Model 92 Series is designed to provide trouble-free operation over extended periods of time. However, as with any precision instrument, the instrument should be checked periodically to verify proper calibration. To make such calibration checks, the following equipment is required:

- a. A reliable signal source of 200 kHz to 500 kHz with less than 1% distortion at levels up to 3 volts across 50 ohms.
- b. A precision voltmeter such as the Ballantine Model 310A or 300H, or the Hewlett-Packard Models 400D or 400H or equivalent.
- c. A precision dc voltmeter capable of measuring -15.0V at an accuracy of 0.25%.

5.2 PRECAUTIONS WHEN CHECKING CALIBRATION

When checking the calibration of an instrument having the sensitivity and bandwidth of the Model 92, it is essential to take precautions against errors resulting from stray pick-up voltages. (See paragraph 3.3.8) A well-shielded signal source must be used in conjunction with coaxial connections to both the Model 92 and the standard reference meter. Even with a well-shielded generator and connections, it is sometimes possible for the reference meter to pick up stray rf signals and feed them into the probe. It is advisable to test for this condition by disconnecting the standard meter and noting any change in level.

5.3 CALIBRATION CHECK

Using the equipment listed in paragraph 5.1, check the calibration of the Model 92 on each range, using a test voltage equal to the full scale value. If the check reveals that calibration is required, the procedure outlined in paragraph 5.4 should be followed.

5.4 CALIBRATION PROCEDURE

The Model 92 should be calibrated at room temperature (74°F) after a minimum warm-up time of one minute.

A calibration outline is provided inside the top cover of the instrument (see Figure 10). The adjustment references listed below are the same as those recorded on the top cover.

Adjustment No. 1. Measure the -15.0V dc supply voltage at Test Point No. 5 located on the main amplifier board to the left of R145. Adjust R145 to $-14.9V \pm 0.1V$.

Adjustment No. 2. Set the FULL SCALE selector to the 1 mV Range and zero the instrument as described in paragraph 3.3.5.

Adjustment No. 3. Set the FULL SCALE selector to the 30 mV Range and adjust R233 for a zero reading on the meter.

Adjustment No. 4. Set the FULL SCALE selector to the 1 mV Range (zero as in Adjustment No. 2 above), apply 1.00 mV input and adjust R303 for a 1.00 mV reading.

Adjustment No. 5. Set the FULL SCALE selector to the 3 mV Range (zero as in Adjustment No. 2 above), apply 3.00 mV and adjust R308 for a 3.00 mV reading.

Adjustment No. 6. Set the FULL SCALE selector to the 10 mV Range, apply 10.0 mV input and adjust R318 for a 10.0 mV reading.

Adjustment No. 7. Set the FULL SCALE selector to the 30 mV Range, apply 30.0 mV input and adjust R328 for a 30.0 mV reading.

Adjustment No. 8. Set the FULL SCALE selector to the 100 mV Range, apply 100 mV input and adjust R341 for a 100 mV reading.

Adjustment No. 9. Set the FULL SCALE selector to the 300 mV Range, apply 300 mV input and adjust R347 for a 300 mV reading.

Adjustment No. 10. Set the FULL SCALE selector to the 1000 mV Range, apply 1000 mV input and adjust R353 for a 1000 mV reading.

Adjustment No. 11. Set the FULL SCALE selector to the 3000 mV Range, apply 3000 mV input and adjust R363 for a 3000 mV reading.

5.5 TROUBLE-SHOOTING PROCEDURE

The following trouble-shooting procedures describe the instrument's cover removal, chopper replacement and voltage and resistance tests.

5.5.1 Cover Removal

The cover of the instrument may be removed from the case by removing the screw on the top of the case.

5.5.2 Chopper Replacement

If unsatisfactory operation develops, a replacement chopper should be tried. (NOTE: The chopper used in the Model 92 Series is a special Boonton Electronics Corporation part. For replacements or spares, call your local Boonton Electronics Representative, or the factory.) If the new chopper does not clear the difficulty, place the original chopper back in the socket. The calibration accuracy should be re-checked after replacement.

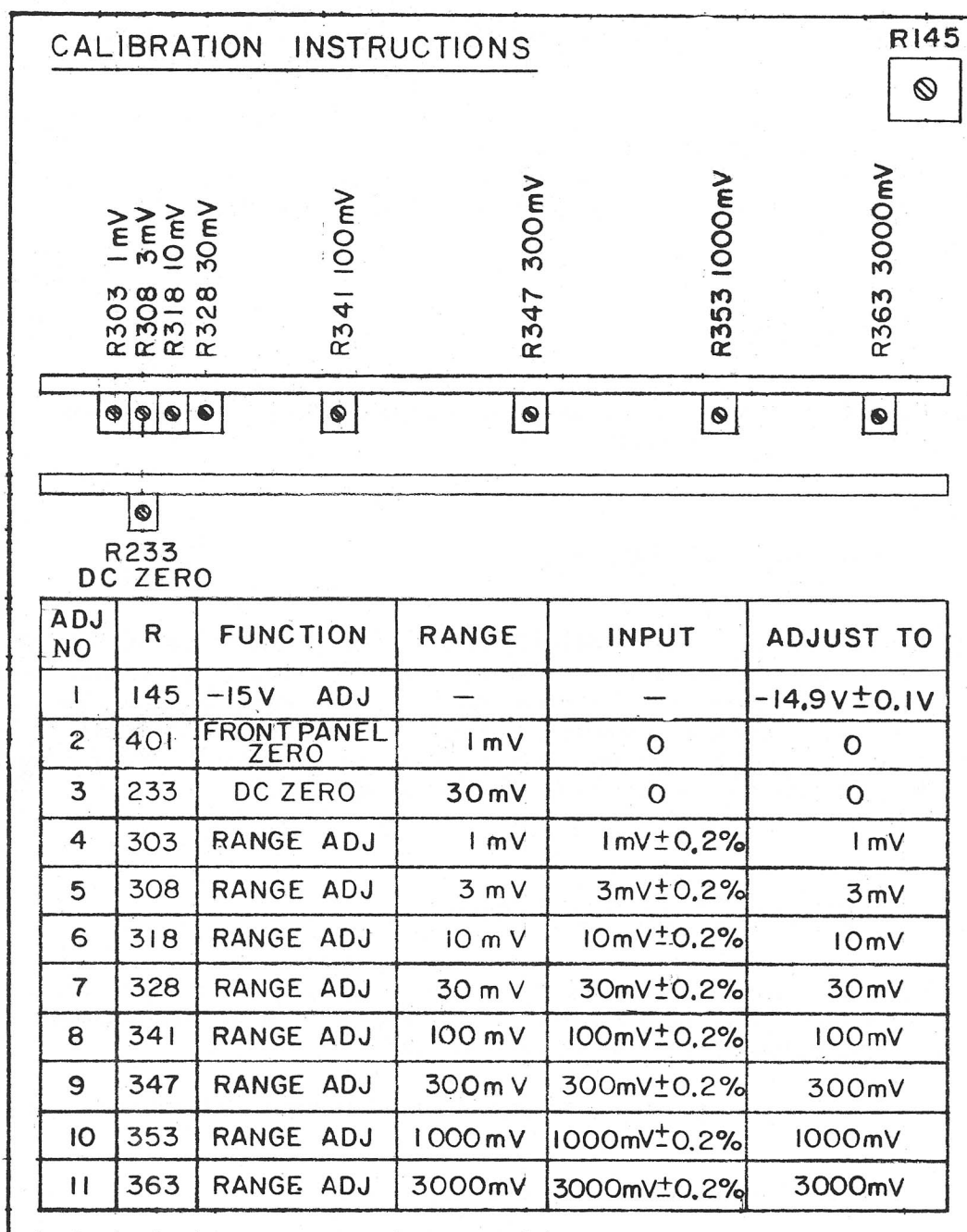


Figure 10. Calibration instructions Printed on the Underside of the Top Cover of the Model 92 Series.

5.5.3 Voltage and Resistance Tests

After determining that the trouble cannot be cured by replacement of the chopper (as noted above) it is advisable to make a systematic check of the ac voltage, dc voltage, and resistance. Once the trouble has been found and corrected, the calibration must be re-checked and readjusted as outlined in paragraphs 5.3 and 5.4.

5.5.4 Test Points

Test Points, waveforms, and related test voltages are shown in the Model 92 schematics at the back of this manual.

5.5.5 Replacement of RF Probes

The serial number of the Model 92 matches that of the Model 91-12F RF Probe with which it was calibrated at the factory. If it is necessary to change probes for any reason, the instrument's calibration **MUST** be rechecked. In some cases, full recalibration (see procedure in paragraph 5.4) may be required. Similarly, if the RF Probe supplied with the instrument is exchanged for a Model 91-4C Low Frequency Probe, recalibration may be required. (See paragraph 3.5.)

5.5.6 Replacement of Batteries (92AB only)

The batteries supplied with the 92AB will normally serve for up to 500 complete charge/discharge cycles before requiring replacement. When replacement becomes necessary, the following procedure should be used.

1. Remove the screw on the top of the instrument cabinet and take off the cover.
2. Unplug the connector cap from the chopper.
3. Unplug the four battery wires (two red and two black) from their terminals to the right of the battery container. Be sure to note their respective positions carefully before unplugging them.

5.5.6 Replacement of Batteries (92AB only) (cont'd)

4. Remove the chassis screws (one on each side) holding the battery mounting plate in place, and slide the battery plate up its rails and out of the case. The cable is long enough to permit placing the plate alongside the case on the workbench.
5. Remove the four screws holding the battery cover to the plate and take off the cover.
6. Replace the old batteries with fresh units and replace the battery cover and screws.
7. Slide the battery mounting plate into place and replace the two holding screws.
8. Replace the four battery leads on their terminals. BE SURE TO PUT THEM ON THE PROPER TERMINALS. Even a brief polarity reversal can damage several transistors.
9. Replace the chopper connector cap.
10. Replace the instrument cover and holding screw.

5.5.7 Probe Tests. The probe assemblies furnished with the Model 92A/AB can be checked for VSWR and frequency response by following the procedures detailed in the paragraphs below.

Should a probe exhibit out-of-tolerance performance in these tests, the user is urged not to attempt repair himself but to send it back to the factory for repair or adjustment.

A. VSWR measurement:

1. Test Equipment:

- a. Oscillator for desired frequency range:
56 - 500 MHz; GR Type 1363
220 - 920 MHz; GR Type 1362
450 - 1050 MHz; GR Type 1361A
- b. Oscillator Power Supply; GR Type 1263-C
- c. GR Voltmeter Rectifier Type 874-VR

5.5.7 Probe Tests. (Cont'd.)

- d. Slotted Line; GR Type 900 LB
- e. RF VTVM; BEC Model 91H, 91DA, 92A, or GR Detector Type 1241
- f. Tee Adapter; BEC Model 91-14A
- g. 50-ohm Termination: BEC Model 91-15A

2. Test Procedure:

- a. Assemble the equipment as shown in the block diagram following this section.
- b. Set the oscillator to the desired test frequency and adjust the output level for a reading of approximately half-scale on the 30 mV volt-meter range.
- c. Adjust the carriage of the slotted line to a point of minimum voltage on the meter, and record the value.
- d. Adjust the carriage to a maximum-voltage point and record this value.
- e. The VSWR is equal to the ratio of the two voltages recorded in steps c and d.
- f. The measurement may be repeated at other frequencies as required.

B. Frequency Response.

1. Test Equipment:

- a. Oscillator for desired frequency range:
 - GR Type 1363; 56 - 500 MHz
 - 1362; 220 - 920 MHz
 - 1361A; 450 - 1050 MHz
- b. Power supply; GR Type 1263-C
- c. GR Voltmeter Rectifier, Type 874-VR
- d. 1.0 GHz Low-Pass Filter; GR Type 874-F100L
- e. 20 dB 50-Ω Pad; GR Type 874-G20

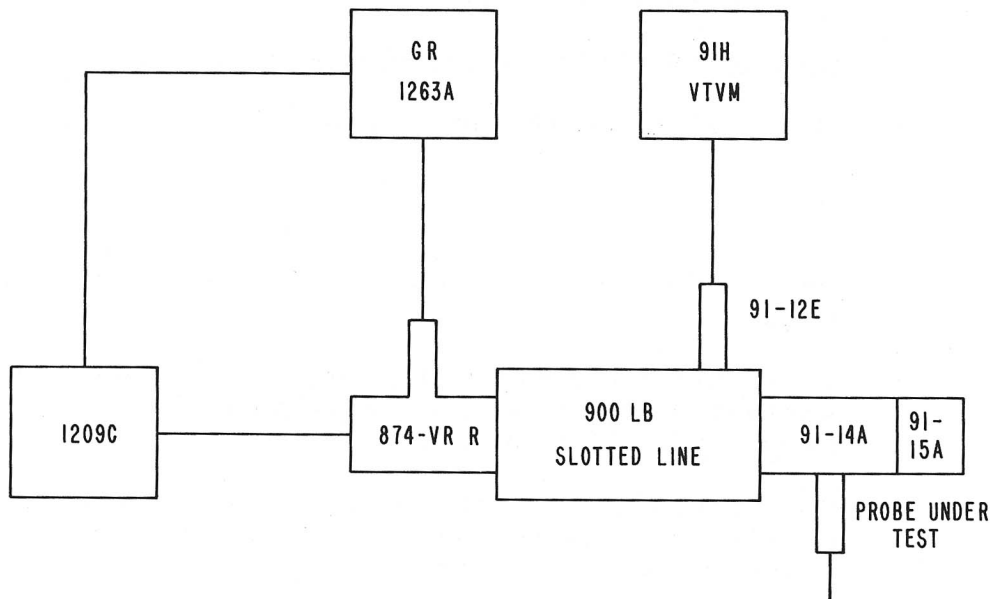
B. Frequency Response (Cont'd.)

- f. BEC Model 91-14A Tee Adapter
- g. BEC Model 91-15A 50-ohm termination
- h. BEC Model 92A/AB RF Millivoltmeter

2. Test Procedure:

- a. Assemble the equipment as shown in the block diagram following this section.
- b. Set the oscillator to the low-frequency end of its tuning range and the voltmeter to the 100 mV range. Adjust the oscillator power to give a reading of 0 dBm on the meter.
- c. Adjust the oscillator to successively higher frequencies as convenient, recording the voltmeter reading at each frequency. The results may be plotted on a graph, if desired.

BLOCK DIAGRAM OF RF PROBE VSWR TEST



BLOCK DIAGRAM OF RF PROBE RESPONSE TEST

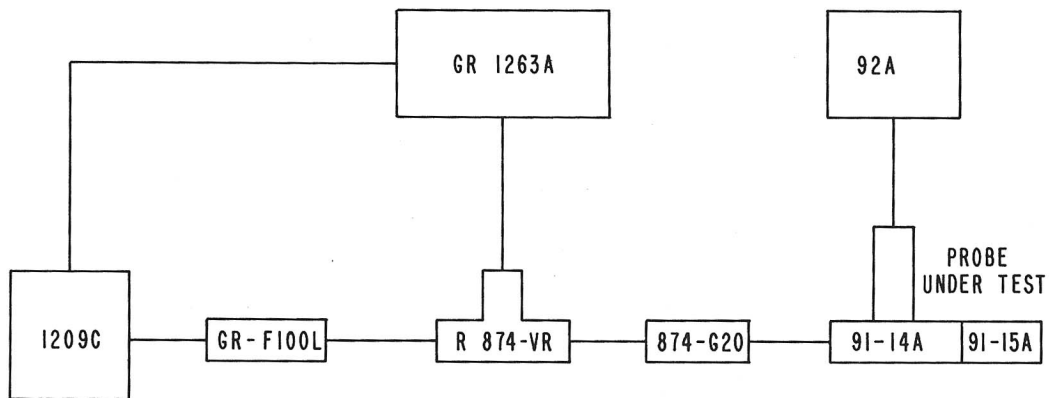


TABLE OF REPLACEABLE PARTS

Reference	Description		BEC Part No.
A201	Operational Amplifier	Nat. Semi. LM302	535003
A301	"	Nat. Semi. LM301A	535002
*BT501	Battery		556000
*BT502	"		"
C101	Capacitor	0.1 μ F $\pm$ 10% 200V	Sprague 192P10402 234005
C102	"	10 μ F $\pm$ 20% 20V	Kemet K10E20 283205
C103	"	100pF $\pm$ 5% 500V	Arco DM15F101-J 200001
C104	"	10 μ F $\pm$ 20% 20V	Kemet K10E20 283205
C105	"	33 μ F $\pm$ 20% 15V	Kemet K33E15 283206
C106	"	10 μ F $\pm$ 20% 20V	Kemet K10E20 283205
C107	"	1.0 μ F $\pm$ 20% 100V	Electron Prod. W1-105 236007
C108	"	1.0 μ F $\pm$ 20% 35V	Kemet K1E35 283199
C109	"	50 μ F 25V	Sprague TE1209 283159
C110	"	" "	" "
C111	"	0.1 μ F $\pm$ 10% 200V	Sprague 192P10402 234005
C112	"	250 μ F 40V	Mallory Type PFP 283207
C113	"	" "	" "
C114	"	100 μ F 25V	Sprague TE1211 283105
C115	"	" "	" "
C201	"	0.1 μ F $\pm$ 10% 50V	TRW 463UWU 234046
C202	"	0.0068 μ F $\pm$ 10% 200V	Sprague 192P68292 234044
C203	"	100pF $\pm$ 5% 500V	Arco DM15F101-J 200001
C204	"	" " "	" "
C205	"	0.022 μ F $\pm$ 10% 200V	Sprague 192P22392 230101
C206	"	0.1 μ F $\pm$ 10% 50V	TRW 463UWU 234046
C207	"	100pF $\pm$ 5% 500V	Arco DM15F101-J 200001
C208	"	0.1 μ F $\pm$ 10% 50V	TRW 463UWU 234046
C209	"	0.01 μ F DISC. 100V	Erie 805-Y5V01032 224119
C210	"	" "	" "
C211	"	0.018 μ F $\pm$ 5% 200V	Sprague 192P18352 234064
C212	"	0.22 μ F $\pm$ 10% 50V	TRW 463UWU 234075
C213	"	100pF $\pm$ 5% 500V	Arco DM15F101-J 200001
C214	"	50 μ F 25V	Sprague TE1209 283159
C215	"	" "	" "
C216	"	" "	" "
C301	"	0.01 μ F 100V	Erie 805-Y5V01032 224119
C302	"	33pF $\pm$ 5% 500V	Arco DM-15-330J 200049
C303	"	0.01 μ F 100V	Erie 805-Y5V01032 224119

*92AB

Reference		Description		BEC Part No.
C401	Capacitor	0.1 μ F $\pm$ 10% 50V	TRW 463UWU	234046
C402	"	" " "	" "	"
CR101	Diode	L Pwr., P1V 125 450mA	Fairchild FD300	530052
CR102	"	L Pwr., Silicon	Texas Inst. 1N914	530058
CR103	"	" "	" "	"
CR104	" , Zener	11V $\pm$ 5% 500mW	Motorola 1N5241B	530082
CR105	" "	6.8V $\pm$ 5% 500mW	Motorola 1N5235B	530089
CR106	"	L Pwr., Silicon	T.I. 1N914	530058
CR107	Rectifier, Sil.	1.5A 200V	Gen. Inst. KBP02	532013
CR108	Diode	L Pwr., Silicon	T.I. 1N914	530058
CR109	"	" "	" "	"
CR110	"	" "	" "	"
CR111	"	" "	" "	"
CR112	" , Zener	16V $\pm$ 5% 500mW	Motorola 1N5246B	530090
CR113	" "	6.2V $\pm$ 5% 500mW	Motorola 1N5234B	530093
CR201	Diode	L Pwr., Silicon	T. I. 1N914	530058
CR202	"	" "	"	"
CR203	"	" "	"	"
CR204	"	" "	"	"
CR205	"	" "	"	"
CR206	"	" "	"	"
CR207	"	" "	"	"
CR208	"	" "	"	"
CR209	"	" "	"	"
CR210	"	" "	"	"
CR211	"	" "	"	"
CR212	"	" "	"	"
CR213	"	" "	"	"
CR214	"	" "	"	"
CR215	"	" "	"	"
CR216	"	" "	"	"
CR217	"	" "	"	"
CR218	"	" "	"	"
CR219	"	" "	"	"
CR301	Diode	L Pwr., Silicon	T.I. 1N914	530058
CR302	"	" "	"	"
CR303	"	" "	"	"
CR304	"	" "	"	"
CR305	"	" "	"	"
CR306	"	" "	"	"
CR307	"	" "	"	"
CR308	"	" "	"	"
* CR502	Diode	L Pwr., Silicon	T.I. 1N914	530058
* CR503	"	" "	"	"

*92AB

<u>Reference</u>		<u>Description</u>		<u>BEC Part No.</u>
DS401	Lamp		Tungsol 349	545107
DS402	"		"	"
F401	Fuse	1/10A 115V	Bussman MDL Slo-Blo	545519
or F401	Fuse	1/16A 230V	" " "	545518
G401	Chopper	Special	Airpax, Type 3 6	540113
*G401	Chopper	Special	Airpax, ER-2092	540123
J101	Connector	Card Edge, 22 Pos.	Amphenol 143-022-03	479231
J102	"	" " "	" "	"
J401	Receptacle		Amphenol 80-PC-2-FT	479119
M401	Meter & Scale			554216
Q101	FET	Junction, Silicon	Motorola 2N5459	528019
Q102	"	" "	" "	"
Q103	"	" "	" "	"
Q104	"	Silicon, N-Channel T	T.I. TIS58	528038
Q105	"	MOS-FET, P-Channel	Hughes HDGP-1001	528057
Q106	"	Junction, Silicon	Motorola 2N5459	528019
Q107	Transistor	Selected, Special		528044
Q108	"	NPN, Silicon	Motorola 2N5088	528047
Q109	"	PNP, Silicon	" 2N5087	528042
Q110	"	PNP	" MPS-A66	528048
Q111	"	PNP, Silicon	" 2N5087	528042
Q112	"	NPN, Silicon	" 2N5088	528047
Q113	FET	N-Channel, Silicon	T.I. TIS58	528038
Q114	"	" "	" "	"
Q115	"	" "	" "	"
Q116	"	Junction, Silicon	Motorola 2N5459	528019
Q117	"	" "	" "	"
Q118	"	" "	" "	"
Q119	Transistor	PNP	" MPS-A66	528048
Q120	"	NPN, Silicon	" 2N3903	528024
Q121	"	PNP, Silicon	" 2N3905	528025
Q122	FET	Junction, Silicon	" 2N5459	528019
Q123	"	" "	" "	"
Q124	Transistor	NPN, Silicon	" 2N4921	528034
Q125	"	PNP, Silicon	" 2N4918	528033
Q126	"	PNP, Silicon	" 2N5087	528042
Q127	FET	MOS-FET	Hughes HDGP-1001	528057

*92AB

Reference		Description		BEC Part No.
Q201	Transistor	Unijunction, Silicon	Motorola 2N4871	528051
Q202	"	NPN, Silicon	" MPS-A10	528043
Q203	"	PNP, Silicon	" 2N5087	528042
Q204	"	NPN, Silicon	" 2N5088	528047
Q205	"	NPN, Silicon	" MPS-A10	528043
Q206	FET	Silicon	" MPS-A12	528052
Q207	Transistor	NPN, Silicon	" MPS-A10	528043
Q208	"	N-Channel, Junction	T.I. TIS58	528038
Q209	"	NPN, Silicon	Motorola MPS-A10	528043
Q210	"	N-Channel, Junction	T.I. TIS58	528038
Q211	FET	Junction, Silicon	Motorola 2N5459	528019
Q212	Transistor	NPN, Silicon	" MPSA10	528043
Q213	"	NPN, Silicon	" 2N5308	528050
Q214	"	" "	" "	"
Q301	FET	Junction, Silicon	Motorola 2N5459	528019
Q302	"	" "	" "	"
Q303	"	" "	" "	"
Q304	Transistor	PNP, Silicon	Motorola 2N5087	528042
Q305	FET	Junction, Silicon	" 2N5459	528019
Q306	Transistor	PNP, Silicon	" 2N5087	528042
Q307	FET	Junction, Silicon	" 2N5459	528019
Q308	Transistor	PNP, Silicon	" 2N5087	528042
Q309	FET	Junction, Silicon	" 2N5459	528019
Q310	Transistor	PNP, Silicon	" 2N5087	528042
Q311	FET	Junction, Silicon	" 2N5459	528019
Q312	Transistor	PNP, Silicon	" 2N5087	528042
Q313	FET	Junction, Silicon	" 2N5459	528019
Q314	"	" "	" "	"
Q315	"	" "	" "	"
Q316	"	" "	" "	"
Q317	Transistor	PNP, Silicon	" 2N5087	528042
Q318	"	NPN, Silicon	" 2N5088	528047
Q319	"	PNP, Silicon	" 2N5087	528042
Q320	"	NPN, Silicon	" 2N5088	528047
Q321	"	PNP, Silicon	" 2N5087	528042
Q322	"	" "	" "	"
Q323	FET	Junction, Silicon	" 2N5459	528019
Q324	"	" "	" "	"
Q325	Transistor	PNP, Silicon	" 2N5087	528042
Q326	FET	Junction, Silicon	" 2N5459	528019
Q327	Transistor	PNP, Silicon	" 2N5087	528042
Q328	FET	Junction, Silicon	" 2N5459	528019
Q329	Transistor	PNP, Silicon	" 2N5087	528042
Q330	FET	Junction, Silicon	" 2N5459	528019
Q331	"	" "	" "	"
Q332	Transistor	PNP, Silicon	" 2N5087	528042
Q333	"	" "	" "	"
Q334	"	" "	" "	"

Reference		Description		BEC Part No.
Q335	FET	Junction, Silicon	Motorola 2N5459	528019
Q336	"	" "	" "	"
Q337	Transistor	PNP, Silicon	" 2N5087	528042
Q338	"	" "	" "	"
Q339	"	" "	" "	"
*Q501	Transistor	NPN	Motorola 2N4921	528034
R101	Resistor	1M 1/2W 5%	AB EB	301159
R102	"	6.2 k Ω 1/4W 5%	AB CB	300101
R103	"	" " "	"	"
R104	"	5.62M 1/4W 1%	Pyrofilm PME65	325397
R105	"	24.3K 3/8W 1%	T.I. MC60D	340405
R106	"	80.6K 3/8W 1%	" "	326467
R107	"	374K 3/8W 1%	" "	340547
R108	"	294K 3/8W 1%	" "	340535
R109	"	1.00M 3/8W 1%	" "	326700
R110	"	91K 1/2W 5%	AB EB	301134
R111	"	47K 1/2W 5%	"	301127
R112	"	33K 1/2W 5%	"	301123
R113	"	300K 1/2W 5%	"	301146
R114	"	169 Ω 3/8W 1%	T.I. MC60D	340147
R115	"	10K 1/2W 5%	AB EB	301111
R116	"	" " "	"	"
R117	"	33K 1/2W 5%	"	301123
R118	"	15K 3/8W 1%	T.I. MC60D	340378
R119	"	15K 1/2W 5%	AB EB	301115
R120	"	3.6K 1/2W 5%	"	301100
R121	"	3K 1/2W 5%	"	301098
R122	"	1M 1/2W 5%	"	301159
R123	"	2.7K 1/2W 5%	"	301097
R124	"	5.6K 1/2W 5%	"	301105
R125	"	" " "	"	"
R126	"	1 k Ω 1/2W 5%	"	301087
R127	"	5.1K 1/2W 5%	"	301104
R128	"	15K 1/2W 5%	"	301115
R129	"	1K 1/2W 5%	"	301087
R130	"	10K 1/2W 5%	"	301111
R131	"	30.1K 3/8W 1%	T.I. MC 60D	326397
R132	"	3.01K 3/8W 1%	" "	340297
R133	"	301 Ω 3/8W 1%	" "	340176
R134	"	33.2 Ω 3/8W 1%	" "	340063
R135	"	1M 1/2W 5%	AB EB	301159
R136	"	2K 1/2W 5%	"	301094
R137	"	24K 1/2W 5%	"	301120
R138	"	" " "	"	"
R139	"	2K 1/2W 5%	"	301094
R140	"	8.2 Ω 1/2W 5%	"	301505

*92AB

Reference		Description		BEC Part No.
R141	Resistor	8.2 Ω 1/2W 5%	AB EB	301505
R142	"	100 Ω 1/2W 5%	"	301063
R143	"	" " "	"	"
R144	"	3.92K 3/8W 5%	T.I. MC 60D	340311
R145	"	1K 1/2W 20%	CTS 360T102B	311257
R146	"	4.75K 3/8W 1%	T.I. MC 60D	340321
R147	"	49.9K 3/8W 1%	" "	340442
R148	"	9.09K 3/8W 1%	" "	340354
R149	"	150K 1/2W 5%	AB EB	301139
R201	Resistor	10K 1/2W 5%	AB EB	301111
R202	"	33K 1/2W 5%	"	301123
R203	"	10K 1/2W 5%	"	301111
R204	"	100 Ω 1/2W 5%	"	301063
R205	"	33K 1/2W 5%	"	301123
R206	"	10K 1/2W 5%	"	301111
R207	"	100K 1/2W 5%	"	301135
R208	"	3.3K 1/2W 5%	"	301099
R209	"	4.7K 1/2W 5%	"	301103
R210	"	10K 1/2W 5%	"	301111
R211	"	150K 1/2W 5%	"	301139
R212	"	10K 1/2W 5%	"	301111
R213	"	" " "	"	"
R214	"	22K 1/2W 5%	"	301119
R215	"	10K 1/2W 5%	"	301111
R216	"	270K 1/2W 5%	"	301145
R217	"	240K 1/2W 5%	"	301144
R218	"	10K 1/2W 5%	"	301111
R219	"	15K 1/2W 5%	"	301115
R220	"	10K 1/2W 5%	"	301111
R221	"	" " "	"	"
R222	"	12K 1/2W 5%	"	301113
R223	"	3.9K 1/2W 5%	"	301101
R224	"	12K 1/2W 5%	"	301113
R225	"	100K 1/2W 5%	"	301135
R226	"	" " "	"	"
R227	"	15K 1/2W 5%	"	301115
R228	"	10K 1/2W 5%	"	301111
R229	"	100K 1/2W 5%	"	301135
R230	"	12K 1/2W 5%	"	301113
R231	"	4.7K 1/2W 5%	"	301103
R232	"	100K 1/2W 5%	"	301135
R233	Trimmer	1K	Bourns 3007P-1-102	311256
R234	Resistor	100K 1/2W 5%	AB EB	301135
R235	"	" " "	"	"
R236	"	27K 1/2W 5%	"	301121
R237	"	100K 1/2W 5%	"	301135
R238	"	" " "	"	"
R239	"	1.6K 1/2W 5%	"	301092
R240	"	470 Ω 1/2W 5%	"	301079

Reference		Description		BEC Part No.
R241	Resistor	62Ω 1W 5%	AB GB	302072
*R241	"	270Ω 1/2W 5%	AB EB	301073
R242	"	150K 1/2W 5%	AB EB	301139
R301	Resistor	130Ω 1/2W	AB EB	301066
R302	"	470K 1/2W 5%	"	301151
R303	Var. Resistor		Bourns 3007P-1-102	311256
R304	Resistor	10K 3/8W 1%	T.I. MC60D	326376
R305	"	470K 1/2W 5%	AB EB	301151
R306	"	51.1K 3/8W 1%	T.I. MC60D	340443
R307	"	2.49K 3/8W 1%	" "	340287
R308	Var. Resistor		Bourns 3007P-1-102	311256
R309	Resistor	28.7K 3/8W 1%	T.I. MC60D	340414
R310	"	200K 3/8W 1%	" "	340515
R311	"	100K 3/8W 1%	" "	340478
R312	"	40.2K 3/8W 1%	" "	326401
R313	"	191K 3/8W 1%	" "	340512
R314	"	11K 3/8W 1%	" "	340364
R315	"	470K 1/2W 5%	AB EB	301151
R316	"	29.4K 3/8W 1%	T.I. MC60D	340415
R317	"	95.3K 3/8W 1%	" "	340476
R318	Var. Resistor		Bourns 3007P-1-102	311256
R319	Resistor	28.0K 3/8W 1%	T.I. MC60D	340412
R320	"	64.9K 3/8W 1%	" "	340456
R321	"	1.00M 3/8W 1%	" "	326700
R322	"	26.1K 3/8W 1%	" "	340408
R323	"	46.4K 3/8W 1%	T.I. MC60D	340438
R324	"	10K 3/8W 1%	" "	326376
R325	"	470K 1/2W 5%	AB EB	301151
R326	"	45.3K 3/8W 1%	T.I. MC60D	326403
R327	"	2.49K 3/8W 1%	" "	340287
R328	Var. Resistor		Bourns 3007P-1-102	311256
R329	Resistor	270K 1/2W 5%	AB EB	301145
R330	"	21.5K 3/8W 1%	T.I. MC60D	340398
R331	"	240K 3/8W 1%	" "	340524
R332	"	18K 1/2W 5%	AB EB	301117
R333	"	26.1K 3/8W 1%	T.I. MC60D	340408
R334	"	154K 3/8W 1%	" "	340501
R335	"	47K 1/2W 5%	AB EB	301127
R336	"	54.9K 3/8W 1%	T.I. MC60D	340447
R337	"	191K 3/8W 1%	" "	340512
R338	"	470K 1/2W 5%	AB EB	301151
R339	"	82.5K 3/8W 1%	T.I. MC60D	340468
R340	"	178K 3/8W 1%	" "	326514
R341	Var. Resistor		Bourns 3007P-1-102	311256
R342	Resistor	17.8K 3/8W 1%	T.I. MC60D	340388
R343	"	2.74K 3/8W 1%	" "	340292
R344	"	470K 1/2W 5%	AB EB	301151
R345	"	24.3K 3/8W 1%	T.I. MC60D	340405

*92AB

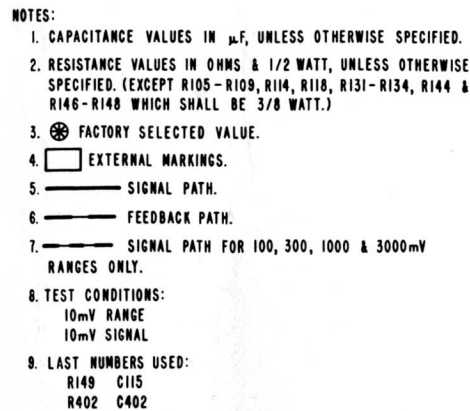
Reference		Description		BEC Part No.
R346	Resistor	232K 3/8W 1%	T.I. MC60D	340522
R347	Var. Resistor		Bourns 3007P-1-102	311256
R348	Resistor	95.3K 3/8W 1%	T.I. MC60D	340476
R349	"	453K 3/8W 1%	" "	340557
R350	"	470K 1/2W 5%	AB EB	301151
R351	"	200K 3/8W 1%	T.I. MC60D	340515
R352	"	634K 3/8W 1%	" "	340575
R353	Var. Resistor		Bourns 3007P-1-102	311256
R354	Resistor	14.3K 3/8W 1%	" "	340377
R355	"	2.49K 3/8W 1%	" "	340287
R356	"	34.8K 3/8W 1%	T.I. MC60D	340423
R357	"	523K 3/8W 1%	" "	340565
R358	"	470K 1/2W 5%	AB EB	301151
R359	"	162K 3/8W 1%	T.I. MC60D	340503
R360	"	806K 3/8W 1%	" "	340587
R361	"	10K 3/8W 1%	" "	326376
R362	"	2.74K 3/8W 1%	" "	340292
R363	Var. Resistor		Bourns 3007P-1-102	311256
R364	Resistor	127K 3/8W 1%	T.I. MC60D	340491
R365	"	604K 3/8W 1%	" "	340572
R401	Var. Resistor	5K	Bourns 3859A-201-502A	311265
RT301	Thermistor	100Ω 10%	Fenwal CB21J1	325005
*R501	Resistor	4.7K 1W 5%	AB GB	302117
*R502	"	100Ω 1/2W 5%	AB EB	301063
*R503	"	90.9Ω 3/8W 1%	T.I. MC60D	340115
*R504	"	" " "	" "	"
*R505	"	274K 3/8W 1%	" "	340531
S401	Switch			465146
S402	"	Slide	Craft 46562F	465134
*S403	"	Rotary		466208
T401	Transformer	Power		446052

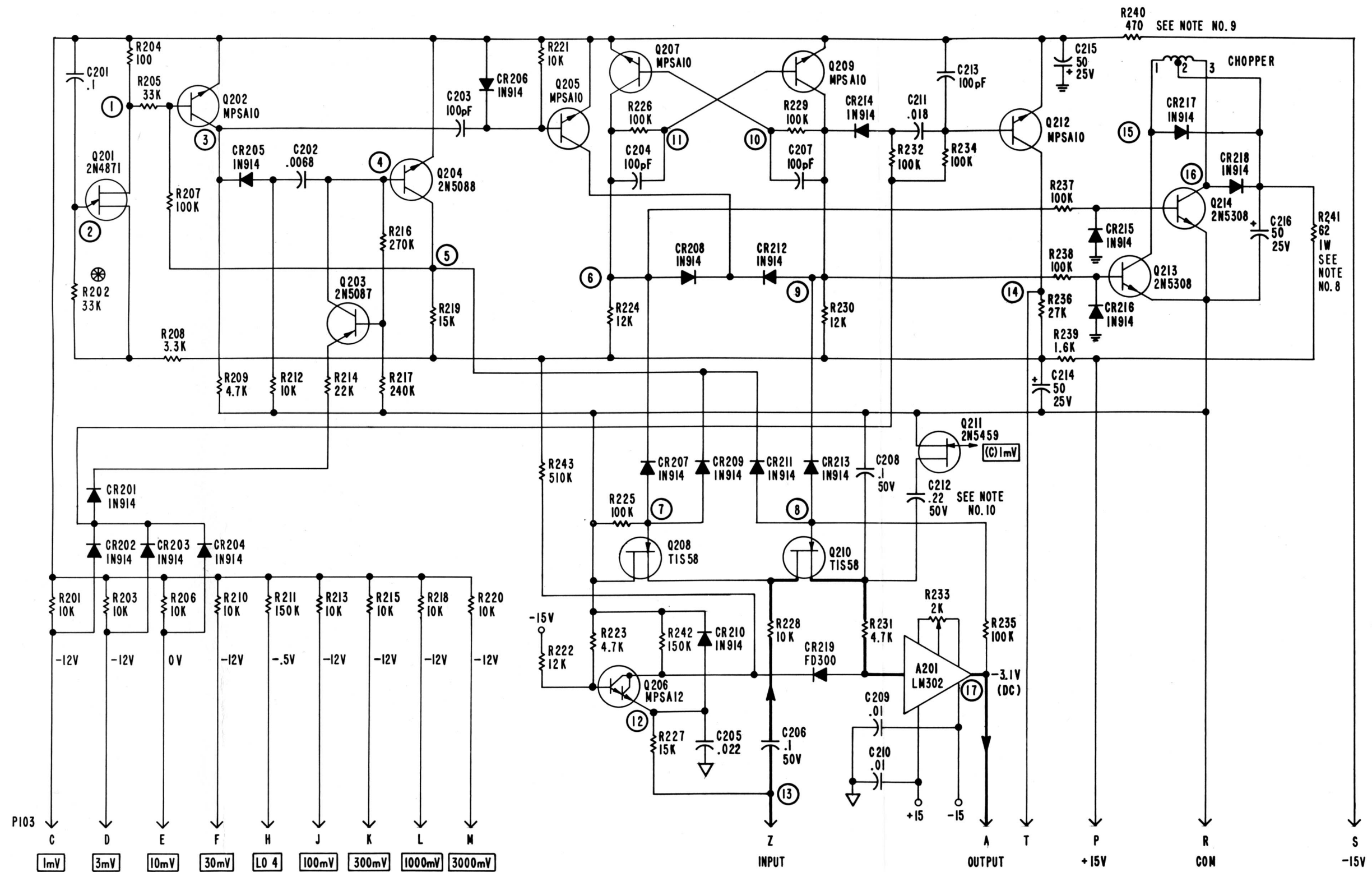
*92AB

SUPPLEMENTAL TABLE OF REPLACEABLE PARTS

MODEL 92AB-02
(Logic-Level Programming Option)

<u>Reference</u>		<u>Description</u>		<u>BEC Part No.</u>
CR801 CR811	Diode		T.I. 1N4148	530096
Q801 Q811	Transistor	PNP Silicon	Mot. MPS 6516	528037
R801	Resistor	160K 5% 1/8W	AB BB	331135
R802	"	39K 5% 1/8W	"	331120
R803	"	100K 5% 1/8W	"	331130
R804	"	160K 5% 1/8W	"	331135
R805	"	39K 5% 1/8W	"	331120
R806	"	100K 5% 1/8W	"	331130
R807	"	160K 5% 1/8W	"	331135
R808	"	39K 5% 1/8W	"	331120
R809	"	100K 5% 1/8W	"	331130
R810	"	160K 5% 1/8W	"	331135
R811	"	39K 5% 1/8W	"	331120
R812	"	100K 5% 1/8W	"	331130
R813	"	160K 5% 1/8W	"	331135
R814	"	39K 5% 1/8W	"	331120
R815	"	100K 5% 1/8W	"	331130
R816	"	160K 5% 1/8W	"	331135
R817	"	39K 5% 1/8W	"	331120
R818	"	100K 5% 1/8W	"	331130
R819	"	160K 5% 1/8W	"	331135
R820	"	39K 5% 1/8W	"	331120
R821	"	100K 5% 1/8W	"	331130
R822	"	160K 5% 1/8W	"	331135
R823	"	39K 5% 1/8W	"	331120
R824	"	100K 5% 1/8W	"	331130
R825	"	160K 5% 1/8W	"	331135
R826	"	39K 5% 1/8W	"	331120
R827	"	100K 5% 1/8W	"	331130
R828	"	160K 5% 1/8W	"	331135
R829	"	39K 5% 1/8W	"	331120
R830	"	100K 5% 1/8W	"	331130
R831	"	160K 5% 1/8W	"	331135
R832	"	39K 5% 1/8W	"	331120
R833	"	100K 5% 1/8W	"	331130





TEST POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
WAVEFORM																

NOTES:

1. CAPACITANCE VALUES IN μF , UNLESS OTHERWISE SPECIFIED.
2. RESISTANCE VALUES IN OHMS & 1/2 WATT, UNLESS OTHERWISE SPECIFIED.
3. EXTERNAL MARKINGS.

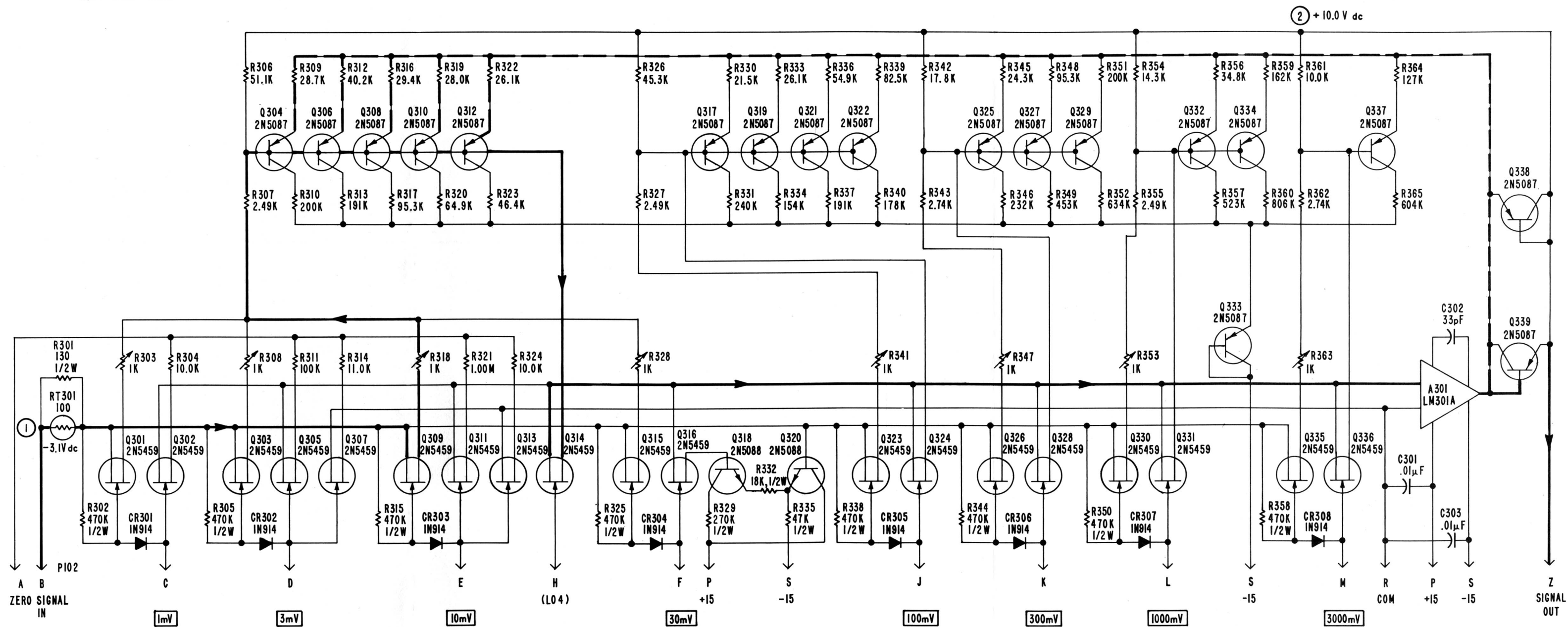
4. COMMON
5. SIGNAL PATH
6. TEST CONDITIONS:
10mV RANGE
10mV SIGNAL

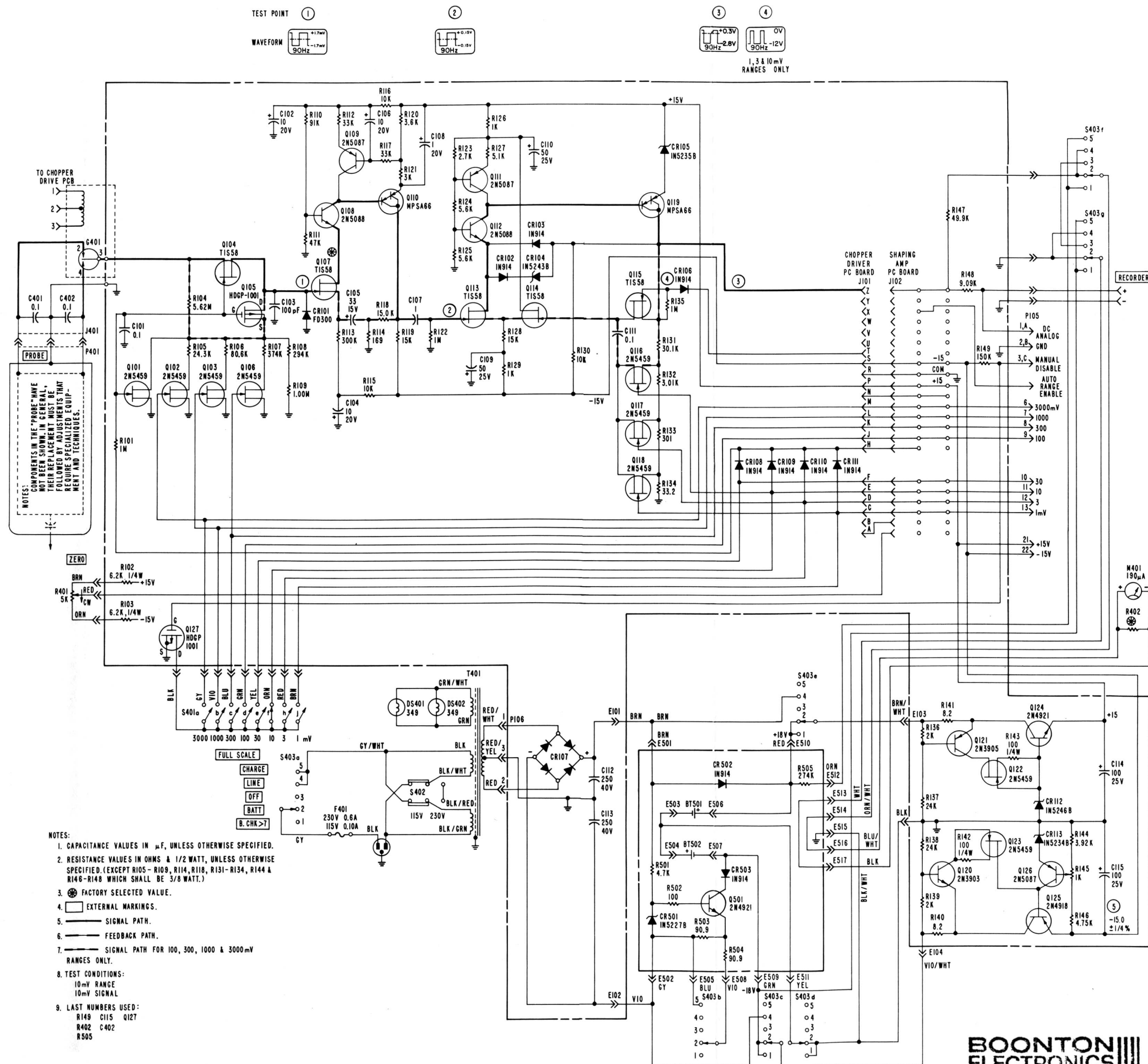
7. LAST NUMBERS USED:
R242 C216 Q214 CR219
8. ON MODEL 92AB THIS VALUE IS 270 Ω , 1/2 W.

9. ON MODEL 42AD THIS VALUE IS 300 Ω , 1/2 WATT.
10. ON MODELS 92AD & 42AD THIS VALUE IS 0.47 μF , 50V.
11. FACTORY SELECTED VALUE.

NOTES:

1. RESISTANCE VALUES IN OHMS AND 3/8 WATT, UNLESS OTHERWISE SPECIFIED.
2. SIGNAL PATH ———
3. FEEDBACK PATH ———
4. EXTERNAL MARKINGS
5. LAST NUMBER USED:
R365 C303 Q339





SCHEMATIC
LOGIC LEVEL PROGRAMMING CONVERTER
TTL/DTL COMPATIBLE
MODEL 92-2B

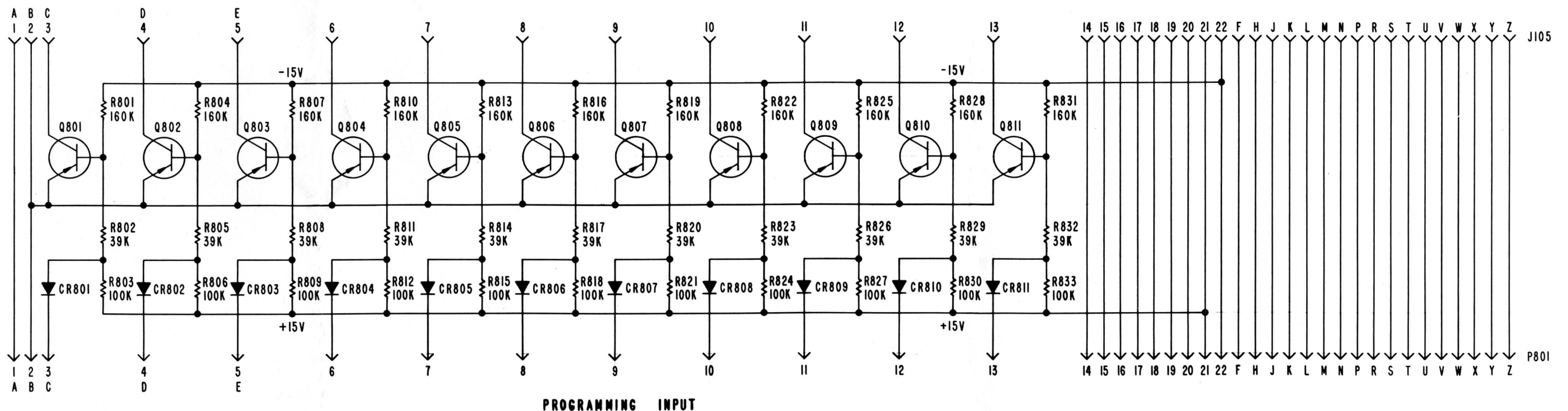
NOTES:

1. RESISTANCE VALUES IN OHMS AND 1/8 WATT, UNLESS OTHERWISE SPECIFIED.
2. ALL TRANSISTORS TO BE TYPE MPS 6516, UNLESS OTHERWISE SPECIFIED.
3. ALL DIODES TO BE TYPE IN4148, UNLESS OTHERWISE SPECIFIED.
4. LAST NUMBERS USED:
R833 Q811 CR811

PIN ASSIGNMENTS

P801					
	92	42		92	42
1	DC ANALOG		A	DC ANALOG	
2	COMMON		B	COMMON	
3	MANUAL DISABLE		C	MANUAL DISABLE	
4	AUTO ENABLE		D	AUTO ENABLE	
5	dBm ENABLE		E	dBm ENABLE	
6	3000mV	N.C	F	MSD 1	
7	1000mV	+10dBm	H	8 \	
8	300mV	0 dBm	J		
9	100mV	-10 dBm	K	2	
10	30mV	-20 dBm	L	1	
11	10mV	-30 dBm	M	8	
12	3mV	-40 dBm	N	4	
13	1mV	-50 dBm	P	2	
14	4		R	1	
15	2	RANGE CODE	S	8	
16	1		T	4	
17	UNDER RANGE		U	2	
18	OVER RANGE		V	1	
19	mV MODE	μW MODE	W	+dBm	
20	+5V DC		X	HOLD	
21	+15V DC		Y	COMPLETE	
22	-15V DC		Z	TRIGGER	

⊗ DIGITAL VERSIONS ONLY



Warranty

Boonton Electronics Corporation warrants its products to the original Purchaser to be free from defects in material and workmanship and to operate within applicable specifications for a period of one year from date of shipment, provided they are used under normal operating conditions. This warranty does not apply to vacuum tubes that have given normal service, to sealed assemblies which have been opened, or to any item which has been repaired or altered without our authorization.

We will repair or, at our option, replace at no charge any of our products which are found to be defective under the terms of this warranty. Except for such repair or replacement, we will not be liable for any incidental damages or for any consequential damages, as those terms are defined in Section 2-715 of the Uniform Commercial Code, in connection with products covered by this warranty.

**BOONTON
ELECTRONICS** ||||
CORPORATION

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Route 287, Parsippany, N. J. - 07054

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PARSIPPANY, N. J. — 07054