

INSTRUCTION MANUAL

Type RV35b
WIDEBAND MILLIVOLTMETER



RADIOMETER

ELECTRONIC MEASURING INSTRUMENTS
FOR SCIENTIFIC AND INDUSTRIAL USE

INSTRUCTION AND OPERATING MANUAL
FOR

Type RV35b
WIDEBAND MILLIVOLTMETER

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INTRODUCTION

The type RV35 Wideband Millivoltmeter is a sensitive, wideband vacuum-tube voltmeter with high measuring stability. It is therefore ideally suited as a general purpose voltmeter for laboratory use.

The RV35 has a sensitivity of 1 mV for full-scale deflection, and a frequency range from 10 cps to 6 Mc. Its meter is furnished with a mirror-backed scale, 140 mm large, and a knife-edge pointer which combine with fine scale graduation to give accurate reading.

The instrument has two voltage scales and a dB-scale. Its input terminal is provided with a UHF-connector for coaxial leads, and a grounding jack. The input impedance is $10\text{ M}\Omega - 15\text{ pF}$ on the volt ranges, and $10\text{ M}\Omega - 25\text{ pF}$ on the millivolt ranges, so that most measurements can be carried out with negligible loading of the measuring object.

The resistive component of the input impedance is kept positive in and beyond the specified frequency ranges, so that oscillations are avoided when measuring impedances with a positive real part.

The vtvm is furnished with an amplifier output. Used as an amplifier, the gain of the vtvm is 80 times in the 1 mV range. The output as well as the input is provided with a UHF-connector and a grounding jack.

The RV35 incorporates a regulated power supply which combines with a high degree of negative feedback in the meter circuitry (60 dB for the amplifier) to render the instrument insensitive to line voltage variations and tube aging.

The vtvm measures the average value of the applied voltage, but is calibrated in the rms value of a sinusoidal voltage.

SECTION 1 SPECIFICATIONS

VOLTAGE RANGES

1 mV to 300 volt full scale. 12 ranges.

First division at 10 microvolts.

Overload-protected against 500 volts.

METER SCALES

Two linear scales, 0 to 1 and 0 to 3, and a -10 to +2 dB-scale (indications for -15 and -20 dB).

The latter gives the voltage level referred to 1 milliwatt in 600 ohms, when the dB-reading of the range switch is added to that of the meter.

FREQUENCY RANGE

10 cps to 6 Mc.

Usable as an indicating meter up to 10 Mc.

ACCURACY

At nominal line voltage $\pm 10\%$:

2% of full scale from 20 cps to 3 Mc.

3% of full scale from 3 Mc to 5 Mc.

5% of full scale from 10 cps to 6 Mc.

INPUT IMPEDANCE

10 megohms shunted by a capacitance which is $15 \mu\text{F}$ on the ranges of 1 volt to 300 volts, and $25 \mu\text{F}$ on the ranges of 1 millivolt to 300 millivolts.

The resistive part decreases to typically 1 megohm at 1 Mc, and to typically $100 \text{ k}\Omega$ at 6 Mc.

CALIBRATION

Meter reads rms value of sinusoidal voltage, but responds to average value of applied voltage.

Two linear mirror-backed voltage scales 0 to 1 and 0 to 3. Scale length 140 mm (5 1/2").

One dB-scale -10 to +2 dB.

AMPLIFIER OUTPUT

Output voltage approx. 80 millivolts at full scale deflection on all ranges.

Output impedance approx. 75 ohms.

TERMINALS

Input and output have UHF sockets, type S0-239, which also accommodate ordinary 4 mm banana plugs.

POWER SUPPLY

Voltages: 110, 115, 127, 200, 220, and 240 volts.

Line Frequencies: 50 to 60 cps.

Consumption : 50 watts.

DIMENSIONS AND WEIGHT

HEIGHT	WIDTH	DEPTH	WEIGHT
260 mm	200 mm	320 mm	7.8 kilos
10 1/4 inches	8 inches	12 5/8 inches	17 lbs.

ACCESSORIES AVAILABLE

Balancing Transformers, type BAT

For plugging into voltmeter input socket:

BAT11: Frequency Range: 25 cps to 50 kc.

BAT12: Frequency Range: 10 kc to 500 kc.

100:1 Voltage Divider Probe, type VDP100

Makes possible measurements with negligible loading on object.

Input Impedance: 2 pF in parallel with 50 M Ω .

Voltage Range: 100 millivolts to 30 volts for full scale deflection on RV35. Max. d-c voltage: 300 volts d-c.

Frequency Range: d-c to 10 Mc.

Division Ratio: 100 to 1.

Accuracy: Better than 2%.

Low-Capacitance Cable Assys

Type	Termination	
	on one end	on other end
3B3	PL-259 UHF	PL-259 UHF
3B9	PL-259 UHF	Banana Plug
3B2	PL-259 UHF	Shielded 14 mm plug with grounding ring for banana plugs.

Length of cable: 1 meter (40").

Capacity: approx. 60 pF.

SECTION 2

GENERAL DESCRIPTION

- 2.1 The principle of the vacuum-tube voltmeter is illustrated by the block-diagram at the end of this manual. The vtvm consists of two cathode followers stages followed by an amplifier. The amplifier drives a rectifier which supplies current to the instrument. The rectifier forms part of the amplifier, as it has been inserted in the amplifier feedback loop.

When voltages above 1 mV are to be measured, the voltage dividers are inserted. A resistive-capacitive 60 dB divider which is located at the input will be activated when the range selector switch, RANGE, is in the volt ranges. The 10-dB steps between the individual ranges are accomplished by the voltage divider located between the cathode followers. This divider has 6 positions, each being utilized twice - first in the mV ranges, next in the volt ranges.

The amplifier is furnished with an output. Used as an amplifier, the vtvm has a gain of 80 times in the 1 mV range. The output resistance is approximately 75 ohms, so that the impedance transformation of the vtvm, used as an amplifier, is large.

The anode voltage of the vtvm is stabilized with a 3-tube regulator which effectively reduces the influence of line voltage variations. To avoid hum from the tube filaments, a d-c grid-voltage is fed to the first five tubes.

Printed circuit boards are utilized for the greater part of the vtvm circuitry to ensure a reliable and robust construction, and to reduce weight to a minimum.

SECTION 3

OPERATING INSTRUCTIONS

3.1 CONNECTING THE VTVM

Before the vtvm is connected to the power switch, make certain that the line voltage selecting switch, S201, is set to the appropriate line voltage. When leaving the factory, this switch is set to 220 volts.

The voltage selecting switch is located on the rear of the cabinet. Re-setting is possible when the centre screw is loosened.

Fuse for 200-220-240 volts is 0.5 amp. slow-blow; for 110-117-127 volts, 1 amp. slow-blow fuse is required.

The power cable, protruding from the rear of the cabinet, is provided with a third conductor, connected to chassis. This conductor is utilized, when a power-plug with a grounding terminal is used.

The vtvm is ready for use after about two minutes warm-up time.

3.2 CONTROLS, METER AND TERMINALS

(1) POWER SWITCH (OFF) and PILOT LAMP (POWER)

Power switch and pilot lamp are located on the right hand side of the panel.

Use bulb, type 6.3 V - 0.3 amp., for pilot lamp.

(2) RANGE

The RANGE-switch is used to select the desired voltage range. The vtvm has 12 voltage ranges in steps of 10 dB (from 1 mV f. s. to 300 V f. s.). The input capacity is stated on the front panel below the range designations. The input capacity is 25 pF in the millivolt ranges, and 15 pF in the volt ranges.

(3) The input is provided with a coaxial connector, UHF S0-239.

19 mm or 3/4 inch below the centre of the coaxial socket is placed an uninsulated 4 mm phone jack which is connected to the vtvm chassis. The input socket will consequently accommodate a coaxial UHF-plug as well as a single or double banana plug.

The input impedance is 10 M Ω in parallel with 15 pF in the volt

ranges, and 25 pF in the millivolt ranges.

Owing to the inevitable dielectric losses, the resistive component of the input impedance will drop at higher frequencies to approx. 1 M Ω at 1 Mc, and to approx. 100 k Ω at 6 Mc. The resistive component of the input impedance is kept positive - even at frequencies beyond the specified range. This prevents undesired oscillations, independent of which impedance with positive real part is connected to the vtvm.

Note: Input voltages in excess of 500 V a-c or d-c are liable to cause a break-down of the capacitors in the input circuit.

(4) METER

The meter is equipped with a mirror-backed scale and a knife-edge pointer, providing for accurate reading, free from parallax.

The two voltage scales are located immediately above and below the mirror. The top scale is graduated into 100 divisions, and is used in the ranges 1 - 10 - 100. The scale numbers range from 0.1 to 1 for direct reading in the 1 mV and 1 V ranges.

The lower scale is graduated into 60 divisions, and is used in the ranges 3 - 30 - 300. The scale numbers range from 0.5 to 3 for direct reading in the 3 mV and 3 V ranges.

The dB-scale is placed underneath the voltage scales and ranges from -10 dB to +2 dB with a division for every half dB. Furthermore, markings have been made for -15 dB and -20 dB. The reference-level of the dB-range is 0.775 volt, corresponding to 1 milliwatt in 600 ohms.

The zero adjustment is accessible through a hole in the front panel immediately above "RANGE". Zero adjustment is seldom required, but may be necessary after long usage or following transport. Before making this adjustment, the power switch must be thrown to "OFF", and the instrument be placed in its normal operating position.

(5) OUTPUT

The output socket (located on the rear of the instrument) is fur-

nished with a UHF S0 239 coaxial connector. 19 mm or 3/4 inch to the left of the connector is placed a 4 mm phone jack directly on the instrument chassis.

The output voltage is approx. 80 mV at full scale deflection. Therefore, the gain of the vtvm, used as an amplifier, is 80 times in the 1 mV range. A doubling of the output voltage is possible without overloading the amplifier.

The output impedance is approx. 75 Ω , so that the output voltage will be halved, if the output is subjected to a load of this value.

3.3 MEASUREMENT

- (1) Connect the power line to the appropriate line voltage (see item 3.1) and switch on the vtvm. Allow the instrument to warm up for two minutes.
- (2) Set RANGE switch to the desired measuring range. The range designation (on the front panel) indicates the maximum voltage measurable within the range selected.
- (3) Connect the measuring object to the INPUT socket.
- (4) The value of the voltage measured is then read on the appropriate voltage scale, viz. the scale in which the end-scale value is the first figure in the range-designation (1 or 3).

For instance, for a measured voltage of 250 mV, the 300 mV range and the lower volt scale are used. Readings can also be made in a higher voltage range, but with loss of accuracy.

3.4 USING THE dB-SCALE

The reference level of the dB-range is 0.775 volt, corresponding to 1 milliwatt in 600 ohms.

The dB-scale is valid in the 1-volt range without additions.

In the other ranges, the level is found by adding the scale reading to the dB-range indication (positive or negative sign being heeded).

For example, if the voltage measured is 9.75 millivolt, +2 dB will be read on the scale in the 10 mV range where the dB-range indication is

-40 dB. This gives: -38 dB.

If the 30 mV range is used, -8 dB will be read on the scale. Added to the dB-range indication (-30 dB), this gives -38 dB as above.

If a voltage other than 0.775 volt is required as reference, the dB-indication for this new reference voltage is simply deducted from the dB-indication for the voltage measured. If, for instance, 1 mV is chosen as reference voltage (unit: dB above 1 mV), -57,8 dB are deducted from the dB-indication for the voltage measured.

3.5 SOURCES OF ERROR

3.51 Erratic Readings Caused by Hum

When the vacuum-tube voltmeter is warmed up, the meter will indicate abt. 1% of full scale. In the presence of hum fields at the input, and with the vtvm set to mV ranges, a somewhat larger deflection will be observed, provided that the input is not short-circuited.

When measuring on high-ohmic circuits, hum may give rise to erratic measuring, as both load and input are high-ohmic. This deficiency will be eliminated if the measuring object is shielded, and a shielded input cable is used. The input cable's capacitive loading of the test object should then be taken into consideration.

When measuring at low voltage levels, hum currents may result in erratic readings if the vtvm is grounded. Smallest errors are obtained if the measuring setup is grounded only at the measuring object.

3.52 Measuring Signals Containing Harmonic Components

RV35 responds to the average value of the applied voltage, but is calibrated in the rms value of a sinusoidal voltage.

A signal that is not sinusoidal may give a reading which deviates from the rms value of the signal. In the table (see next page) is shown a comparison of rms values with the values read on RV35 when the measured voltage has a fundamental frequency component of 100, and a 2nd or 3rd harmonic component of 10, 20 or 50.

INPUT VOLTAGE % HARMONIC	TRUE RMS VALUE	RV35 INDICATION
0	100	100
10% 2' harmonic	100, 5	100
20% 2' harmonic	102	100-102
50% 2' harmonic	112	100-110
10% 3' harmonic	100, 5	96-104
20% 3' harmonic	102	94-108
50% 3' harmonic	112	90-116

3.6 RV35 USED AS AMPLIFIER

- (1) Connect power line to appropriate line voltage (see item 3.1), and turn on the vtvm. Allow the vtvm to warm up for about two minutes.
- (2) Interconnect OUTPUT-socket on rear of cabinet and the circuitry (equipment) to which the amplified signal is to be fed. Unloaded, the output voltage is approx. 80 mV at full meter deflection. As the output impedance is approx. 75 Ω , this voltage will drop to approx. 40 mV for a 75 Ω load.
- (3) Feed the signal to be amplified to INPUT.
- (4) Select desired amplification by means of RANGE-switch. Maximum gain is obtained in the 1 mV range (approx. 80 times), and will decrease 10 dB for each consecutive step of RANGE switch. The input signal must not exceed the double value of range designation.

In order to obtain optimal linearity and stability of meter reading, the meter circuit rectifier has been incorporated in the feedback loop. The frequency characteristic and nonlinearity of the rectifier circuit will therefore show up in the OUTPUT signal. Contact potential of the rectifier diodes and dc voltage across the meter will cause cross-over distortion. The frequency characteristic will result in an approx. 3 dB rise in amplitude at 10 cps, and approx. 1 dB at 6 Mc.

The meter reading above 2 Mc will to some extent depend on the load applied, when the numerical value of the load impedance is not much larger than 75 Ω . It must therefore be recommended to remove the load, if optimal measuring accuracy is desired.

SECTION 4 CIRCUIT DESCRIPTION

4.1 INPUT DIVIDER

Between the input socket and the 1st cathode follower, V101, is placed a resistive-capacitive divider, consisting of R2, R3 + R4 + R101, C3 and C4. The divider is used in the volt ranges and provides an attenuation of 60 dB.

The divider is adjusted to correct value by means of ADJ4 and ADJ5.

The input resistance at low frequencies is in the main determined by R2.

The input capacitance is the sum of the grid capacitance of V101 (10 pF), the capacitance of the input socket and divider, and the stray capacitances to chassis. When the cathode follower grid in the volt ranges is disconnected from the input, the input capacitances of the vtvm will be reduced by the 10 pF of said grid to 15 pF.

4.2 10 dB DIVIDER

The load on the 1st cathode follower (V101) is a divider (R7-R12) with 10 dB steps. In the 1 mV and 1 V ranges, the grid of the 2nd cathode follower V102 is connected to the cathode of V101. For each higher voltage range, this grid is moved downwards on the divider until the 300 mV or 300 V range is reached.

At higher frequencies, capacitive adjustment of the divider is made with ADJ6 and ADJ7. The divider is followed by the 2nd cathode follower which has a negligible loading effect on the divider.

4.3 AMPLIFIER, RECTIFIER, OUTPUT

The four pentode stages, V103 - V106, in combination with the meter circuit form a highly stable amplifier. The signal on the grid of the input stage (V103) is amplified and then rectified in the meter circuitry. The meter current is 0.5 mA for full scale deflection.

The negative feedback is 60 dB at medium frequencies. Towards higher and lower frequencies, the negative feedback is controlled by means of

corrective networks between the individual tubes and in the anode circuits.

The voltage present across R145, which is proportional to the current through the rectifier, is the signal fed back. The voltage is stepped down via R118 and R119 to R117 (in the cathode of the amplifier's input stage). Over the greater part of the frequency range, calibration is accomplished by means of R119 (ADJ2). At the highest frequencies, however, calibration is carried out by adjusting ADJ3, which compensates for such changes in the phase shift as are caused by the tolerance of diverse components.

Calibration at the lowest frequencies is made with ADJ1 and ADJ9.

Since the negative feedback voltage is obtained across R145 (in series with the meter circuit), the feedback will ensure a current through the rectifier proportional to the output voltage of the second stage. This coupling ensures a linear scale deflection, irrespective of the meter resistance and the resistivity of the diodes.

The meter rectifier is provided with extremely fast, low-capacitance, silicon diodes, which even at high temperatures have no influence on the meter reading.

The OUTPUT socket is connected to the cathode of the output tube (V106).

Regulated anode voltage is fed to all tubes in the measuring circuit, effectively to reduce hum and the effect of line voltage variations. Further to reduce the hum level, a d-c filament voltage is fed to the first five tubes.

4.4 POWER SUPPLY

The regulated power supply provides 250 volts for tube anodes and screen grids.

The regulator contains three tubes, V201-V203. V201 is a pentode and functions as a series regulator tube. The control grid in the series tube is connected to the anode of the cascode amplifier, which consists of two triodes (V202). The regulator reference voltage is obtained across V203, which is placed in the cathode of the cascode and isolated by an LP-filter.

The input grid of the cascode is connected to the output of the power sup-

ply via a divider. A change in the output voltage will be amplified in the cascode amplifier and then fed to the grid of the series tube. The resistance of the series tube will now vary to oppose the change. The potentiometer, ADJ8, is used to set the output voltage at the correct value, 250 V.

The rectifier, CR202, supplies the tubes V101 - 105 with a filament current whose hum component is reduced by the capacitor C205 - C206.

The filament current for the remaining tubes is an a-c current from the power transformer.

The primary windings of the power transformer are provided with outlets for 110 - 115 - 127 - 200 - 220 - 240 volts. By means of the line voltage selecting switch (which also serves as a fuse-holder), the power line is connected to the desired outlet.

SECTION 5 MAINTENANCE

5.1 GENERAL

The RV35 is designed to withstand rough treatment, but careful handling and proper operation assure a long life and high reliability.

Necessary repairs should be carried out only by skilled personnel provided with the proper equipment to ensure that the repairs are correctly made.

5.2 REMOVING THE CABINET

Withdraw power plug from power outlet before removing the cabinet.

The cabinet consists of three sections: a front panel plate, a one-piece back and bottom, and a cover (top and sides).

(1) The Cover

The cover is attached to the chassis by means of 4 screws on the top, and is fastened on either side by 4 buttons at the bottom. When the 4 top screws are removed, the cover can be lifted off the chassis.

(2) One-Piece Back and Bottom

The bottom plate is fastened with 4 screws, while the back plate is secured by means of 2 screws near the upper edge.

Place the instrument upside down on a protective padding and remove the six screws mentioned. The one-piece back and bottom can now be removed, if care is exercised to allow for the power cord to pass freely through the hole in the back plate.

(3) Front Panel

The built-in meter is mounted on the instrument chassis, but is spring-loaded so as to press against the panel plate.

The panel is fastened to the chassis with 6 screws. Before loosening these screws, however, the pointer-knob must be removed. This is accomplished by unscrewing the knob screw with a 2 mm hexagonal wrench (Umbraco wrench), and then pulling the knob outwards.

Place the instrument with the front panel upwards on a protective

padding, and first remove the two screws nearest the base. As the remaining four screws are loosened, the meter springs will press out the panel.

5.3 TUBE REPLACEMENT

Tubes should be replaced only when they are defective, since a tube replacement requires a subsequent adjustment (see item 5.4).

If attempts are made to locate a defective tube, only one tube at a time should be replaced. The tube should be returned to its former position if it does not prove to be the source of trouble. This procedure will simplify the subsequent adjustments.

5.31 V101 to V106

Replacing tubes in the measuring circuit may cause deviations in calibration and frequency characteristic (see item 5.43).

5.32 V201 to V203

Replacing these tubes may require adjustment of the power supply (see item 5.42).

5.4 ADJUSTMENTS

5.41 General

Adjustments should be carried out only when absolutely necessary, and then only by skilled personnel trained in using the required precision equipment.

5.42 The Regulated Power Supply

The output voltage as measured between chassis and pin No. 3 of V201 (marked "A" on the circuit diagram) is adjusted by means of the potentiometer, R203, ADJ8, to $250\text{ V} \pm 2\%$.

An indication of adequate regulation will be hum voltages between "A" and chassis not exceeding 0.2 mV, and variations in the d-c voltage between "A" and chassis not exceeding 0.3 V for a 10% variation in line voltage with new tubes.

5.43 Amplifier

Whenever one of the tubes in the measuring circuit is replaced,

it may be necessary to recalibrate the vacuum-tube voltmeter and adjust the frequency characteristic in the 1 mV range.

5.431 Calibrating (1 kc)

For this purpose use a generator capable of supplying 1 mV at 1000 cps (400 cps) with an accuracy better than 0.2%.

If the output voltage of the generator is not measured with an average value measuring instrument, the generator distortion must be taken into account. (See item 3.52).

- (1) Let the vtvm be switched on for 15 minutes after the cover has been removed.
- (2) Connect the generator to the vtvm input, using a shielded cable to avoid hum.
- (3) Set RANGE switch to the 1 mV range. With 1 mV - 1000 cps (400 cps) fed to input, adjust ADJ2 to obtain full deflection on meter.

ADJ2 is located on the right hand side of the vtvm, and is accessible through the hole second from the bottom in the amplifier shield.

5.432 Frequency Characteristic (HF)

To adjust the HF frequency characteristic, use a generator capable of generating approx. 1 mV with an accuracy better than 0.2% from 1 kc to 3 Mc, and better than 0.3% up to 5 Mc, as measured with an average value measuring instrument.

- (1) Let the instrument be switched on for 15 minutes after the cover has been removed.
- (2) Connect the generator to the vtvm input by means of a terminated cable.
- (3) Set RANGE switch to the 1 mV range and apply approx. 0.9 mV, 1 kc. Take down reading.
- (4) Change frequency of input signal to 5 Mc (amplitude as before), and adjust ADJ3 to reading at 1 kc (bottom hole in amplifier shielding).

- (5) Switch to 2 Mc and measure the deviation as compared with 1 kc (0.9 mV). A deviation larger than 0.4% will require a change of the value of C121 (C121 to be increased for positive deviations, decreased for negative deviations).

If the value of the capacitor is changed, steps (4) and (5) must be repeated.

5.433 Frequency Characteristic (LF)

To adjust the LF frequency characteristic, use a generator capable of generating approx. 1 mV with an accuracy better than 0.5% from 10 cps to 1 kc (measured on an average value measuring instrument).

- (1) Leave the vtvm turned on 15 minutes after the cover has been removed.
- (2) Connect the generator to the vtvm input, using a shielded cable.
- (3) Set RANGE switch to the 1 mV range and apply approx. 0.9 mV, 1 kc. Take down reading.
- (4) Change frequency to 30 cps and adjust ADJ9 (top hole in amplifier shielding) to reference level at 1 kc. (if the actual vtvm does not have ADJ9, resistor R122 should be changed).
- (5) Switch frequency to 10 cps and adjust ADJ1 (the hole in amplifier shielding nearest to the front panel) until reading is 1% below the reference level at 1 kc.
- (6) Switch to 15 cps and measure deviation as compared with 1 kc. If the error exceeds 1%, split the error between 10 and 15 cps readings.
- (7) Shift to 30 cps and reset reading with ADJ9, to reference level at 1 kc, if required.

In case a correction has been necessary, steps 5-6-7 must be repeated.

5.44 Input Divider (60 dB)

5.441 Adjusting Input Divider (1 kc - 10 kc)

For this purpose, use a generator with a negligible frequency response error from 1 kc to 10 kc, and a precision divider (60 dB), providing attenuation from 1 V to 1 mV.

- (1) Leave the vtvm turned on 5 minutes after the cover has been removed.
- (2) Connect the generator to the vtvm input via the attenuator giving 60 dB attenuation.
- (3) Set RANGE switch to the 1 mV range, and adjust reading to approx. 0.9 mV at 1 kc. Take down reading.
- (4) Switch RANGE to 1 V range, and increase the signal by 60 dB, using the attenuator. Take down reading. Change to 10 kc, and take down reading again.
- (5) Commence by adjusting at frequency where error is most pronounced, and then adjust at other frequency. Repeat adjustments at 1 kc and 10 kc, until the readings match at either frequency.

The error at 10 kc is corrected with ADJ5 (located on right side near front panel), whereas the error at 1 kc is corrected with ADJ4.

5.442 HF Control of Input Divider

Use same generator as for 5.432, in this instance, however, with an output voltage of 1 volt across the resistor terminating the cable.

- (1) Connect the generator to the vtvm input by means of a terminated cable.
- (2) Measure deviation at 5 Mc as compared with 100 kc. If the deviation exceeds 0.5%, the value of R6 must be changed.

If the deviation is positive, the value of R6 must be reduced.

It must be recommended to recheck 5.441, if R6 has been changed.

5.45 10 dB Divider

Using a generator of the type required for 5.432 - in this instance, however, capable of generating voltages between 1 mV and 300 mV - the frequency characteristic at the highest frequencies can be adjusted with ADJ6 and ADJ7.

- (1) Leave the vtvm turned on for 15 minutes after the cover has been removed.
- (2) Place the instrument in its usual operating position with the trimming holes at the front end of the bottom plate accessible to an insulated trimming tool.
- (3) Set RANGE switch to 3 mV range, and set input voltage to give nearly full scale deflection at 100 kc. Take down reading.
- (4) Apply a 4 Mc voltage of equal amplitude to input of vtvm.
- (5) Adjust ADJ7 through front trimming hole in bottom plate to reading obtained at 100 kc.
- (6) The frequency characteristic in the 10 mV range is next adjusted in the same way by means of ADJ6 through rear trimming hole in bottom plate. However, the frequencies of the voltage applied have to be 100 kc and 5 Mc.

Note: Some ways and means of adjusting the vacuum-tube voltmeter have been broadly outlined in the section above. The rigorous demands set up for the measuring equipment as well as the tolerances stipulated for the various adjustments are motivated by a wish to provide a simple and sufficient adjusting procedure. The tolerances should not be interpreted as warranty data.

SECTION 6 ACCESSORIES

6.1 BALANCING TRANSFORMERS, TYPE BAT

The type BAT 1:1 transformers change the one-side grounded input of an instrument to a balanced input.

Two models are available:

Type BAT11 is an audio-frequency type for use from 25 cps to 50 kc.

Type BAT12 is a carrier-frequency type for use from 10 kc to 500 kc.

The Balancing Transformers are designed with special attention to the frequency response, the electrostatic shielding, and the input impedance. The input terminals accommodate ordinary 4 mm banana plugs.

6.11 SPECIFICATIONS - TYPE BAT11

VOLTAGE RATIO

1 to 1

FREQUENCY RESPONSE

25 cps to 50 kc within ± 0.5 dB.

INPUT IMPEDANCE

Higher than 10 kilohms throughout the frequency range, provided that the secondary load is less than $20 \mu\text{F}$.

SHIELDING

The mutual capacitance between the windings is less than $1 \mu\text{F}$.

SYMMETRY

Common-mode signal rejection:

90 dB at 500 cps

70 dB at 5 kc

45 dB at 50 kc

MAGNETIC PICK-UP

When the primary is connected to a source with 300 ohms impedance - a typical case - the magnetic pick-up is negligible.

When the transformer is used with RV35, the magnetic pick-up of the line frequency is generally small enough to be neglected

INSULATION

The d-c leakage between the primary and the shield is less than 5×10^{-10} mhos. The working voltage is 250 volts d-c, and the test voltage is 1000 volts d-c.

SIGNAL VOLTAGE

The input voltage should not exceed 100 volts at frequencies above 250 cps and 0.4 volt per cps below 250 cps.

DISTORTION

With a 5 volt input and a 300 ohms primary source impedance, the distortion is:

less than 0.2% 2nd and 0.2% 3rd harmonic above 100 cps.
abt. 0.6% 2nd and 1% 3rd harmonic at 30 cps.

WEIGHT

500 grams net (1 lb. 2 oz.).

6.12 SPECIFICATIONS - TYPE BAT12

VOLTAGE RATIO

1 to 1.

FREQUENCY RESPONSE

10 kc to 500 kc within ± 0.5 dB.

INPUT IMPEDANCE

Higher than 3 kilohms throughout the frequency range, provided that the secondary load is less than $20 \mu\text{F}$.

SHIELDING

The mutual capacitance between the windings is less than $1 \mu\text{F}$.

SYMMETRY

Common-mode signal rejection:

65 dB at 50 kc
60 dB at 100 kc
50 dB at 500 kc

MAGNETIC PICK-UP

When the primary is connected to a source with 300 ohms impedance - a typical case - the magnetic pick-up is negligible.

When the transformer is used with RV35, the magnetic pick-up of the line frequency is generally small enough to be neglected.

INSULATION

The d-c leakage between the primary and the shield is less than 5×10^{-10} mhos. The working voltage is 250 volts d-c, and the test voltage is 1000 volts d-c.

SIGNAL VOLTAGE

The input voltage should not exceed 100 volts.

WEIGHT

225 grams net (8 oz.).

6.2 100:1 VOLTAGE DIVIDER PROBE, TYPE VDP100

The voltage divider probe, type VDP100, is to be used when minimum loading on the object to be measured is desired.

The probe, which is HF-compensated by means of a variable capacitor, maintains the division ratio from d-c to 10 Mc. within $\pm 2\%$.

The HF-compensation can be adjusted in the following way:

- (1) Connect the vtvm input directly to the output of a generator with an output impedance less than 1 k Ω . At a frequency of 100 kc, set the generator output signal for 1 volt reading on the vtvm.
- (2) Connect the vtvm to the generator via the voltage divider probe, and adjust the variable capacitor (through the hole in the probe body) for 10 mV reading on the vtvm.

Note: When the range switch of the vtvm is set in the volt-ranges, the input capacity of the vtvm is 10 pF less than when the switch is set in the millivolt-ranges. Consequently, when the range-switch is set in the volt-ranges, the division ratio is less than 100 (about 90) at frequencies above 10 kc.

6.21 SPECIFICATIONS

DIVISION RATIO

100 to 1.

FREQUENCY RANGE

d-c to 10 Mc.

ACCURACY

Better than 2%.

INPUT IMPEDANCE

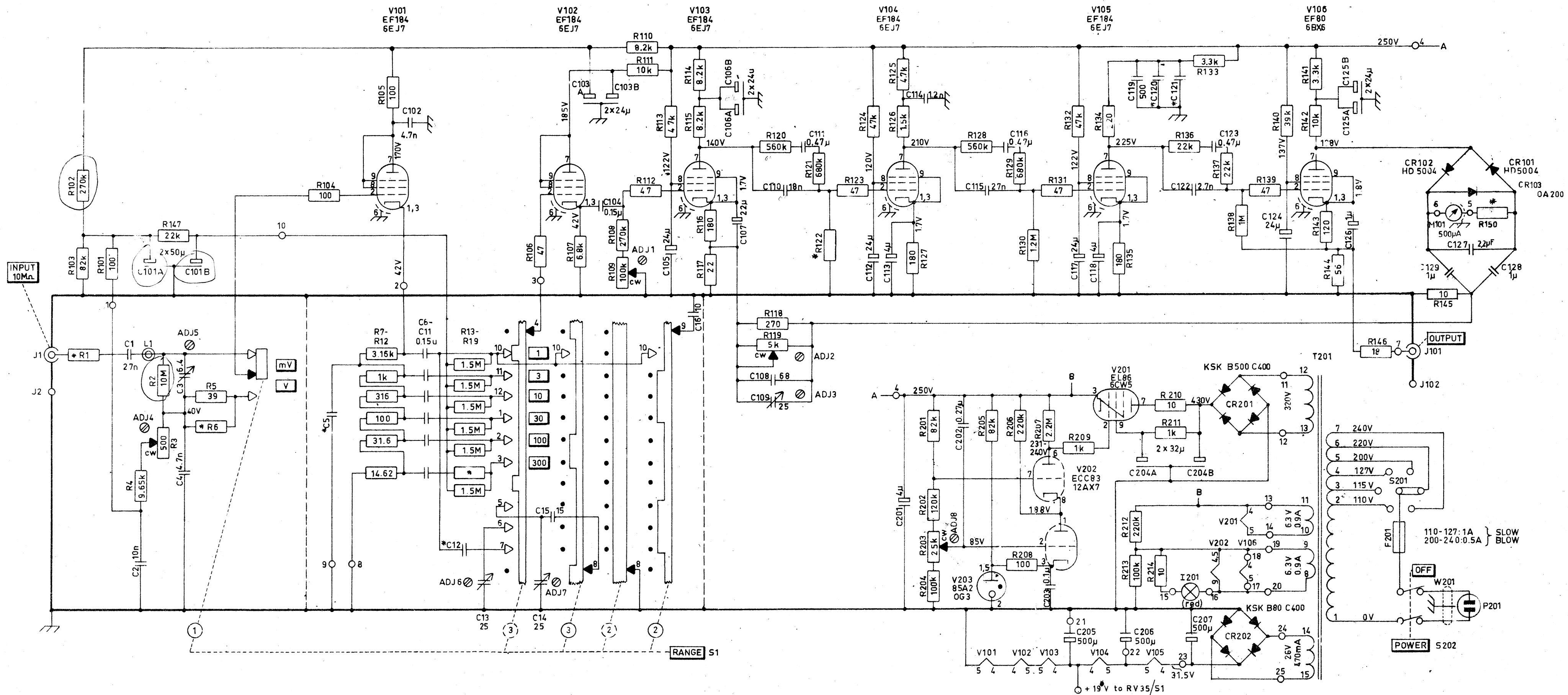
50 M Ω in parallel with 2 pF.

VOLTAGE RANGE

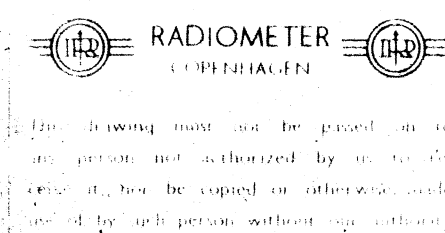
100 millivolts to 30 volts for full scale deflection on RV35.

Max. d-c voltage: 300 volts.

LENGTH OF CABLE: 1 meter (40").



cw: CLOCKWISE POSITION
 *: FINAL VALUES FACTORY ADJUSTED
 VALUES IN Ω OR pF IF NOT OTHERWISE SPECIFIED
 ALL d-c POTENTIAL MEASURED WITH RESPECT TO CHASSIS. VTVM INPUT RESISTANCE >60M
 ○-PRINT TERMINAL.
 12



RADIOMETER COPENHAGEN				Malestok	Tegn.	EA	26/2-64
72 EMDRUPVEJ NV				~	Kont.	Ha	28/2-64
WIDEBAND MILLIVOLTMETER				Erstatter			
TYPE RV35b				1065-A1			
From no. 86392 to no.				Erstatter af			