RADIOMETER

Type RV34

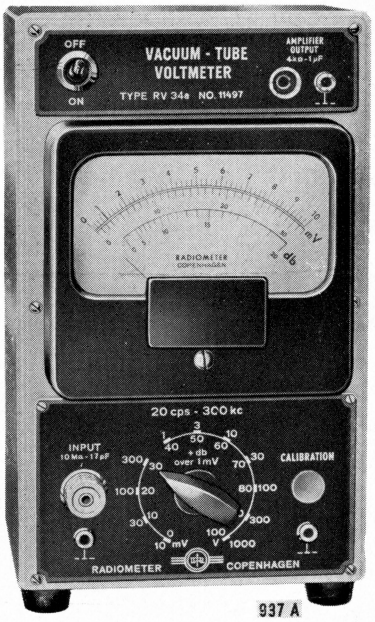
VACUUM-TUBE VOLTMETER

Electrical

measuring instruments for
industrial and scientific work

Type RV34

VACUUM-TUBE VOLTMETER



Vacuum-Tube Voltmeter type RV34

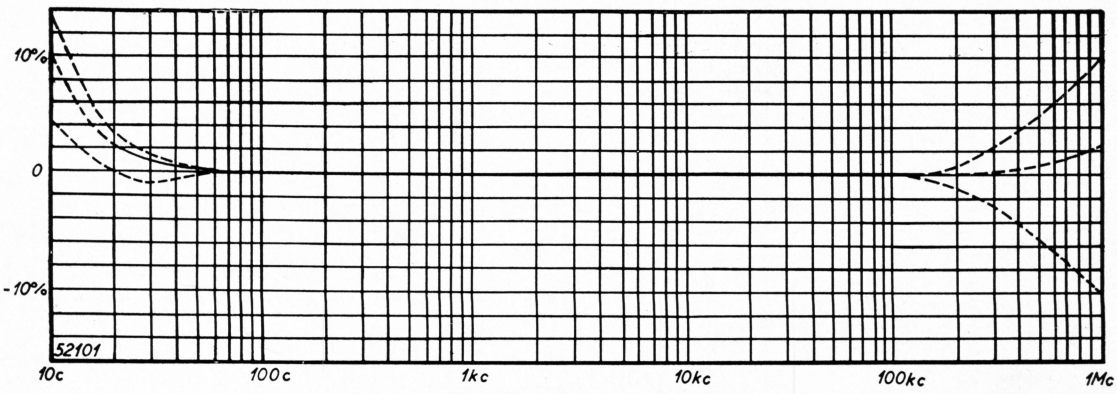
20 cycles - 300 kc

Introduction:

This Vacuum-Tube Voltmeter features a very high input impedance, good sensitivity, a relatively wide frequency range, and small size. It is suitable for measurements on the acoustic range, on the supersonic, and on the lower carrier frequency ranges. Its high input impedance makes possible measurements on sources with a high internal resistance.

Description:

The Vacuum-Tube Voltmeter consists of a cathode-follower input stage followed by a voltage divider, a 2-stage amplifier stabilized with negative feedback, a rectifier meter, and a power supply. The instrument has 11 measuring ranges with full scale deflection for 10 mV on the most sensitive range and for 1000 volts on the highest range. (Should not be used at more than 1000 V peak or 700 V r-m-s). The sensitivity is changed in steps of 10 db by means of a voltage divider across the cathode resistor of the cathode follower. Voltages over 1 volt are fed to the grid of the cathode follower via a 40 db input-voltage divider. The input impedance is almost independent of the range setting.
Due to the negative feedback the amplifier calibration will remain almost unaffected by line



Typical frequency response of type RV34. The upper and lower curves indicate the limits of the response of the individual instruments.

voltage variations. The meter is fed from a full-wave rectifier bridge circuit (Graetz coupling) and indicates the mean value of the input voltage, but its scale is calibrated in r-m-s volts of a sine wave. After replacement of tubes it is possible to calibrate to an exactly known voltage by means of a potentiometer which is accessible after removal of a plug button on the front panel. The dial has two linear volt scales (0-10 and 0-30) and a common db scale. The instrument is effectively protected against overload through the clipper effect of the amplifier tubes.

The Vacuum-Tube Voltmeter can be used as an amplifier with a gain of about 60 db. Its wide frequency range, high output voltage, and low distortion makes it suitable for many purposes, e. g. as a detector amplifier in bridge measurements.

A supporting device mounted on the back of the cabinet makes it possible to use the instrument in a tilted position.

The input jack is of the coaxial type intended for a shielded cable with plug, but it takes a normal 4 mm banana plug as well. In order not to load the source under measurement with an extra capacity it is recommended to use short unshielded leads whenever possible. No shielded cable is supplied with the Vacuum-Tube Voltmeter, but the cables specified under extra accessories can be supplied.

SPECIFICATIONS:

Measuring ranges:
10-30-100-300 mV and 1-3-10-30-100-300-1000 V full-scale deflection (700 volts being the highest allowable voltage). The meter has 2 linear volt scales and a common db scale. The sum of the readings of the db scales of the meter and the range switch gives the voltage in db over 1 mV.

Frequency range:
The frequency response of the amplifier is linear within 1 % from 50 to 100,000 cycles, and within 3 % from 20 cycles to 300,000 cycles. The Vacuum-Tube Voltmeter can be used on the frequency range 10 cycles to 1 megacycle.

Accuracy at 1000 cycles:
2 % of full-scale deflection.

Input impedance:
10 megohms shunted by 17 pF on the 10 mV to 1 V ranges, and 10 megohms shunted by 14 pF on all other ranges.

Effect of line voltage variations:
A line voltage variation of 10 % will cause a change in indication of only 1.5 %.

Amplifier:
Maximum amplification: about 60 db. Variable in steps of 10 db.

Frequency response when amplifier unloaded:
Within 1 db from 20 c/s to 80 kc/s.

Distortion factor:
About 1 % at 20 V output; about 3 % at 40 V output.

Input impedance:
10 megohms shunted by 17 pF on the 10 mV to 1 V ranges, and 10 megohms shunted by 14 pF on all other ranges.

Output impedance: About 4 kilohms.

Power supply:
110-127-150-200-220-240 V, a-c.

Consumption: 13 watts.

Dimensions: Height: 235 mm
Width: 142 mm Depth: 95 mm.

Weight: 3.1 kilos.

Extra Accessories:
Type C3 B3 shielded cable. 1 m long and terminated with 2 plugs, both fitting the front panel jack. Total capacity about 40 pF. Type C3 B9 shielded cable. 1 m long and terminated with 1 plug fitting the front panel jack, and 1 banana plug. Total capacity about 40 pF. Type AD1 adapter which provides for connecting the shielded cable type C1 B2 to the input jack of the vacuum-tube voltmeter. The type C1 B2 shielded cable is provided with Radiometer Standard 14 mm concentric plugs, used with numerous other Radiometer instruments. It is 1 m long and has a total capacity of about 45 pF.

Data subject to change without notice.

DYVAD TIPPESENS BOGTRYKKERI A/S
KGL. HOFLEVERANDØR KØBENHAVN K
9-52-1000

I N D E X

Type RV34 VACUUM-TUBE VOLTMETER

(1) General Description

This vacuum-tube voltmeter is designed to measure a-c voltages in the sonic and the supersonic range.

The instrument has 11 voltage ranges with full-scale deflection for 10, 30, 100, and 300 millivolts and 1, 3, 10, 30, 100, 300, and 1000 volts. An additional db scale indicates the voltage level in db over 1 millivolt. The instrument covers 20 c/s to 300 kc/s on all measuring ranges. The input impedance is 10 megohms on all ranges in parallel with about 17 pF on the ranges 10 mV to 3 V, and about 14 pF on the ranges 3 V to 1000 V.

The instrument can be used as an amplifier with a gain of approximately 60 db on the 10 millivolt range.

The voltmeter is fed from a 50-60 c/s line. The instrument is substantially insensitive to line voltage variations.

(2) Operating Principle

The instrument consists of a cathode-follower input stage, a two-stage amplifier with negative feedback, and a full-wave crystal-diode rectifier meter. The measuring ranges are set by means of two ganged attenuators, one mounted between the cathode follower and the amplifier and the other mounted before the cathode follower. The amplifier employs negative feedback and is therefore almost independent of line voltage variations and tube aging. The rectifiers and the meter are automatically disconnected when the instrument is used as an amplifier.

(3) Setting the Line Voltage

When leaving the factory the instrument is set to 220 volt line voltage, but operation at the voltages 110, 127, 150, 200, and 240 volts is also possible. The setting is made by moving a strap on the line transformer.

Note: Do not forget to set the voltage indicator at the back of the instrument to the voltage chosen.

(4) Operating the Vacuum-Tube Voltmeter

The instrument is ready for use after a warm-up period of about one minute. It is only possible to measure on sources one terminal of which is connected to chassis. A superimposed d-c voltage of 300 volts can be allowed for.

(5) Measuring Ranges

The vacuum-tube voltmeter has 11 ranges with full deflection for: 10, 30, 100, and 300 millivolts and 1, 3, 10, 30, 100, 300, and 1000 volts. The frequency range is 20 cps to 300 kc, or with restricted accuracy 5 cps to about 1 Mc. The max. allowable input voltage is 600 V rms.

(6) Accuracy and Frequency Response

The accuracy at 1 kc is 2% of full-scale deflection and about the same accuracy can be obtained within the frequency range 50 c/s to 100 kc/s, because the response of the amplifier is straight on this range. On the range 20 c/s to 50 c/s the response of the amplifier shows a maximum rise of about 1% at 30 c/s, and about 2% at 20 c/s. The response at low frequencies is not affected by the setting of the range switch. At frequencies higher than 100 kc/s the response is generally between +2% and -2% up to 300 kc/s (see the appended diagram with typical response curves).

(7) Input Impedance

The input impedance depends on the position of the switch. In the positions "10", "30", "100", "300" millivolts and "1" Volt the input voltage is fed direct to the grid of the cathode-follower, and an input impedance of 10 megohms in parallel with about 17 pF is obtained at low frequencies. The resistive component of the input impedance is dependent on the frequency. At 50 kc/s it is about 7 MΩ, and at 300 kc/s it is about 4 MΩ.

In the positions 3 volts to 1000 volts a 40 db attenuator is inserted before the cathode follower. The input impedance is about 14 pF in parallel with 10 MΩ at frequencies up to 50 kc. At 100 kc/s the resistive component is about 6 MΩ, and at 300 kc/s it is about 4 MΩ.

(8) Resistance to overload

The circuits are so designed that neither the rectitifiers nor the meter can be damaged by overload. The input voltage should not exceed about ten times the voltage that gives full-scale deflection during a long period, so as not to damage the cathode-follower, and it should not exceed 600 volts so as not to cause a break-down of the input switch.

(9) Influence of waveform

The indication of the meter is proportional to the average value of the a-c voltage, but the calibration is made so that the meter reads the rms value of a sinusoidal voltage. The deflection practically only depends on the fundamental wave, and the influence of harmonics or other (weaker) frequencies is negligible.

(10) Influence of Line Voltage

In general ±10% change in line voltage causes only about ±1.5% change in reading. If the influence of line voltage variations is much greater one or both tubes are probably worn out.

(11) Calibrating the Vacuum-Tube Voltmeter

The stability of the voltmeter is so good that in general no calibration is required, except after tube replacement or when compensating for heavy wear of tubes. The calibration is made by measuring an exactly known voltage of e.g. 10 millivolts at 1 kc/s. The meter needle is set to the correct deflection by turning the slotted potentiometer shaft which is accessible through a hole covered by a plug button on the front panel.

(12) Hum Voltages

With short circuited input terminal a minute deflection is observed with the switch in the "10 mV" position. The deflection is caused by hum voltages and does not affect the reading, provided that the voltage to be measured is 2 or 3 times greater. At frequencies close to the line frequency the hum voltages may cause slight oscillations of the meter needle when measuring at low levels. The true reading is the average of the highest and lowest deflection.

When measuring at the line frequency two different deflections are had if the line plug is reversed. Also in this case the correct value will be the average of the two readings. The hum voltage referred to the input is generally less than 100 microvolts. It is set to a minimum by means of a potentiometer across the filament winding of the transformer. The potentiometer shaft has a slot for screw-driver adjustment and is accessible when the plug button at the back of the voltmeter has been removed.

(13) Using the Vacuum-Tube Voltmeter as an amplifier

When using the instrument as an amplifier the gain is about 60 db in the "10 mV" position, 50 db in the "30 mV" position, etc. When a banana plug is inserted in the output jack, the rectifiers and the meter are automatically disconnected. The output impedance is 4 kΩ in series with 1 µF. The frequency response depends on the load. The amplification is about 1 db down at 15 cps and 80 kc/s with unloaded amplifier. The maximum output voltage is about 50 volts. At 20 volt output, unloaded, the distortion is about 0.5%, and at 40 volts it is about 2%. At higher output voltages the distortion increases rapidly.

(14) Servicing the Vacuum-Tube Voltmeter

The frequency response is dependent on the wiring and the location of components in the amplifier and the attenuator. The wire-wound resistors of the attenuator are of a non-inductive type and should not be replaced by resistors of another type.

The attenuator mounted before the cathode follower consists of a 10 MΩ resistor in series with 102.2 kΩ. A trimmer is placed in parallel with the 10 MΩ resistor. It will probably never be necessary to adjust this trimmer (unless the frequency response on the ranges 3-1000 volts is not straight at frequencies beyond 1 kc/s).

After replacement of a tube the sensitivity and the hum level must be checked.

Tube No. 1 is a type ECC81 or 12AT7 and some specimens will cause too much hum even after setting the hum compensating

potentiometer to its optimal position. The potentiometer is accessible through a hole at the back of the instrument. The hole is covered with a plug button. Tube No. 2 is a type EF80 or 6BX6.

If the instrument does not operate at all the fault may be due to a defective fuse. A 1-amp fuse is mounted at the line transformer in order to protect the transformer in case the instrument is connected to a d-c power line by mistake.

(15) Accessories

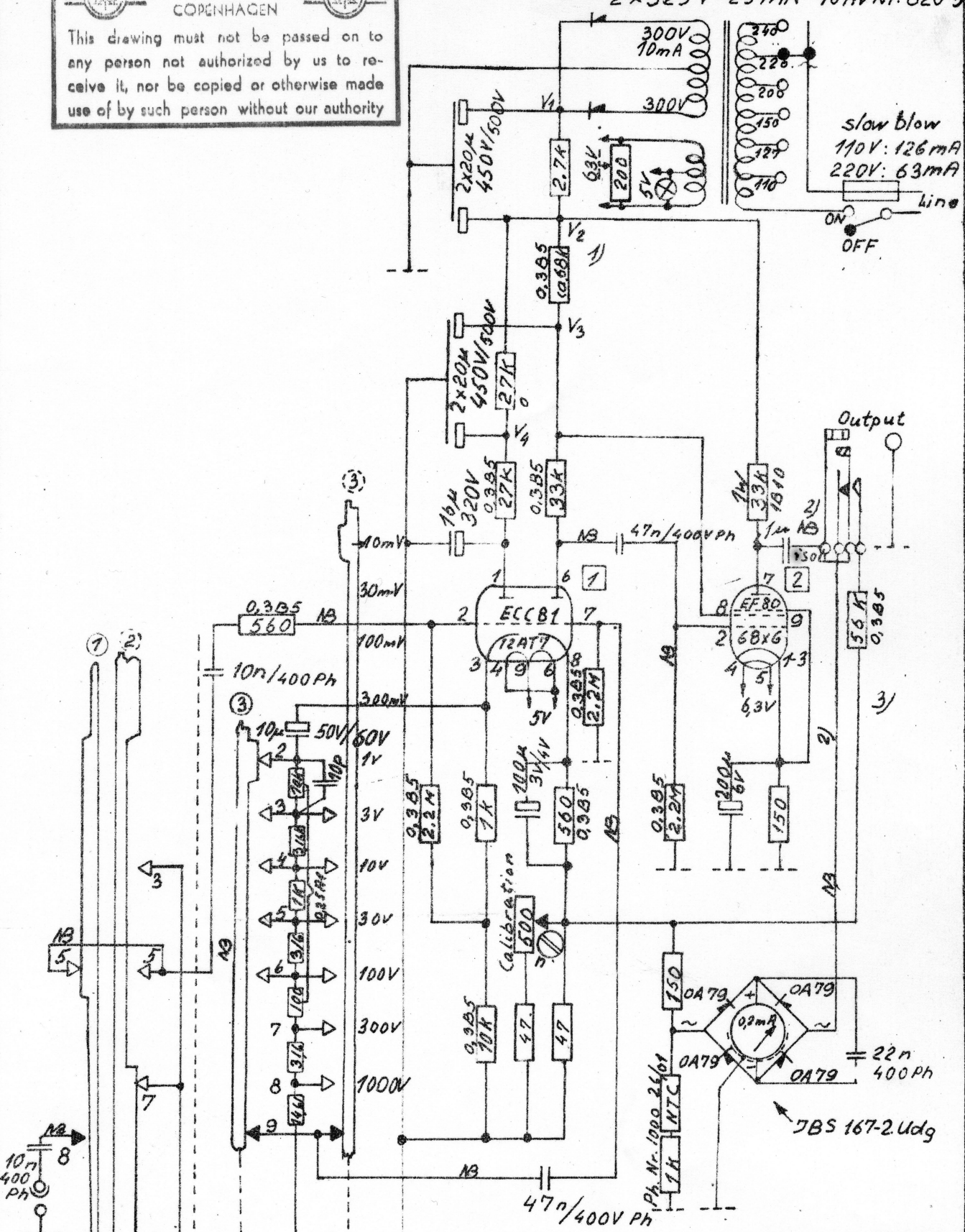
In order not to load the source under measurement with extra capacity it is recommended to use short unshielded leads. If shielding is required the follwing cables can be supplied as extra accessories:

1) A 1 m long shielded cable with 2 plugs that fit the front panel jack. The total capacity of the cable with plugs is about 40 pF.

2) A 1 m long shielded cable with one plug which fits the front panel jack and with one banana plug. Total capacity about 40 pF.

3) A 1 m long shielded cable with two 14 mm concentric plugs and a 14 mm adapter that fits the input jack. The adapter can be supplied separately.

Ventil:
DVI S10M28e plus
2×325V-25mA 16HVNr. 820-5



RADIOMETER
KØBENHAVN

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Vacuum Tube Voltmeter
TYPE: RV34a
DIAGRAM. From no. to no.

Erstatter:
769-A4
Erstatt. af: