ROHDE & SCHWARZ

MULTIMETER VOLTAN

Type UVV BN 120001

Übersetzung von
nach R 21420

Instruction Book

MULTIMETER VOLTAN

Type UVV

BN 120001

Zusammengestellt
nach R 23230

Printed in West Germany

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Drawings and Diagrams

1. Characteristics

1.1 Uses

The VOLTAN is a fully transistorized multimeter for use in modern electronic test assemblies. Type UVV is employed to advantage as a

high-impedance, high-sensitivity multimeter for the measurement of the operating voltages and currents encountered in modern electronic equipment as well as for AC measurements at frequencies up to 100 kHz;

utility multimeter in test and development laboratories;

utility service multimeter in the field;

ohmmeter with 1.3 V test voltage, for example, for semiconductor function tests.

A high-voltage probe is available to extend the DC voltage range up to 30 kV. Another DC probe facilitates the measurement at points that carry RF voltage superimposed on the DC voltage and do not allow the AC conditions to be changed by the measurement (e.g. oscillator circuits).

The URV probe with adapter permits measurements to be made up to 300 MHz. The UVV is then used as an RF tuning indicator, for example, or signal tracer. A correction curve permits the applied RF voltage to be determined to an accuracy of about 20%.

1.2 Description

The high input impedance (10 MΩ and 100 MΩ) achieved by the use of an operational amplifier incorporating field-effect transistors, the high voltage sensitivity, the low voltage drop on the current ranges, and the almost complete freedom from earthing effects ensured by the double-screening system (the instrument is completely floating when solely powered from batteries) make the UVV particularly suitable for measurements on semiconductor circuits.

Another convenience to the operator - made possible by the use of a linearized rectifier on the DC as well as on the AC ranges - is the orthopolar pointer deflection; which allows the instrument to be operated with one hand when a variety of semiconductor voltages of different polarity have to be measured. A special indicator on the meter scale shows the polarity and the type of voltage or current (AC or DC) being measured.

The voltage input is fully overload-protected by means of protection diodes. If any of the AC (~) ranges is selected, then a DC blocking capacitor is switched into circuit, whilst on the ± DC ranges an AC-rejection filter is automatically introduced. In the AC/DC (≃) mode, direct and alternating voltage as well as current measurements can be carried out without the need for operating an AC/DC switch; in this mode of operation the response of the UVV extends right down to DC.

The Multimeter is fed from the built-in 12-V Ni Cd storage battery or, via the cable supplied with the unit, from the AC supply. In the latter case, the 12-V storage battery and the 1.3-V battery used for resistance measurement are charged simultaneously (floating operation). In the CHARGE position of the function selector the meter indicates the battery voltage. The fully charged battery provides about 40 operating hours.

Note: The designations DC and AC refer to the type of current and always embrace current and voltage measurements.

1.3 Specifications

AC voltage measurement

Range	3 mV to 3 V f.s.d., up to 1000 V via test input x 10
Subranges	3/10/30/100/300 mV/1/3/10/30/ 100/300 V

Frequency range (2% limit)

mode ⎓	0 to 100 kHz 0 to 15 kHz in the 3-mV range 0 to 50 kHz in the 10-mV and 300-V ranges+)
mode ~	10 Hz to 100 kHz 10 Hz to 15 kHz in the 3-mV range 10 Hz to 50 kHz in the 10-mV and 300-V ranges+)

Error limits
in the temperature range

+10 to +30°C	±1.5% of reading plus 0.5% of f.s.d.
0 to +40°C	±1.5% of reading plus 1% of f.s.d.
-10 to +50°C	±1.5% of reading plus 1.5% of f.s.d.
3-mV range	1% of f.s.d. in addition
Input impedance	10 MΩ shunted by 30 pF
Range 10 mV to 100 mV	10 MΩ shunted by 40 pF
3-mV range	9.5 MΩ shunted by 50 pF
x 10 input for the ranges 300 mV to 300 V ...	100 MΩ shunted by 8 pF } max. 1000 V_{rms}
additional error	
0 to 100 Hz	±2% of reading
100 Hz to 3 kHz	0 to -5% of reading
3 kHz to 100 kHz	0 to +2% of reading
Type of rectification ..... (also for AC current measurement)	quasi-rms rectification, Bouke rectifier up to crest factor 2
Input	4-mm telephone jacks

+) < 10% up to 300 V/100 kHz

AC current measurement

Range	3 mA+) to 1000 mA f.s.d.
Subranges	3/30/300 nA/3/30/300 µA/3/10/30/100/300/1000 mA
Frequency range (2% limit) (irrespective of input capacitance)	0 to 100 kHz≃, 10 Hz to 100 kHz~, ≤ 50 kHz for the ranges 100 to 1000 mA ++)
Input capacitance	40 pF

Error limits
in the temperature range

+10 to +30°C	±1.5% of reading plus 0.5% of f.s.d.
0 to +40°C	±1.5% of reading plus 1.0% of f.s.d.
-10 to +50°C	±1.5% of reading plus 1.5% of f.s.d.
Voltage drop at f.s.d.	31.6 mV 100 mV in the ranges 300 and 1000 mA
Input	4-mm telephone jacks

DC voltage measurement

Range	3 mV to 300 V f.s.d. up to 1000 V via test input x 10, up to 30 kV with 30-kV DC probe
Subranges	3/10/30/100/300 mV/1/3/10/30/100/300 V

Error limits
in the temperature range

+10 to +30°C	±1% of reading plus 0.5% of f.s.d.
0 to +40°C	±1% of reading plus 1% of f.s.d.
-10 to +50°C	±1% of reading plus 1.5% of f.s.d.
3-mV range	3% of f.s.d. in addition

Input resistance

Range 10 mV to 1 V	10 MΩ ±1%
Range 3 mV	approx. 9.5 MΩ

x 10 input

Additional error for the ranges 10 mV to 300 V	±2% of reading; max. 1000 V
Input	4-mm telephone jacks

+) 0.3 nA in the 3-mV range

++) < 10% at 100 kHz

UVV 30-kV DC Probe

Attenuation	100 : 1
Input resistance	1000 MΩ
Error limits of measurement	±6%
Max. permissible test voltage	30 kV

DC current measurement

Range	3 nA+) to 1000 mA f.s.d.
Subranges	3/30/300 nA/3/30/300 µA/3/10/30/100/300/1000 mA

Error limits
in the temperature range

+10 to +30°C	±1.5% of reading plus 0.5% of f.s.d.
0 to +40°C	±1.5% of reading plus 1% of f.s.d.
-10 to +50°C	±1.5% of reading plus 1.5% of f.s.d.
Voltage drop at f.s.d.	31.6 mV 100 mV in the ranges 300 and 1000 mA

Resistance measurement

Range	100 Ω to 10 MΩ mid-scale position
Subranges	100 Ω/1/10/100 kΩ/1/10 MΩ
Scale range	0.1 to 10 x nominal value (mid-scale)

Error limits

0.3 to 3 x nominal value	±3%
0.1 to 10 x nominal value	±5%
Test voltage	1.3 V

General Data

Zero drift	< 100 µV/°C
Inputs	unbalanced, floating, capacitance to earth approx. 850 pF

Power supply

AC supply	110/220 V ±20%
Power consumption from AC supply	0.5 VA
Battery operation	Ni Cd storage battery, 12 V, 100 mAh

Operating time with battery

fully charged	40 hours

+) 0.3 nA in the 3-mV range

Charging time ..... 15 hours

Resistance measurement ..... power supply from second Ni Cd battery (1.5 V)

Both storage batteries are charged during AC supply operation (floating operation).

Overall dimensions (W x H x D) and weight ..... 200 x 150 x 50 mm; 2 kg

1.4 Accessories

1 power cable, 2 m, R&S Stock No. LKA 08025
1 probe tip G 1220
1 clip, insulated, R&S Stock No. FD 831 rt
1 test cable, shielded, R&S Stock No. 120001-50
1 test cable, shielded, R&S Stock No. 120001-51
2 test cables 0334 G 12005

1.5 Recommended Extras

30-kV DC Probe BN 10503
DC Probe BN 10504

2. Preparation for Use and Operation

2.1 Preparation for Use

(see Fig. 3)

The set is factory-adjusted for operation from an AC supply of 200 to 250 V. To adapt it to a supply voltage of 100 to 130 V, remove the rear wall and the cover of the transformer case (on top, left). Then insert a 63-mA fuse into the fuse holder at the socket marked "110...120 V". (A 32-mA fuse is used for 220 V).

2.1.1 Front-panel Controls

(Fig. 2)

No.	Engraving	Function
1		Main meter
	0...3.16 0...10 V-A	Scales for linear E and I measurements
	-20 dB...+2 dB	Scale for logarithmic E and I measurements
	∞ ... 0 Ω	Scale for resistance measurements
	Batt. 9...15 V	Scale with limit indicators (10 V and 13.5 V) for the measurement of the battery voltage
2		Socket for connection to the AC supply. The UVV is earthed if an earthed power cable is connected to this socket.
3		Indication of the range selected with switch 4 .
4		Range selector.

No.	Engraving	Function
5		Function selector
	OFF	In this position the transformer is separated from the AC supply and the battery from the amplifier.
	CHARGE	With the AC supply connected, the storage batteries Ba1 (1.3-V cell) and Ba2 (12-V Ni Cd battery) are charged. The voltage of Ba2 is indicated on the Batt. 9...15 V scale of meter 1 .
	±	DC voltage or current measurement with low-pass filter of $\tau \approx 50$ msec (2.2 MΩ, 22 nF); rejection of 50-Hz components about 23 dB. Measured is the rms value of the DC and superimposed AC.
	≂	DC and AC voltage or current measurement without low-pass filter and blocking capacitor.
	~	AC voltage or current measurement with blocking capacitor switched in.
	Ω	Resistance measurement with 1.3 V test voltage.
	□	The green field indicates that current is drawn from the main battery Ba2 (also in AC supply operation)
		The red field indicates charging if the UVV is connected to the AC supply.
6	0	Screwdriver adjustment for setting the electrical zero of meter 1 in the 0 position of the range selector 4 (see section 2.1.7).

No.	Engraving	Function
7	± V 10 MΩ ‖ 30 pF	Test input for voltage measurement (DC and AC) with the following input impedances: Range 3 mV: 9.5 MΩ, 50 pF shunt Range 10 mV - 100 mV: 10 MΩ, 40 pF shunt Range 300 mV - 330 V: 10 MΩ, 30 pF shunt
8	± V x 10 100 MΩ ‖ 10 pF	Input for DC and AC voltage measurement with high impedance and 1/10 input sensitivity. Voltage limit 1000 V ≃. For frequency response see section 1.3.
9	(⊥)	This socket is connected to the internal screening system. Capacitance to earth approx. 850 pF; permissible voltage 500 V≃.
10	Ω +1.3 V	Input for resistance measurement. The test item must have no voltage of its own. The test voltage is 1.3 V so that semi-conductor functions (forward and reverse effects) can be checked. Note: Only resistances ≥ 10 Ω may be connected to 10 and 11 in the ranges ≥ 3 mA. If 10 and 11 are shorted and 5 is at Ω - for setting the zero for the resistance measurement - the ranges ≥ 3 mA must not be switched in because of the danger of overloading the battery Ba1.

<table>
<tr><th>No.</th><th>Engraving</th><th>Function</th></tr>
<tr><td>11</td><td>± A
40 pF</td><td>Input for current measurement (DC and AC).
The current measuring resistors are in parallel with this input without protection and are not DC blocked in the ~ mode either.
To avoid overloading in the ranges ≥ 3 µA refer to section 2.2.3.
The resistances are the same as specified on the front panel for the resistance ranges:
<table>
<tr><td>Range</td><td>3 nA</td><td>30 nA</td><td>3 µA</td><td>30 µA</td><td>300 µA</td><td>3 mA</td></tr>
<tr><td>R</td><td>10 MΩ</td><td>1 MΩ</td><td>10 kΩ</td><td>1 kΩ</td><td>100 Ω</td><td>10 Ω</td></tr>
</table>
<table>
<tr><td>Range</td><td>10 mA</td><td>30 mA</td><td>100 mA</td><td>300 mA</td><td>1 A</td></tr>
<tr><td>R</td><td>3.16 Ω</td><td>1 Ω</td><td>0.316 Ω</td><td>0.316 Ω</td><td>0.1 Ω</td></tr>
</table>
The test voltage at f.s.d. is 31.6 mV for the ranges 3 nA to 100 mA and 100 mV for the ranges 300 mA and 1 A.</td></tr>
<tr><td>12</td><td>Ω</td><td>Screwdriver adjustment for setting the zero of the measurement range used, with sockets 10 and 11 shorted and switch 5 at Ω. The zero slightly depends on the range because of the internal resistance of the voltage source Bal in the 100-Ω range.</td></tr>
<tr><td>13</td><td></td><td>Screwdriver adjustment for setting the mechanical zero, switch 5 at OFF (see section 2.1.2).</td></tr>
<tr><td>14</td><td></td><td>Polarity indicator
Indication of test-voltage polarity
- left
~ centre (rest position)
+ right
referred to the hot input socket.</td></tr>
</table>

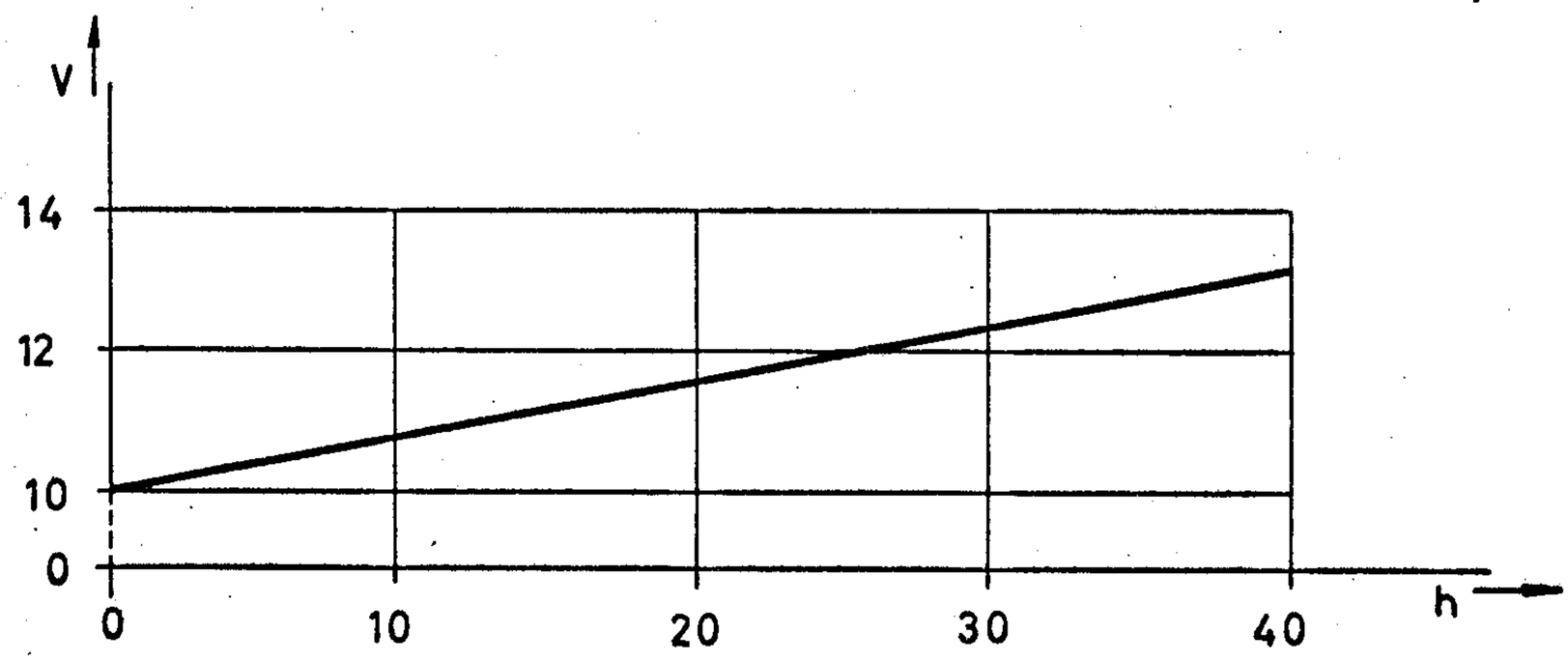
2.1.2 Setting the Mechanical Zero

The mechanical zero (left-hand rest position) of the pointer can be checked if the function selector 5 is at OFF. If the pointer fails to point to 0 of the topmost scale, correct with 11 .

2.1.3 Checking the Battery Voltage

Set switch 5 to CHARGE.

The lowest, short scale of the meter (9...15 V) indicates the battery voltage. With battery operation, take care that the battery voltage is sufficient in respect of the operating time provided.
Do not discharge the battery below 10 V and do not store the set with the battery discharged.



During AC supply operation the pointer is within the green range of the battery voltage scale.

2.1.4 Charging the Battery

If the battery voltage has dropped to about 10 V and measurements are to be taken with battery operation then the Ni Cd storage battery must first be charged:

Connect the UVV to the AC supply with the power cable.
Set switch 5 to CHARGE.

The battery voltage can be observed on the meter during charging. Terminate the charging process when the battery voltage is 13.5 V. The charging time for a Ni Cd battery that has dropped to 10 V is about 15 hours.

Exceeding the charging time by a few hours after reaching 13.5 V is of no consequence, but long overcharging impairs the life of the battery.

The 1.3-V cell Ba1 for resistance measurement is also charged when the 12-V Ni Cd battery is charged. If the UVV is mainly operated from the AC supply and the cell has not been charged for some time, it may be discharged. Then set switch 5 to CHARGE for a few minutes. The 1.3-V cell is charged from the Ni Cd battery Ba2, connection to the AC supply is not absolutely necessary.

2.1.5 Battery Operation

Check that a sufficient operating time is ensured for the Ni Cd battery (see section 2.1.2). In addition to complete independence of the AC supply, battery operation offers the advantage of perfect isolation of the UVV from earth for measurements on critical and sensitive circuit points. No problems of potential will thus occur. The capacitance between chassis potential 9 and earth is about 25 pF in battery operation. If necessary, chassis potential 9 can be connected to a guard potential if the guard voltage does not exceed 42 V to earth (risk of electric shock).

2.1.6 AC Supply Operation

Connect the UVV to the AC supply with the power cable.

AC supply operation is preferable unless complete isolation from earth is required. The buffer current maintains or renews the battery charge so that changeover to battery operation is possible at any time.

Note:

To switch the UVV off in AC supply operation it is not sufficient to draw the power cable from the wall socket, since then the battery takes over automatically. To switch off, set the function selector 5 to OFF.

2.1.7 Setting the Electrical Zero

The electrical zero can be set with the screwdriver adjustment 6 . The mechanical zero must be corrected before (see 2.1.1).

In the 0 position of the range selector 4 adjust 6 until the pointer of meter 1 is at 0 of the topmost scale (1 to 10) and the pointer of the type-of-current indicator 14 at mid-position. This adjustment can be carried out while a test item is connected.

The electrical zero is very stable under normal temperature conditions. It need be checked and adjusted only for accurate measurements in sensitive ranges (also for AC) or after a great variation of ambient temperature. A wide zero shift may, however, affect all measurement ranges.

2.1.8 Modes of Operation

The following modes can be selected:

$\pm$ DC voltage or current measurement, even if AC voltages or currents are superimposed.

Rejection of AC about 23 dB at 50 Hz.

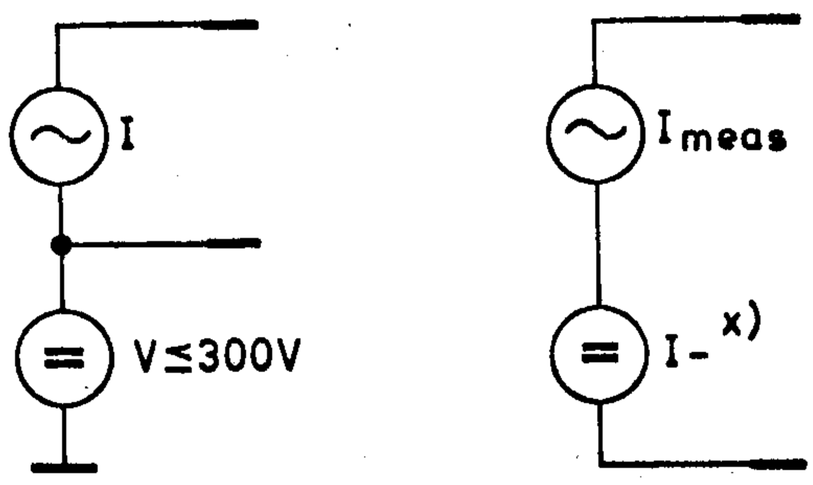
$\sim$ For measuring DC and AC voltages or currents in one measuring process without switching the function selector 5 from $\pm$ to $\sim$.

Note: The quasi-rms responsive rectifier measures the rms value of the sum of the individual components. This mode of operation is therefore recommended only for pure DC or pure AC.

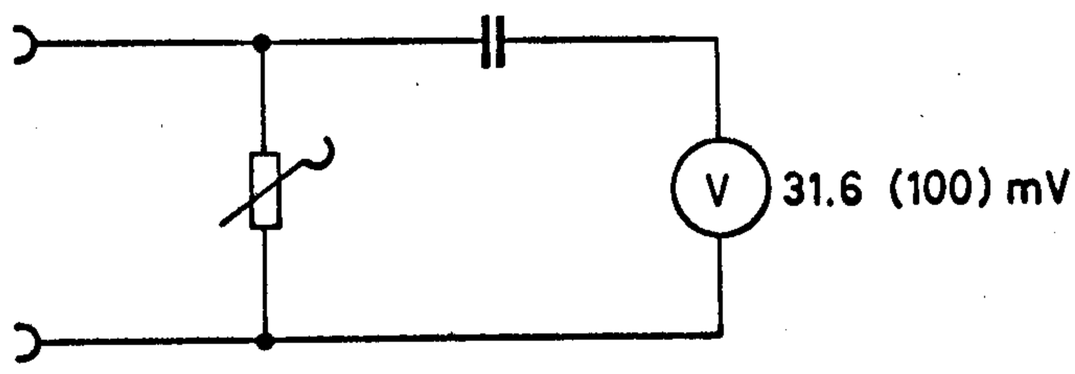
The peak value of each half-wave is indicated for DC or AC voltages or currents with very low frequency. Due to the inertia of the meter and to the dynamic rectifier characteristics the peak value turns into the rms value at higher frequencies.

~ For measuring pure AC voltages or currents. A common-mode DC voltage of 300 V may be superimposed. The common-mode rejection is about 90 dB.

The maximum permissible common-mode DC voltage at the current sockets 9 and 11 is 300 V (voltage sensitivity 31.6 mV). Although any superimposed DC current is suppressed for the measurement it loads the current-measuring resistors. In the ranges $\geq$ 30 µA, the rms value of the sum of DC and AC current must not exceed the selected range by more than a factor of 10. In case of doubt, check in the ≃ mode first.



+) $I- \leq$ 10 x range value



Current measuring circuit in ~ mode

Ω For resistance measurements and checking of semiconductor functions (forward and reverse effects).

Note: If the sockets 10 and 11 are shorted and switch 5 is at Ω, do not switch to ranges ≥ 3 mA since the battery Ba1 might be overloaded.

2.2 Operation

(Fig. 2)

2.2.1 Range Selection and Reading

Voltage measurement

Set pointer 3 to 0 using switch 4 .
Set switch 5 to ±, ≃ or ~ .
Apply test voltage to 7 and 9 or to 8 and 9 .
Set 4 to more sensitive ranges until the reading is between 30 and 100% of f.s.d.

Current measurement

Set pointer 3 to 0 using switch 4 .
Set switch 5 to ±, ≃ or ~.
Connect current source to sockets 9 and 11 .
Set 4 to more sensitive ranges until the reading is between 30 and 100% of f.s.d.
The pointer will first go to full-scale value, but this does not cause any damage.

Voltages and currents are read either on the linear V - A scale or on the logarithmic scale marked dB. The range value refers to full-scale deflection.

The absolute voltage in dB is

E [dB] = position of pointer 3 in dB + reading in dB

Add with the correct polarity sign.

Examples:

Range +30 dB, reading + 1 dB ⟶ measured voltage +31 dB
Range +10 dB, reading -11 dB ⟶ measured voltage -1 dB
Range -20 dB, reading - 3 dB ⟶ measured voltage -23 dB

Resistance measurement

Set pointer 3 to 0 using switch 4 .
Set switch 5 to Ω.
For the zero adjustment see section 2.2.4.
Connect the test item to sockets 10 and 11 .
Set switch 4 to more sensitive ranges (minimum full-scale value 100 Ω) until the reading is between 10 and 100% of f.s.d.

Determining the type of current and the polarity sign

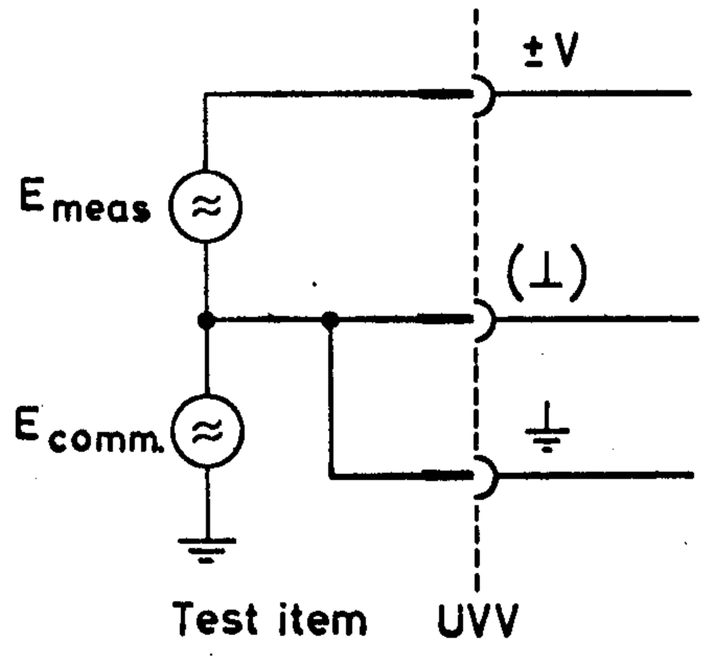
If the reading is >20% of f.s.d. and the polarity indicator 14 is at + or -, a DC current or voltage is being measured. The indicated polarity refers to the hot socket. If the pointer of the polarity indicator 14 rests at about mid-position, an AC current or voltage is measured.

2.2.2 Voltage Measurement

Connect the voltage source to sockets 7 - 9 or 8 - 9 . A common-mode potential to earth up to 500 V is permissible. The common-mode rejection is frequency- and range dependent. In case of doubt check prior to the measurement for any inadmissible effect, by applying only the common-mode voltage to the potential of the shorted input sockets. More favourable (if feasible) is it to switch off the signal voltage in the test circuit and to investigate the effect of the common-mode voltage. The internal resistance of the voltage source thus taken into account has a strong influence.

If there is no common-mode voltage, it is best to connect the sockets 9 (⊥) and 2 (⏚). If the measurement conditions are problematic and common-mode voltages exist, the chassis ⏚ 2 need not be earthed for battery operation (without AC supply connection).

With common-mode voltages < 42 V (risk of electric shock) socket 2 may be connected to the common-mode potential.



Always make sure that the earthy point of the test item is connected to socket 9 .

If measurements are taken on high-impedance sources and in sensitive ranges it may be necessary to use shielded leads BN 120001-50 (-51). These leads increase the load capacitance by about 100 pF.

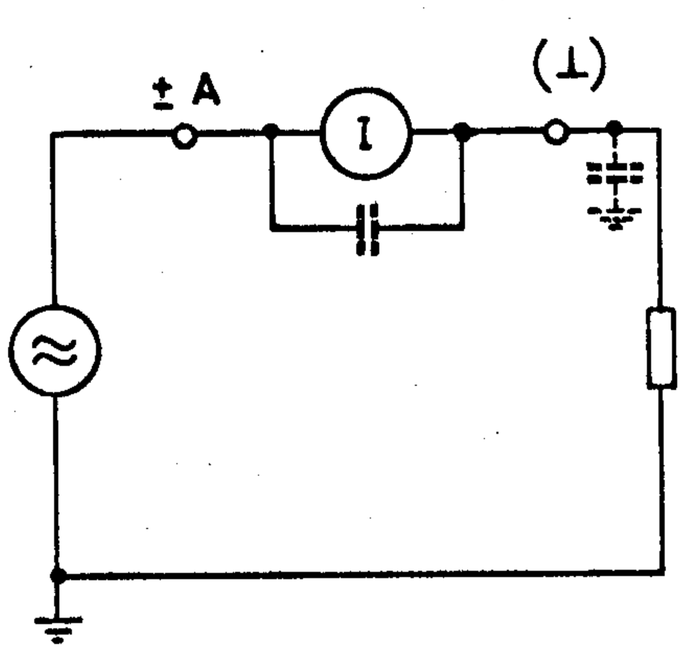
Use the input ±V x 10 socket 8 if a very high input impedance is desirable. The additional errors specified in section 1.3 then apply to the measurement ranges ≥ 300 mV. The errors for the ranges ≤ 100 mV are not specified; they rise to about 10%.

2.2.3 Current Measurement

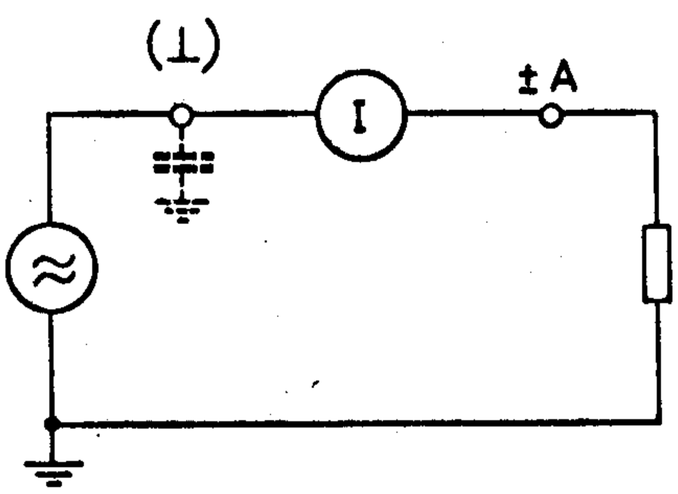
Current measurements are critical. There will be only few current measuring instruments that do not have burns near their measuring resistors and hardly any technician that has not seen his instrument in smoke when trying to investigate the strength of a current source.

Never connect the AC supply to sockets 9 and 11 .
The best protection against faults in operation is heedfulness.

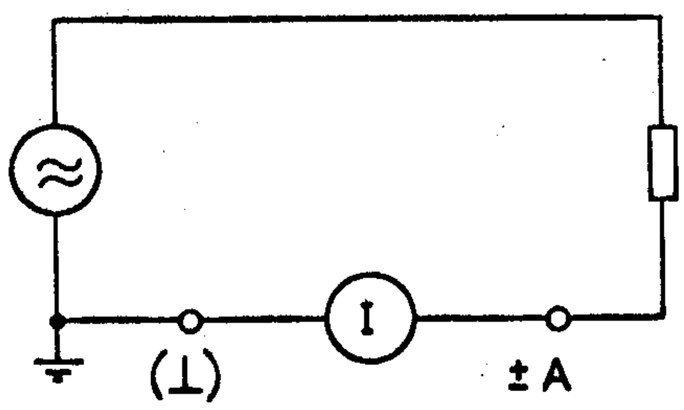
What has been said in section 2.2.2 on common-mode interference also applies to current measurements. The earthy point of a current source must be connected to 9 . At higher frequencies and with high-impedance sources, the input capacitance and capacitance to earth of socket 9 must be taken into account. In particular the capacitance to earth may lead to considerable errors if the test setup is not appropriate.



Poor test setup



Better test setup (if the current source tolerates charging with C (⊥) ⟶ ⏚



Very good test setup (if practicable)

The most favourable test setup is obtained by connecting socket 2 (⏚) to 9 (⊥) and feeding the UVV from the battery (separated from the AC supply). The voltage between sockets 11 and 9 must then be ≤ 42 V (electric shock hazard).

Moreover, the input capacitance should be taken into account as it causes a frequency and range dependent error. For errors < 2% the upper limit frequency is

Range	3 nA	30 nA	300 nA	3 µA	30 µA
f_{lim} (40 pF)	40 Hz	400 Hz	4 kHz	40 kHz	100 kHz
R_{meas}	10 MΩ	1 MΩ	100 kΩ	10 kΩ	1 kΩ

Range	300 µA	3 mA	10 mA	30 mA	100 mA
f_{lim} (40 pF)	100 kHz	100 kHz	100 kHz	100 kHz	100 kHz
R_{meas}	100 Ω	10 Ω	3.16 Ω	1 Ω	0.316 Ω

$$F_{lim}\ (2\%) \approx \frac{10}{2\pi\ C_{ptotal}\ R_{meas}}$$

C_{ptotal} = total parallel capacitance of test item

R_{meas} = current measuring resistor of the range selected

2.2.3.1 Extension of the Current Ranges to 1 and 0.3 nA

The overall current range can be extended to 1 and 0.3 nA, mainly for DC measurements on semiconductors and insulation materials. The voltage ranges 10 mV (1 nA) and 3 mV (0.3 nA) are used with R_{meas} = 10 MΩ for this purpose. Connect the test item to sockets 7 and 9. A particularly carefully arranged test setup and shielding against noise are indispensable.

2.2.3.2 Permissible Waveforms for AC Current Measurements

With waveforms whose peak factors do not exceed 2 (peak value/rms value = 2), the UVV gives a correct current indication. In case of doubt as to whether the peak factor is < 2, set switch 4 to the next higher

range. If the value then measured differs less than 10% from that obtained in the lower range, the latter can be considered correct.

2.2.4 Resistance Measurement

Prior to the measurement adjust the zero of the resistance scale (after setting the electrical zero according to section 2.1.7).

Set switch 5 to Ω.
Select the desired range (100 Ω to 10 MΩ) with 4 .
Short sockets 10 and 11 .
Set the pointer of the meter to 0 of the resistance scale by means of the screwdriver adjustment 6 .
Remove short-circuit.

Note: While sockets 10 and 11 are shorted or a resistor ≤ 10 Ω is connected - switch 5 at Ω - do not switch to ranges ≥ 3 mA since the voltage source Ba1 might be overloaded.
Mind the measurement ranges.

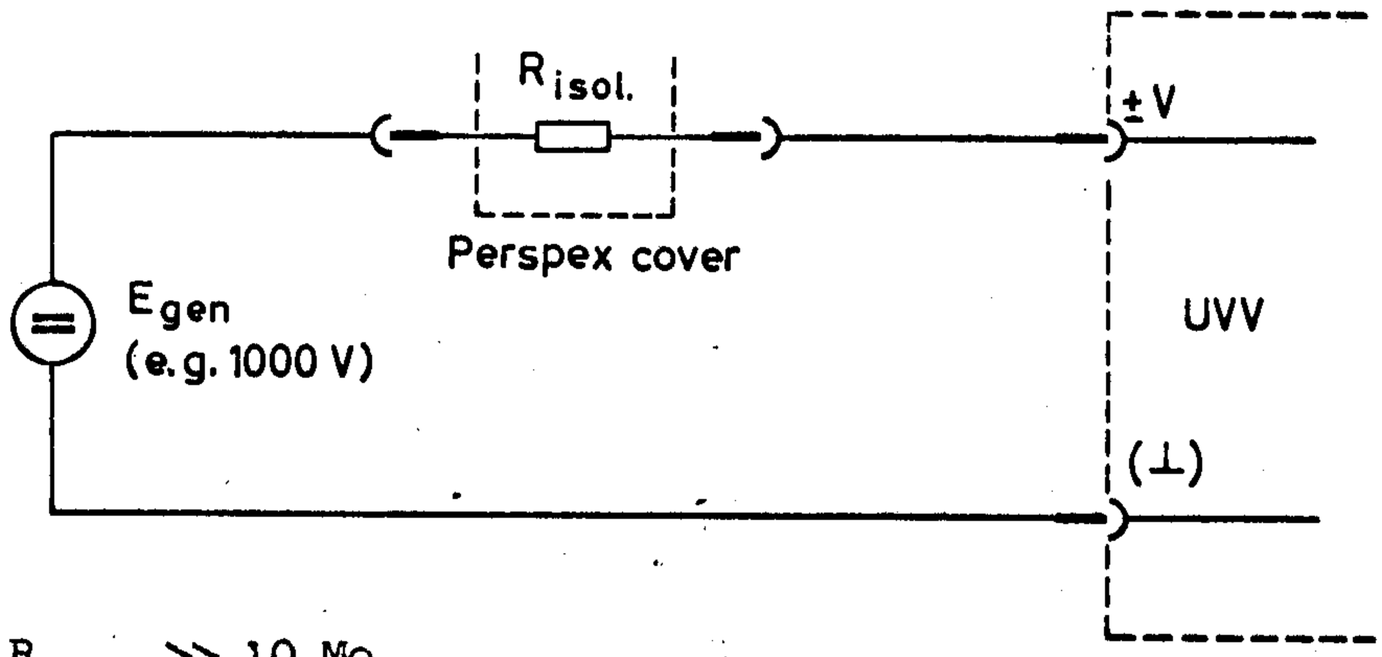
Connect the test item to sockets 10 and 11 . The test item must not have an inherent voltage.

2.2.4.1 Measurement of Isolation Resistance

Isolation resistance up to 10^{14} Ω can be measured by means of an external test voltage (e.g. 1000 V).

Set switch 5 to ±.
Select 300-V range with 4 (or a lower range, if necessary).

The circuit arrangement is as follows:



For $R_{isol} \gg 10\ M\Omega$

$$R_{isol}\,[\Omega] = \frac{E_{gen}}{E_{meas}} \times 10^7$$

2.2.5 Measurement Using Accessories

2.2.5.1 DC Voltage Measurement Using 30-kV Probe BN 10503

DC voltages up to 30 kV can be measured in conjunction with the 30-kV Probe. Its input resistance is 1000 MΩ, providing a voltage division of 1:100. The reading must therefore be multiplied by 100.

The 30-kV Probe is also used to measure smaller voltages without excessive loading of the test item. The smallest measurable voltage is in this case 10 mV.

Insert the 2-pole plug of the Probe into sockets 7 and 9, taking care that (⊥) of the plug is connected to socket 9 (⊥) of the UVV. The single pin of the Probe marked ⏚ must be connected to earth potential for reasons of safety. This can be done via socket 2 if the UVV is earthed via the power cable or in another suitable way. Moreover a connection must be established between ⊥ of the voltage source and socket 7.

2.2.5.2 DC Voltage Measurement Using DC Probe BN 10504

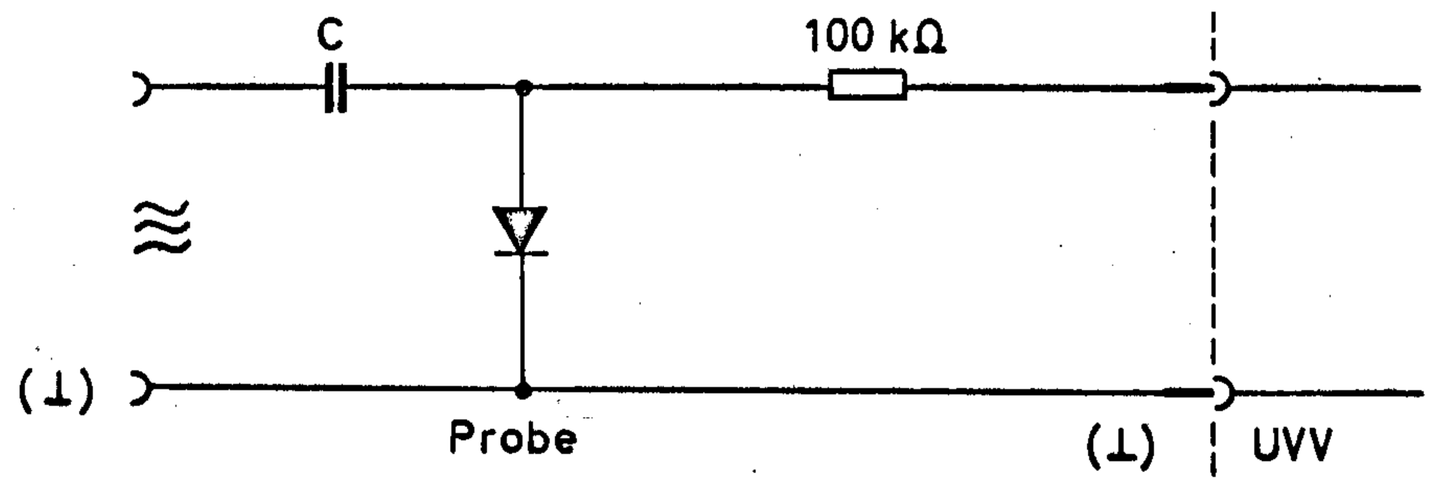
The DC Probe is used to measure DC voltages with superimposed AC voltage at check points that do not tolerate capacitive loading (e.g. RF circuits).

Set switch 5 to ±.
Connect DC Probe to socket 7 or 8 .
Connect the test point that is nearest to chassis potential to socket 9 .

The input capacitance of the Probe is about 1 pF if the Probe is held at its rear end. The built-in 500-kΩ resistor causes an error of -5% when the Probe is connected to 7 and an error of -0.5% when the Probe is connected to 8 .

2.2.5.3 Measurement Using an RF Diode Probe
(Fig. 4)

Any diode probe that has no built-in load resistor and is designed as shown in the drawing may be connected to the UVV.

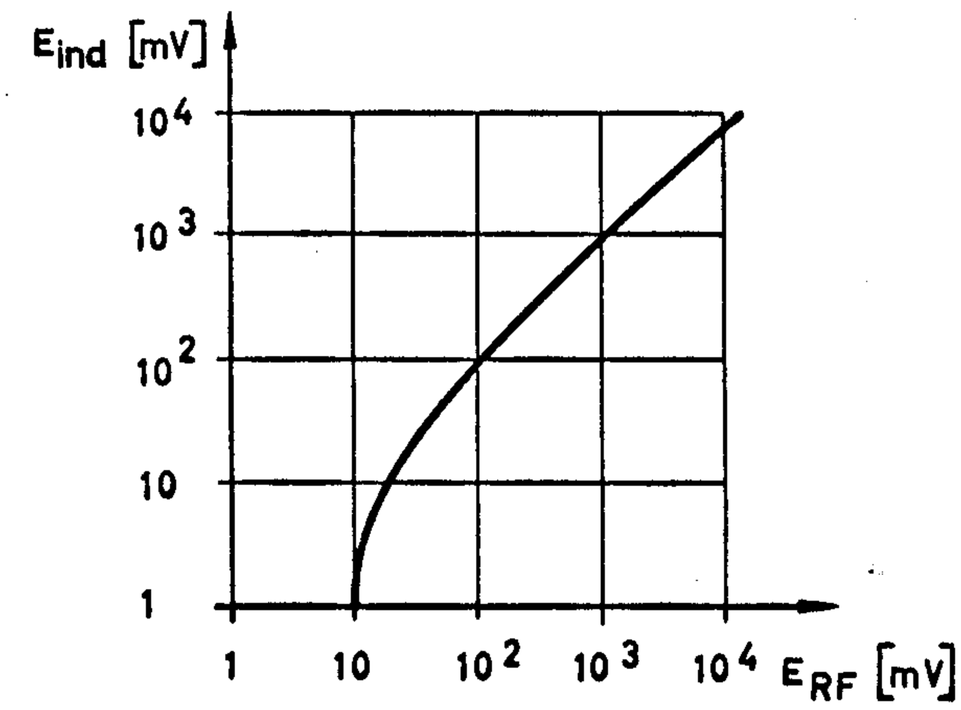


The user can easily make up a diode probe.

Set switch 5 to ±.
Connect the RF diode probe to sockets 7 and 9 .

The relation between the RF input voltage and the rectified output voltage being non-linear, the measured value cannot be read directly in volt. The relative indication, however, is often sufficient for

signal tracking or for tuning RF circuits. The curve below, applicable to germanium point-contact diodes, permits a more accurate determination of the measured value.



For other types of diode or for more accurate measurements a calibration curve must be determined. To do so, measure the AC input voltage $E_{in}\sim$ at a frequency of 1 to 10 kHz with an adequate diode coupling capacitor ($C \geq 10$ nF) for the probe, using the UVV.

3. Maintenance and Repair

3.1 Required Measuring Instruments and Accessories

Voltmeter (> 10 MΩ): UVV BN 120001; URI BN 1050 or UFWD BN 1110 for systematic fault location and for measuring the battery voltage.

AF oscillator: SRB BN 40851 or SBF BN 40861 for adjusting the input and main attenuators.

3.2 Maintenance Instructions

(see Fig. 3)

Care should be taken that the Ni Cd storage batteries Ba1 and Ba2 are always adequately charged ($E_{Ba2} \geq 10$ V). If even after a longer charging time the voltage of Ba2 fails to rise beyond 11 V, then the battery should be replaced by a new one. To do so, withdraw the rear panel after loosening of two screws. Loosen board 120001-33 and swing it down. The Ni Cd battery Ba2 is soldered to this board at the right. The Ni Cd battery Ba1 (for resistance measurement) soldered between the sockets 10 and 11 behind the front panel is then also accessible.

3.2.1 Readjusting to Specification

(see circuit diagram 120001 S)

C1 is used for the capacitive adjustment of the input divider for the test inputs ±V x 10.

Set 5 to ~ .
Set 4 to 10 V.

For the adjustment, apply a voltage of 10 V with a frequency of 10 kHz to socket 7 and adjust C1 accurately for full-scale deflection of 10 V.

Set 4 to 1 V.

Apply the same voltage of 10 V and 10 kHz to socket 8 and adjust C1 for full-scale deflection (mind the body effect on C1).

Adjust the main divider R3 to R7 with the trimmers C2 and C3.

Set 5 to ~.
Set 4 to 30 V.
Connect AF generator to sockets 7 and 9.
Adjust AF generator voltage to 30 V and frequency alternately to 300 Hz and 3 kHz.
Adjust C2 so as to reduce the difference in reading on meter 1 to 0.
Set 4 to 300 mV.
Adjust AF generator voltage to 300 mV and frequency alternately to 300 Hz and 3 kHz.
Repeat the adjustment with C3.
Check the ranges 30 V, 3 V and 300 mV and average out any residual differences by slightly readjusting C2 and C3.

Adjust the gain in the 3-mV range with potentiometer R33.

Set 4 to 3 mV.
Set 5 to ~.
Apply 3 mV to sockets 7 and 9.
Adjust the pointer to full-scale deflection (3 mV) with R33.

Note: This adjustment affects the electrical zero (see section 2.1.7); therefore adjust the gain and the zero alternately.

The operating point of the input differential amplifier can be adjusted with potentiometer R35. The correct operating point is attained if 4.5 V is measured at the gate of T1 (right).

Potentiometer R38 is used for the coarse adjustment of the electrical zero. Adjust so that at mid-position of 6 (R39) the pointer of meter 1 is at 0 of the V-A scale (at normal ambient temperature).

The indication of the main meter I II (1) can be adjusted with potentiometer R68 (at normal ambient temperature).

Set the electrical and mechanicalzeros (see section 2.1.7 and 2.1.2).
Set 5 to±.
Set 4 to100mV.
Apply 100 mV DC ±0.3% to sockets 7 and 9 .
Adjust potentiometer R68 for full-scale deflection of meter 1 .

The indication of the battery voltage Ba2 can be adjusted with potentiometer R70.

Measure battery voltage with a voltmeter.
Set 5 to CHARGE.
Adjust battery voltage indication to the measured value using R70.

3.3 Repair Instructions

Fault diagnosis

Set switch 5 to CHARGE.
Is the pointer within the green field of the battery voltage indicator?
Connect socket 2 to the AC supply with the power cable.
Does the battery voltage rise?
If the battery voltage indication does not change, check the AC supply voltage.
Can the electrical zero be adjusted (see section 2.1.7)?
Potentiometer 6 should cover a range of about ±2.5. mV.
Set 5 to ⎓or ~.
Set 3 to 3 mV.
Does meter 1 show full-scale deflection when socket 7 is touched with a screwdriver?

The answers to these questions facilitate the following systematic fault location.

Systematic fault location

Measure the DC voltages relative to the -pole of battery Ba2 at all test points marked in the circuit diagram, using a voltmeter (R_{in} > 10 MΩ). It is best to start on the right in the circuit diagram and to proceed toward the left. The voltages specified in the circuit diagram should be obtained within a tolerance of ±5%. Of particular importance is the symmetry of the voltages (better than 0.1 V) at the differential transistor stages T1 to T17.

If no distinct differences from the specified values are found, proceed according to the given circumstances.

3.3.1 Circuit Description

(see circuit diagram 120001 S)

Amplifier

A differential push-pull operational amplifier made up of field-effect transistors (T1, T3, T4) in the input guarantees the required stability and a high input impedance. Antipolar shunted diodes (G1 1 and G1 2) following the overload protection resistor R26 in the input prevent overloading of the UVV in the voltage ranges. Range dependent negative feedback and a capacitively compensated high-impedance input divider C1, R1, R2 provide a wide voltage range. The current measuring resistors R9 to R18 are connected via a Kelvin-wired deck of the range selector S1 so that contact resistances have no effect.

Rectifier

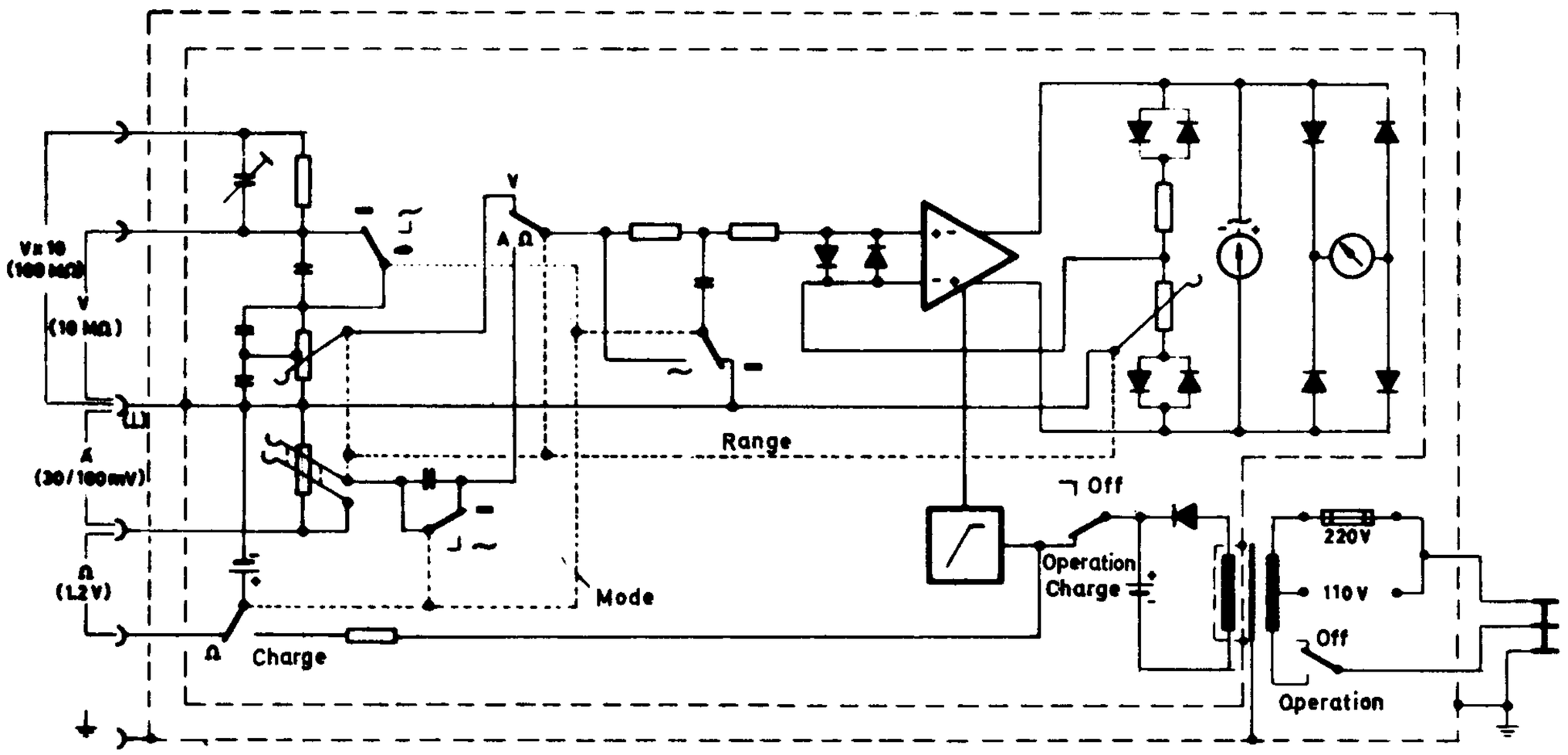
The Bouke rectifier G1 18 to 21, C21, C22 in the meter circuit ensures rms-responsive indication even of signals deviating strongly from the sinewave form, such as frequently encountered in AF measurements.

Diodes G1 14 to G1 17 compensate for the non-linearity of the diodes in the rectifier circuit. Besides a practically linear scale, the possibility of using the rectifier circuit also for DC measurements ($\simeq$, $\pm$) is thus obtained. AC measurements can thus be made at very low frequencies down to DC without switchover and the advantage of uniform scales and polarity independent indication for DC measurements is ensured. The polarity indicator I 1II preceding the rectifier indicates the polarity of test voltage or test current or, in its centre position, the measurement of AC voltage or current.

Power supply

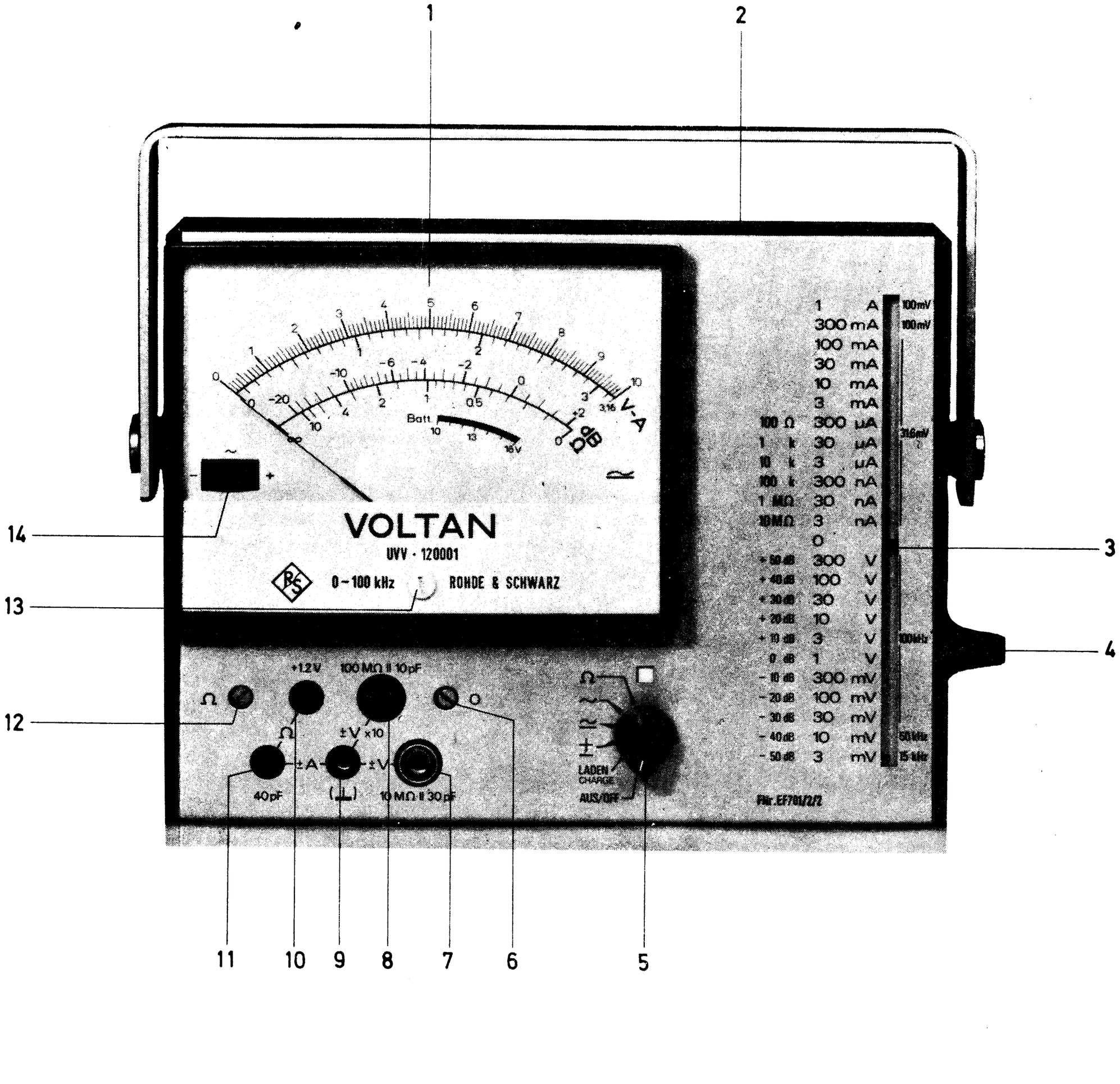
The UVV is suitable for AC supply and battery operation. A Ni Cd storage battery (Ba2) with a nominal voltage of 12 V (100 mAh) supplies power for about 40 hours of battery operation. It can be recharged via the built-in charger circuit. During operation from the AC supply both batteries (Ba1 and Ba2) are charged simulteneously (floating operation).

Double shielding of the power transformer Tr1 reduces the hum voltage between ($\perp$) and ($\frac{\perp}{=}$) to 0.1 to 0.5 V (depending on the polarity of the power plug. A voltage stabilizer for the supply voltage is provided between the battery and the amplifier. Transformer Tr1 can be changed over for AC supply voltages of 110 to 130 V and 200 to 250 V.



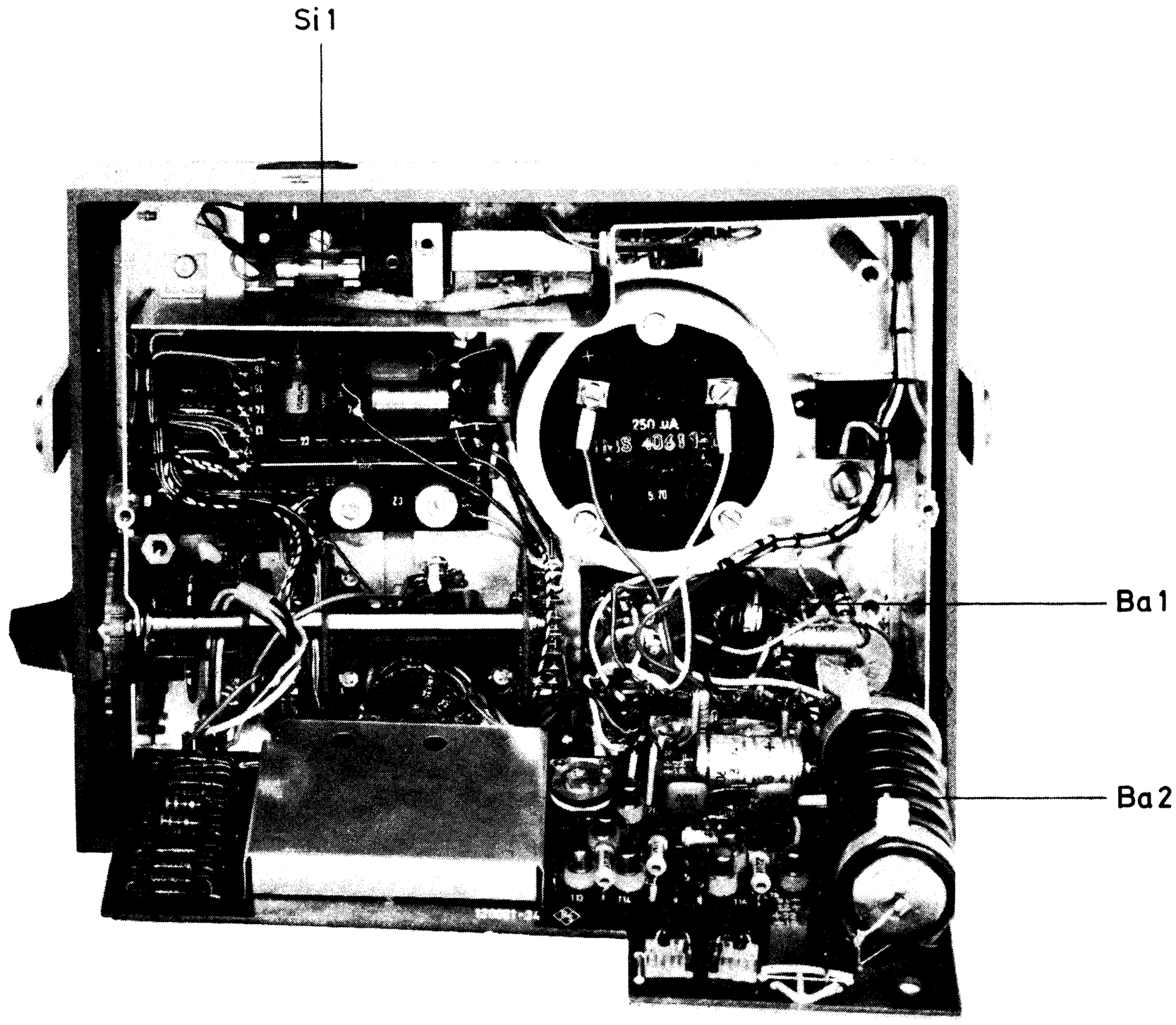
Block diagram of Multimeter VOLTAN Type UVV

Fig. 1



Front-panel controls

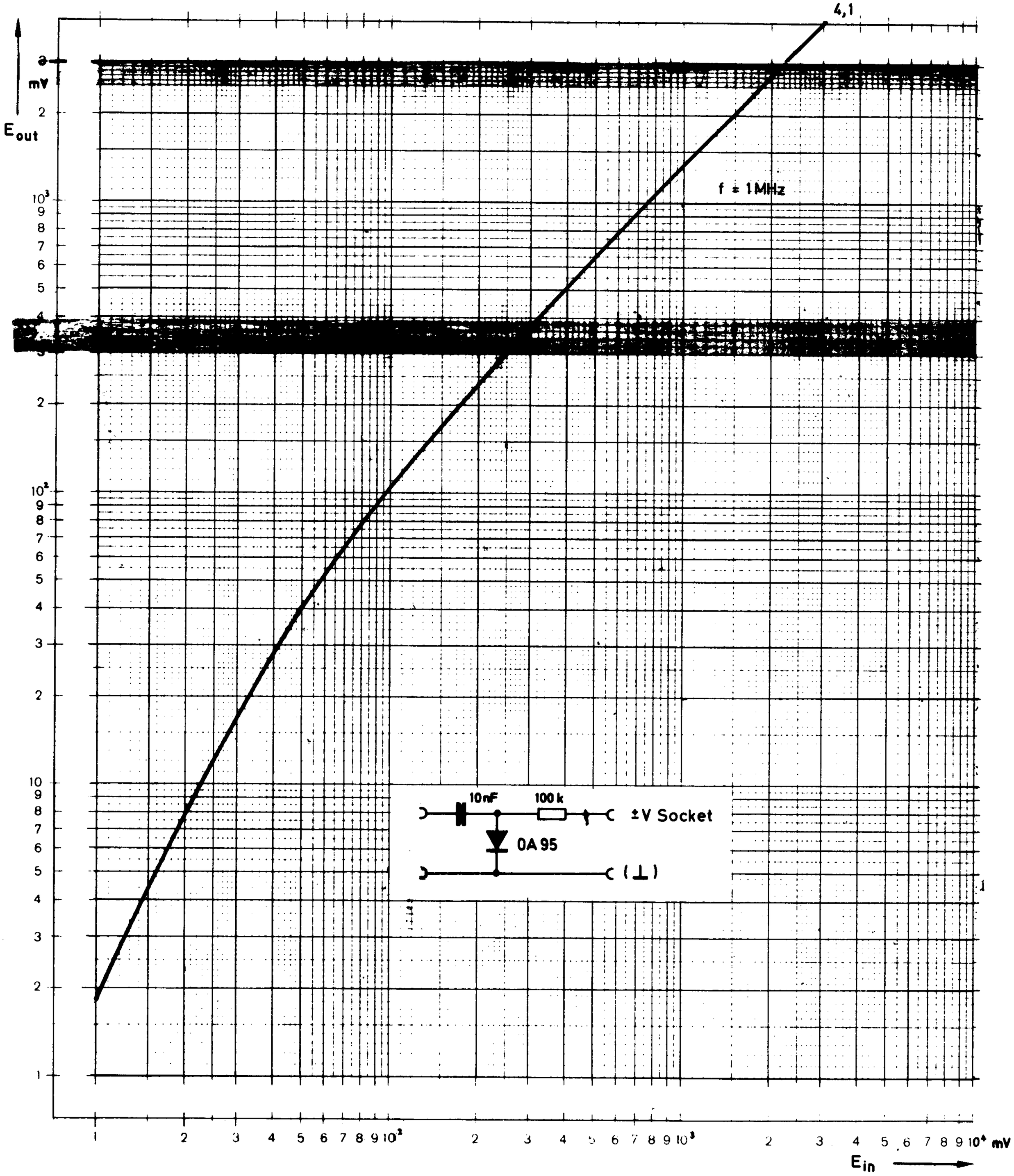
Fig. 2



Rear view

Rear panel removed, board 120001-34 swung down,
fuse box opened

Fig. 3



Calibration curve for germanium point-contact diode 0A 95

Fig. 4

Translations for Parts Lists

Anavolt Type UVV	Multimeter VOLTAN Type UVV
Buchse	Socket
Drahtwiderstand	Wire-wound resistor
Drehspul-Strommesser	Moving-coil meter
Elko	Electrolytic capacitor
Ge-Diode	Germanium diode
Gerätestecker	Free receptacle
Heißleiter	Thermistor
Keramik-Kondensator	Ceramic capacitor
Kf-Kondensator	Synthetic-foil capacitor
KS-Kondensator	Synthetic-foil capacitor
Mikroschalter	Micro switch
MKT-Kondensator	Metallized synth.-foil capacitor
Netztrafo	Power transformer
Rohrtrimmer	Tubular trimmer
Scheibentrimmer	Disc trimmer
Schicht-Drehwiderstand	Variable depos.-carbon resistor
Schichtwiderstand	Film resistor
Schmelzeinsatz	Fuse
Si-Diode	Silicon diode
Si-Trans.	Silicon transistor
Stahl-Akkumulator	Ni Cd storage battery
Stufenschalter	Rotary switch
Tantalelko	Electrolytic tantalum capacitor
Z-Diode	Zener diode

Kenn-zeichen	Stück-zahl	Benennung	Sach-Nr.		Bemerkungen
1	2	3	4	5	6
Ba 1		Stahl-Akkumulator	BAC 30010		
Ba 2		Stahl-Akkumulator	BAC 30110		
Bu 1		Buchse	FRB 46010		
Bu 2		Buchse	FRB 46007		
Bu 4		Buchse	FRB 46010		
Bu 5		Buchse	FRB 46010		
Bu 6		Buchse	FRB 46010		
Bu 7		Buchse			enth.in 120001-11.1
C 1		Rohrtrimmer	CVC 72692 p 3		
C 2		Scheibentrimmer	CVC 10521 p 16		
C 3		Scheibentrimmer	CVC 10511 p 30		
C 4		KS-Kondensator	CKD 1/125/125		
C 6		KS-Kondensator	CKS 44157 n 1,47		
C 7		KS-Kondensator	CKS 44157 n 13,5		
C10		Kf-Kondensator	CKF 62223 n 22		
C11		Kf-Kondensator	CKF 62223 n 22		
C12		MKT-Kondensator	CKG 50053 n 100		

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Liste Nr.
120001 Sa

Liste besteht aus 8 Blatt

Blatt Nr. 1

Ersatz für Liste

Stückliste/Schaltteilliste zu
Anovolt Type UVV

Lfd. Nr. X Kennzeichen	Stückzahl	Benennung	Sach-Nr.		Bemerkungen
1	2	3	4	5	6
C15		Ki-Kondensator	CKF 62223 n 22		
C16		KS-Kondensator	CKD 2/1250/125		
C17		Keramik-Kondensator	CCH 68/27		
C18		Keramik-Kondensator	CCH 68/22		
C19		Keramik-Kondensator	CCH 68/82		
C20		Keramik-Kondensator	CCH 68/22		
C21		Tantalelko	CEV 33423 u 22		
C22		Tantalelko	CEV 33423 u 22		
C23		Tantalelko	CEV 33423 u 22		
C25		Elko	CED 21/50/35		
C26		Tantalelko	CEV 41223 u 1		
C27		Tantalelko	CEV 41223 u 1		
C28		Scheibentrimmer	CVC 10512 p 30		
C29		Keramik-Kondensator	CCG 50960 n 10		
C30		Keramik-Kondensator	CCG 50960 n 10		
G1 1		Si-Diode 1 N 4154	GFE 24422		
G1 2		Si-Diode 1 N 4154	GFE 24422		

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Stückliste/ Schaltteilliste zu
Anovolt Type UVV

Lfd. Nr. X Kenn-zeichen	Stück-zahl	Benennung	Sach-Nr.		Bemerkungen
1	2	3	4	5	6
G1 6		Ge-Diode AA 118	GCE 17420		
G1 7		Si-Diode 1 N 4154	GFE 24422		
G1 8		Ge-Diode AA 118	GCE 17420		
G1 9		Si-Diode 1 N 4154	GFE 24422		
G110		Ge-Diode AA 118	GCE 17420		
G111		Ge-Diode AA 118	GCE 17420		
G114		Ge-Diode AA 118	GCE 17420		
G115		Ge-Diode AA 118	GCE 17420		
G116		Ge-Diode AA 118	GCE 17420		
G117		Ge-Diode AA 118	GCE 17420		
G118		Ge-Diode AA 118	GCE 17420		
G119		Ge-Diode AA 118	GCE 17420		
G120		Ge-Diode AA 118	GCE 17420		
G121		Ge-Diode AA 118	GCE 17420		
G122		Z-Diode ZF 12	GEE 25420 E 12		
G125		Si-Diode 1 N 4148	GFE 26421		
J 1		Drehspul-Strommesser	JNS 40611		

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Ersatz für Liste

Stückliste Schaltteilliste zu:
Anovolt Type UVV

TGL 4[illegible] Kennzeichen	Stückzahl	Benennung	Sach-Nr.		Bemerkungen
1	2	3	4	5	6
R 1		Schichtwiderstand	WFE 631 M 45		
R 2		Schichtwiderstand	WFE 631 M 45		
R 3		Schichtwiderstand	WFE 641 M 9		
R 4		Schichtwiderstand	WFE 551 k 900		
R 5		Schichtwiderstand	WFE 351 k 90		
R 6		Schichtwiderstand	WFE 351 k 6,84		
R 7		Schichtwiderstand	WFE 351 k 3,16		
R 9		Drahtwiderstand	WDF 22050 m 100		
R10		Drahtwiderstand	WDF 22050 m 316		
R11		Schichtwiderstand	WFE 351 E 1		
R12		Schichtwiderstand	WFE 351 E 3,16		
R13		Schichtwiderstand	WFE 351 E 10		
R14		Schichtwiderstand	WFE 351 E 100		
R15		Schichtwiderstand	WFE 351 k 1		
R16		Schichtwiderstand	WFE 351 k 10		
R17		Schichtwiderstand	WFE 551 k 101		
R18		Schichtwiderstand	WFE 651 M 1,11		

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Stückliste / Schaltteilliste zu
Ahovolt Type UVV

Lfd. Nr. X Kennzeichen	Stückzahl	Benennung	Sach-Nr.		Bemerkungen
1	2	3	4	5	6
R21		Schichtwiderstand	WFE 641 M 9,72		
R22		Schicht-Drehwiderst.	WS 9122 F/100 k		
R23		Schichtwiderstand	WFE 321 k 180		
R25		Schichtwiderstand	WFE 321 M 2,2		
R26		Schichtwiderstand	WFE 521 k 10		
R29		Schichtwiderstand	WFE 321 k 22		
R30		Schichtwiderstand	WFE 321 k 22		
R31		Schichtwiderstand	WFE 321 E 820		
R32		Schichtwiderstand	WFE 321 k 10		
R33		Schicht-Drehwiderst.	WSG 10ooo k 50		
R34		Schichtwiderstand	WFE 321 k 27		
R35		Schicht-Drehwiderst.	WSG 10ooo k 10		
R36		Schichtwiderstand	WFE 321 k 68		
R37		Schichtwiderstand	WFE 341 k 63		
R38		Schicht-Drehwiderst.	WSG 11ooo/10 k		
R39		Schicht-Drehwiderst.	WS 9122 F/1 k		
R43		Schichtwiderstand	WFE 321 k 6,8		

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Ersatz für Liste:

Stückliste / Schaltteilliste zu: Anovolt Type oVV

420; 6569; 100 S 68

Lfd. Nr. Kenn-zeichen	Stück-zahl	Benennung	Sach-Nr.		Bemerkungen
1	2	3	4	5	6
R46		Schichtwiderstand	WFE 321 k 2,2		
R47		Schichtwiderstand	WFE 321 k 2,2		
R48		Schichtwiderstand	WFE 321 k 1		
R49		Schichtwiderstand	WFE 321 k 1		
R50		Schichtwiderstand	WFE 321 k 15		
R51		Schichtwiderstand	WFE 321 k 15		
R52		Schichtwiderstand	WFE 321 k 2,7		
R53		Schichtwiderstand	WFE 321 k 2,7		
R55		Schichtwiderstand	WFE 341 k 2,5		
R56		Schichtwiderstand	WFE 351 E 150		
R57		Schichtwiderstand	WFE 351 E 47,4		
R58		Schichtwiderstand	WFE 351 E 15		
R59		Schichtwiderstand	WFE 321 E 3		
R60		Schichtwiderstand	WFE 341 k 2,7		
R61		Schichtwiderstand	WFE 321 E 3		
R62		Schichtwiderstand	WFE 321 k 3,3		
R63		Schichtwiderstand	WFE 321 k 3,3		
R64		Schichtwiderstand	WFE 331 k 1,5		
R65		Schichtwiderstand	WFE 331 k 1,5		
R66		Schichtwiderstand	WFE 321 E 100		
R67		Schichtwiderstand	WFE 321 k 2,2		
R68		Schicht-Drehwiderst.	WSG 11000 / 1 k		
R69		Schichtwiderstand	WFE 321 k ~~27~~ 33kΩ		
R70		Schicht-Drehwiderst.	WSG 10000 k 10		
R71		Schichtwiderstand	WFE 321 k 4,7		
R72		Schichtwiderstand	WFE 321 k 10		

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Ersatz für Liste

Stückliste / Ersatzteilliste zu

Anovolt Type UVV

Vervielfält.-Pause Nr.

Arbeitspause Nr.

Lfd. Nr. Kenn-zeichen	Stück-zahl	Benennung	Sach-Nr.		Bemerkungen
1	2	3	4	5	6
R73		Schichtwiderstand	WFE 321 k 4,7		
R74		Schichtwiderstand	WFE 321 k 39		
R75		Heißleiter	WHD 232/10 k/10		
R79		Schichtwiderstand	WFE 321 k 1,5		
R80		Schichtwiderstand	WFE 321 E 470		
R82		Schichtwiderstand	WFE 321 k 10		
		-			
S 1		Stufenschalter	120001 - 28		
S 2		Stufenschalter	120001 - 14		
S 4		Mikroschalter	SDH 32300		
Si 1		Schmelzeinsatz	M 0,063 C DIN 41571x) M 0,032 C DIN 41571x)		bei 115...125V bei 220...240V Netzsp.
					x) zusätzl.je 1 St. Ersatz
St 1		Gerätestecker			enth.in 120001

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Änd.-zust.	Änd.-Mittlg. Nr.	Datum	Name
a	-	9.69	Ibs

Liste Nr. 120001 Sa

Liste besteht aus Blatt

Blatt Nr. 7

Ersatz für Liste

Stückliste / Schaltteilliste zu: Anovolt Type UVV

Arbeitsfält.-Pause Nr.

Arbeit-pause Nr.

28; 0568; 100 S 68

Ltd. FK Kenn-zeichen	Stück-zahl	Benennung	Sach-Nr.		Bemerkungen
1	2	3	4	5	6
T 1		Dual-FET 2 N 3958	GSF 24396		
T 3		Si-Trans.	GQF 25438		
T 4		Si-Trans.	GQF 25438		
T 7		Si-Trans.	GQF 25438		
T 8		Si-Trans.	GQF 25438		
T10		Si-Trans. BC 177 A	GQE 25340		
T11		Si-Trans. BC 177 A	GQE 25340		
T13		Si-Trans. BC 107 B	GQF 25540		
T14		Si-Trans. BC 177 B	GQE 25349		
T16		Si-Trans. BC 107 B	GQF 25540		
T17		Si-Trans. BC 177 B	GQE 25349		
T20		Si-Trans. BC 107 B	GQF 25540		
Tr 1		Netztrafo (Gr.)	120001 - 17		hierzu bes.Stückliste

Diese Zeichnung ist unser Eigentum. Vervielfältigung, unbefugte Verwertung, Mitteilung an andere ist strafbar und schadenersatzpflichtig.

Revisions-Paus Nr.

Arbeitspause Nr.

ROHDE & SCHWARZ
MÜNCHEN

ICDE	Datum	Name
geschrieben	6.69	Wil
bearbeitet		Ibg
geprüft		
normgeprüft		

Änd.-zust.	Änd.-Mittlg. Nr.	Datum	Name
a	-	9.69	Ibg
b	15503	9.70	Ibg

Liste Nr.
120001 Sa

Liste besteht aus Blatt

Blatt Nr. 8

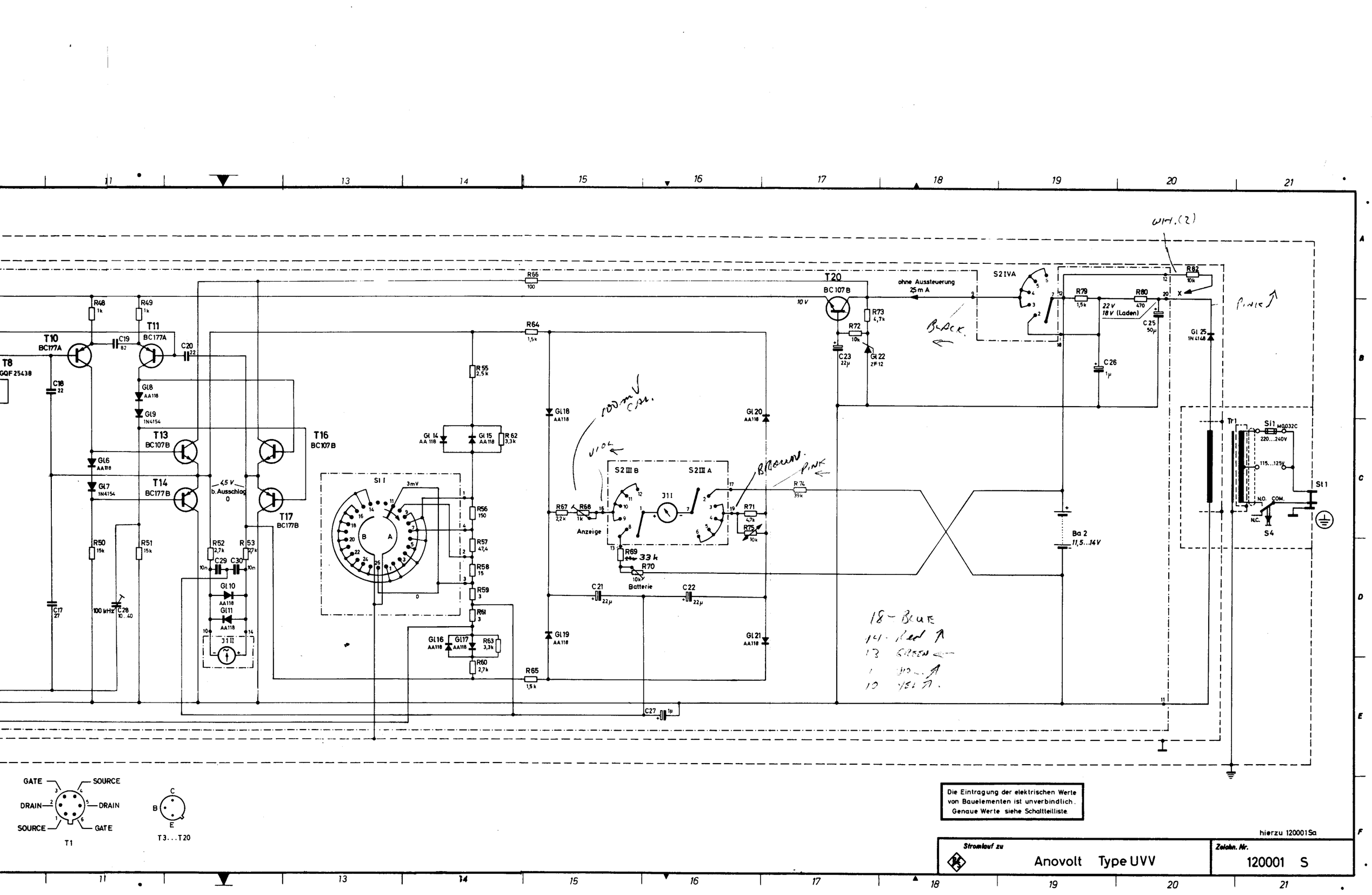
Ersatz für Liste

Stückliste / Schaltteilliste zu
Anovolt Type UVV

68; 6170; 120 S 68

Translations for Drawings and Diagrams

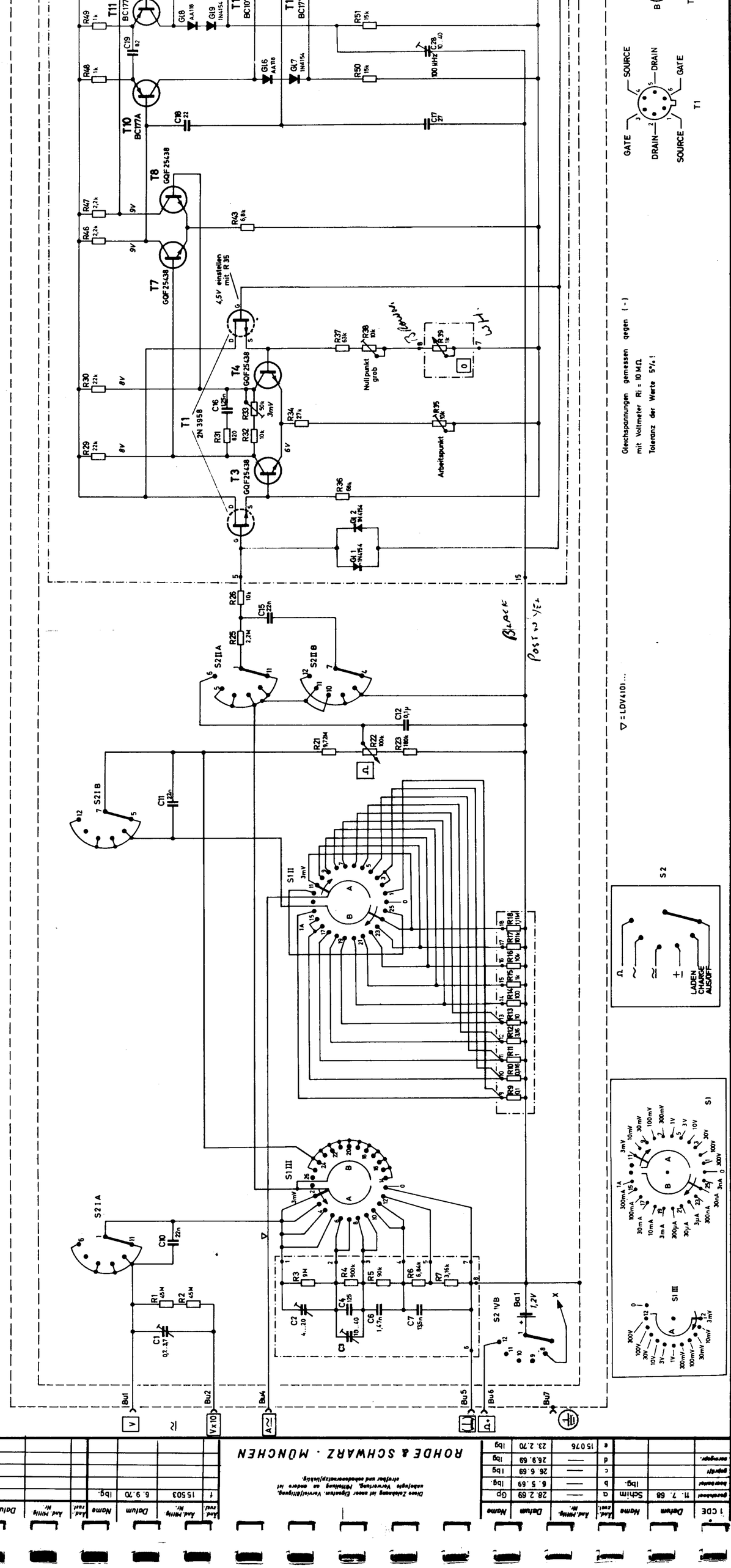
Anavolt Type UVV	Multimeter VOLTAN Type UVV
Anzeige	Reading
Arbeitspunkt	Operating point
Batterie	Battery
b. Ausschlag 0	With 0 deflection
Die Eintragung der elektrischen Werte von Bauelementen ist unverbindlich. Genaue Werte siehe Schaltteilliste.	No responsibility is accepted for errors in component values. Accurate values are given in the parts list.
einstellen mit R35	Adjust with R35
Gleichspannungen gemessen gegen (-) mit Voltmeter Ri = 10 MΩ Toleranz der Werte 5 %	DC voltage measured to (-) with voltmeter of R_{in} = 10 MΩ tolerance 5%
hierzu ...	See ...
Laden	Charge
Nullpunkt grob	Zero coarse
ohne Aussteuerung	Without saturation
Stromlauf zu	Circuit diagram of
Zeichn. Nr.	Drawing No.



Die Eintragung der elektrischen Werte von Bauelementen ist unverbindlich. Genaue Werte siehe Schaltteilliste.

hierzu 120001Sa

Stromlauf zu	Zeichn. Nr.
Anovolt Type UVV	120001 S



ROHDE & SCHWARZ · MÜNCHEN
Dieses Zeichnung ist mein Eigentum. Vervielfältigung, Weitergabe, Verwertung, Mitteilung an andere ist strafbar und schadenersatzpflichtig.

	Name	Datum	Änd.-Mitteilg. Nr.	Änd. zust.
gezeichnet	H. 7. 68	28. 2. 69		a
konstruiert		6. 5. 69		b
geprüft		26. 6. 69		c
normgeprüft		26. 9. 69		d
		23. 2. 70	15076	e

	Name	Datum	Änd.-Mitteilg. Nr.	Änd. zust.
	lbg.	6. 9. 70	15503	1

Änd. zust.	Änd.-Mitteilg. Nr.	Datum	Name		

4396.066.35

Zusammenstell-Vorschrift Nr. R 23230

zur ~~deutschen~~ englischen Geräte ~~Grundgeräte Einschub-Zusatzgeräte-Baugruppen Einsatz-Rahmen Anlagen-~~ Beschreibung für

Typ UVV BN 120001 FNr. EF 701/2/3...12
M 1808/1...100

Zusammenstellung ..... nach Pos.-Nr.
Umschlag ..... Karton mit Rückenbindung
~~Kunststoffordner 40 mm~~
~~Kunststoffordner 60 mm~~
~~ohne, dafür 4fachlochung mit Banderole~~
Umschlagbeschriftung .... auf 1. Seite nach Vorlage R 22870 Bl.0
~~auf Rücken nach Vorlage R~~
Register ..... ~~Nr. 4319 (1 ... 10)~~
~~Nr. 4320 (11 ... 20)~~
~~Nr. 4321 (21 ... 30)~~
~~Nr. 4322 (31 ... 40)~~

Pos.-Nr.	Teil	Sach-Nr.	Blatt-Nr.	ÄZ	Bemerkung
1	Titelblatt	R 22870	1		auf Karton
2	Hinweisblatt	R 14500			
3	Beschreibung	R 22870	2...35		
4	Übers.-Liste	R 22870	36		
5	Schaltteilliste	120001 Sa	1	b	
6	"	"	2	a	
7	"	"	3	-	
8	"	"	4	b	
9	"	"	5	a	
10	"	"	6	a	
11	"	"	7	a	
12	"	"	8	b	
13	Übers.-Liste	R 22870	37	-	
14	Stromlauf	120001 S		f	
15	Zus.-Vorschrift	R 23230			

5 KWB	Name	Datum	5 ZU	Name	Date	
bearb.	Mayer	4.10.71	Transl.	Mä	Sept.71	
geschr.	Mayer	5.10.71	Typed	Eck		
geprüft			Liste besteht aus 1 Blatt			R 23230