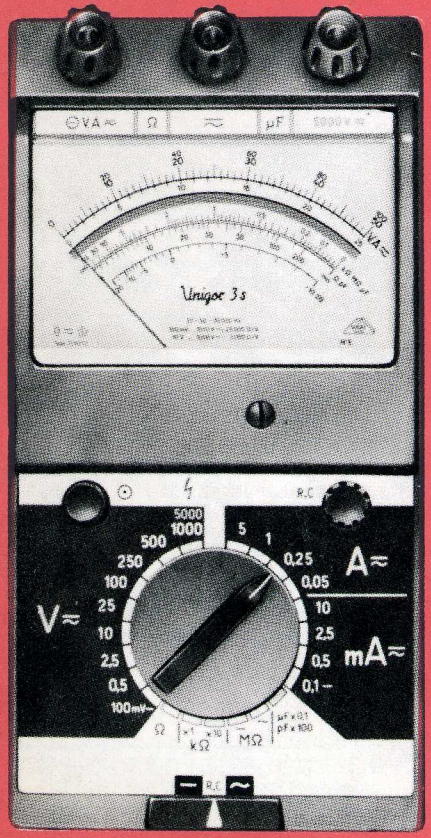
Unigor 3s



C. P. GOERZ
ELECTRO
AKTIENGESELLSCHAFT

Instruction manual

for

– Unigor 3s –

Model 22 62 13

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C. P. GOERZ ELECTRO AKTIENGESELLSCHAFT
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The new

— Unigor 3s —

continues the tradition of the multirange instruments manufactured by C. P. GOERZ and is noted for a number of remarkable innovations:

contemporary style and practical construction of operational elements;

still greater reliability by use of Germanium diodes, and

increased overload protection by use of an additional fuse.

The solid construction and advantages due to special circuit features ensure that the new **Unigor 3s** will meet the highest demands. Unigor 3s is capable of being used as a measuring instrument in every field of electrical engineering but will prove particularly useful for radio, television, and communication engineering where demands for sensitivity are particularly high.

Internal resistance
25,000 Ω/V on DC
2,000 Ω/V on AC

Accuracy
±1% for DC measurements
±1.5% for AC measurements

Moving Coil System
with shock-resistant taut suspension movement (no pivot friction).

Mirrored Scale
88 mm length with linear graduations for all current and voltage ranges.

Overload protection
is achieved by a very sensitive cut-out switch, fuse and a voltage suppressor for the Germanium diodes.

Special circuit features
A built-in current transformer enables a measurement of the DC and AC components of an alternating current with a superimposed direct current.

Built-in power supply for resistance measurements. Well planned construction with printed circuit plates.

Technical data

Ranges

DC ranges (—)			
Voltage	Internal resistance	Current	Intern. resist. approx.
5,000 V	25 MΩ	5 A	0.12 Ω
1,000 V	25 MΩ	1 A	0.45 Ω
500 V	12.5 MΩ	0.25 A	1.2 Ω
250 V	6.25 MΩ	0.05 A	6 Ω
100 V	2.5 MΩ	10 mA	30 Ω
25 V	625 kΩ	2.5 mA	120 Ω
10 V	250 kΩ	0.5 mA	530 Ω
2.5 V	62.5 kΩ	0.1 mA	1,900 Ω
0.5 V	12.5 kΩ	40μA(100mV)	2,500 Ω
100 mV (40μA)	2.5 kΩ	—	—

AC ranges (~)				
Voltage	Output	Internal resistance	Current	Intern. resist. approx.
5,000 V	—	25 MΩ	5 A	0.12 Ω
1,000 V	—	2 MΩ	1 A	0.45 Ω
500 V	+46 dB	1 MΩ	0.25 A	1.2 Ω
250 V	+40 dB	500 kΩ	0.05 A	6 Ω
100 V	+32 dB	200 kΩ	10 mA	50 Ω
25 V	+20 dB	50 kΩ	2.5 mA	80 Ω
10 V	+12 dB	20 kΩ	0.5 mA	1,000 Ω
2.5 V	dB-Scale	1 kΩ	—	—
0.5 V	−14 dB	50 Ω	—	—

Resistance- and capacity ranges			
Range		Centre scale values	Measuring voltage
Ω	1 Ω...200 Ω	33 Ω	1.5 V-battery
kΩ×1	20 Ω... 50 kΩ	1 kΩ	
kΩ×10	200 Ω...500 kΩ	10 kΩ	
MΩ —	20 kΩ... 50 MΩ	1 MΩ	100...130 V —
MΩ ~			100...240 V ~
pF×100	100 pF...20,000 pF	3,300 pF	100...240 V ~
μF×0.1	2,000 pF...5 μF	0.1 μF	45... 65 c.p.s.

Extension of ranges

Extended range	with	Model
100 A —	Plug-in	GE 42 60
50 A —	shunt 100 mV	GE 42 59
25 A —	Accuracy class 0.5	GE 42 58
500/5 A ~ 100/1 A ~ 25/0.25 A ~	Current-transformer (100:1) for a burden of 500/5A and 5 VA: class 0.2 additional error with UNIGOR 3 smaller than 0.2% (45 . . . 65 c.p.s.)	GE 44 07
500/0.25 A ~ 100/0.05 A ~ 20/0.01 A ~	Clip on current transf. (2,000:1) additional error smaller than 3% (45 . . . 65 c.p.s.)	GE 44 53
25 kV — (625 MΩ)	Voltage multiplier (test probe)	GE 41 30
10 kV ≈ (50 MΩ)	Voltage multiplier 5 kV (25 MΩ) additional error smaller than 5%	GE 41 54

Accuracy

Limits of error

The limits of error as stated below apply for horizontal position, at an ambient temperature of 20 deg. Centigrade and for sinusoidal AC of 50...60 c.p.s.

Current and voltage ranges (V, A)

DC: ±1% of full scale
AC: ±1.5% of full scale
5000 V≂: ±2.5% of full scale

Resistance and capacity ranges

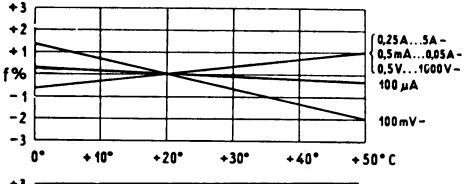
DC: ±1% of scale length
±4% of measured value at centre scale
AC: ±1.5% of full scale
±6% of measured value at centre scale

Influence of temperature

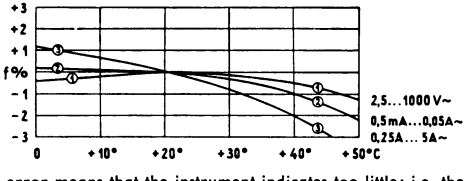
On DC a maximum of 0.8% of the rated value, on AC a maximum of 1% of full scale, for every 10 deg. Centigrade.

The approximate magnitude of the additional temperature error within a temperature range of 0 deg. Centigrade to +50 deg. Centigrade is shown by the following graphs.

Additional temperature error ft in % of true value for DC



Additional temperature error ft in % of full scale deflection for AC



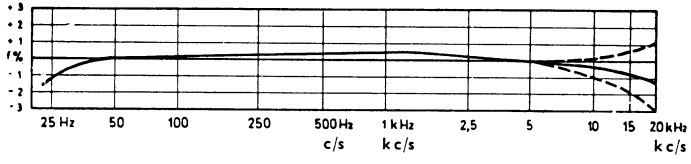
Note: A negative additional error means that the instrument indicates too little; i.e. the true value is obtained by adding the stated percentage to the reading.

Influence of frequency

The frequency error for voltage ranges up to 500 V and current ranges up to 0.25 A is for

25 c.p.s....10,000 c.p.s.: 1.5% max. of full scale
10,000 c.p.s....20,000 c.p.s.: 3% max. of full scale.

The approximate magnitude of the additional frequency error within a frequency range of 25 c.p.s. to 20,000 c.p.s. is shown by the following graph.



The maximum frequency error of 3% is also valid for voltage range 1,000 V in the frequency range up to 1,500 c.p.s. as well as for current ranges 1 and 5 A up to 5,000 c.p.s.

The input capacity of Unigor 3s is approximately 70 pF for all AC ranges.

External field influence

The influence of an external DC or AC field (50 c.p.s.) of 5 Gauss is negligible.

Influence of wave form

When calibrating Unigor in effective values the form factor (effective value divided by mean value) of 1.11 for sinusoidal waves was taken into account. A deviation from the sinusoidal form may cause an error. In general a peaked wave will cause a negative, a flat-topped wave a positive error.

Test voltage

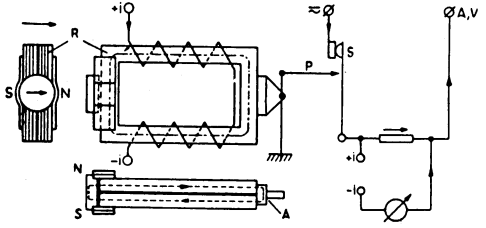
5,000 V according to IEC and VDE standards. The voltage test at 5,000 V assures safe operation of the instrument at voltages up to 1,500 V. At higher voltages the instrument must never be touched and for this reason the "5,000 V" range is clearly marked with a red warning arrow.

Overload protection

The Unigor 3 s is protected by several independent means against damage due to faulty use and overloads.

Protective cut-out switch

A sensitive relay connected in series with the measuring movement opens a contact and breaks the measuring circuit when the instrument is subjected to an overload.



The high sensitivity of the relay is due to the utilization of the principle of saturation blocking. The relay armature (A), which is attached to a contact spring (S), is held to the relay yoke (R) by a permanent magnetic flux. A certain excitation of the relay coil causes saturation in the yoke. The increase of magnetic resistance due to the saturation reduces the holding flux of the permanent magnet NS, so that the armature is moved away by the force (P) thereby opening the contact of the protective cut-out switch.

The overall breaking period from the moment of overload to the interruption of the measuring circuit is 0.005 to 0.01 sec. The relay operates both on DC and AC excitation. The actuating current is about 10 to 20 times as high as the current of the movement for full scale deflection. Thus, as a rule, the protection is effective at a measured value equalling 10 to 20 times the amount of the range selected.

The protective cut-out switch prevents furthermore a short in the 5 A-position should the range selector be erroneously turned from the 1,000 V-range to the 5 A-range during a voltage measurement. In the position between the two ranges, marked by an asterisk (*) in the circuit diagram, the relay is directly connected to the input in series with a resistor to actuate the cut-out switch before the 5 A-position is reached. Max. cut-off power: 15 kVA AC, 2 kw DC (500 V)

H.R.C. fuse: To protect the high current ranges, especially the 5 A-range, at which the cut-out switch would only become operative between 50 and 100 A, a fuse rated at 6 A is inserted into the circuit which also protects the instrument against a direct short in any current range.

Rectifier protection: A neon lamp with an especially low ignition voltage connected in parallel to the secondary winding of the instrument transformer, limits the damaging voltage peaks to permissible values, thus protecting the Germanium diodes.

Although the cut-out switch provides the instrument with an almost perfect overload protection the possibility of damage to the components has still to be considered should the instrument be subjected to very heavy overloads in worst cases of misuse.

The following rules should therefore be observed:

After the current range has been selected, the instrument must never be connected to voltages. A prolonged overload below the operating value of the cut-out switch or the H.R.C. fuse rating should under all circumstances be avoided because of the thermal strain on the electrical components. Furthermore, even momentary connections to voltages exceeding 1,000 V (or in excess of 5,000 V to the 5,000 V terminal) should be avoided since the instrument is not designed for higher voltages (see also page 10).

In cases of sudden overload of at least 40 times the normal value on DC (the AC—DC switch being erroneously in the "~" position) the relay is actuated by the current impulse occurring in the secondary winding of the transformer. However, the cut-out switch is not effective against a direct current building up slowly. Heavy mechanical shocks or the effects of strong external fields on the relay may trip the cut-out switch into its "OFF" position. Such external fields have, however, no influence on the reading.

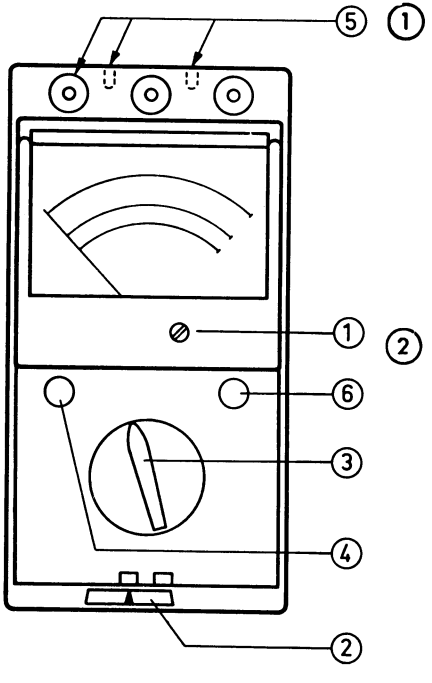
During current measurements on the secondary side of powerful instrument transformers it is advisable to keep the protection switch button depressed in its "ON" position to avoid an accidental interruption of the transformer secondary circuit.

After the instrument has been subjected to an overload the cut-out switch should not be reset before the cause for its actuation has been rectified.

The fuse and spare cartridges are accessible after the removal of the base plate (rated current 6A, 5 mm dia., 25 mm long).

Measuring operations: general remarks

To avoid errors place Unigor in approximately horizontal position and not in the proximity of iron masses, external fields (busbars) or other moving coil instruments.



(1) With the current cut off check the zero position adjustment of the pointer. After cleaning the scale window the electrostatic charge should be neutralized by breathing on the glass or touching it or wiping it with a damp cloth.

(2) Set the AC—DC switch to the desired position : DC(—), AC(~), or for measuring resistances and capacitances to the central position (R, C). Changing from — to ~ through the R,C position during measurement permissible. This does not interrupt the circuit.

(3) Set the range selector to the required range. When measuring current or voltage always begin with the highest and switch down to the most suitable smaller range. This does not interrupt the circuit.

(4) Before connecting Unigor press push button into the "ON" position should it be in the "OFF" position.

(5) (6) Connection of the instrument and operation of the RC-knob according to the detailed instructions in the following paragraphs. There are abridged instructions on the base plate.

Please observe range limits. For measuring higher values always use separate voltage multiplier and shunt or use instrument transformer or clip-on transformer.

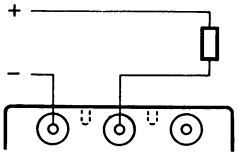
Earthing conditions and maximum voltages to earth will be discussed in detail in the instructions for the measurements of current and voltage.

When measuring DC voltages with non-repetitious or periodically repetitious superimposed voltage peaks exceeding 1,000 V the 5,000 V-range must be selected. Otherwise flash-overs might occur which would impair the insulating quality of the internal circuit and cause burn-outs of essential components. Such peaks may occur e.g. in an iron core winding through which a direct current is flowing when the circuit is suddenly interrupted. These excessive high voltage peaks may also occur during measurements of transducers or television sets.

After use the range selector is always to be set to the highest voltage range. Do not use the range selector to switch off the circuit as the position between 1,000 V and 5 A is not an "OFF" position, but a protective position (see page 8).

DC current measurements

direct connection for currents up to 5A

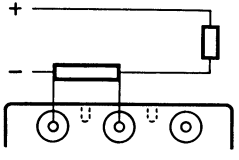


Range selector : 5A to 0.1 mA
AC — DC switch: "—"
Reading on : V,A-scale

with separate shunt for currents exceeding 5A

Besides the plug-in shunts for 25, 50 and 100 A/0.1 V (see page 4), which have been especially designed for the instrument other existing shunts may also be used for the measurement of higher currents.

According to the rated voltage drop across the shunt the connections should be made as follows:

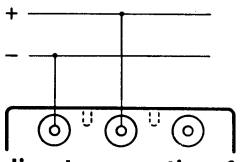


Rated voltage drop across shunt:	60 mV	100 mV	300 mV
Range to be selected (AC - DC Switch "—")	0.1 V	0.1 V	0.5 V
Full scale value at scale division with scale markings	60 30 15	100 50 25	60 30 15

Whenever possible connect Unigor to that conductor which has a lower voltage to earth. For safety reasons this voltage must not exceed 1,500 V.

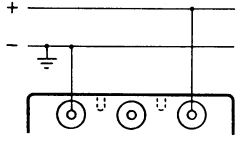
DC voltage measurements

direct connection for voltages up to 1,000 V (25,000 Ω/V)



Range selector : 1,000 V to 100 mV
AC—DC switch: "—"
Reading on : V,A-scale

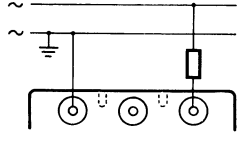
direct connection for voltages up to 5,000 V (25 MΩ)



Range selector : 5,000 V
AC—DC switch: "—"
Reading on : V,A-scale

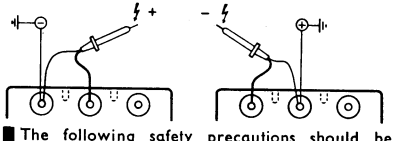
with separate voltage multiplier up to 10 kV (50 MΩ)

voltage multiplier 5 kV (25 MΩ), model GE 4154



Range selector : 5,000 V
AC—DC switch: "—"
Reading on : V,A-scale

with high voltage probe up to 25 kV (625 MΩ) model GE 4130



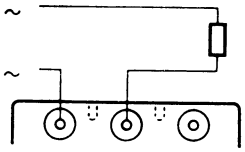
Range selector : 0.5 V
AC—DC switch: "—"
Reading on : V,A-scale

The following safety precautions should be taken when measuring voltages exceeding 1,500 V:
Connect one of the two voltage terminals, when using the test probe also the protective lead, directly to earth potential. Where this is impossible other safety precautions must be taken.
First connect instrument and select measuring range, then switch on the voltage or probe the voltage with test probe.
Do not touch the instrument when under voltage.

For technical data of the separate voltage multipliers see page 4.

AC current measurements

direct connection for currents up to 5 A



Range selector : 5 A to 0.5 mA
AC—DC switch: "~"
Reading on : V,A-scale

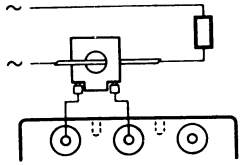
Whenever possible connect Unigor to that conductor which has the lower voltage to earth. For safety reasons this voltage must never exceed 1,500 V.

with separate current transformer up to 500 A

AC currents exceeding 5 A are to be measured with a separate instrument transformer model GE 4407 (see page 4).

The secondary winding is to be connected to the two "≂" terminals. The primary conductor for the current to the measured should be threaded through the transformer hole once or several times in the same direction according to the required range.

The current transformer is tested for a maximum service voltage of 650 V. When this voltage is exceeded do not touch the instrument or the connection leads to the transformer.



Range selector : According to table
AC—DC switch: "~"
Reading on : V,A-scale

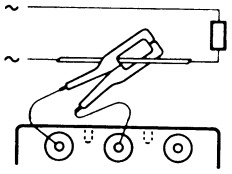
Extended current range at n primary turns				Range on Unigor 3 s
n=1	n=2	n=5	n=10	
500 A	250 A	100 A	50 A	5 A
100 A	50 A	20 A	10 A	1 A
25 A	12.5 A	5 A	2.5 A	0.25 A

The accuracy of the current transformer corresponds to class 0.2 for a secondary output up to 5 VA and a nominal current ratio of 500:5.

The additional error due to the insertion of this transformer does not exceed 0.2% of the full range value at a frequency of 45...65 c.p.s. This applies to all ranges listed in the chart.

with clip-on transformer up to 500 A

For AC current measurements without interrupting the circuit, the clip-on transformer model GE 4453 (see page 4) should be used (turns ratio 2,000:1). Connect the two sockets in the handles of the clip-on transformer to the "≂" terminals of Unigor.



Clip-on transformer range: 500 A, 100 A, 20 A
Range selector : 0.25 A, 0.05 A, 10 mA
AC—DC switch : "~"
Reading on : V,A-scale

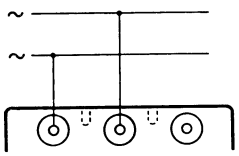
The possible additional error due to the clip-on transformer will not exceed ±3% of full range, provided the surfaces of the plier core are in contact with each other practically without an airgap. It is therefore essential to keep the surfaces clean.

Use the clip-on transformer only for service voltages up to 650 V.

AC voltage measurements

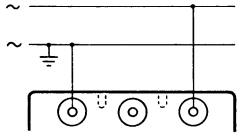
direct connection for voltages up to 1,000 V

Internal resistance at 0.5 V: 50 Ω
2.5 V: 1,000 Ω
10 to 1,000 V: 2,000 Ω/V



Range selector : 1,000 V to 0.5 V
AC—DC switch: "~"
Reading on : V,A-scale

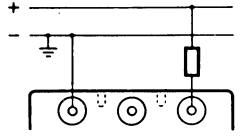
direct connection for voltages up to 5,000 V (25 MΩ)



Range selector : 5,000 V
AC—DC switch: "~"
Reading on : V,A-scale

with separate voltage multiplier up to 10 kV (50 MΩ)

voltage multiplier 5 kV (25 MΩ) model GE 4154



Range selector : 5,000 V
AC—DC switch: "~"
Reading on : V,A-scale

For reasons of safety the following should be noted when measuring voltages above 1,500 V:

Connect one of the two terminals used directly to earth potential. Where this is impossible other safety precautions have to be taken. Connect instrument and select the desired range before switching on the voltage.

AC current and voltage measurements with frequencies up to 20,000 c. p. s.

In order to guarantee an equally high accuracy for frequencies up to 20,000 c.p.s. the terminal ⊖ should be earthed or connected to that measuring point which has the least potential to earth. At higher frequencies the input capacity causes a reduction of the internal resistance

The input capacity is approximately 70 μμF.

Measurement of superimposed DC and AC

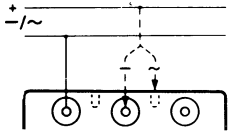
without blocking off the DC component

By means of a built-in transformer it is possible to determine the AC and DC components by a current or voltage measurement. The measurement is to be carried out in exactly the same manner as has been described in the preceding paragraphs for current and voltage measurements (pages 11...15).

To avoid overloading Unigor the selected range must not be smaller than the DC or AC component to be measured. It is therefore important to measure both, AC **and** DC component, before selecting the next smaller range.

with the DC component blocked off

In any measurements in the audio-frequency range of AC voltage with superimposed DC it is desirable to block off the DC component. This is achieved by connecting to terminal ⊖ and socket "μF". A condenser within the instrument then blocks the DC component for voltages up to 750 V. This voltage is not to be exceeded to avoid destruction of the condenser.



Proceed now with the AC measurements as outlined previously. Owing to the condenser connected in series to the internal resistance of the instrument, the reading will be influenced by the frequency in the lower frequency ranges (see table).

The additional error will decrease with increasing frequency and range.

Additional negative error Δf in % of indication	in the ranges			
	10 V~	25 V~	100 V~	250 V~
≦ 0.5	≧ 800 c.p.s.	≧ 320 c.p.s.	≧ 80 c.p.s.	≧ 32 c.p.s.
≦ 1	≧ 560 c.p.s.	≧ 220 c.p.s.	≧ 56 c.p.s.	
≦ 1.5	≧ 450 c.p.s.	≧ 180 c.p.s.	≧ 45 c.p.s.	≧ 25 c.p.s.
≦ 2.5	≧ 350 c.p.s.	≧ 140 c.p.s.	≧ 35 c.p.s.	

Measurement of current and voltage amplification (attenuation) in decibels

The decibel scale permits the direct reading of current and voltage amplification (attenuation) in decibels. The amplification (attenuation) is proportional to the logarithmic ratio of the voltage (current) in decibels (dB) at the input and output of a four terminal network, e.g. at transmission lines, amplifiers, attenuation units, etc. The dB-values for amplification are given positive, those for attenuation negative signs.

The dB-scale is therefore graduated in positive and negative values, starting from a reference point (0 dB). The reference point 0 dB, also called 'level zero' is defined by a power of 1 mW in a resistor of 600 Ω which corresponds to a voltage of 0.775 V.

The definition of the reference point 0 dB (level 0) is used in connection with measurements of power level and of residual attenuation in communication engineering, which is, as a rule, carried out with a standard generator as signal source. The standard generator has an emf of 1.55 V and an internal resistance of 600 ohms and when connected to a four terminal network with an impedance of 600 ohms will cause a voltage of 0.775 V at its input terminals. The output level can be read directly in dB if the instrument is set to the 2.5 V-range. For other ranges a range constant expressed in dB has to be added to the dB-scale reading owing to the level difference to the 2.5 V-range. These range constants for ranges up to 500 V are listed in the following table (see also base plate):

Voltage Ranges	0.5 V	2.5 V	10 V	25 V	100 V	250 V	500 V
Range constant k	—14 dB	0	+12 dB	+20 dB	+32 dB	+40 dB	+46 dB

Example: At the input of a four terminal network a level of $be = -5$ dB is read in the 2.5 V-range ($ke = 0$) and a level of $ba = +9$ dB is read at the output, the instrument being now set to the 25 V-range ($ka = +20$). The voltage amplification is the level difference between output and input level taking into account the relevant range constant k. Level difference $= ba + ka - (be + ke) = 9 + 20 - (-5 + 0) = 34$ dB. The voltage amplification is therefore 34 dB.

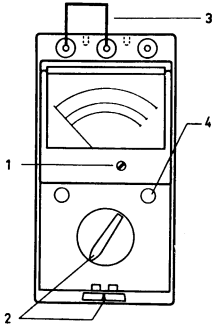
Another unit of attenuation, much in use, is the neper. If the value read on the decibel scale in dB is to be expressed in neper the reading has to be multiplied by 0.115, owing to the relation 1 dB = 0.115 neper or 1 neper = 8.68 dB.

Resistance measurement with built-in battery

Before use a standard dry cell of 1.5 V (approx. 20 dia × 37 mm) is to be inserted into the battery compartment. The battery compartment is located on the underside of the instrument and is easily accessible by unfastening the knurled screw and removing the base plate. It is recommended to check the condition of the battery from time to time and to replace a battery that has started to decompose, before it soils the battery compartment.

Adjustment of Unigor before measuring

Ranges: Ω, kΩ×1, kΩ×10



Short circuit black terminals

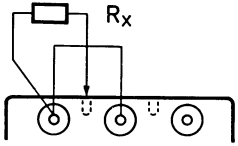
Correct possible deviation of pointer from zero with zero adjuster

Adjust R,C-knob to full scale deflection (0 on kΩ, MΩ, μF-scale)

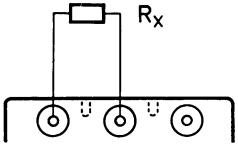
The battery should be replaced when the pointer cannot be adjusted to full scale or indication after adjustment does not remain constant. Range of adjustment approx. 1.65 ...1.3 V

Set the AC—DC switch to "R, C" and select range required

Carrying out the measurement



Range : Ω (1 Ω...200 Ω)
Connection : Short circuit black terminals. Connect R_x to terminal ⊖ and socket Ω
Reading on: Ω,pF-scale in ohms



Range : kΩ× 1 (20 Ω... 50 kΩ)
kΩ×10 (200 Ω...500 kΩ)
Connection : R_x to black terminals
Reading on: kΩ, MΩ, μF-scale directly in kilo ohms in range kΩ×1

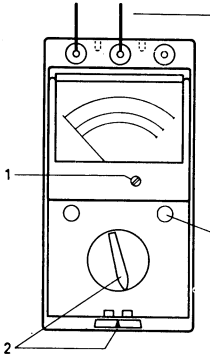
In range kΩ×10 the reading is to be multiplied by 10

Resistance and capacity measurements with external voltage supply

Adjustment of Unigor before measuring

Ranges: MΩ—, MΩ~, pF×100, μF×0.1

External voltage 100...130 V— in MΩ— range
100...240 V~ in MΩ~, pF×100,
μF×0.1 ranges



Connect black terminals to AC or DC voltage according to range selected. In capacity measurements the range of the measuring voltage is only valid from 45 to 65 c.p.s. The accuracy is independent of frequency

Correct possible deviation of pointer from zero with zero adjuster

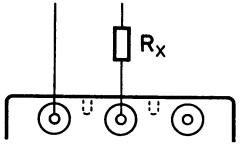
Adjust R,C-knob to full scale deflection (0 on kΩ, MΩ, μF-scale)

Set the AC—DC switch to "R,C" and select range required

Carrying out the measurement

Range: MΩ— (20 kΩ...50 MΩ)

100...130 V—

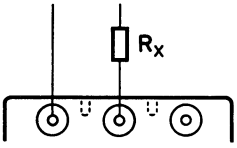


Connection: Insert resistance Rx between one pole **of the external DC voltage** and one terminal of the instrument

Reading on kΩ, MΩ, μF-scale in Megohms

Range: MΩ~ (20 kΩ...50 MΩ)

100...240 V~

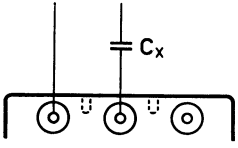


Connection: Insert resistance Rx between one pole **of the external AC voltage** and one terminal of the instrument.

Reading on the kΩ, MΩ, μF-scale in Megohms.

Range: pF×100 (100...20.000 μμF)

100...240 V~

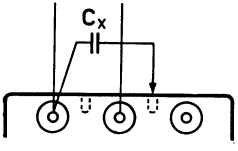


Connection: Insert condenser Cx between one pole **of the external AC voltage** and one terminal of the instrument.

Reading on Ω,pF-scale multiplied by 100 will give the value of Cx in pico-farad.
(1 pF=1 μμF=10^{-6}μF).

Range: μF×0.1 (2000 μμF...5 μF)

100...240 V~



Connection: Connect **external AC voltage** directly to terminal of Unigor. Connect condenser Cx to terminal ⊖ and μF-socket.

Reading on kΩ, MΩ, μF-scale multiplied by 0.1 will give the value of Cx in micro-farad.

The above described capacity ranges are not suitable for the measurement of **electrolytic condensers.**

Maintenance

The instrument does not require any special maintenance. It is, however, recommended to replace the battery as soon as its voltage is so low that the pointer cannot be adjusted to full scale deflection by means of the R,C-knob or the indication does not remain constant after the adjustment. A discharged or decomposing battery should be removed from the battery compartment. The condition of the battery should therefore be checked from time to time. The battery is easily accessible after removing the base plate.

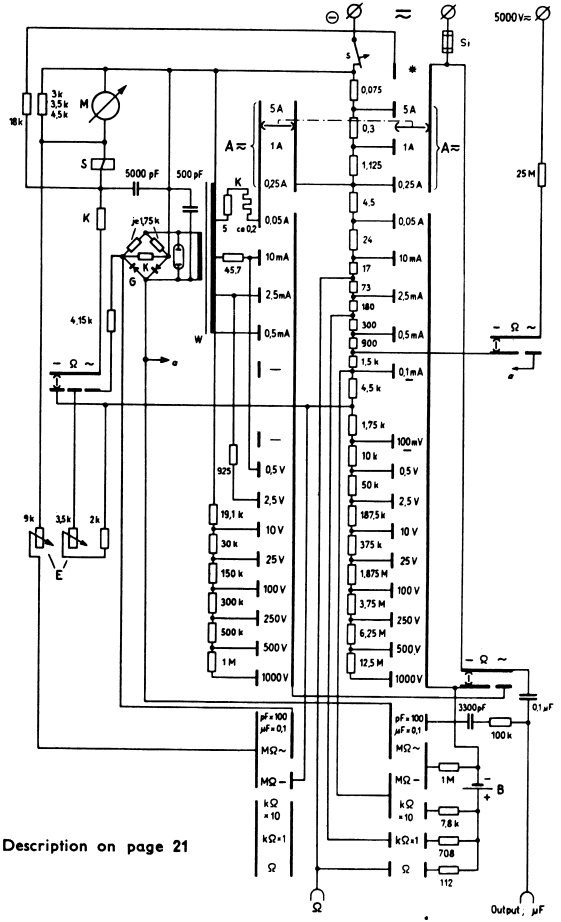
When the instrument is soiled by dust, liquids, etc. it should be cleaned with a dry, soft cloth, if necessary with alcohol or spirit. **Special care has to be taken to keep the surface between the terminals clean, since a heavy layer of dirt in this area will impair the insulation and may reduce the input resistance, especially in the high voltage ranges.**

M = taut suspension movement
W = instrument transformer
G = rectifier bridge
S = cut-out switch relay
s = cut-out switch contact

Si = fuse
B = 1.5 V battery
E = adjuster for resistance and capacity ranges

The resistors marked K serve for the adjustment of the resistance of the moving coil system and the cut-out switch to 833 ohms as well as for the sensitivity adjustment of the AC ranges.

Circuit diagram



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