INSTRUCTION MANUAL

Type IM5

MEGOHMMETER

RADIOMETER

ELECTRONIC MEASURING INSTRUMENTS

FOR SCIENTIFIC AND INDUSTRIAL USE

INSTRUCTION AND OPERATING MANUAL

FOR

Type IM5
MEGOHMMETER

INDEX

MEGOHMMETER

Type IM5

INTRODUCTION

The Megohmmeter is intended for measuring resistances in the range 1 MΩ to 100×10^6 MΩ. The field of application comprises measurements of insulation resistance of capacitors, transformers, cables, insulation materials, including printed circuit boards.

The Megohmmeter is provided with a special guard circuit which makes it possible to make measurements which require guarding, such as measurements of the leakage between two cable cores or measurements of insulation resistance in three-terminal networks.

The Megohmmeter is provided with the test voltages 50, 100, 200, 500, and 1000 volts. As the short circuit current is limited to 4 mA, the Megohmmeter will not be highly dangerous to the operator. Neither will it be damaged in the case of a short-circuit in the unknown under measurement.

The Megohmmeter is provided with a charging circuit which is used when measuring the insulation resistance of capacitors. Among other things the circuit has the effect that even very large capacitors are rapidly charged.

SECTION I

GENERAL DESCRIPTION

1.1 OPERATING PRINCIPLE

The operating principle of the Megohmmeter appears from the simplified schematic diagram shown in fig. 1 of drawing No. 1523-A4.

In combination with the standard resistance R_N the resistance R_X of the unknown forms a voltage divider across which a d-c test voltage is impressed. The voltage present across the standard resistance R_N depends on the ratio between R_X and R_N and is fed to a vacuum-tube voltmeter where it gives rise to a deflection on the meter which is calibrated directly in megohms. The vacuum-tube voltmeter is of the vibrator type, so it has no zero drift. Full deflection is had when the unknown resistance R_X is 1000 times as high as the standard resistance R_N (10,000 times on the highest range).

The d-c test voltage is drawn from a built-in electronically regulated d-c source thus eliminating the influence of line voltage variations.

When calibrating the Megohmmeter (switch B at position CALIBRATE) the input voltage of the vacuum-tube voltmeter is drawn from a voltage divider (1:1000 or 1: 10,000) which is fed from the test voltage. Thus the absolute magnitude of the test voltage will be of no importance as the calibration and measurement is made at the same voltage. The amplifier of the vacuum-tube voltmeter can be so adjusted that the meter deflects to a calibration mark on the scale.

When measuring the insulation resistance of large capacitors, a special charging circuit is used. When the switch B is set to CHARGE, the capacitor is charged through the resistor r instead of the standard resistor. As the resistance r is low, the capacitor is rapidly charged. If the insulation resistance is measured after a certain time, the time can therefore, even in the case of large capacitors, be counted from the moment when the charging commences. During the charging the vacuum-tube voltmeter is connected to the arm of the potentiometer r. When adjusting the potentiometer, it is possible to have a suitable de-

eIM5
1-1a/958

flection of the meter of the vacuum-tube voltmeter corresponding to a specified limit value.

When the switch B is set to MEASURE, the change in deflection will be dependent on the insulation resistance in proportion to the limit value.

It is a condition that the standard resistance is adjusted in accordance with the limit value.

The unknown, R_X, is connected to the two terminals marked + and - which are insulated from the internal chassis so that no leakage will occur between the terminals but only from each of the terminals to the internal chassis. See fig. 2, drawing No. 1523-A4 where R_1 and R_2 represent the leakage resistances from the terminals. The only requirement is that R_1 is reasonably high in proportion to the standard resistance R_N, which is always the case in practice.

The internal chassis, which is insulated from the external chassis, is connected to the terminal GUARD. External guard electrodes may be connected to this terminal. The principle of this appears from the examples given in item 1.3.

By means of switch A the terminal marked - or the terminal GUARD can be connected to the EXTERNAL chassis. At ordinary measurements the switch is set at - thus grounding the terminal marked -, to which grounded terminals of the unknown are connected.

When the switch B is at the position CALIBRATE, the terminals marked + and - are dead. Furthermore the unknown is automatically short circuited through 44 kΩ so that the operator is not exposed to danger from loaded capacitors or cables.

1.2 THE STABILITY OF THE TEST VOLTAGE

When measuring large high-quality capacitors, an extremely high stability of the test voltage is required. Owing to the high insulation resistance of the capacitor the standard resistor R_N must adapt a high value (the ranges $x10^5$ or 10^6) to obtain a reasonable deflection on the meter. This involves a high time constant which depends on the capacitor and the resistance standard. A change in the test voltage will be transferred directly to the input of the vacuum-tube voltmeter without being exposed to the voltage division which generally occurs in the case of purely ohmic unknowns. Owing to the high time constant, however, it will be long before the voltage transferred to the vacuum-tube voltmeter dies away, so the meter needle will make jerky movements when the instrument is connected to an unstable power line.

At a test voltage of for instance 1000 volts a change in voltage of 0.001% due to a line voltage variation of 1% will have the effect that a voltage of 10 mV is transferred to the input of the vacuum-tube voltmeter. As the sensitivity on the ranges up to x10^5 megohms inclusive is 1 volt for full deflection (the 1 MΩ graduation mark), the transferred voltage will amount to 1% of full deflection. On the range x10^6 megohms the sensitivity has been increased to 100 mV for full deflection so that the voltage transferred will now amount to 10% of the input voltage corresponding to full deflection. Similar conditions apply to the other test voltages.

From this it appears that it is advantageous to use the range x10^5 megohms as much as possible, i.e. to utilize the meter scale up to the 100 MΩ graduation mark before switching to the range x10^6 megohms.

1.3 GUARDING

The principle of the guarding system appears from figs. 3 & 4 of diagram No. 1524-A4. Fig. 3 illustrates a set-up for measuring the specific resistance of an insulating material. The external guard electrode 3, which is connected to the GUARD terminals is intended for guarding of leakage currents along the surface of the insulating material between the electrodes 1 and 2. Switch A (GROUNDING SWITCH) is in position —. In the equivalence diagram leakage resistance is shown instead of the leakage current proper. It will be seen that R_{2-3} loads the power supply which, however, is of no importance when only R_{2-3} is greater than about 2 megohms. R_{2-4} is of no importance because the terminal marked — is grounded. R_{1-3} shunts the resistance standard, but if R_{1-3} is of a reasonably high value in proportion to R_N (e.g. 100 times higher than R_N) the shunting will not affect the result of measurement seriously.

The table on next page states the value of R_N as a function of the setting of the range switch (MULTIPLIER).

range (MULTIPLIER switch)	resistance value of R_N
x1	1 kΩ
x10	10 kΩ
$x10^2$	100 kΩ
$x10^3$	1 MΩ
$x10^4$	10 MΩ
$x10^5$	100 MΩ
$x10^6$	100 MΩ

NOTE: Make sure that the lead from electrode No. 1 to the terminal marked + does not touch the cabinet or the lead which is connected from electrode No. 2 to the terminal marked –, as the insulation resistance of the lead will affect the result of measurement.

Fig. 4 shows a set-up for measuring the direct leakage between two conductors in a cable. The conductors 1 and 2 are connected to the terminals marked + and –, while the jacket 3 is connected to the terminal GUARD. The A switch (GROUNDING SWITCH) is in position GUARD. It appears from the equivalence diagrams that the leakage resistances R_{1-3} and R_{2-3} from the conductors 1 and 2 to the jacket 3 do not affect the result of measurement. R_{2-3} loads the power supply which is of no importance when only R_{2-3} is greater than 2 megohms. R_{1-3} shunts the resistance standard R_N, but if the value of R_{1-3} is reasonably high in proportion to R_N (e.g. 100 times higher than R_N), the shunting will not affect the result of measurement seriously.

NOTE: There is a potential difference between the terminal marked – and the cabinet when the GROUNDING SWITCH is in position GUARD.

SECTION 2

DETAILED DESCRIPTION OF THE TYPE IM5 MEGOHMMETER

The type IM5 Megohmmeter consists essentially of three units, viz., a power supply, a switch unit, and a vacuum-tube voltmeter. The electric operation of these units is described in detail below. The complete circuit diagram of the instrument is shown in the schematic diagram appended to the instructions.

2.1 POWER SUPPLY

By means of a voltage selector, the primary of the transformer T1 can be set to any of the voltages 110, 115, 127, 200, 220, or 240. Furthermore, the primary has a tap of 10 volts. By moving the lead that is connected to the zero of the winding to this tap, the Megohmmeter can be adapted to voltages that are 10 volts below the nominal ones.

The voltage from one of the secondaries of the line transformer is rectified in the bridge rectifier CR5 and via the filter C17 and R47 and the dropping resistor R46 fed to the voltage-regulator tube V5 across the anode of which a +150 volt d-c voltage is drawn for the operation of the vacuum-tube voltmeter. The voltage-regulator tube V4 is operated on +150 volts and gives off a d-c voltage of +85 volts which is used as reference voltage in the electronic voltage-regulator circuit.

The other secondary of the line transformer is provided with several taps from which it by means of the switch VOLTAGE SELECTOR (S3E) is possible to select the a-c voltage corresponding to the desired test voltage. The a-c voltage is fed from the switch to the voltage-doubler rectifier CR6, CR7, C19, and C20. The positive terminal of the rectifier is connected to the anode in the series-regulator tube V6, while the negative terminal is connected to the binding post E2. The necessary degree of stabilization of the test voltage is obtained by regulating the internal resistance of the series-regulator tube V6 so that it picks up a higher plate voltage, in the case of an increasing voltage from the voltage-doubler rectifier circuit and vice versa. By this means, the test voltage can be kept comparatively constant.

By means of the VOLTAGE SELECTOR (S3D), the negative terminal of the voltage-doubler rectifier is coupled to a resistance network (R49 to R58) the other end of which is coupled to the reference voltage +85 volts. As the reference voltage is constant, any change in the test voltage will give rise to a certain error voltage across the output of the resistance network which is connected to the emitter in the transistor Q1. The collector voltage is drawn across a tap of the resistance network. The error voltage amplified by the transistor is fed to the grid of the series regulator tube V6 via a compensation diode, tube V7. The compensation diode is intended for the cancellation of heater voltage variations, if any. As a definite change of the heater voltage is the equivalent of a definite change of the cathode potential referred to the other electrode potentials, the operating point of the series regulator tube would be displaced in the absence of the compensation diode.

To obtain an optimal stabilization of the test voltage the screen grid voltage of the series regulator tube is drawn from the reference-voltage source of +85 volts.

A third secondary gives off voltage for operating the vibrator of the vacuum-tube voltmeter. Furthermore a d-c voltage is supplied after rectification for use in the charging circuit. See items 2.2B and 2.2E.

The fourth secondary supplies filament current for all tubes and dial lamps. Furthermore the winding is loaded with the potentiometer ∞ SETTING R63, which is used when setting the ∞ deflection of the meter. See item 2.3.

2.2 SWITCH UNIT

A description of the operation of the switches, potentiometers, etc., of the switch unit is given below.

2.2A CALIBRATE-CHARGE-MEASURE OPERATING SWITCH

When the operating switch is in position CALIBRATE, a calibrating voltage is fed to the input of the vacuum-tube voltmeter. The calibrating voltage is obtained by a voltage division of the test voltage of 1000:1 (the resistors R35 and R36), which is obtained from the power supply. When the MULTIPLIER switch S2C is in pos. $x10^6$, a 10,000:1 voltage division is made between resistors R35 and R36 paralleled by R37. To avoid shunting of the voltage divider with the resistance standards R27 to R31 of the switch MULTIPLIER S2B, these are automatically disconnected with the operating switch S4 during the calibrating procedure.

In the position CALIBRATE each of the binding posts E1 and E2 are connected to the internal chassis through R33 and R34, respectively. In this way the unknown is short-circuited with 44 kilohms. In the position CHARGE the input of the vacuum-tube voltmeter is connected to the arm of the potentiometer CHARGE (R38) so that a variable input voltage can be fed to the vacuum-tube voltmeter. The binding post E1 is connected to the arm of the potentiometer through the resistor R32. As the total test voltage is fed to the binding post E2, the said resistor is used for protecting the contacts of the operating switch if the unknown is a capacitor, or a short circuit occurs in the unknown.

In the position MEASURE the connection to the arm of the potentiometer CHARGE R38 is cut off. To avoid leakage currents the arm is connected to the internal chassis. For the same reason the output of the voltage divider for the calibrating voltage R35, R36, and R37 is connected to the internal chassis. The binding post E1 has been connected directly to the input of the vacuum-tube voltmeter, the resistor R32 being short-circuited so that it does not affect the result of measurement. As the resistance standard (R27 to R31) is now connected, the test voltage is divided between the resistance of the unknown and the standard resistance. The voltage resulting from the voltage division is present across the terminal E1 and is fed to the input of the vacuum-tube voltmeter.

2.2B VOLTAGE SELECTOR

As mentioned in item 2.1 the switch S3 is used for selecting the tap of the line transformer and the resistance network (R49 to R58) that corresponds to the test voltage desired. Furthermore the amplification of the vacuum-tube voltmeter is changed in accordance with the test voltage as the correct tap of the feedback resistance network R19 to R25 is selected.

At the same time the dropping resistors in the charging voltage circuit R39 to R43 are changed so that the charging voltage fed to the potentiometer CHARGE is set in accordance with the desired test voltage.

2.2C MULTIPLIER SWITCH

The value of the resistance standard is set by means of this switch. In the position x10^5 and x10^6, where all physical resistance standards are disconnected, the resistance standard is represented by the input impedance of the vacuum-tube voltmeter of 100 megohms.

The range x10^6 has been obtained by increasing the sensitivity of the vacuum-tube voltmeter 10 times. This is done by transferring the selection of the tap carresponding to the test voltage desired to the switch section S3B of the VOLTAGE SELECTOR other than that used for the ranges x1, x10......x10^5, S3A. This changing over of the switch section is brought about independently of the actual setting of the VOLTAGE SELECTOR by means of a set of contacts in the MULTIPLIER switch S2A, when only the latter is in position x10^6.

In a similar way the charging circuit is changed, as the charging voltage must be reduced to the same degree as the sensitivity of the vacuum-tube voltmeter is changed in the range x10^6. By means of a set of contacts in the MULTIPLIER switch S2D, a resistance R44 is coupled in parallel across the CHARGE potentiometer R38, thus decreasing the voltage across the potentiometer about 10 times. The parallel coupling is maintained irrespective of the setting of the switch VOLTAGE SELECTOR when only the MULTIPLIER switch is in position x10^6.

As mentioned in item 2.2A the calibrating voltage is decreased to the same degree as the sensitivity is increased in the range x10^6. By means of a set of contacts in the MULTIPLIER switch S2C the resistor R37 is connected in parallel across the resistor R36 so the division ratio is changed from 1000:1 to 10,000:1. The parallel coupling is maintained irrespective of the actual setting of the VOLTAGE SELECTOR when only the MULTIPLIER switch is in position x10^6.

2.2D "CALIBRATE" POTENTIOMETER

By means of the potentiometer CALIBRATE (R26) the feedback factor—and consequently the sensitivity—can be fine adjusted so that when calibrating, it is always possible to obtain the correct sensitivity of the vacuum-tube voltmeter.

2.2E "CHARGE" POTENTIOMETER

The CHARGE potentiometer R38 is used for setting the charge voltage fed to the input of the vacuum-tube voltmeter when the operating switch CALIBRATE-CHARGE-MEASURE is in position CHARGE.

2.2F BINDING POSTS

The unknown is connected across the binding posts E1 and E2 marked + and –, respectively. The lower end of the resistance standard (R27 to R31), which is connected to the internal chassis, has been connected to the binding post GUARD E3. The proper use of the guarding system has been described in item 1.3.

2.2G GROUNDING SWITCH

The switch S1 is used for connecting the binding post E2 or E3 to the external chassis and accordingly to ground. See item 1.1.

2.3 VACUUM-TUBE VOLTMETER

The d-c voltage which during measurement is present across the resistance standard as a result of the voltage division between the standard and the resistance of the unknown, is fed to the input of the vacuum-tube voltmeter. Tube V1 is a neon lamp which is used to protect the vacuum-tube voltmeter and the resistance standards against overvoltages in case of short circuit in the unknown. The d-c voltage is fed to a vibrator (Z1) via the input filter, C1 to C3, R3 and R4, which removes the hum voltages, if any. In the vibrator the d-c voltage is transformed into a-c voltage. The two resistors R1 and R2 protect the vibrator contacts. The input impedance of the vacuum-tube voltmeter of 100 megohms is composed of the impedance of the input filter and the dynamic input impedance of the vacuum-tube voltmeter. The latter is due to the grid leak resistor R5, the grid capacitor C4, and the trimmer C5, which when exposed to a square-wave voltage gives an impedance of about 90 megohms. The impedance is dependent on the frequency. At the factory, however, it is set to the line frequency on which the instrument is going to operate. Generally it is 50 cps. The vacuum-tube voltmeter, which incorporates the tubes V2 and V3, has negative feedback. The magnitude of the negative feedback is determined by the output of the feedback resistance network R19 to R25, to which the cathode of tube V2 is connected. Within a certain narrow range the potentiometer CALIBRATE provides for changing the part of the output current from tube V3 that is fed through the feedback resistance network. By this means a fine adjustment of the feedback and accordingly of the sensitivitv is obtained.

The potentiometer R14 is used for adapting the feedback resistance network.

The diodes CR1 and CR2 used in the rectifier circuit of the indicating meter are silicon diodes to eliminate the influence of temperature variations on the calibration of the scale.

From the potentiometer ∞SETTING (R63) an a-c voltage is fed to the grid of tube V2 through a small air capacitor. When adjusting the voltage supplied, a residual reading on the indicating meter can be outbalanced.

SECTION 3
OPERATION

3.1 CONTROLS AND TERMINALS

The controls and terminals specified below are located on the front panel of the Megohmmeter.

CALIBRATE	Used for calibrating the Megohmmeter.
CHARGE	Used for setting the charge voltage when measuring on capacitors.
VOLTAGE SELECTOR	Used for setting the desired test voltage.
GROUNDING SWITCH	Used for grounding the terminal marked – or the terminal GUARD.
MULTIPLIER	Used for setting the resistance range.
CALIBRATE CHARGE MEASURE	Used as operating switch. In position CALIBRATE the Megohmmeter is calibrated. In position CHARGE capacitive unknowns are charged. In position MEASURE the unknowns are measured.
∞ SETTING	Used for adjusting the deflection to ∞ on the indicating meter.
ON-OFF	Line switch.
+ –	Terminals for connecting the unknown.
GUARD	Terminal in the guard system.

The power cord is connected on the back panel of the instrument. A jack on the left-hand panel and on the back panel provides for grounding the instrument.

3.2 CONNECTING THE MEGOHMMETER AFTER UNPACKING

The instructions below should be complied with when using the instrument for the first time.

1) Make sure that the line voltage selector of the instrument is set at the voltage available. (The selector is set to 220 volts at the factory).

2) Make sure that the line line frequency stated at the receptacle corresponds to the line frequency available. (The Megohmmeter is generally supplied for operation on 50 cps. On request, however, it can be supplied for operation on 60 cps).

3) **Ground the jack on the left-hand panel.**

4) Check the mechanical setting of the meter. If the needle does not rest at ∞, it is put back by means of the slotted screw on the meter.

5) Connect the instrument to the power line by means of the power cord supplied.

6) Switch on the instrument by setting the ON-OFF switch to ON.

7) Let the instrument warm up for 1-2 hours so that moisture, if any, can be removed.

8) Set the VOLTAGE SELECTOR to 50 volts, the MULTIPLIER switch to 10^6, and the operating switch CALIBRATE-CHARGE-MEASURE to MEASURE.

9) Without connecting an unknown see if the meter deflects to ∞. If not, adjust the potentiometer ∞SETTING with a screwdriver until the needle is at ∞.

10) The Megohmmeter is now ready for use.

3.3 OPERATING THE MEGOHMMETER

3.3A CONNECTION AND INITIAL ADJUSTMENT

1) Ground the jack on the left-hand panel. Connect the instrument to the power line by means of the power cord.

2) Switch on the instrument by setting the ON-OFF switch to ON.

3) Let the instrument warm up for 5 minutes.

4) Set to the desired test voltage with the VOLTAGE SELECTOR.

5) Set the operating switch CALIBRATE-CHARGE-MEASURE to CALIBRATE.

6) Set the control CALIBRATE so that the meter deflects to the calibrating mark C.

Note: On the range x10^6 the calibration may deviate a little from the calibration on the ranges x1, x10...., x10^5. When changing over to or from the range x10^6, the instrument should be recalibrated, if the deviation is intolerable.

A recalibration should also be made when changing the test voltage.

3.3B MEASURING INSULATION RESISTANCES (NON-CAPACITIVE UNKNOWNS)

7B) Connect the unknown to the terminals + and –, and the guard terminal, if any, of the unknown to the terminal GUARD as shown in drawing No. 1525-A4. (The operating switch in position CALIBRATE).

8B) Set the GROUNDING SWITCH as shown in drawing No. 1525-A4.

9B) Set the MULTIPLIER switch in accordance with the value of resistance expected.

10B) Set the operating switch to MEASURE.

11B) Set the MULTIPLIER switch so that a suitable deflection of the meter needle is obtained - preferably within the meter range 1-10 megohms.

12B) The resistance value of the unknown is had by multiplying the meter reading by the multiplying factor to which the MULTIPLIER has been set.

13B) At the end of the measurement set the operating switch back to CALIBRATE and remove the unknown.

3.3C MEASURING INSULATION RESISTANCES (CAPACITIVE UNKNOWNS)

7C) Connect the unknown to the terminals + and – and the guard terminal, if any, of the unknown to the terminal GUARD as shown in drawing No. 1525-A4. (The operating switch in position CALIBRATE).

8C) Set the GROUNDING SWITCH as shown in drawing No. 1525-A4.

9C) Set the operating switch to CHARGE.

10C) Set the MULTIPLIER switch and the potentiometer CHARGE so that the range and the meter reading correspond to the expected resistance value or the limit value specified.

11C) Set the operating switch to MEASURE.

Note: If you want to measure the insulation resistance after a certain time, leave the operating switch in position CHARGE during the period required.

12C) The meter will deflect to the right if the insulation resistance is higher than the value mentioned in item 10C, and to the left if it is below this value.

Note: In the two upper ranges the needle may jump a little at first because of frictional electricity in the operating switch.

13C) When the needle has come to a rest, the resistance value is determined by multiplying the meter reading by the multiplying factor to which the MULTIPLIER switch has been set.

14C) At the end of the measurement set the operating switch back to CALIBRATE. The unknown has now been discharged and can be removed.

SECTION 4
MAINTENANCE

4.1 GENERAL

The type IM5 Megohmmeter is a very delicate instrument, so unnecessary repairs or attempts to improve the accuracy should not be made.

Such repairs as may become necessary, should only be made by skilled persons provided with sufficient measuring equipment and tools to ensure a proper repair.

4.2 REMOVING THE INSTRUMENT FROM THE CABINET

The Megohmmeter can be removed from the cabinet when the four hexagon-head screws on the front panel have been removed.

4.3 TUBE REPLACEMENT

Generally the tubes need not be replaced until they cause some kind of trouble. All tubes are readily accessible when the instrument has been removed from the cabinet.

Tubes with average characteristics can be used for any replacement.

4.4 ADJUSTING THE TEST VOLTAGE

Remove the Megohmmeter from the cabinet. To prevent accidents set the GROUNDING SWITCH to GUARD, so that no voltage is present between the insulated chassis and the front panel.

Set the VOLTAGE SELECTOR to 1000 volts and switch on the instrument. By means of the potentiometer 1-P2 (R50), the test voltage is so set within the range 1000 volts ±50 volts that the anode voltage of the series regulator tube is within 275 volts ±25 volts. It is assumed that the line voltage adopts the nominal value. When measuring the test voltage, a vacuum-tube voltmeter is connected across the terminal — and the terminal GUARD, and the operating switch is set to MEASURE. When measuring the plate voltage of the series regulator tube, the vacuum-tube voltmeter is connected between the chassis (GUARD) and pin No. 6 of tube No. 6.

Next the VOLTAGE SELECTOR is set to the test voltages 500, 200, 100, and 50 volts in the said order of succession. The test voltages should then adopt the nominal value ±5% and the plate voltage of the series regulator tube should be 275 volts ±25 volts. In the case of a 50 volt test voltage, however, the plate voltage of the series regulator tube is 325 volts ±25 volts.

4.5 ADJUSTING THE FEEDBACK RESISTANCE NETWORK OF THE VACUUM-TUBE VOLTMETER

This adjustment should always be made when the tubes of the vacuum-tube voltmeter have been replaced, and if the calibrations of the vacuum-tube voltmeter are not identical in the ranges $x10^5$ and $x10^6$ at a test voltage of 50 volts.

Remove the Megohmmeter from the cabinet. Set the GROUNDING SWITCH to GUARD so that no voltage is present between the insulated chassis and the front panel. The instrument must be grounded during the adjustment. The ground lead is conveniently connected to the terminal GUARD.

Set the VOLTAGE SELECTOR to 50 volts and the MULTIPLIER to $x10^6$. Set the operating switch to MEASURE and make sure that the meter reads ∞. If not, adjust the potentiometer ∞ SETTING until the meter reads ∞.

Then set the operating switch to CALIBRATE. Set the potentiometer P1 (R 14) so that the meter readings are identical in the positions $x10^5$ and $x10^6$ of the MULTIPLIER switch. Then see whether the potentiometer CALIBRATE is approximately at the center of its range of settings (from 3 to 7) when the potentiometer is so set that the meter needle deflects to the calibrating mark C. If not, set the potentiometer to its center position (5) and change the value of the resistor R13 placed between one end of the potentiometer R26 and the chassis so the meter deflects approximately to the calibrating mark C.

4.6 CLEANING THE INSTRUMENT

Owing to the heavy demands on the insulation the instrument should be inspected and cleaned now and then. Remove dust, dirt and grease from the terminals +, –, and GUARD. Inside the instrument especially the binding posts, the operating switch, the GROUNDING SWITCH, and the VOLTAGE SELECTOR should be kept clean so that there is no leakage from the live parts to the chassis.

4.7 POTENTIALS

The list of tube potentials below can be used when servicing the Megohmmeter. The potentials stated are average values from a large number of measurements, so deviations of up to 20% of these values are generally of no importance. The measurements should be made with a vacuum-tube voltmeter. All voltages **measured are** referred to chassis.

tube V2	pin No. 6	56 volts	18.7
	- - 1	55 volts	54.7
	- - 3	1.8 volts	2.9
tube V3	pin No. 7	125 volts	112
	- - 8	100 volts	96.8
	- - 1	1.6 volts	2.6
tube V4	pin No. 1 & 3	85 volts	84
tube V5	pin No. 1	150 volts	148
tube V6	pin No. 6	275 volts +)	292
	- - 1	85 volts	84
	- - 9	−2.9 volts	−2.2
tube V7	pin No. 6	−2.9 volts	
	- - 3	−1.4 volts	1.26
transistor Q1	collector (C)	−1.4 volts	
	emitter (E)	0.4 volts	

+) At a test voltage of 50 volts the voltage is 325 volts

SECTION 5

SPECIFICATIONS

RANGE:
1 MΩ to 10^8 MΩ in 7 decades

SCALE:
Calibrated in megohms from 1 MΩ to 100 MΩ

MULTIPLIER:
1, 10, ..., 10^6

TEST VOLTAGES:
50, 100, 200, 500, and 1000 volts, d-c. These voltages may be used on all ranges.

ACCURACY OF TEST VOLTAGES:
±5%

STABILITY OF TEST VOLTAGES:
±0.015% for ±10% line voltage variations

ACCURACY:
Within the scale range from 1 MΩ to 10 MΩ the following accuracies are obtainable:

±3% up to 10^5 MΩ
±4% up to 10^6 MΩ
±5% up to 10^7 MΩ

POWER SUPPLY:
Voltages: 110, 115, 127, 200, 220, 240 volts
Line frequency: 50 cps
If the line frequency differs from 50 cps, please state frequency when ordering.

TUBES:

1 EF80 (6BX6)	1 85A2 (5651)
3 EF86 (6267)	1 Z10
1 150B2 (6354)	1 OC460

DIMENSIONS:
Height: 460 mm Width: 285 mm Depth: 245 mm

WEIGHT:
13 kilos

FINISH:
Grey enamel

ACCESSORY SUPPLIED:
1 type 12G19- 1.5 power

SECTION 6

EXTRA ACCESSORIES

The accessories described below are not supplied with the Megohmmeter, but can be supplied separately.

6.1 COMPONENT ADAPTER, type IM501

The component adapter serves to accelerate the working speed of the type IM5 Megohmmeter so as to make it more suitable for production control.

The **adapter** is designed as a small guarded box with three plugs that fit into the terminals +, –, and GUARD. The front is provided with two clips that provide for the connection of unknowns with coaxial leads.

The adapter is guarded in the same way as the terminals of the Megohmmeter. To avoid potentials between the cabinet of the Megohmmeter and the dust cover of the component adapter, the GROUNDING SWITCH of the Megohmmeter should always be in position GUARD.

The distance between the two clips is variable from 35 mm to 65 mm. To change the position of the clip: loosen the hexagon nut on the stud of the holder, move it in the slot in the supporting plate to the desired position, and tighten the nut.

6.2 COMPONENT JIG, type KPH1

The component jig is an electrically operated clamping device that ensures a maximum of convenience and speed. It is especially suited for production or acceptance control.

The function selector of the Megohmmeter actuates the clamping mechanism of the jig in such a way that no test voltage is applied during the exchange of components.

The feature of automatic discharge of the Megohmmeter is preserved for increased safety in the testing of capacitors.

The maximum operating rate depends on the measuring range, and the component under test.

The terminal spacing of the jig can be varied from 35 to 100 mm for components of different sizes.

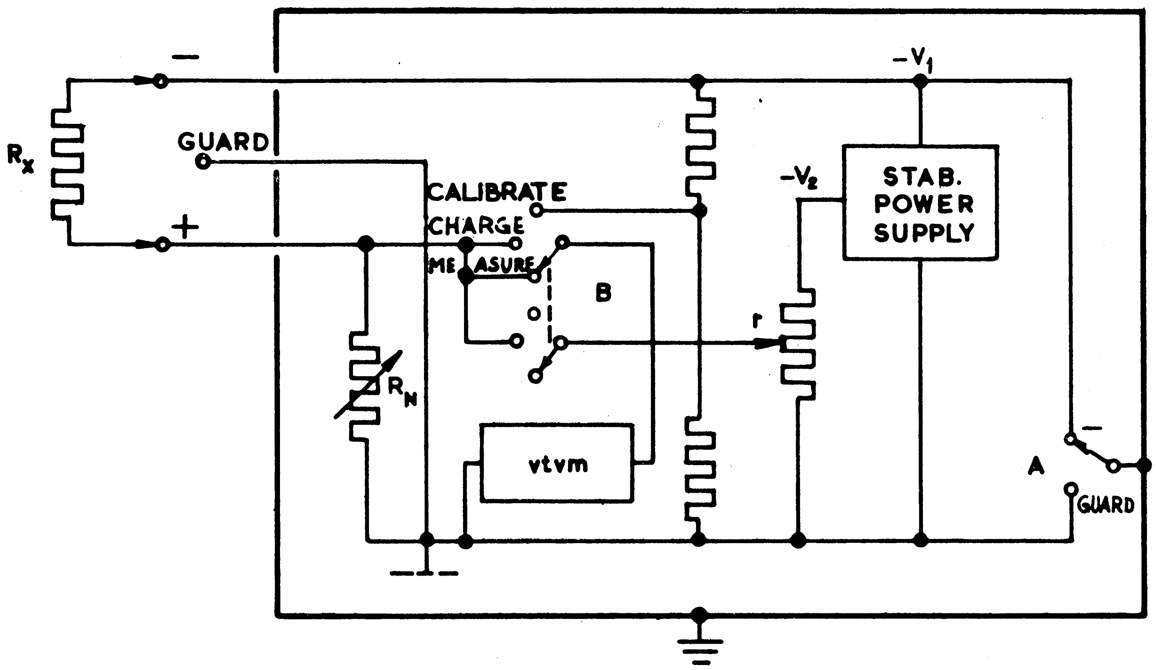


FIG. 1 SIMPLIFIED SCHEMATIC DIAGRAM OF IM5

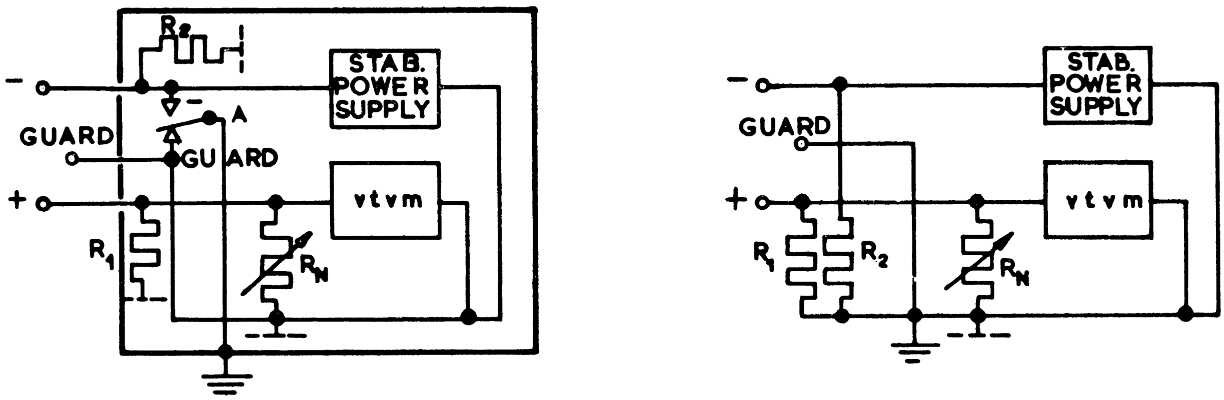


FIG. 2 THE INFLUENCE OF THE LEAKAGE RESISTANCES OF THE INSULATED TERMINALS

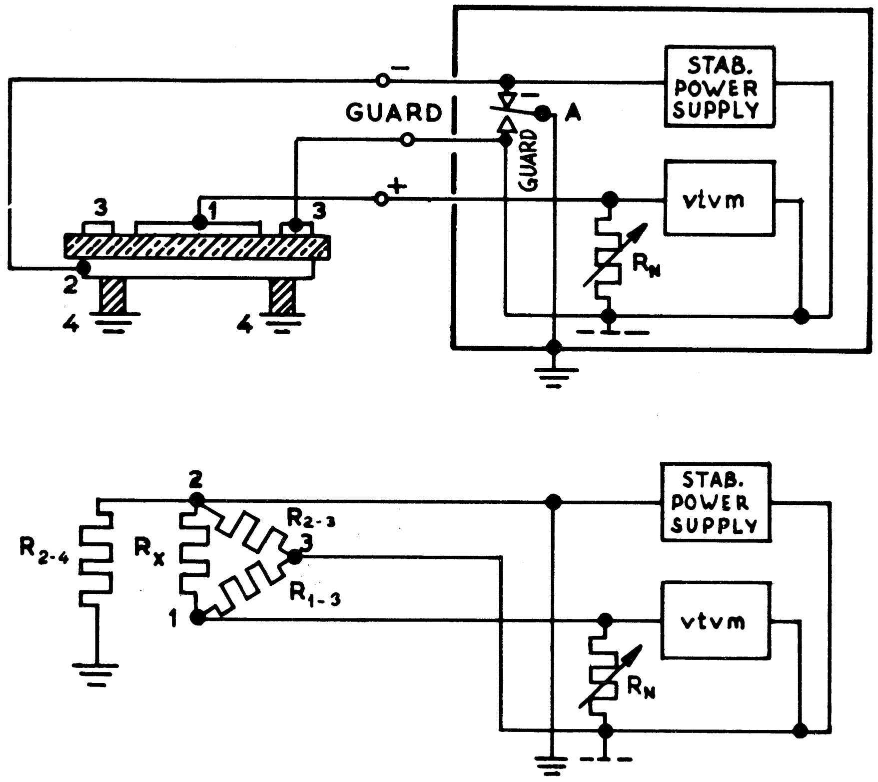


FIG. 3 GUARDING WHEN MEASURING SPECIFIC RESISTANCES

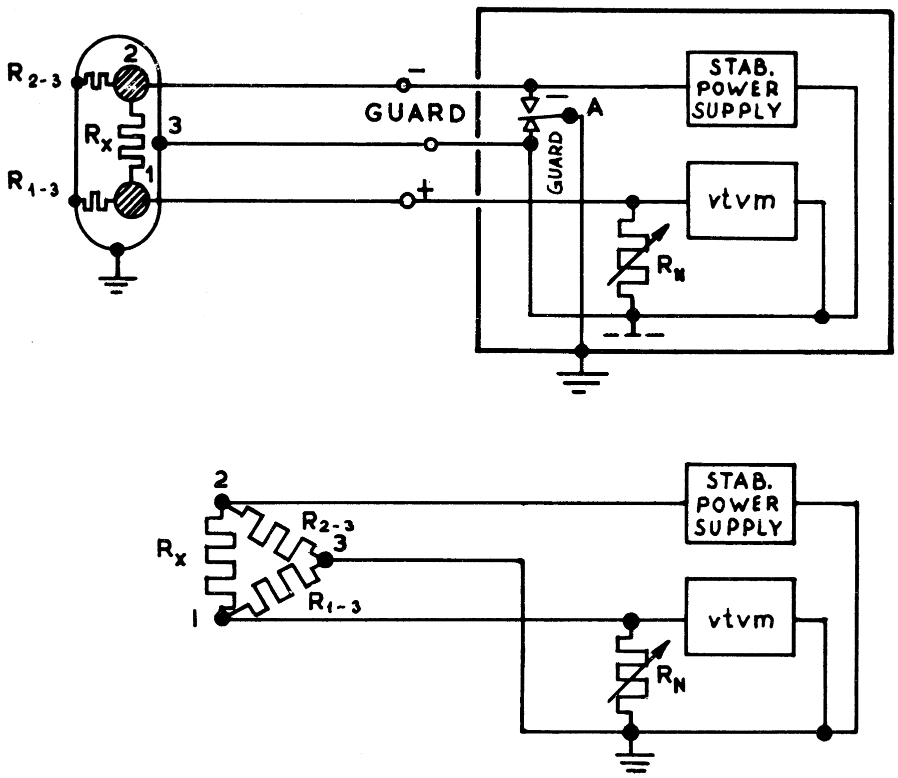
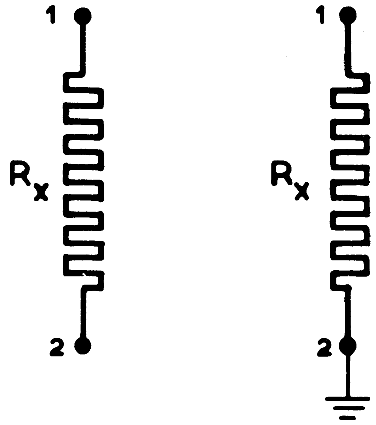
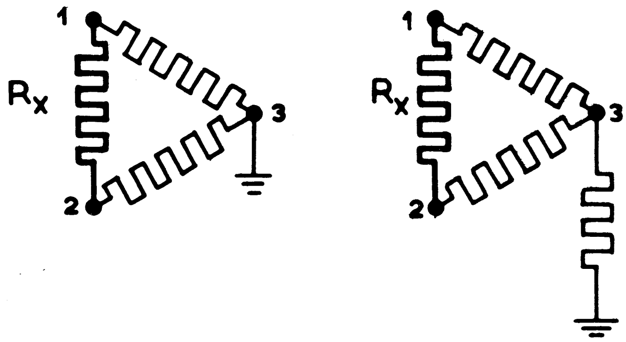
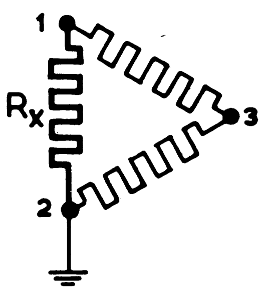
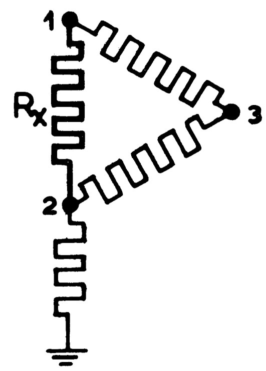
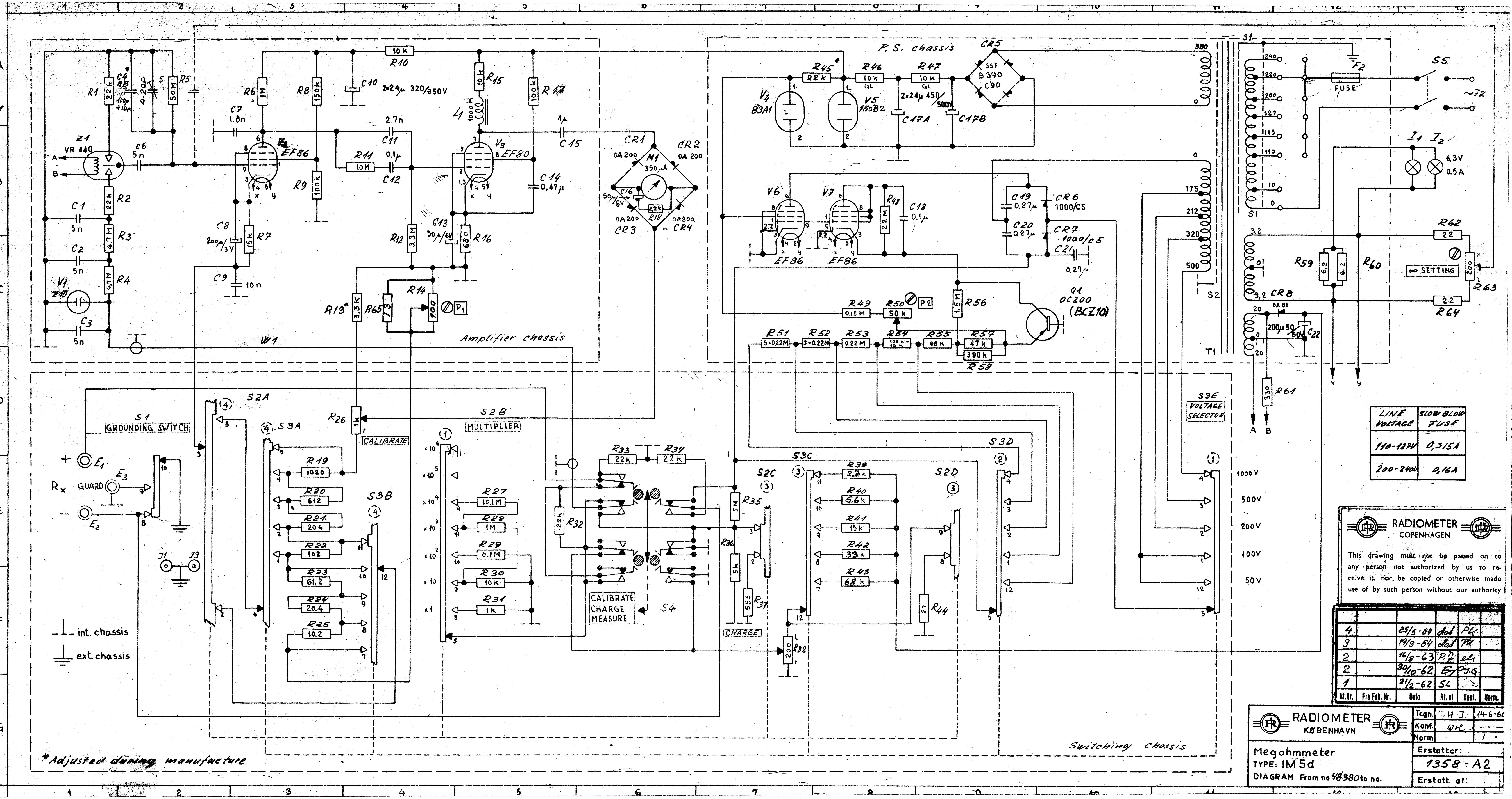


FIG. 4 GUARDING WHEN MEASURING LEAKAGE BETWEEN TWO CABLE CONDUCTORS

UNKNOWN	Connection to Megohmmeter
	1 is connected to terminal + 2 is connected to terminal − GROUNDING SWITCH in position →
	1 is connected to terminal + 2 is connected to terminal − 3 is connected to terminal GUARD GROUNDING SWITCH in position GUARD
 (2 may be ungrounded) 	1 is connected to terminal + 2 is connected to terminal − 3 is connected to terminal GUARD GROUNDING SWITCH in position −

HOW TO CONNECT THE UNKNOWN



LINE VOLTAGE	SLOW BLOW FUSE
110-127V	0,315A
200-240V	0,16A

RADIOMETER COPENHAGEN

This drawing must not be passed on to any person not authorized by us to receive it, nor be copied or otherwise made use of by such person without our authority

Ht.Nr.	Fra Fab. Nr.	Dato	Rt. af	Konf.	Norm.
4		25/5-64		PK	
3		19/3-64		PK	
2		16/8-63	P.J.		
2		30/10-62		P.J.G.	
1		21/2-62	SL		

RADIOMETER KØBENHAVN

Megohmmeter
TYPE: IM 5d
DIAGRAM From no 48380 to no.

Tegn.	H.J. 14-6-60
Konf.	
Norm	
Erstatter:	
	1358-A2
Erstatt. af:	