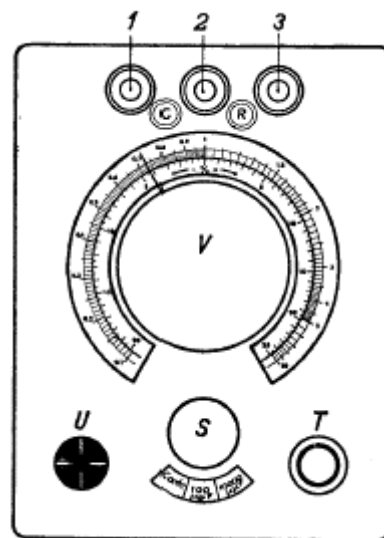


DESCRIPTION

The Philips GM 4140 bridge has been designed for the measurement of resistances of 0.1 ohm to 10 megohm and of capacities from 1 μF to 10 μF . However larger resistances than 10 megohm and capacities larger than 10 μF can be measured, when their values are compared to standard resistors and standard capacitors respectively by connecting external standard known values to compare the value of resistance or capacity. Furthermore inductance can be determined and compared with this instrument and also short circuits between windings can be determined. The capacity and resistance of electrolytic capacitors (and consequently the loss factor) with help of a known capacity and a known resistance can be measured. The bridge can be feed with an external frequency source up to 10,000 Hz to measure the resistance of electrolytic capacitors. This voltage source has to supply only 7 W at 100 V to and 11 W at 220 V.

A percentage standard scale makes it possible to measure a large numbers capacitors, resistances and inductors quickly to reject parts, which exceed a certain tolerance. A deviation of 0.1% can be read.



A cathode ray indicator is used for determining bridge balance, which enables accurate measurements very easy and fast. Another advantage of this indicator is that it indicates whether a lower or a higher switch range should be used. It is important that there are no electrostatic or magnetic fields in the vicinity of Terminal "2", for accurate measurement. Because otherwise the high sensitivity of the indicator no sharp minimum would be obtained. The connections from the device being tested should be screened and connected to earth. This is why the power cord of the instrument is shielded and connected to earth.

SETTING UP

First determine the supply voltage (100 - 150 V or 170 - 250 V). To adjust the bridge for the other voltages, remove the four screws underneath the unit and take the cardboard away. On the marked strip by the transformer position "127 V" corresponds with voltages 100 V - 170 V and position "220 V" with voltages 170 V - 250 V. After adjustment the cardboard must be carefully replaced before replacing the case.

CONNECTION

The terminal at the back of the device must be connected to earth. This is very important when measurements of small capacities or large resistances are to be made. Within a minute of being plugged in to the mains supply for the bridge is ready for use.

CONTROL POSITION

If knob "V" has, perhaps become twisted on its axis this can be remedied by putting knob "S" in control position "Contr." Then with nothing connected to terminals "1, 2 and 3", and knob "T" turned fully clockwise adjust the bridge balance knob "V" so that the arms of the green cross on the indicator are as narrow as possible. The pointer of knob "V" must now be on position "1" of the scale. If this is not the case then the knob should be loosened and carefully turned and reset in the correct position before re-tightening.

MEASUREMENTS

a. Measurement of resistances

First set "S" to the appropriate position:

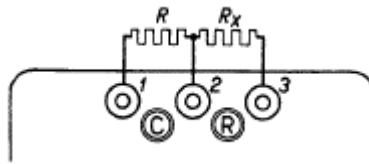
Position 1 ohms for resistances from 0.1 - 10 ohm

Position 100 ohms for resistances from 10 - 1000 ohm.

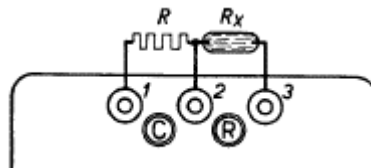
Position 10000 ohms for resistances from 1000 - 100000 ohm

Position 1 Mohms for resistances from 100000 ohm - 10 megohm

The unknown resistance is then connected to the terminal "R". Bridge balance knob "V" is adjusted so that the arms of the cross "U" are as narrow as possible. The value of the unknown resistance is obtained from the indication of the outside scale multiplied with the position of knob "S". For the measurement of resistances larger than 10 megohm, set knob "S" in on the "open bridge position". The unknown resistance is connected to terminal "R" and the standard resistance with which it is to be compared on terminals "1 and 2". After balancing using "U" with help of knob "V" on minimum the value is found by multiplying the scale reading with the value of the standard resistance.



The same procedure can be used to measure the resistance of electrolytes and other solvents. In this case it is recommended to use a voltage source with a higher frequency (e.g. 500 or 1000 Hz), to prevent electrolysis or polarisation. The "S" on open bridge can also be fed with a voltage source with a higher frequency (500 or 1000 Hz) for use with electrolytics to prevent polarisation. Terminals inside the case need to be accessed to use this feature.



b. Measurement of capacities

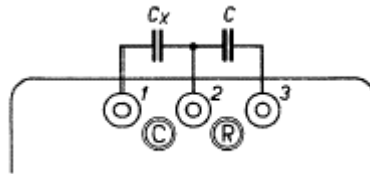
First set "S" to the appropriate position:

Position 100 μF for capacities from 10 μF -1000 μF

Position 10000 μF for capacities from 1000 μF -0.1 μF

Position 1 μF for capacities from 0.1 μF -10 μF

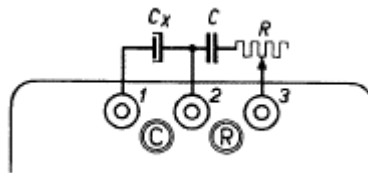
The unknown capacitor is then connected to the terminal "C". Bridge balance knob "V" is adjusted so that the arms of the cross "U" are again on the smallest width. The value of the unknown capacitance is obtained from the indication of the outside scale multiplied by the position of knob "S". For the measurement of small capacities, one must however, deduct $10\ \mu\text{F}$ from the indicated value. This $10\ \mu\text{F}$ forms the precisely adjusted internal capacitors connected between terminals "1,2 and 3". The "Open Bridge" position "\I/" can be used for the measurement of capacities smaller than $90\ \mu\text{F}$ (down to $1\ \mu\text{F}$); when the bridge is balanced using knob "V", the unknown value will be (scale reading $\times 10\ \mu\text{F}$) - $10\ \mu\text{F}$.



To measure of capacities larger than $10\ \mu\text{F}$ connect the unknown capacitor to terminal "C" and a similar standard capacity between "2 and 3". Turn knob "S" to the "Open Bridge" position "\I/" and after adjusting "V" for balance the unknown capacitance = scale reading \times standard capacity.

c. Measurement of electrolytic capacitors

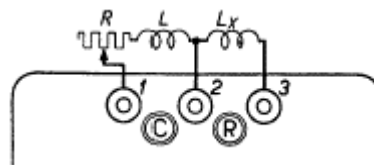
Knob "S" is set to "Open bridge" position and the unknown capacitor is connected to terminals "C". Connect a (loss-less) standard capacitor with a calibrated adjustable resistor in series. The series resistor is first set to zero. Then adjust "V" so that the arms of the cross "U" have minimum width. Knob "T" should be turned counter clockwise a little. If it is not possible to get a sharp null, this indicates that the capacitor has a parasitic series resistance. The accurate balance position can be obtained by adjusting the resistor.



At balance the capacity of the electrolytic capacitor equals the reading multiplied by the standard capacitor and the parasitic resistance of the electrolytic capacitor equals $1/\text{reading} \times$ setting of the calibrated resistor.

d. Measurements of inductance

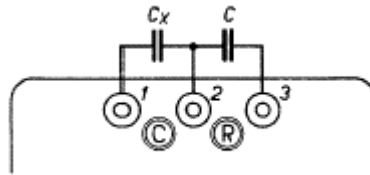
The unknown inductor should be connected to terminal "R" and "S" set to the "Open Bridge" position "\I/". Connect a standard inductor with a calibrated adjustable resistance in series between terminals "1 and 2". Adjust "V" and the calibrated adjustable resistor for as narrow possible indication on the cathode ray indicator.



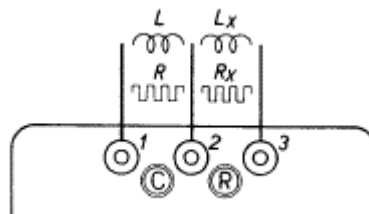
The self inductance of the unknown inductor = scale reading \times standard inductor value, and the resistance of the unknown inductor = scale reading \times totally present resistance (totally present resistance = resistance of the standard inductor + value of the calibrated adjustable resistance). If two equal inductors are connected to "1 and 2" and "2 and 3" a short circuit on one will prevent a sharp minimum being obtained. These measurements are preferably done at a higher frequency (500 Hz).

Per cent scale

To check large numbers of resistances, capacitors and inductors are within a particular tolerance. In position "%" of knob "S" one can quickly measure the deviation in percent of the comparisons standard (- 20% to + 25%) within a deviation of 0.1%.



For capacitors, the capacitor to be checked is connected to the terminal "C" and the comparison standard connected to "2 and 3". Bridge balance knob "V" is used to indicate how many per cent it is larger or is smaller than the comparison standard. This measurement can be done at reduced sensitivity, which is a very fast way for rough checking, (see below).



For resistances and self inductances the parts to be checked are connected to the terminal "R" and the comparisons standard connected to "1 and 2".

Sensitivity adjustment

The highest sensitivity is obtained when knob "T" has been turned fully clockwise. In this position, best accuracy is obtained. For quick measurements it is advised to turn knob "T" a little anti-clockwise. This is also of interest for the measurement of capacities or inductance with a loss resistance that otherwise no minimum can be obtained, before the resistance elements have been brought into balance. Finally, to measure a completely unknown capacity or resistance reducing the sensitivity is in order. Begin with an arbitrary range on switch "S" and adjust knob "T" so that the arms of "U" approximately 6 mm wide. Turn bridge balance knob "V" clockwise and if the arms of the cross narrow without a sharp minimum, then this indicates that a higher range must be used. If the arms become narrower when knob "V" is turned anti-clockwise then a lower range should be used.