MILANO ICE ITALY

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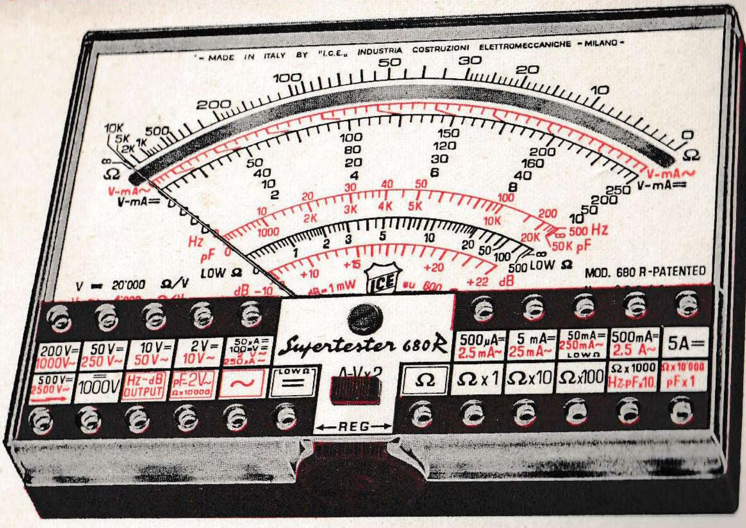
20141 MILANO - ITALY

Supertester 680 R

PATENTED - 20.000 OHMS/VOLT - 4th Series

OPERATOR'S MANUAL AND REPAIR GUIDE

INDEX



THE "SUPERTESTER 680 R"

Measurements = 128 x 95 x 32 mm. - Weight = 300 gr.

4th SERIES WITH REMOVABLE CIRCUIT

To facilitate the checking and substitution of damaged components.

4TH EDITION Part One: INTRODUCTION AND DESCRIPTION

PATENTED I.C.E. SUPERTESTER MODEL 680 R (SENSITIVITY 20,000 ohms/volt)

For more than twenty five years technicians all over the world have been using I.C.E. Test Meter analysers manufactured by the Industria Costruzioni Elettromeccaniche. Their confidence in our products is due to the continuous effort on our part to keep abreast of the new technological requirements caused by the rapid progress made in the electrical and electronic fields.

This new "Supertester 680 R" offers many features which are the result of the most up to date techniques, backed by many years of experience and testing in our laboratories.

It is very practical due to its quality, numerous features and its size (128 x 95 x 32 mm.). Modern metallic layer resistors have been used, which, as well as giving a precision of 0.5%, guarantee this precision with a stability in absolute time that is four times above the normal "precision" resistors used in Test Meter analysers.

These alone put the "Supertester 680 R" above all other analysers manufactured up to now. Furthermore a large mirror scale allows more precise readings from the "Supertester 680 R" by avoiding parallax errors.

A glass cartridge fuse, rated at 160 mA, forms part of the Resistance measuring circuit, since experience has shown that 90% of resistor failures in multimeters are caused by the inadvertent failure to re-select the correct function and range, when changing from a resistance to a voltage measurement. Four spare fuse-links are provided, conveniently mounted within the instrument on the meter back-plate.

With the Supertester 680 R it is possible to carry out all measurements, even those which need mains connection, without having to extract the Test Meter from the Carrying case. The new patented carrying case, as well as having an invisible double base to contain the probes and other accessories, allows the analyser to be set at 45° in respect to the support, facilitating the reading of the quadrant.

The use of the compensated magnetic nucleus indicating instrument fully shields the instrument against external magnetic fields, providing it with absolute stability in calibration, even if placed in a magnetic field produced by magnets, transformers, impedences etc. The Test Meter may therefore be used even on metal and steel surfaces without the reading being altered. No other meter provides this facility.

A special electrical circuit which, together with a static limitor, allows the Meter Movement and associated rectifier to be able to withstand accidental or incorrect overloading up to 1000 times above the range setting.

Therefore the instrument does not need to be returned so frequently to specialised firms for replacement of damaged rectifiers.

The other characteristics and technical qualities that put this instrument in advance of its competitors are as follows:

The upper panel is in unbreakable "CRYSTAL" which allow the maximum use of the reading face and completely eliminates shadow.

Special electrical circuit to compensate for errors due to the fluctuation of temperature. Antishock instrument with sprung suspensions. Container in new unbreakable material.
Resistance measurements up to 10 Megaohms direct with supply only from the internal 3 V battery, and up to 100 megaohms with mains supply (125 to 250 Volts). Resistance measurements even with very low values such as tenths of an ohm, using an internal 3 V battery. In addition, measurements of very high resistance may be made (up to 1000 MOhms) with d.c., using the Resistance Measurement Multiplier Model 25 (see page 62).
Direct reacting of frequency, capacity, output power and reactance detector.
Minimum weight: only 300 grams including the 3 Volt battery fitted inside the analyser container.
Absence of rotating switches increasing reliability totally eliminating mechanical contacts, and reducing the danger of accidentally passing from one range to another. To change range it is only necessary to move one probe terminal, which, in many cases, is faster than rotating a switch, and allowing the user to reflect on the type and the measurement range to be selected. Unnecessary overloads and errors with damaging consequences to the electrical circuit are also eliminated.
Ohms, pF and Hz adjustment rheostat, with the serrated edge of the knob on the front side

and therefore clearly visible and easily adjustable even when the analyser is in its carrying case.
The "Supertester 680 R" is a completely adaptable instrument for the discriminating radio and electronic technician.
Because of its advanced technical characteristics and design it has been covered by patents throughout the world.
In the 4th series of this Supertester 680 R, the printed circuit can be completely extracted if faulty. See instructions on pages 39 and 40.
Measurements that can be effected directly without the aid of any other apparatus with the patented supertester I.C.E. mod. 680 R:

10 FIELDS OF MEASUREMENTS AND 80 RANGES !!!

VOLTS A.C.	**= 11 ranges:**	2-10-50-250-1000-2500 Volts and **4-20-100-500 and 2000 Volts**
VOLTS D.C.	**= 13 ranges:**	100 mV - 2 V - 10-50-200-500-1000 Volts **200 mV - 4 V - 20-100-400 and 2000 Volts**
AMP. D.C.	**= 12 ranges:**	50 μA - 500 μA - 5 mA - 50 mA - 500 mA - 5 Amp. and **100 μA - 1 mA - 10 mA - 100 mA - 1 Amp. and 10 Amp.**
AMP. A.C.	**= 10 ranges:**	250 μA - 2,5 mA - 25 mA - 250 mA - 2,5 Amp. and **500 μA - 5 mA - 50 mA - 500 mA - 5 Amp.**
OHMS	**= 6 ranges:**	x 1 - x 10 - x 100 - x 1000 - x 10000 and Low Ohms
REACTANCE DETECTOR	**= 1 range:**	from 0 to 10 Megahoms
FREQUENCY	**= 2 ranges:**	from 0 to 500 and from 0 to 5000 Hz.
V. OUTPUT VOLTAGE	**= 9 ranges:**	10-50-250-1000-2500 V and **20-100-500-2000 Volts**
DECIBELS	**= 10 ranges:**	from — 24 to + 70 db.
CAPACITY	**= 6 ranges:**	from 0 to 50000 and from 0 to 500000 pF using the mains and from 0 to 20, from 0 to 200, from 0 to 2,000 and from 0 to 20,000 Microfarad using the incorporated 3 Volts battery.

All the ranges in bold faced type are obtained by pressing the button AV X 2 which switches the sensitivity of the instruments without changing the value of the resistance shunted on the circuit in consideration, with consequent higher accuracy in the reading.
Furthermore, the above ranges of the SUPERTESTER 680 R can be extended with the aid of accessories are specifically designed for this purpose by I.C.E.

The principal accessories are:

Electronic range extender Mod. 30

Direct Voltage 5/25/100 mV - 2,5/10 V with 10 MOhm/V.

Direct Current 0,1/1/10 μA.

Temperature indicator — 100/+ 100/250/1000 °C.

Watt-meter Mod. 34 ranges 100/500/2500 W.

Electronic Volt. Ohmeter Model 660 I.C.E.

Transistor and diode tester Transtest Mod. 662 I.C.E.

Signal Injector Model 63 - I.C.E.

Pincer ammeter Amperclamp for low and high ammetric measurements in alternated current without interrupting the circuits to be tested (from 250 mA to 500 Amperes).

Transformer for high ammetric measurements in alternated current Model 616 I.C.E. (from 25 to 100 Amperes).

Additional shunts Model 32 I.C.E. for high current measurements in direct current from 25-50 to 100 Amperes D.C.

High Voltage-probe Mod. 18 I.C.E. for high voltage tests (25,000 V - D.C.).

Temperature probe for instantaneous temperature tests mod. 36 I.C.E., two scales from — 50 to + 40 °C and from + 30 to + 200 °C.

Light meter Model 24 I.C.E. two scales: from 2 to 200 Lux and from 2,000 to 20,000 Lux.

Sequencescope Model 28 I.C.E. as a phase cyclic indicator.

Resistance multiplier Mod. 25.

Fluxmeter Model 27 I.C.E. for magnetic field measurement.

The characteristics of all the above mentioned accessories are briefly described from page 57 to 63. (Further details will be sent on request).

IMPORTANT: To ensure the long life of the SUPERTESTER I.C.E. Model 680 R, carefully follow all the maintenance instructions on Page 36.

ACCURACY OF THE READING

The accuracy or better the class of our Supertester 680 R is 1% in D.C. and 2% in A.C. According to the international rules in force the accuracy of an indicating instrument (the to called "class of the instrument") is given as **an absolute percentage** and therefore the maximums permissible reading error is always referred to the accuracy percentage guaranteed by the Producer **referred to the full scale value.** For instance: let us examine an instrument guaranteed by the producer as a "class 2 instrument" for the range 250 Volt full scale value; in this case the maximum permissible error ± 2% is to be referred to the full scale value that, in the case of the range 250 V corresponds to an absolute value of 5 Volts. According to the international rules and what previously said, the instrument can be considered belonging to the class 2 instrument, only if the error is not higher than ± 5 volts in any point of the scale.
That is, the instrument belongs to such an accuracy class (2%) if it for instance, indicates 255 or 245 instead of 250, 105 or 95 instead of 100; 15 or 25 instead of 20. From this it can be seen that the error, as a **relative percentage** is increasing more and more in the initial part of the scale; as a consequence, in order to have the most accurate readings it is always advisable to choose, while using a Tester, the most convenient range so that the reading is carried out most preferentially in the end scale area.
According to the main international rules, the control of the accuracy is to be carried out with the instrument lying orizontally, at a 20 °C temperature and, in the case of measurement in A.C., with sinusoidal current.
If the above mentioned conditions change, for the accurate control of class accuracy, the interferences due to such variations will have to be taken into account.

INSTRUCTIONS FOR USE OF THE ANALYSER PATENTED MODEL I.C.E. 680 R

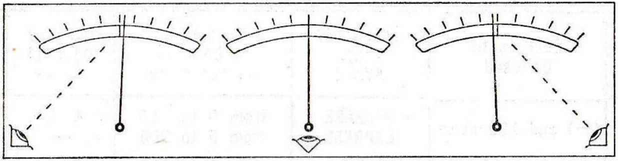
To use the I.C.E. Model 680 R Analyser correctly and thus avoid possible errors in operation, it is essential to carefully follow the instructions given herewith.
For any measurement it is very important to plug the leads into the appropriate sockets **completely.**

In the SUPERTESTER 680 R the five common sockets for the different measurement fields, namely available for different ranges, have a double line for better indentification and with the exception of the common for the ohmmetric measurements, are located left of the switch that doubles the ammetric and voltmetric ranges. Before effecting any measurement, make sure that the instrument pointer is exactly on zero by rotating, with the aid of a screwdriver, the small button with a slot situated on the casing of the instrument below the instrument panel.

All measurements with direct current must be read on the black scale and those with alternating current on the red scale. The same applies to the white and red wording at the side of the relative sockets.

In the schematic circuit diagrams illustrated in the following the scale to be examined for the correct reading is marked by a much heavier line as compared with the others.

When a high precision reading is be made with the SUPERTESTER I.C.E. 680 R indicator instrument, the pointer must be read through the mirror scale as follows: after connecting the plugs to the circuit under test, the pointer must be given time to stop oscillating and when motionless on the resulting indication, it should be looked at with one eye, moving the head until no reflection of the pointer in the underlying mirror is seen (that is, in a position perfectly perpendicular to the pointer). In such a position, always without further moving the body, the reading will be without parallax errors, that is, without those errors due to an off-perpendicular position of the operator.



When effecting measurements, make absolutely certain that no part of the casing comes into contact with the circuits being tested, as contact with the current flowing there might prove dangerous.

D.C. VOLTAGE MEASUREMENTS

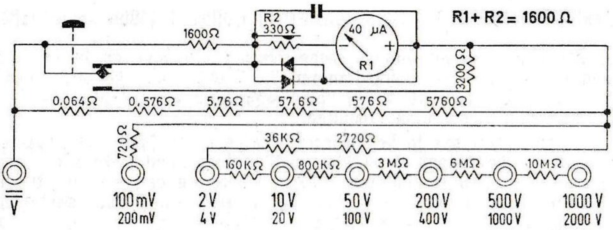
For D.C. voltage measurements introduce **as far as it will go** the black lead (negative) into the socket in the lower part of the instrument marked with the black wording on a white ground "=" and the other red lead (positive) in one of the side sockets also with black wordings "100 mV"; "2 V"; "10 V"; "50 V"; "200 V"; "500 V"; "1000 V" according to the range required. When there is doubt about the magnitude of the voltage to be measured, always plug into the highest range so as to avoid subjecting the resistance to overloads.

If necessary, after the first reading, the red lead can be moved to the next lowest range in order to achieve a more accurate reading.

Accurate scale readings, with reference to the range and therefore to the selected socket are obtained taking into account the data of the following table:

Selected range	Sockets to be used	Sensitivity key AV x 2	Numbering to be read on the scale	Multiply the reading by	Divide the reading by
100 mV=	(=) and 100 mV=	RELEASE	from 0 to 10	X 10	—
200 mV=		**DEPRESS**	from 0 to 200	—	—
2 V=	(=) and 2 V=	RELEASE	from 0 to 200	—	: 100
4 V=		**DEPRESS**	from 0 to 200	—	: 50
10 V=	(=) and 10 V=	RELEASE	from 0 to 10	—	—
20 V=		**DEPRESS**	from 0 to 200	—	: 10
50 V=	(=) and 50 V=	RELEASE	from 0 to 50	—	—
100 V=		**DEPRESS**	from 0 to 10	X 10	—
200 V=	(=) and 200 V=	RELEASE	from 0 to 200	—	—
400 V=		**DEPRESS**	from 0 to 200	x 2	—
500 V=	(=) and 500 V=	RELEASE **DEPRESS**	from 0 to 50	X 10	—
1000 V=	(=) and 1000 V=	RELEASE	from 0 to 10	x 100	—
***2000 V=**		**DEPRESS**	from 0 to 200	X 10	—

*** For this last range, due to the high voltage which is very dangerous for the operator, carry out the measurement without touching directly either the plugs or the analyser, that is switch on the voltage only AFTER having connected the analyser with the circuit to be tested.** All possible danger of short circuit through the body will be so prevented!
The scale sector to be read for all D.C. measurements (=) is the first black scale located below the mirror.



Simplified Voltmetric DC Circuit.

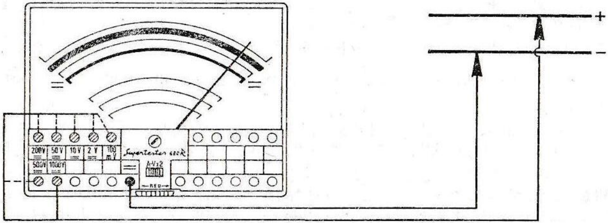


Diagram showing how to insert the Supertester 680 R in the DC Volts Circuit.

VOLTAGE MEASUREMENTS (VOLTS) IN ALTERNATING CURRENT (4000 ohms/Volt)

To carry out alternating current voltage measurements introduce **as far as it will go** one of the leads into the low socket marked in red "~" (A.C.) and the other lead into one of the sockets also marked in red "10 V~"; "50 V~"; "250 V~"; "1000 V~"; "2500 V~"; according to the most suitable range required.

When a high tension circuit has to be measured (range up to 2500 Volt) **operate with great care because there is the danger of an electrical discharge** and make sure therefore not to touch or even get too close to the live circuit. Therefore only connect the leads to the circuit to be measured when this is not live. Then, after having made sure that the Tester, the leads and plugs are in a stable position and correctly set for the particular measurement, that is on an insulated table, far from any part of the body and any conductor of electricity, the current may be switched on to the circuit and the reading taken without however touching the plugs or the tester.

When there is any doubt about the voltage to be measured, always plug into the highest range so as to avoid possible overloads to the resistance. If necessary, after the first reading, the terminal of the various ranges can be inserted into the next lowest range so that a more accurate reading may be obtained.

To measure within the 2 V A.C. rating, the first lead is introduced into the lower socket marked $\frac{\text{pF - 2 V}}{\Omega \times 10{,}000}$ while the second socket to be used is the same used for the 50 µA and 100 mV ranges.

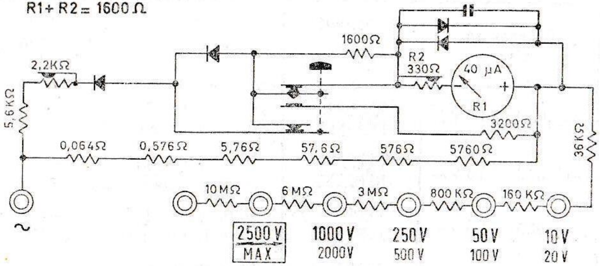
In order to get an accurate reading of the scale with reference to the range and therefore to the selected socket, take into account the data of the table of the following page.

For the ranges 4-20-100-500 and 2000 Volts A.C. use the sockets of the ranges 2-10-50-250 and 1000 Volts respectively, pressing the sensitivity button (AV x 2) which doubles the ranges taken into consideration, to make this point cleare, we report in the following the table to be taken into account for the correct reading of the scale with reference to the range and therefore to the selected socket.

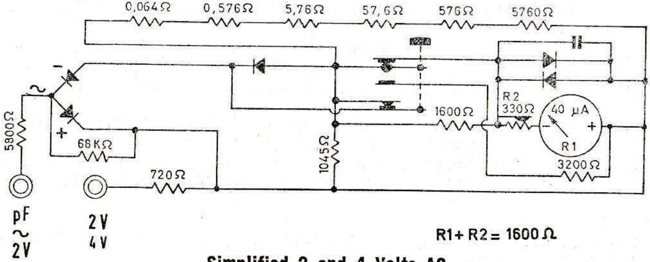
Selected range	Sockets to be used	Sensitivity key AV x 2	Numbering to be read on the scale	Multiply the reading by	Divide the reading by
2 **4**	(pF-2V ~) and 2 V ~	RELEASE **DEPRESS**	from 0 to 200 from 0 to 200	— —	: 100 : 50
10 **20**	(~) and 10 V ~	RELEASE **DEPRESS**	from 0 to 10 from 0 to 200	— —	— : 10
50 **100**	(~) and 50 V ~	RELEASE **DEPRESS**	from 0 to 50 from 0 to 10	— x 10	— —
250 **500**	(~) and 250 V ~	RELEASE **DEPRESS**	from 0 to 250 from 0 to 50	— x 10	— —
1000 ***2000**	(~) and 1000 V ~	RELEASE **DEPRESS**	from 0 to 10 from 0 to 200	x 100 x 10	— —
*2500 Maximum	(~) and 2500 V ~	RELEASE **DEPRESS**	from 0 to 250	x 10	—

* For these two last ranges, due to the high voltage which is very dangerous for the operator, carry out the measurement without touching directly either the plugs or the analyser; therefore switching the current on the circuit only after having connected the analyser with the circuit to be tested! All possible danger of short circuit through the body will be consequently prevented.

The scale sector to be read for all A.C. measurements (~) is the first red sector located below the mirror.



Simplified Voltmetric AC Circuit.



Simplified 2 and 4 Volts AC.

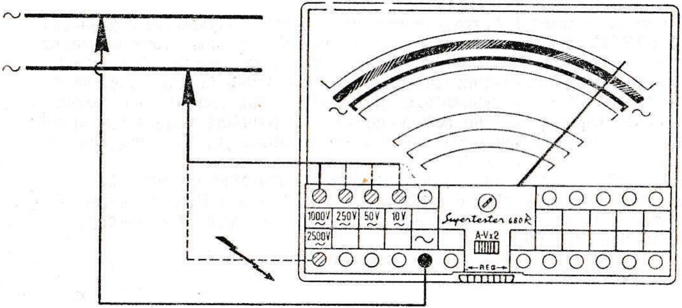


Diagram showing how to insert Supertester 680 R to measurge AC voltage.

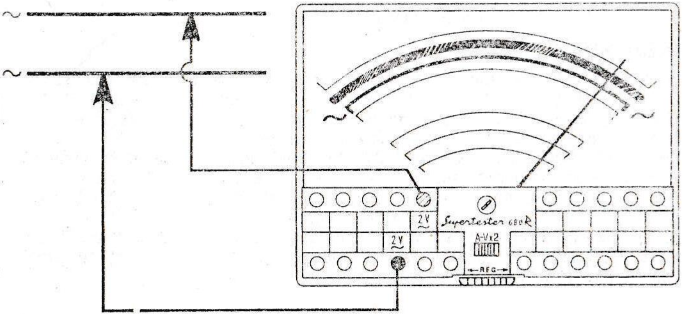


Diagram showing how to insert Supertester 680 R to measure 2 V AC.

As it may be seen from the electrical diagram relating to alternating current voltage measurements, our SUPERTESTER Model 680 R, as well as almost all the most popular American analysers, has adopted a rectifier circuit with only one half wave because this system, in addition to measuring the normal alternating current, makes it possible to check the symmetry of the average value between the two alternations of the alternating current being examined. In fact in practice it may happen that two half waves of an alternating current may become asymmetrical, i.e. that the two half waves have not the same outline and the same amplitude. An example would be the presence of a direct component.
Should this asymmetry affect the average value, it may be revealed by the I.C.E. Tester Mod. 680 R by reversing the leads at the measuring points. The difference between the two measurements makes it possible to calculate the average value, the percentage of asymmetry present and therefore the

$$\% \text{ of asymmetry} = \frac{V1 - V2}{V1} 100$$

where V 1 = major deviation
V 2 = minor deviation.

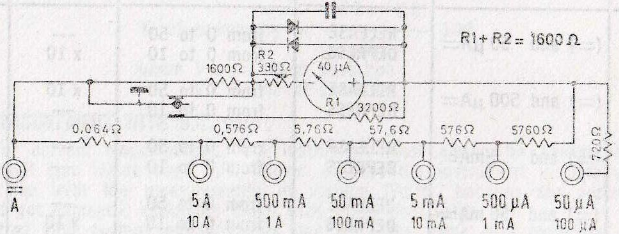
CURRENT MEASUREMENT WITH D.C. (mA)

WARNING: For current measurements, the instrument **must always be connected in series** with the circuit (see figure page 17). Never connect the instrument in parallel with the circuit live like with the measurements of voltage (Volts), because the resistances and shunts would get damaged, especially those with a low ohm value.
Make sure that with current measurements (mA D.C.) the black lead (negative) is inserted **as far as it will go** into the lower central socket marked with the black wording on a white ground "=" (D.C.) and the other red one (positive) in one marked "50 μA - 500 μA - 5 mA - 50 mA - 500 mA - 5 Amp" according to the range required.
It is most important to bear in mind that, when there is doubt about the amplitude of the current to be measured, the highest range (5 A.) should always be used so at to avoid damaging the resistances and shunts in the circuit.

Subsequently, if required, after the first reading, the red lead of the various ranges may be inserted into the next lowest range so as to obtain a more accurate reading.
For the ranges 100 μA, 1 mA, 10 mA, 100 mA, 1 A and 10 A D.C., use the sockets of the ranges 50 μA, 500 μA, 5, 50, 500 mA and 5 A, pressing the sensitivity button which doubles the ranges in consideration. To make anyway this point clearer, the following table to be taken into account for a more accurate reading of the scale, referring to the range and therefore to the selected sockets.

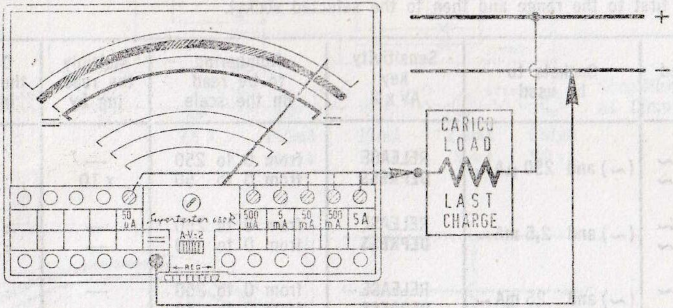
Selected range	Sockets to be used	Sensitivity key AV x 2	Numbering to be read on the scale	Multiply the reading by	Divide the reading by
50 μA=	(=) and 50 μA=	RELEASE	from 0 to 50	—	—
100 μA=		**DEPRESS**	from 0 to 10	x 10	—
500 μA=	(=) and 500 μA=	RELEASE	from 0 to 50	x 10	—
1 mA=		**DEPRESS**	from 0 to 10	—	: 10
50 mA=	(=) and 5 mA=	RELEASE	from 0 to 50	—	: 10
10 mA=		**DEPRESS**	from 0 to 10	—	—
50 mA=	(=) and 50 mA=	RELEASE	from 0 to 50	—	—
100 mA=		**DEPRESS**	from 0 to 10	x 10	—
500 mA=	(=) and 500 mA=	RELEASE	from 0 to 50	x 10	—
1 A=		**DEPRESS**	from 0 to 10	—	: 10
5 A=	(=) and 5 A=	RELEASE	from 0 to 50	—	: 10
10 A=		**DEPRESS**	from 0 to 10	—	—

Higher amperage ranges (25-50 and 100 Amp. D.C.) can be measured with the SUPERTESTER 680 R by means of the auxiliary shunts Model 32 I.C.E., as for this check the technical data in the chapter: AUXILIARY ACCESSORIES, page 63. The voltage drop in the different current ranges D.C. is a follows: 50 μA = 100 mV; 500 μA = 294 mV; 5 mA = 317.5 mV; 50 mA, 500 mA and 5 A = 320 mV; 25-50-100 A by means of auxiliary shunts as previously mentioned, voltage drop = 100 mV.



Simplified current DC Circuit.

Diagram shewing how to insert Supertester 680 R for current measurements DC.



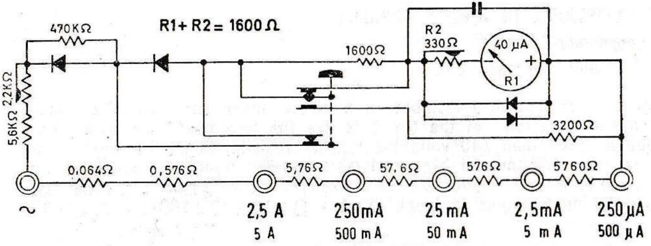
CURRENT MEASUREMENTS (A) IN ALTERNATING CURRENT

WARNING: For current measurements (Amperes) both in A.C. and in D.C. the instrument **must always be connected in series with the circuit. Never connect the instrument in parallel with the circuit live** as done in the case of voltage measurements because the resistances and shunts would be damaged, especially those with a low ohm value. Be sure that, with current measurements with A.C. (μA, mA and A) the first lead is inserted as far as it goes in the lower socket marked in red (~) and the second lead in one of the socket also marked in red (250 μA~; 2,5 mA~; 250 mA~ and 2,5 A~) according to the range

For the ranges: 500 μA~; 5 mA~; 50 mA~; 500 mA~ and 5 A~; the sockets of the ranges 250 μA; 2.5 mA; 250 mA and 2.5 A must be used. On depressing the sensitivity key, the range being tested is doubled. For a more accurate reading, consult the following table referring first to the range and then to the selected socket.

Selected range	Sockets to be used	Sensitivity key AV x 2	Numbering to be read on the scale	Multiply the reading by	Divide the reading by
250 μA~ **500 μA~**	(~) and 250 μA~	RELEASE **DEPRESS**	from 0 to 250 from 0 to 50	— x 10	— —
2,5 mA~ **5 mA~**	(~) and 2,5 mA~	RELEASE **DEPRESS**	from 0 to 250 from 0 to 50	— —	: 100 : 10
25 mA~ **50 mA~**	(~) and 25 mA~	RELEASE **DEPRESS**	from 0 to 250 from 0 to 50	— —	: 10 —
250 mA~ **500 mA~**	(~) and 250 mA~	RELEASE **DEPRESS**	from 0 to 250 from 0 to 50	— x 10	— —
2,5 A~ **5 A~**	(~) and 2,5 A~	RELEASE **DEPRESS**	from 0 to 250 from 0 to 50	— —	: 100 : 10

For higher current ranges with A.C. (from 250 mA up to 500 A) cfr. page 63, description Amperclamp and Transformer 616.



Simplified current AC Circuit.

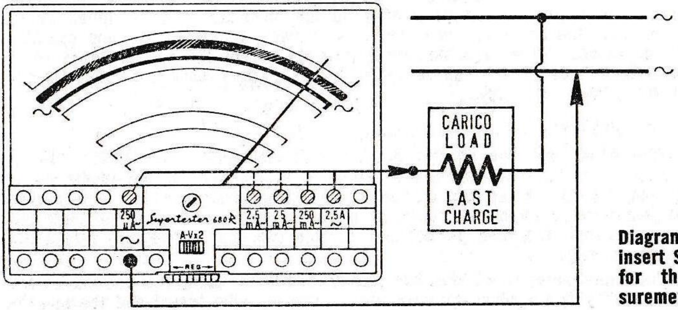


Diagram showing how to insert Supertester 680 R for the current measurements with AC.

MEASUREMENTS OF RESISTANCE IN DIRECT CURRENT

(from 1 ohm to 10 megohms)

(from 1/10 ohm to 30 ohms see page 23).

Before effecting any measurement of resistance in a circuit make sure that the circuit is not live, because if the ohmic circuit of the tester is live the fuse protection burns out and if the existing voltage is lower than 140 volts the relative resistances are damaged. Having checked this point, for low medium and high resistance measurements, introduce as far as it will go one of the leads into the lower socket marked in black Ω and the other lead in one of the upper sockets marked also **in black Ω x 1 - Ω x 10** - Ω x 100 and Ω x 1000 according to the range required.

The next step is to connect the plugs together and turn the knob marked "REG." (battery adjustment) until the instrument pointer is at the full scale value, i.e. at "0" ohms. Finally connect the resistance to be measured across the two plugs making sure that the reading taken on the upper scale of the instrument relating to the ohms value is multiplied by the range chosen. Every time the range of the ohmeter is changed, repeat the zeroing operation by turning the central knob. When it is no longer possible to get the pointer to return to zero, change the battery incorporated (an ordinary 3 Volt battery used for hand torches) making sure that the polarity is correct.

— negative; + positive.

For the battery replacement, see the chapter dealing with maintenance (page 38). Having completed the resistance tests, never leave the terminals in position on the ohmic circuit because the plugs might be shortened and discharge the battery after a while. Furthermore the ohmic circuit incorporated might accidentally be connected to a live circuit and thus damage, as above mentioned, the fuse protection. In this case to restore the fuse follow the detailed instructions, page 39.

It may be useful for the operators of the Supertester 680 R to know the various current values which flow according to the ohms value of the resistance being tested and the selected range. In the range Ohms x 1, the following will be the relation between the scale in ohms and the corresponding flow in mA.

Ω	∞	10000	5000	2000	1000	500	400	300	200	150	100	90	80	70	60	50	40	30	20	15	10	5	0
mA	0	0.3	0.595	1.47	2.86	5.5	6.75	8.7	12.25	15.4	20.6	22.5	24	26.1	28.6	31.5	35.3	40	46.2	50	54.5	60	66.6

For the ohms x 10 range, divide the readings by 10.

For the ohms x 100 range, divide the readings by 100.

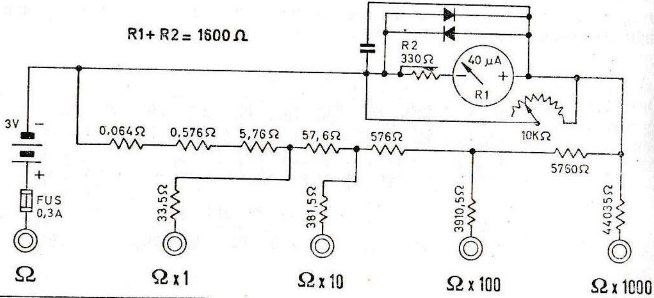
For the ohms x 1000 range, divide the readings by 1000.

It should be borne in mind that the various readings mentioned above will be obtained provided the ohms circuit is fed with exactly 3 volts. Should the battery provide a greater or a lesser voltage, the readings will be effected accordingly.

These output figures are useful and important for various applications such as, for example, the measuring of the consumption of an instrument or a relay, or to know on which range to measure the continuity of the filament of a valve or a low voltage lamp so as to ensure that such a filament is not overloaded and thus fused.

In measuring bear in mind that the common ohms socket is positive while that of the various ranges, ohms x 1, ohms x 10, ohms x 100 and ohms x 1000 is negative. This point is important especially when measuring rectifiers and electrolytic capacitors.

Simplified Ohmmetric DC Circuit.



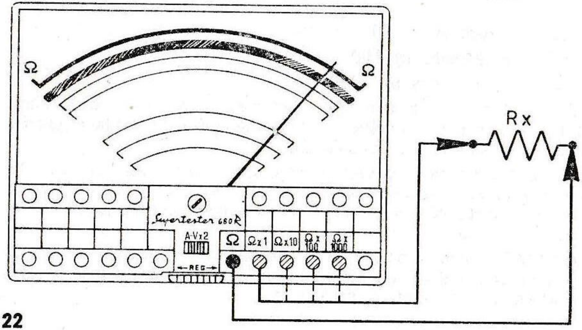


Diagram showing how to measure resistances with the Supertester 680 R.

D.C. RESISTANCE MEASUREMENTS FOR VERY LOW RESISTANCES

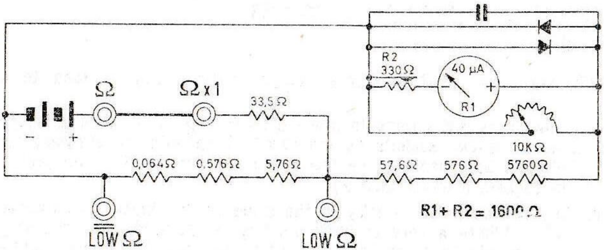
(Tenths of Ohm to 30 Ohms)

On our SUPERTESTER 680 R, very low resistances, e.g. tenths of Ohm, can be read to a good accuracy.

To be able to carry out very low Ohms measurements proceed as follows: first, with a bridge supplied with the kit, shortcircuit the two sockets Ω and Ω x 1; Then with the rheostat set the needle on the end of the scale and measure the low resistance through the two probes which must be inserted in the sockets marked: LOW Ω.

In the model 680 R the reading can be made directly in the scale on the black arch located immediately above the dB scale. Where a very accurate reading is required, then the very low resistance of the probe wire should be taken into account by shunting the probes before inserting the resistance under examination. The probe resistance should be subtracted from the total reading obtained after measuring the resistance under examination.

As it is shown in the scale, the 0 Ohm does not correspond to the absolute zero of the instrument because also the very low resistance of the tester internal circuit has been taken into account for a higher accuracy.



Simplified ohmmetric circuit for low values.

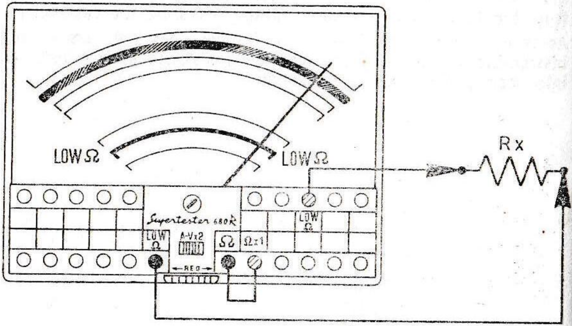


Diagram how to measure low resistances with the Supertester 680 R.

MEASUREMENTS OF RESISTANCE IN ALTERNATING CURRENT

(From 100 K ohms to 100 megohms)

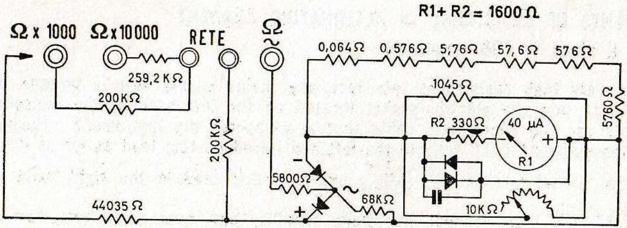
To measure very high resistances introduce any mains supply with a voltage between 125 and 250 V A.C. into the electric socket located on the left hand of the instrument; for the mains supply use the appropriate cable that accompanies the instrument. Having done this, turn the knob marked "REG." fully to the left and introduce test lead as far as it will go into a lower central socket marked pF - 2 V / Ω x 10,000 and the other lead in the right hand upper socket marked Ω x 10,000 / pF x 1 then connect the plugs together and once more turn the knob marked "REG." (mains control) until the instrument pointer has moved to the bottom of the scale opposite 0 Ohms. Finally the resistance to be measured is inserted between the plugs and it should be remembered that the readings taken on the scale must be multiplied by 10,000.

REACTANCE DETECTOR

In normal pratice it is often necessary to find out if there is any reactance in a circuit. For instance, establish if a capacitor in parallel with a resistance is in working order without having to remove it from the circuit.

To do this it is only necessary to measure the resistivity value of the circuit on the ohms x 1000 range, first using the analyser circuit fed by the battery incorporated and then repeating the measurement on the same range feeding into the circuit alternating, current from the mains which is connected to the socket on the left hand side of the instrument with a voltage of from 125 to 250 Volt - 50 Hz as described in the previous chapter.

If there is any difference in the two readings, i.e. that taken using the battery and that resulting from the mains, this shows clearly the presence of reactance in the circuit.



Ohmmetric AC Circuit.

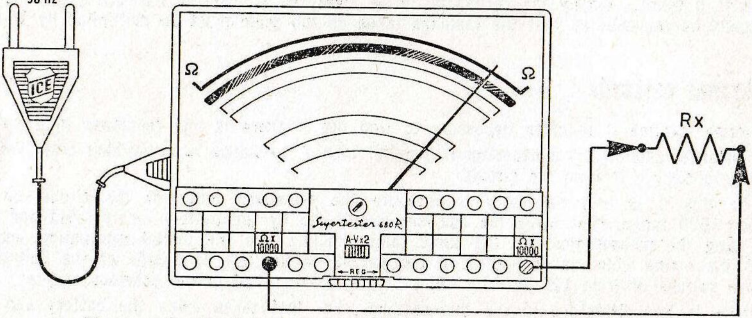
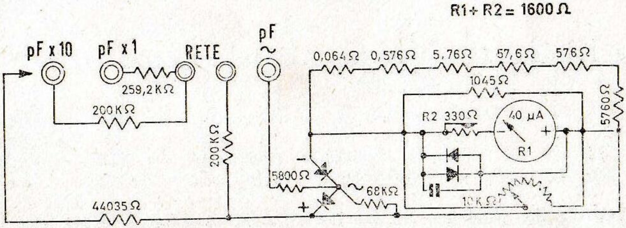


Diagram showing how to measure high resistances trough AC mains.

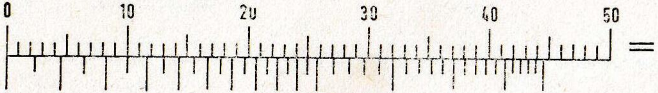
MEASUREMENTS OF CAPACITANCE

For the measurement of the capacitance of paper, ceramic or mica condensers in the range 50 - 500,000 pF, proceed as follows: Plug into the socket situated on the left hand side of the instrument alternating current 50 cycles with voltage between 125 and 250 volts. For the current supply use the special cable that accompanies the SUPERTESTER 680 R. Then turn fully to the left the knob marked "REG." (mains control) and introduce one of the plugs as far as it will go into the lower central socket marked in red $\frac{\Omega \times 10{,}000}{\text{pF - 2 V}}$ and the other plug in one of the upper sockets marked $\frac{\Omega \times 1{,}000}{\text{Hz - pF} \times 10}$ or $\frac{\Omega \times 10{,}000}{\text{pF} \times 1}$ according to the range required. Then connect the two plugs together and turn the knob marked "REG." (mains control) until the instrument pointer moves to the bottom of the scale at 0 Ohm. Finally connect, between the plugs, the condenser to be tested always making sure that the figure read on the capacitance scale is multiplied by the range chosen. It should be borne in mind that if the condenser is not well insulated, the reading will not be accurate.



Simplified circuit for measurements of capacitance.

To measure the capacitance of 1 microfarad up to 20,000 μF both of paper and electrolytic condensers, proceed as follows: Introduce the leads into the sockets Ω, Ω x 1, Ω x 10, Ω x 100 or Ω x 1,000 according to the range required. Then connect the plugs together and carry out the zeroing operation as for ohm measurements in D.C. Then connect between the plugs the condenser being tested and reverse its polarity several times, only when the pointer is back steadily on the 0 value. If the condenser is operating properly, the pointer should move to the following readings of the instrument according to the capacity and then return towards zero μF. If this does not occur, it means that the condenser is not properly insulated and it should therefore be rejected, unless the condenser is electrolitic and working at low voltages and the polarities of the tester are of opposite sign as compared with those of the condenser. In such a case, the condenser is not to be considered not efficient because the difference from the 0 value is given by the live leakage current inverted in respect with its normal working voltage. It should however be borne in mind that, due to the above mentioned leakage current, the condenser cannot charge completely and consequently the maximum displacement of the pointer will result lower than expected. The valid balistic measurement will be therefore that obtained when inverting the polarity once the pointer has come back to the 0 value.



0	1	2	3	5		10	15	20	30	Ω x 1000
0	10	20	30	50		100	150	200	300	Ω x 100
0	100	200	300	500		1000	1500	2000	3000	Ω x 10
0	1000	2000	3000	5000	μF	10 000	15 000	20 000	30 000	Ω x 1

Comparison between the scale 0 ÷ 50 and the different capacitance values according to the different ohmmetric ranges which have been used.

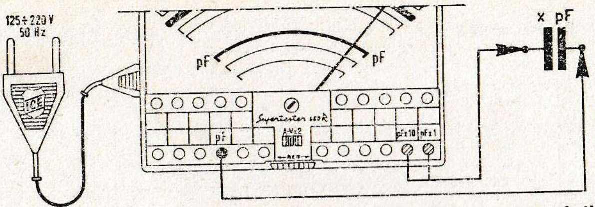
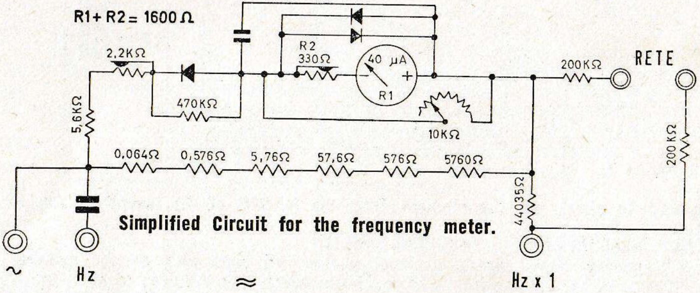


Diagram how to check the capacitances from 50 to 500 pF by means of the AC mains.

FREQUENCY MEASUREMENTS - FREQUENCY METER

To effect frequency measurements, connect to the left hand plug on the analyser marked 125 ÷ 220 V~ in any voltage from 125 to 250 of which it is required to know the frequency. For the power supply use the special cable that accompanies the SUPERTESTER 680 R. Then turn fully to the left the knob marked "REG." and introduce a lead fully into the lower central socket marked in red "~" and the other lead into the upper socket marked Ω x 1,000 / Hz - pF x 10 for measurements up to a maximum of 500 Hz.
Short-circuit the plugs together and zero the instrument (pointer at 0 Ω). The lead originally inserted in socket (~) is then inserted in the socket marked in red Hz - dB / output and, maintaining the plugs short-circuited, the frequency in Hz is read directly on the special scale marked with the same code.
Should it be required to test a frequency above 500 Hz but not exceeding 5,000 Hz, after having zeroing on the range Hz, relating to the current to be measured, it is only necessary to connect in series on the same plug an accurate 5,000 pF condenser and the frequency can then be read off the scale and multiplied by 10. If it is desired to test voltages outside the range 125-250, a transformer will be necessary which will convert the voltage to a value between the two figures indicated.



Simplified Circuit for the frequency meter.

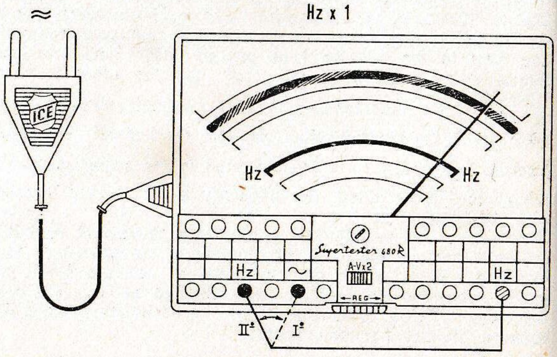


Diagram how to use the Supertester 680 R for frequency measurements.

OUTPUT MEASUREMENTS (Volts and decibels)

For output measurements introduce completely one of the leads into the lower socket marked in red $\frac{\text{Hz - dB}}{\text{output}}$ and the other lead into one of the right hand side sockets also marked in red "10 V~"; "50 V~"; "250 V~"; "1000 V~"; according to the range required.

When the value of the power output is in doubt, always start with the highest range so as to avoid possible overloads to the circuit. If necessary, after the first reading, the lead may be inserted in the next lowest range in order to have a more accurate reading.

It should be borne in mind that for the measurement of power in dB, the base level has been taken as zero dB. The modern International Standard is in fact: 0 dB = 1 mW at 600 ohms, equivalent to 0.775 Volts actual.

On the scale are marked directly the dB values for the range 10 V A.C. Using the range 2 V, subtract — 14 dB from the reading observed in the scale; using the range 4 V~ subtract — 8 dB from the reading observed in the scale; using the ranges 50 and 100 V A.C., the dB reading will be that observed increased by 14 dB and 20 dB respectively.

With the 250 Volt and 500 Volt ranges A.C. add 28 dB and 34 dB respectively.

With the 1000 Volt and 2000 Volt ranges A.C. add 40 dB and 46 dB respectively. With the 2500 Volts range add + 48 dB.

We would like to explain for the less experienced reader the symbolic value of dB. It is a relative measurement and therefore can assume any value in accordance with the reference for comparison.

There is a relationship with the Watts, but whereas these represent an absolute quantity, the dB can have very high values both positive and negative, or on the other hand very low values in accordance with the terms of reference which have been chosen.

The dB, as a unit and as a psychophysical quantity, representing the minimum variation in acoustic power perceptible to the human ear, but this variation of power may be of the order of milliwatts, or of watts without changes of the acoustic perception of the variations in dB.

In fact the formula which relates dB. with watts is as follows:

$$dB. = 10 \log._{10} \frac{W\,1}{W\,0}$$

that is ten times the logarithm on a decimal basis of the ratio between Watts in consideration (W 1) and the reference Watts (W 0).

In case of amplification, the value dB is positive. In case of attenuation, the dB value is negative.

In the I.C.E. Mod. 680 R tester the reference (0 level) marked on the scale is, as already said, represented by 1 mW at 600 ohms, that is the International Telephone Standard has been assumed.

Normally however the load of a radio receiver or an amplifier is provided by the moving coil loudspeaker with an approx. 3 ÷ 7 ohms impedance. Therefore to the reading taken on the instrument, must be added a certain factor represented by the letter K which can be computed using the following formula:

$$K = 10 \times \log. \frac{600}{\text{load resistance}}$$

always remembering, as already explained, that for the 10 volt range, the dB values are read directly on the scale. For the 50 volt range, add 14 dB to the readings. For the 250 volt range, add 28 dB to the readings. Thus the total dB in the various ranges will be as follows:

10 volt range = dB reading + K.
50 volt range = dB reading + K + 14 dB.
250 volt range = dB reading + K + 28 dB.
1000 volt range = dB reading + K + 40 dB.

Dividing the total dB by 10 we obtain the logarithm of the ratio between the power output of the receiver and the Standard one, which in the case of the 680 model is 1 mW. Once obtained the logarithm, we can look up in a logarithm table the corresponding number to be divided by 1000 as 1 mW is a thousandth part of a watt; we thus obtain the output in watts of the receiver or the amplifier to be tested.

The following example can be of help:

We assume that the moving coil of the loudspeaker is 3.2 ohms and that the reading on the tester connected in parallel with the moving coil of the speaker gave a figure of 14 dB measured on the 10 volt output range.

The K factor is calculated as follows:

$$K = 10 \times \log. \frac{600}{3.2} = 10 \times \log.\ 188.$$

On a logarithmic table the logarithm of 188 is 2.274 thus:

$$10 \times 2.274 = 22.74.$$

The total dB will therefore be: $14 + 22.74 = 36.74$.

Dividing the total dB by 10 we find the logarithm of the power ratio: 36.74 divided by $10 = 3.674$.

A logarithm table will show that the logarithm of 3.674 is 4.721. This shows that the measured output is 4.724 time greater than the Standard one which, as already said, is 1 mW.

This means that the output is 4.721 mW. There is also a very much simpler and quicked method of measuring the output in Watts for a radio receiver or for an amplifier. First measure the output voltage already described, on the primary of the output transformer with the secondary closed on the moving coil of the loudspeaker, alternatively on the terminals of the moving coil bearing in mind the impedance value supporting the measurement and then apply the following formula: $W. = \frac{V^2}{Z}$ where W. = output power, V^2 voltage output squared, Z = output impedance (from 4000 to 7000 ohms approximately, to the primary of the transformer according to the type of transformer and final valve in use); from 3 to 7 ohms in the moving coil of the loudspeaker, bearing in mind that this figure may vary according to the type of loudspeaker.

For further details, consider few examples illustrating also this system of measuring the output in watts:

The measured output voltage at the primary terminals of the output transformer is 100 volts; knowing the impedance value of the primary of the transformer in question, usually around 5000 ohms, we get the following:

$$W = \frac{100^2}{5000} = \frac{100 \times 100}{5000} = \frac{10{,}000}{5000} = 2 \text{ watts.}$$

If the above mentioned impedance instead of 5000 ohms is 7000 ohms, we have:

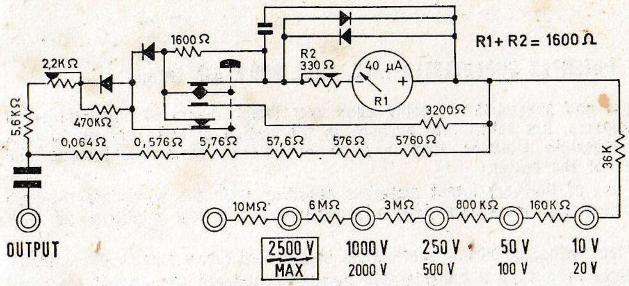
$$W = \frac{100^2}{7000} = \frac{100 \times 100}{7000} = \frac{10{,}000}{7000} = 1.42 \text{ watts.}$$

If on the other hand we measure the voltage at the terminals of the secondary of the output transformer, that is in parallel with the moving coil of the loudspeaker, we find for example an output voltage of 3 volts; as we know that the impedance of the moving coil of the loudspeaker to be tested is for example 5 ohms, we get the following:

$$W = \frac{3^2}{5} = \frac{3 \times 3}{5} = \frac{9}{5} = 1.8 \text{ watts}$$

On the other hand, of the impedance of the moving coil is for example 3.2 ohms, we have the following:

$$W = \frac{3^2}{3.2} = \frac{3 \times 3}{3.2} = \frac{9}{3.2} = 2.81 \text{ watts.}$$



Simplified Circuit for output meter.

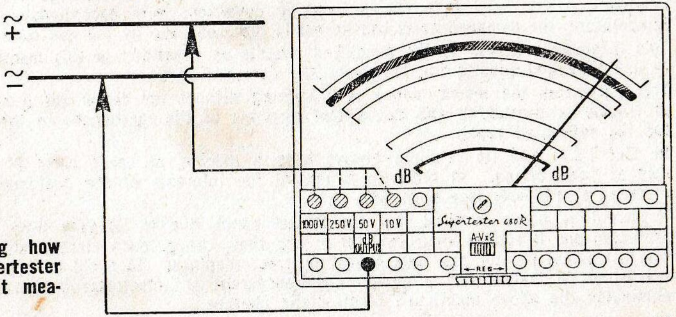


Diagram showing how to use the Supertester 680 R for output measurements.

Third Part

MAINTENANCE OF THE PATENTED SUPERTESTER I.C.E. MOD. 680 R 4th series

I.C.E. with its experience and specialisation going back over twenty years of manufacture of all kinds of Tester - Analysers, has taken into account in the design of this very up to date model 680 R, all the possible troubles that may be encoutered during continuous and sometimes incorrect use of the tester.

This new model makes use of the very latest materials resulting from the up-to-date research carried out by the largest and most important electrical and chemical concerns all over the world.

These materials can in fact withstand strong mechanical shocks and heavy electrical overloads.

However, should the tester drop from a considerable height or undergo exceptional electrical overloads, or be used in particular working conditions with exceptionally high humidity or temperature, the damaged parts can be easily replaced even by the non experienced operators.

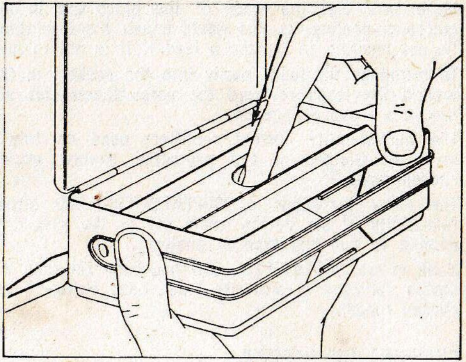
This is possible thanks to the simplified circuits as described in this manual and to facility in detecting and substituting the eventually damaged part.

This eliminates the inconvenience of remaining without the tester for a long time in case of trouble or breakdown and consequent dispatch of the instrument to the specialised firm for the requested repair.

In fact I.C.E. and its retailers always keep a number of spare parts in stock which are sold at fixed prices. In order to safeguard the interests of the customer, we give a list of these spare parts (see page 64).

It should be borne in mind that the Cristal panel, due to its very high insulation, if not protected and if rubbed vigorously for a long time, can produce electrostatic currents moving the instrument pointer and thus giving incorrect readings. To avoid definitely this drawback, the panel is coated with a completely transparent anti-electrostatic film which completely eliminates the above mentioned electrostatic charges.

How to remove the Test meter 680 R from its carrying case.



Open the lower part of the carrying case and with the first finger push the Test Meter 680 R through the central hole in the carrying case.

If, due to exceptional rubbing, the antistatic protective film is rubbed off, it can be raplaced by applying antistatic solution with a cottoncloth or a soft brush.

We can supply the solution as indicated at very small cost (see page 64).

Blow gently or use a soft cloth or brush to remove the dust. Never use petrol or spirit as this would give even worse results; at the most to remove eventual deposits, use a few drops of clean water and let it dry in the open air. Do not wipe with a cloth.

Make sure that the leads of the plugs are in good condition that is without abrasions, cracks or peeling; as this would impair the insulation and represent a danger to the operator. Do not hesitate to replace a lead it if is not in good working condition.

To introduce the leads easily into the sockets in the under part of the box, wind the wires around the leads or wind the wires themselves and fix them with an elastic band. See sketches A and B page 64.

The high-stability current rectifiers used on this Patented SUPERTESTER Mod. 680 R are made of Germanium and protected against accidental overloads, even 1000 times the chosen range.

The many thousands of SUPERTESTERS 680 already sold have clearly shown the good realiability of the device itself and of the special statical protection we have patented and applied to our last type of analyser.

None of our SUPERTESTER 680 has been returned with its rectifiers out of use or indicating device damaged or with its index bent owing to accidental overloads (also 1000 times the chosen range).

CHANGING THE BATTERY

The battery (ordinary 3 Volt torch type) should be replaced when it is no longer possible to shift the pointer to the full scale value even when the potentiometer has been completely turned to the right. In any case replace it not less than once a year because with the formation of sulphates it might give out fumes that could damage and corrode the circuits and the resistances inside the tester. To change the battery it is remove the base plate of the tester by loosening the four bottom screws and then remove the left spring pressing down on the bottom of the battery and then extract the battery which is now free in its seat. When replacing the battery, make sure that the poles are in the correct position bearing in mind that the bottom of the battery is the negative pole (—) and the top the positive pole (+). The search for any eventually damaged part will be greatly aided by consulting the general schematic circuit and the simplified detailed circuits in this manual.

In order not to dull the surface of the Crystal Panel, or other parts in plastic, do not drop any solder and especially do not let the hot point of the soldering iron come into contact with them.

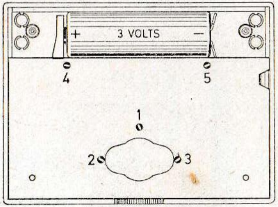
To replace eventually damaged resistances use a clean small soldering iron in order not to overheat the printed circuit during the replacement and to avaid damage during the replacement operation.

To detect and locate exactly the resistance to be replaced it will be enough to look at the printed circuit and eventually to compare with the schematic structural diagram shown in full size on page 72.

To extract and substitute the faulty component remove the printed circuit as indicated in the figure on page 40.

To do this with the 4th in the series of Supertester 680 R's, soldering is unnecessary; all you need to do is unscrew the five screws shown in this diagram.

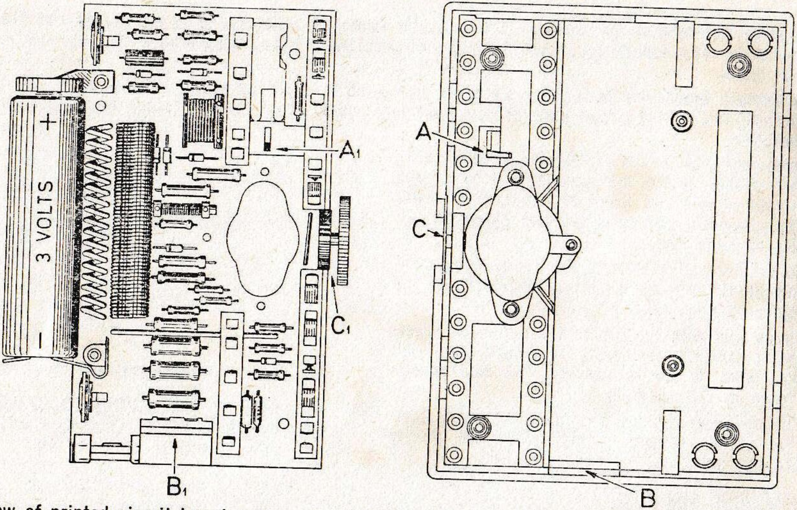
The diagram on page 56 shows the exact position of the contact springs when the probes are not inserted.



POSITION OF THE SCREWS TO BE LOOSENED FOR REMOVAL OF THE PRINTED CIRCUIT AS SHOWN ON PAGE 40.

CHANGING THE FUSE

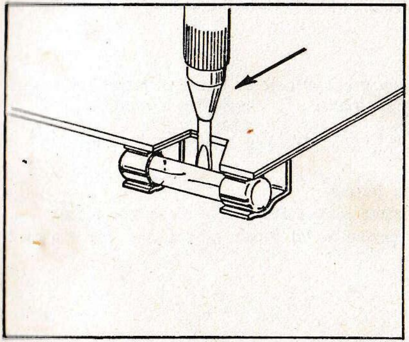
As already mentioned on page two of the first part of this booklet, our twenty five years or more experience has shown that 90% of the resistances put out of action by exceptional overloads due to incorrect operation are those in the Ohms circuit.

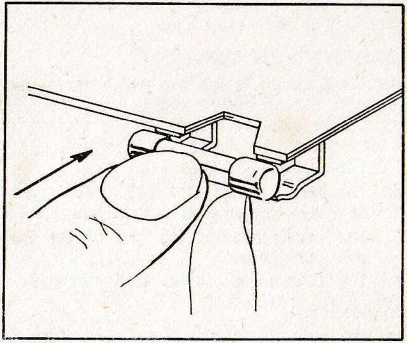


View of printed circuit board, after removal for replacement of faulty components.
To re-assemble the circuit in its original position, make sure that the lever, A, which operates the sensitivity switch is at rest, i.e., towards **the centre of the instrument.**
Also ensure that the set-zero potentiometer, C1, is correctly located in the recess C, and **the lip on the mains-socket B1 is mated with the recess B.**

As some of these resistances are also used for the Milliampere circuit, we have tried to protect them as much as possible, i.e. for voltages higher than 140 Volts, by fitting a fuse in series with the range common to the Ohmmeter. If the Ohmmeter does not work correctly, the first thing to do is check that the fuse has not blown.

The fuse-link may be checked for continuity using another ohm-meter, or examined visually, using a magnifying-glass. If the fuse has failed, it should be replaced with one of the spares located on the meter back-plate.





REPAIR OF THE I.C.E. TEST METER 680 R - 4th SERIES

Attention: all the numbered check points can be seen in the diagram on page 73.

As, in most cases, faults are caused by high current overloads in the individual components, those which feel the Joule effect most (overheating due to overloading) are the fuse (see page 39) and the resistors.

Here, in most cases, a visual check will be sufficient as the colour of the protective paint on the top of the resistors will probably be burnt or discoloured.

To do this easily and quickly, just remove the printed circuit after having removed the screws 1-2-3-4 and 5 indicated on page 39.

If the damaged component still cannot be located, proceed to a more rigid examination as described in the next chapter.

Faults due to the ohms circuit

The Ohms circuit is the one which, more than any other circuit in the test meter, is subject to faults due to misure and faults in the Ampere circuit. To check this circuit, shortcircuit the probes inserted in one of the sockets marked Ω, and the other in the socket relative to the ranges Ω x 1, Ω x 10, Ω x 100, Ω x 1000. The following faults may occur:

1. **The needle does not move.**
2. **The needle reaches the end of the scale too fiercely.**
3. **As above but only on certain ranges. For other ranges the needle does not move.**
4. **The needle reaches the end of the scale correctly for some ranges and for others it does not move.**
5. **The various base scales do not coincide.**

PARAGRAPH 1)

In this case, the fault may be due to the following:

A) **Blown fuse:** Following the instructions on page 41, check whether it has actually blown and if it has, renew it following the instructions on the same page.

B) **Moving coil interrupted:** Using another efficient test meter of any types set on Ω x 1000, check the 50 μA circuit. The needle of the reference Test meter will indicate a value of around 10,000 Ω. If the needle of the faulty Test Meter does not move, shortcircuit points 2 and 3 and repeat the test on points 12 and 13. If the reference Test Meter indicates 2000 Ω and the needle of the Test Meter being tested reaches the end of scale, this means that the circuit of the moving coil is in good condition and the fault is therefore in the Ohms circuit. In this case proceed as follows.

C) **Battery interrupted:** The two components of the 3 volt torch battery may often have corrosion on the zinc covering and therefore do not make contact with each other.
Check this by removing the battery elements, set the reference test meter on the range Ω x 1 and, with the help of two crocodile clamps, insert the probes in the contact springs of the battery of the first Test Meter ensuring the correct polarity, then proceed with the check by shortcircuiting the probes. If the needle moves towards the end of scale, this means that the battery is faulty and must either be substituted, or its elements dismantled and its contact points cleaned with emery paper.

D) **Battery flat:** Proceed as above and replace it.

E) **The probe inserted in the Ω socket does not close the contact below which connects the battery:** Check and retouch very carefully by using thin flat nosed pliers, or the point of a very thin screwdriver (see the exact position of the contacts in the diagram on page 57).

F) **Probe wires interrupted:** In most cases the leads break at the point in which they meet the probes or plug, i.e. where the wire bends, although there is no visible indication of this on the rubber sleeve. To locate the point in which the internal copper wires are broken, apply a pull of a few kilograms between the probe and the plug. If the sleeve expands it means that there is an internal breakage and the wire or faulty probe must be substituted. It is also possible to detect a breakage by shortcircuiting the common of the OHMMETER with Ω x 1, Ω x 10, Ω x 100, Ω x 1000 using the probe being tested.

Breaks in the printed circuit track: This is a very rare fault. Check the layout of the circuit with a magnifying glass starting from the + and — points of the battery (see diagram) If necessary, repair it with a soldering iron with a very fine tip.

PARAGRAPH 2)

A) **Faulty rheostat:** hold together the two probes inserted in the Ω x 1 range turning the knob of the rheostat to the left and, with an electrical connection, shortcircuit points 20 and 22 (see diagram). If the needle goes back to zero replace the rheostat.

B) **The closing contact of the rheostat circuit corresponding to the Ω socket does not close:** proceed as above, turning the rheostat knob to the left and then shortcircuit points 21 and 22 (see diagram). If the fault is in the contact, the needle goes to the end of the scale. In this case check the closing of the contact and clean it or correct its position whichever is necessary.

C) **The closing contact of the rheostat circuit corresponding to the Ω x 1000 socket does not close:** Set the test meter for resistance measurements in A.C. Ω x 1000 (see page 25) Shortcircuit points 21 and 25 and proceed as in paragraph B.

D) **The closing contact of the rheostat corresponding to the Ω x 1000 socket does not close:** As above but set the Test Meter on the Ω x 10,000 range.

E) **Interruption in a resistor in the shunt chain of the ampere circuit:** The fault is located in one of the following shunts: 0.064, 0.576, 5.76. Rotate the rheostat half way, bring the probes together after having inserted them on the Ω x 1 range. If the needle moves fiercely to the end of the scale and its speed reduces slowly as the higher Ohms ranges are introduced, this confirms the fault. Shortcircuit points 19 and 9 to check the 0.064 resistor, points 19 and 1 for the 0.576 resistor and points 1 and 7 for the 5.76 resistor. When the interrupted value is shortcircuited the needle goes to the middle of the scale.

PARAGRAPH 3)

A) **Interruption of a resistor in the shunt chain of the Ampere circuit:** The fault is located in one of the following shunts: 57.6 Ω, 576 Ω, 5760 Ω. An interruption in the 57.6 Ω resistor causes an interruption in $\Omega \times 1$ range and an overload on the galvanometer for the ranges $\Omega \times 10$, $\Omega \times 100$, $\Omega \times 1000$. An interruption in the 576 Ω resistor causes an interruption in the ranges $\Omega \times 1$, $\Omega \times 10$ and an overload on the galvanometer for the ranges $\Omega \times 100$, $\Omega \times 1000$. An interruption in the 5760 Ω resistor causes the interruption of the ranges $\Omega \times 1$, $\Omega \times 10$, $\Omega \times 100$ and a slight overload according to the position of the rheostat on the range $\Omega \times 1000$.

PARAGRAPH 4)

A) **Interruption of a resistor in series with the Ohms ranges:** The fault is in one of the following resistors: 34.5 Ω, 382.5 Ω, 3910 Ω, 44031 Ω, corresponding respectively to the ranges $\Omega \times 1$, $\Omega \times 10$, $\Omega \times 100$, $\Omega \times 1000$. When it has been decided which range is interrupted, check the continuity of the AMP circuit associated with it, as follows: After having inserted the common Ω socket, insert the other end in the 50 μA socket for an interruption in the range $\Omega \times$ 100Q in the 500 μA socket for an interruption in the range $\Omega \times$ 10Q and in the 5 mA socket for an interruption in the range $\Omega \times$ 1Q. These checks should be done as quickly as possible to avoid overloading the circuits and running down the battery.

B) **Interruption of the resistor of the range $\Omega \times$ 10,000:** This fault prevents the needle from indicating when the test meter is used in 50 Hz A.C. As this may also be caused by a fault in the rectifier, it is advisable to measure the continuity of the circuit without using the A.C. main supply.

The resistors to be tested are 200,000 Ω and 259.2 KΩ. For this purpose it is necessary to short circuit the pins of the current plug on the left hand side of the analyser and one end of a probe in the Ω socket and the other end in the $\Omega \times$ 10,000 socket. If the resistors are efficient the instrument which was already at the end of the scale on the $\Omega \times 1000$ range must indicate approximately 450,000 Ω on the Ohms scale. If this does not occur it is necessary to check which resistor of the three making up the circuit is interrupted. This is done by maintaining the above mentioned conditions and short circuiting the points 15 and 29 and 15 and 28 (see diagram). The resistor to be substituted is that which, after having been short circuited, causes the needle to move.

The second resistor of 200 KΩ making up the Ω x 10,000 circuit can be checked on points 15 and 18. The test meter must be set on the Ω x 1000 range and the pins at the side of the mains plug shortcircuited and the needle zeroed at the end of the scale. Then shortcircuit points 15 and 14. The continuity of the resistor is indicated by the needle going over the end of the scale.

PARAGRAPH 5)

A) **Alteration of the resistance values of the components of the ohms and amps circuits:** this fault can be caused enther by the resistors forming part of the ohms circuit or those forming part of the ampere circuit complementary to it.

To carry out this test it is necessary to have a reliable Test Meter with a good internal battery. Bear in mind that the overloads tend, in most cases, to raise the value of the resistors.

Set the reference Test Meter with the red probe in the Ω socket and the black probe in the 10 V DC socket. Insert the free end of the red plug in the 50 μA socket and the free end of the black plug in the (=) socket.

If the voltage of the battery in the reference test Meter is exactly 3 volts, the test Meter being tested will indicate 15 divisions (on the scale 50).

Set the reference Test Meter on Ω x 1000. Insert the black probe in the (=) socket and the red probe in the 500 μA socket. The reading will be 65 μA.

Set the reference Test Meter on Ω x 100, insert the black probe in the (=) socket and the red probe in the 5 mA socket. The reading will be approx. 650 μA.

For the ranges 50 mA and 500 mA proced as above bearing in mind for the 50 mA range to set the reference Test Meter on the Ω x 10 range and on the Ω x 1 for the 500 mA range. The currents will be 6.5 mA for the first and 65 mA for the second.

If the readings differ considerably from those mentioned and these differences are confirmed by the end of scale Ohms checks, replace the shunt resistor under test.

If, after the check, the current values read conform with those indicated the end of scale, differences in the reading of the zero ohms can be attributed to the resistors in series relative to the ohms circuit which must be substituted.

PARAGRAPH 6)

A) Fault in the Ampere circuit in D.C.: see paragraph 2E), 3A) and 5).

PARAGRAPH 7)

A) Faults in the Ampere circuit in A.C.: if the test meter does not work in the A.C. Ampere ranges, this may be caused by the interruption or alteration of the resistors in the shunt chain which composes the D.C. Ampere circuit.
However, it is advisable to check the circuit as in the instructions in paragraph 6). If the linkage is efficient, the fault must be in the rectifying section made up of a diode, the semi-fixed calibration rheostat and two resistors. The efficiency of the rectifying section can easily be measured as follows:
Set the reference Test Meter on $\Omega \times 1000$, insert the end of the positive probe (Ω) in the 250 μA a.c., socket and the negative probe in the common A.C. socket ($\sim$). If the diode is working properly, the needle of the instrument being tested should be approximately on the 22nd division of the black scale.
Reverse the probes and repeat the test: If the diode is working properly the needle of the instrument being tested must always indicate 1.5 divisions approximately (black scale) to the left of zero. If the room temperature is high, this reading may reach 2 to 2.5 divisions. If higher positive or negative readings are given, this means that the diode is conducting with a reduced rectifying capacity. If the readings are nil or almost nil, the diode is interrupted. In both cases, the diode must be substituted. It is situated between points 10 and 11 on the diagram.
After having checked the diode of the rectifying section, check the efficiency of the scale correction diode of the doubling range sections as follows: set up the Test Meter as for the previous check, and depress the button. The reading must go from 22 divisions (black scale) to approximately 7 divisions (black scale). After reversing the probes press the button again. The needle will move from — 1.5 to approximately 0.5. If it does not, it means that the fault is in the second diode or in the circuit associated with range doubling. Check the sections of the switch relative to this diode by connecting the red probe of the

reference Test Meter set on Ω x 100 range, to point 27 (see diagram) and the black probe to point 22. The reading on the reference Test Meter should move from zero with the button released to 500 Ω approximately with the button depressed; on reversing the probes, the reading should move from zero with the button released to 7000 Ω with the button depressed.

PARAGRAPH 8)

A) **Checking of the D.C. Volts circuit:** the continuity of the volts circuit can easily be carried out by setting the reference Test Meter on Ω x 1000, then inserting the black probe in the (=) socket, and the red one in the 100 mV socket; the instrument under test exceeds the end of scale and the reference Test Meter measures 2000 Ω. It may seem obvious to use the range Ω x 100 instead of Ω x 1000, but in doing this the instrument under test would be overloaded causing the protection diodes to come into play. This would reduce the resistance to the poles of the Galvanometer and the total value of the 100 mV range by modifying the value of 2000 Ω which would not be obtainable on the Ω x 100 range of the Reference Test Meter. Move the red probe onto the 2 V range. The needle will go to the 36th division (black scale). The movement on the 10 V range will bring the needle to the 12th division approximately; on the 50 V range, to the 3rd division approximately; on the 200 V range, to 3 to 4 divisions; on the 500 V range to 3/10ths of a division and on the range 1000, to 3/20ths of a division.

In the event of an interruption in the chain of resistors, the needle will not move when the probe is inserted in the socket relative to the faulty range.

Range on which the interruption shows up	**Resistors to be replaced**
100 mV	720 Ω
2 V	36 KΩ
10 V	160 KΩ
50 V	800 KΩ
200 V	3 MΩ
500 V	6 MΩ
1000 V	10 MΩ

PARAGRAPH 9)

A) **Faults in the A.C. voltmeter circuit:** If the Test Meter does not work on the voltmeter range in A.C., this may be caused by interruption or alteration of the additional serially linked resistors which are the same as those composing the D.C. voltmeter circuit. You are advised to check the circuit as per the instructions relative to the faults in the D.C. Volts circuit in paragraph 8). Regarding the testing of the rectifying section, see the instructions given in paragraph 7) except for 2 V A.C., the instructions for which are as follows:

Set the reference Test Meter on Ω x 1000, insert the black plug in the socket pF 2 V, and the red plug in the range 2 V 250 μA, the needle must reach the 25th division on the black scale. On reversing the probes, the needle must indicate approximately the space of one division to the left of the zero.

If it does not, check the Germanium diode as follows: set the reference Test Meter on Ω x 100. With the red probe on point 17, and the black probe on point 16 (see diagram), the reading will be approximately 1500 Ω. After reversing the probes the reading will be approximately 500 Ω; Repeat the operation for the second Germanium diode. With the red probe on point 25 and the black probe on point 24, the reading should be 1500 Ω and, after reversing the probes, 500 Ω approximately.

Check the section of the range doubling switch relative to the 2 V A.C. and the relative diode, as follows:

Set the reference Test Meter as follows: red probe on point 5, black probe on point 4 (see diagram). The needle of the reference Test Meter must indicate zero. Press the button and the reading moves to 2200 Ω approximately. Invert the probes and repeat the operation. The reading will be respectively zero and 500 Ω approximately.

When the efficiency of the diodes has been established, check the other resistors 5800 Ω and 720 Ω.

To measure the first resistor, set the reference Test Meter on the range Ω x 100. Insert the black probe in the pF 2 V A.C. socket. Touch point 5 with the red probe. The reading must correspond to 5800 Ω. To measure the 1045 Ω resistor, keep the reference Test Meter set on Ω x 100, and touch point 16 with the black probe and point 18 with the red probe. The reading will be 1050 Ω approximately. In this case, the reversing of the probes causes a considerably lower reading as the diode in parallel relative to the resistor are set in direct conduction. To measure the 720 Ω resistor set the reference Test Meter on Ω x 10, insert the red probe in the 2 V A.C. socket and, with the black probe, touch the point 2 (see diagram), the reading will be 720 Ω approximately.

PARAGRAPH 10)

A) **Output measurement check:** the above-mentioned circuit follows the sequence of the Volts circuit in A.C., the only extra element is the capacitor which can be checked by following the instructions relative to frequency measurements. A fault in the capacitor due both to a short circuit or a disconnected component lead, makes the reading of the mains frequency impossible. The reading would be the end of scale for a shortcircuit and it would move only slightly in the event of a disconnected component lead. If required, it is possible to carry out a static check of the capacitor as follows:
Insert the reference Test Meter on Ω x 100, insert the red probe in the OUTPUT socket, and the black probe in the 250 μA socket. Wait a few moments, and then reverse the probes. A slight impulse of amplitude of half a division, should occur. This test confirms whether the capacitor is working correctly or not.

LIST OF POSSIBLE FAULTS DUE TO ALTERATIONS OR INTERRUPTION IN THE VARIOUS COMPONENTS

The following is a list of the various components with an indication of faults shown up by them if their values go infinite (interruption) or drop to zero (short circuit); obviously a simple increase or decrease in the determined value indicates a fault which is less grave but which shows the same symptoms as extreme cases.

FAULTY OR ALTERED VALUE, 720 Ω

If interrupted the needle does not move, energising the ranges 100 mV, 50 μA, 2 V A.C., 250 μA A.C. If shortcircuited the reading exceeds 50% for the 100 mV D.C. range, and 8% for the 2 V A.C. range. There is no reading error for the 50 μA D.C. and 250 μA A.C. ranges.

FAULTY VALUE 2720 Ω

If interrupted, the needle does not move supplying the V ranges D.C. from 2 V to 1000 V inclusive. If shortcircuited the reading exceeds 7.5% on the 2 V D.C. range and 1.5% approx. for the 10 V, range, and so on in proportion for the other ranges.

FAULTY VALUE 36 KΩ

If interrupted, the needle does not move supplying the V ranges D.C. from 2 V upwards. The same applies to the ranges in A.C. from 10 V upwards.

If shortcircuited on the range 2 V D.C. the reading is excessively high (the needle goes to end of scale with 240 mV approx). On the 10 V D.C. range the reading exceeds 20% approx., on the 50 V D.C. range, the reading exceeds 4% approximately, and so on in proportion for the other ranges.

On the A.C. range there is a very large error in excess which is reduced for the lower ranges.

FAULTY VALUE 160 KΩ

If interrupted the Test Meter works normally up to the 2 V D.C., and 10 V A.C. ranges inclusive, no indication in the upper ranges.

If short-circuited, the Test Meter works normally up to the 2 V D.C., and 10 V A.C. ranges.

The reading at the end of the scale in the 10 V D.C., and 50 V A.C. ranges will still be that of the previous ranges; high reading error for higher ranges.

FAULTY VALUE 800 KΩ

If interrupted the Test Meter works normally up to the 10 V D.C., 50 V D.C. ranges inclusive. No reading for the higher ranges.

If short circuited the Test Meter works normally up to the 10 V D.C. and 50 V A.C. ranges inclusive. The end of scale reading on the 50 V A.C. and 250 V A.C. ranges is the same as those for the 10 V D.C. and 50 V A.C. ranges.

Faulty reading in excess for the higher ranges.

FAULTY VALUE 3 MΩ

If interrupted the Test Meter works normally up to the 50 V D.C. range and 250 V A.C. ranges inclusive.

No indications on the higher ranges.

If short circuited, the Test Meter works normally up to the 50 V D.C., and 250 V A.C. ranges inclusive whilst the end of scale reading of the 200 V D.C., and 1000 V A.C. ranges is the same as that for the 50 V D.C. and 250 V A.C. ranges. High reading error for the higher ranges.

FAULTY VALUE 6 MΩ

If interrupted the Test Meter works normally up to 200 V D.C. and 1000 V A.C. ranges. No reading on the higher ranges.

If shortcircuited the Test Meter works normally up to the 200 V D.C. and 1000 V A.C. ranges. The end of scale reading of the 500 V D.C. and 2500 V A.C. ranges are the same as that for the 200 V D.C. range.

Reading in excess for the 1000 V D.C. range.

FAULTY VALUE 10 MΩ

If interrupted the Test Meter works normally up to the 500 V D.C. and 2500 V A.C. ranges. No reading on the 1000 V D.C. range.

If shortcircuited the Test Meter works normally up to the 500 V D.C. and 2500 V A.C. ranges. The end of scale reading for the 1000 V D.C. range is the same as that for the 500 V D.C. range.

FAULTY VALUE 0.064 Ω

If interrupted the needle of the Test Meter goes to the end of scale with 40 μA for all the Ampere ranges. Fierce movement over the end of scale for all the ohms ranges. Error exceeding 20% approximately in all the volts ranges.
If shortcircuited, weak reading of the needle on the 5 A range with instrument supplied with nominal current. Readings faulty by 10% on the 500 mA D.C. range.

FAULTY VALUE 0.576 Ω

If interrupted no readings on the 5 A range. From 500 mA to 50 μA the instrument shows the same sensitivity as for 40 μA end of scale. Fierce movement to the end of scale for all the ohms ranges. Reading in excess of 20% for all the volts ranges.
If shorcircuited, faulty reading of 90%, on the 500 mA range, and 10% approx. on the 50 mA range.

FAULTY VALUE 5.76 Ω

If interrupted no reading on the 5 A and 500 mA ranges. For 50 mA to 50 μA, the instrument shows the same sensitivity as for 40 μA. Fierce movement over the end of scale for all the ohms ranges. Reading in excess of 20% for all the volts ranges.
If shorcircuited, reading faulty by 90% on the 50 mA range and 10% on the 5 mA range. The ohms ranges at end of scale do not coincide. The range Ω x 1 just reaches 10% of end of scale.

FAULTY VALUE 57.6 Ω

If interrupted no reading for the ranges 5 A, 500 mA, 50 mA and Ω x 1, on the ranges 5 mA, 500 mA, 50 μA the instrument shows the same sensitivity as for 40 μA end of scale. Fierce movement of the needle to end of scale for the ranges Ω x 10, Ω x 100, Ω x 1000. Volts range in excess of 20% approximately.
If shortcircuited, reading faulty by 90% on the 5 μA range and 10% on the 500 mA range.

The ends of scale of the ohms ranges do not coincide, especially the $\Omega \times 10$ range, which just reaches the 10% of the end of scale.

FAULTY VALUE 576 Ω
If interrupted no reading on the ranges 5 A, 500 mA, $\Omega \times 1$, $\Omega \times 10$. The 500 μA and 50 μA ranges show the same sensitivity as 50 μA end of scale. Fierce movement to the end of scale for the ranges $\Omega \times 100$, $\Omega \times 1000$. Volts ranges in excess of 20% approx. If shortcircuited, reading faulty by 90% on the 500 μA range and by 10% on the 50 mA range. Reading in excess of approx. 10% for all the remaining Ampere ranges.

FAULTY VALUE 5760 Ω
If interrupted no reading for the ranges 5 A, 500 mA, 50 mA, 5 mA, 500 μA $\Omega \times 1$, $\Omega \times 10$, $\Omega \times 100$; the 50 μA range shows the same sensitivity of end of scale as 40 μA.
If shortcircuited the Ampere ranges are reduced by 5 times as much for the 50 μA range which is changed to 100 μA. Excessive sensitivity for the ohms ranges except for the $\Omega \times 1000$ range, which just reaches 4/10 of the end of scale.

FAULTY VALUE 5.6 KΩ SEMI-FIXED 2.2 K RHEOSTAT
If interrupted no reading for all A.C. ranges.
If shortcircuited no reading for all the A.C. ranges.

FAULTY VALUE 5800 Ω
If interruped no reading on the 2 V A.C. range and on the ohms ranges in A.C.
If shortcircuited, considerable errors in excess in the 2 V A.C. range.
Noticeable reading errors on the scale $\Omega \times 1000$ in A.C.

FAULTY VALUE 1045 Ω
If interrupted, considerable errors in excess in the 2 V A.C. range.
If shortcircuited, no reading on the 2 V A.C. range.

FAULTY VALUE 1600 Ω
If interrupted, no reading when the Ampere ranges are doubled.
If shortcircuited reading in excess when the doubling operation is carried out.

FAULTY VALUE 3200 Ω

If interrupted, reading in excess when the volt Ampere ranges are doubled.
If shortcircuted, no reading during the above operations.

FAULTY VALUE: Germanium rectifier diodes in points 10 and 11 (see diagram on page 73). A fault in these puts A.C. ranges out of action except for the 2 V A.C. range and the ohms circuit in A.C.

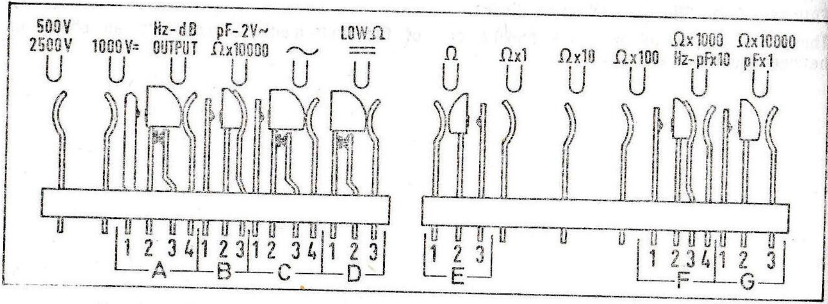
FAULTY VALUE: Germanium rectifier diodes in points 26 and 27 (see diagram on page 73). Intervenes only during the doubling operation and if faulty causes faults in the A.C. circuit AV x 2.

FAULTY VALUE: Silicone protection diodes.
These are in parallel with the moving coil of the instrument. Check with an ohmmeter between points 6 and 8.

REPLACEMENT OF FAULTY METER MOVEMENT (or Galvanometer)

Should it become necessary to replace the meter movement (galvanometer), please note that the new movement assembly supplied is already fully calibrated by ICE for current and resistance. The internal resistance of the meter has been adjusted by means of a 330 ohm rheostat (variable resistor) which is supplied with the new assembly - do NOT turn this variable resistor as it has already been adjusted to the exact value by ICE and fixed in position with epoxy resin. Simply remove the original rheostat from the printed circuit board by desoldering, and fit the new 330 ohm variable resistor supplied, taking care not to alter the semi-fixed preset value of the component. Then fit the printed circuit board to the new meter movement, using the original screws.

DIAGRAM OF THE SWITCHING CONTACTS



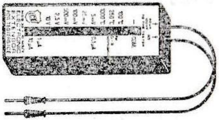
Exact position of the contacts in the rest position i.e. without probes

SUPPLEMENTARY ACCESSORIES TO BE USED WITH OUR "SUPERTESTER 680"

With these accessories I.C.E. has widened the ranges of tests and measurements which can be carried out with the "SUPERTESTER 680 R".

The main characteristics are described hereunder.

ELECTRONIC RANGE EXTENDER MOD. 30



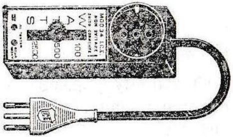
Provides the following additional facilities:

a) D.C. Electronic Millivoltmeter, with ranges of 0 to 5 mV, 0 to 25 mV, 0 to 100 mV, 0 to 2.5 V, and 0 to 10 V, with an input resistance of 10 MOhm/V.

b) Nano and Microammeter - providing a sensitivity of 2 nA/division on the mV ranges!

c) Pyrometer/Temperature Indicator with ranges of 0 to + 100 °C, 0 to + 250 °C and 0 to 1000 °C.

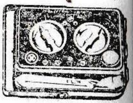
WATT-METER MOD. 34



Provides three ranges of 100, 500 and 2500 Watts, full-scale.

Invaluable for measurements of the power consuption of domestic appliances and other small electrical devices.

I.C.E. ELECTRONIC VOLT-OHMMETER MODEL 660 B



VOLTAGE IN D.C.	0.1, 0.5, 2.5, 10, 25, 100, 250, 500, 1000 V
PEAK-PEAK VOLTAGES	2.5, 10, 25, 100, 250, 500, 1000 V
INPUT RESISTANCE IN D.C.:	11 Mohms on all ranges (1 Mohm in the probe).
IMPEDANCE P.P. INPUT	1.6 Mohms with approximately 10 pF in parallel.
OHMS CIRCUIT	Independent supply with a 1.4 V internal mercury battery. This circuit has been set so that the reading occurs on the same Ohms scale as the Test Meter model 680 multiplied by factors (Ohm x 10,000 x 100,000 x 1,000,000) which allow measurements from 10,000 Ohms to 10 thousand MegaOhms!
INTERNAL SUPPLY	With a 9 V battery which is automatically inserted when the negative probe of the indicating instrument is inserted in the relative socket.
SHIELDED PROBE	With switch incorporated for the following switchings: V-D.C.; V - peak-peak; Ohm.

DESCRIPTION

High stability precision resistors (± 1%) guarantee the time of the initial calibration. The electronic circuit with a two stage highly counteracted differential gives perfect alignment and stability.

The accurate selection of field effect transistors (FET) and complementary planar silicone transistors allow particular insensitivity of the zero in the different ranges, which is especially important for the first range: 100 mV (exceptional for an electronic voltmeter).
The group of resistors used for the differential circuit is of the metal layer type with a low temperature co-efficient. The system is set for direct use with the Test Meter Models 680. In the probe there is a 1 Mohm resistance, 2 silicone diodes with a very high reverse voltage, a high voltage polyester capacitor, a rhodium plated printed circuit with layers and a slider which can be operated from outside and which is fitted with solid silver contacts. This type of electronic voltmeter is one of the most modern of its kind, it is extremely compact, measuring 126 x 85 x 32 mm, and weighs only 280 grams. The advantages of using the I.C.E. Model 660 instead of the tube type voltmeter are as follows:

INDEPENDENT POWER SUPPLY: this makes the instrument very versatile as it can be used anywhere.

THERMAL SETTLING IN PERIOD: in comparison with tube type voltmeters which need a relatively long thermal settling in period, the electronic voltmeter model 660 does not need this, rendering it, as already mentioned, more versatile.

ZERO STABILITY: the grid current in the triodes, its fluctuation and the high input resistance have always been the main causes of the zero instability of such voltmeters.
The current dispersion of the FET of no higher than one nano Ampere has allowed the creation of the voltmeter with 100 mV end of scale sensitivity with an input impedance of 11 Mohms and absorbed current of only 0.0091 μA full scale. This extreme sensitivity has allowed the Ohms ranges of the test meter to be increased to the factor of 1 million Ohms with an increase in resistive values up to 10,000 Mohms with a 1.4 V power supply obtained from the internal mercury battery (lasting 2 years).

TRANSISTOR AND DIODE TESTS, I.C.E. MOD. TRANSTEST 662

Due to the limited space available, the following is a brief summary of the numerous measurements which can be carried out using the Transistor and Diode Tester TRANSTEST 662 I.C.E. together with the Supertester 680.

For transistors: Icbo (Ico) - Iebo (Ieo) - Iceo - Icer - Vce sat - Vbe - hFE (ß).

For diodes: Vf - Ir.

A comprehensive manual, given free of charge, accompanies the instrument. This explains plainly and clearly how to carry out the different measurements and, for the benefit of the less experienced technician, explains the basic concept of each one.

As for the diode test, the device incorporated in the TRANSTEST 662 measures the voltage drop under 5mA D.C., whilst the reverse characteristic measures the reverse current under 3 Volts.

Both the direct current and reverse test voltage have been chosen to standardise use for both low, medium and high power diodes.

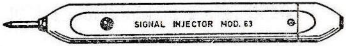
The instrument is made of a very new type of resin and is consequently perfectly shock and impact proof when used under normal conditions.

It is small in size (126 x 85 x 28 mm) and light (250 grams).

I.C.E. have incorporated some very noteworthy and important improvements in this instrument and have taken out several international patents for it. Its excellent design, mechanical construction and special circuit make it extremely suitable for professional purposes.

In the design of this instrument, as for the Supertester 680 R I.C.E. has aimed for absolute international supremacy in both the high quality and low price, which has been kept down, thanks to the high level of automation reached by I.C.E.

SIGNAL INJECTOR
MODEL 63 - I.C.E.



The signal injector model 63 has been designed and manufactured by I.C.E. to enable the radio technicians to quickly locate faults and interruptions in the circuit of any equipment with valves or transistors, both with high or low frequency such as radios, televisions, amplifiers etc. The electrical circuit of this I.C.E. injector 63, contains solid state components which have an unlimited life.

Two special transistors, assembled as in the classical circuit with locked oscillator, give a signal with two basic frequencies of 1000 Hz (audio frequency) and 500,000 Hz (radio frequency).

The wave-form generated has a steep front, and because of the special circuit of the oscillator, covers a spectrum of continuous frequency which extends from low frequency audio to high frequency radio and video signals.

For ease of use, this signal injector model 63 I.C.E. is independent and does not need to be connected to other instruments. It integrates and completes the numerable features of the TESTER 680 R and all the other Test Meters on the market.

I.C.E. RESISTANCE MEASUREMENT MULTIPLIER, MODEL 25

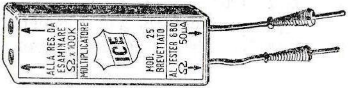
TECHNICAL DESCRIPTION

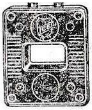
The Resistance Measurement Multiplier, Model 25, is one of the comprehensive range of accessories specially designed to enhance the usefulness of the I.C.E. "Supertester", Model 680 Series,Multimeter.

The small rectangular moulded unit contains a printed circuit board carrying a single-stage transistor amplifier, together with its associated components. These include a variable resistor which is pre-set during manufacture to adjust the multiplying factor to exactly "x 100,000".

Power for this accessory is drawn from the multimeter resistance measuring circuitry. The normal test-prod leads may be inserted into two 2 mm sockets at one end of the unit; two fly-leads at the other end, terminated in 2 mm wander-plugs, being connected to the multimeter.

Current passing through the resistor under test is amplified by a factor of 100,000 and applied to the "680" metering circuit.




ICE 616

I.C.E. TRANSFORMER MOD. 616
For ampere measurements in A.C. Possible measurements: 250 mA - 1 - 5 - 25 - 50 and 100 Apm. A.C. Size 60 x 70 x 30 mm. Weight 200 grams.


AMPERCLAMP

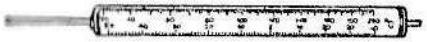
PINCER AMMETER AMPERCLAMP
For immediate ampere measurements in A.C. without breaking the circuit to be tested. 6 ranges: 2.5 - 10 - 25 - 100 - 250 and 500 Amps A.C. Also 250 mA range with the reducer mod. 29 (available on request). Weight only 290 grams. Pocket size.


ICE 18

HIGH VOLTAGE PROBE MOD. 18 I.C.E.
(25,000 V D.C.)


ICE 24

LIGHT METER MOD. 24 I.C.E.
Two scales from 2 to 200 Lux and from 200 to 20,000 Lux. Also efficient when used as an Exposure Meter.

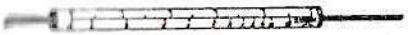

ICE 36

PROBE FOR TEMPERATURE TESTS
Instantaneous, with two scales: from + 30 to + 200 °C and from — 50 to + 40 °C.
Mod. 36 I.C.E.


ICE 32

ADDITIONAL SHUNTS (100 mV) MOD. 32 I.C.E.
For ampere ranges: 10-25-50 and 100 Amp. D.C.

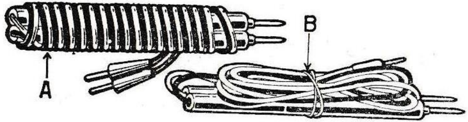
SEQUENCESCOPE MOD. 28 I.C.E.
Used as a cyclic phase indicator.



FLUXMETER MOD. 27 I.C.E. - for magnetic field measurement.

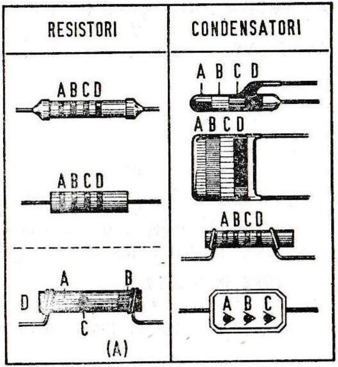
SPARE PARTS FOR THE TESTER 680 R I.C.E.

Metal layer resistance with precision 0.5 x 100; indicate the Ohms value required.
Wire resistors (shunts); indicate the Ohms value required.
Complete Rheostat with serrated knob.
Germanium diode for rectifying current.
Silicone diodes for protecting the instrument against overloads.
High precision 56,000 pF capacitor.
3 Volt high stability battery.
Fuse, for Resistance Measurement circuit protection (Box of 10 fuses).
Indicator, 40 μA, 1600 Ω, complete with front crystal panel with sockets and plate indicating the range and AV x 2 switch.
Printed circuit already drilled.
Printed circuit complete with soldered resistors and contact springs.
Probes, complete with leads and plugs.
Upper front in transparent crystal already treated with antistatic solution.
Unbreakable plastic base.
Complete lead with plug for mains.
Carrying case.
Insulated crocodile clamps (indicate either red or black)
Bridge for LOW Ω.
Instruction manual.
Antistatic solution to remove electrostatic charges from the panel (one dose).



COLOUR CODE FOR RESISTORS AND CONDENSERS

Colour	A	B	C	D	
Black . .	—	0		± 20%	
Brown . .	1	1	0	± 1%	
Red . . .	2	2	00	± 2%	
Orange .	3	3	000		
Yellow . .	4	4	0000		
Green . .	5	5	00000	± 5%	C
Blue . . .	6	6	000000		
Violet . .	7	7	—		
Grey . . .	8	8	—		
White . .	9	9	—	± 10%	
Gold . . .	—	—	—	± 5%	R
Silver . .	—	—	—	± 10%	
Colourless	—	—	—	± 20%	



The colour of **A** (body of the resistance or the first strike) indicates the first figure The colour of **B** (one of the extremities) or the second strike indicates the second figure. The colour of **C** (the point or third strike) indicates the number of zeros to be added to the first figures.

The colour of **D** indicates the tolerance, as a percentage, with reference to the nominal value.

Notice as for the lay-out **(a)**:

1) When the colour does not exist it means that the colour is the same of the body.
2) When the extremity **D** has the same colour than the body, the tolerance is ± 20%.

TECHNICIAN'S REFERENCE POINTS

OHM'S LAW $I = \frac{V}{R}$; $R = \frac{V}{I}$; $V = R \cdot I$

$W = V \cdot I$; $W = \frac{V^2}{R}$; $W = I^2 \cdot R$; $I = \sqrt{\frac{W}{R}}$

$R = \frac{V^2}{W}$; $R = \frac{W}{I^2}$; $V = \frac{W}{I}$; $V = \sqrt{W \cdot R}$

V = Voltage in Volts - R = Resistance in Ohms - I = Intensity of Current in AMPERES - W = Power in Watts (the letter P (power) in also used)

RESISTORS IN SERIES

The total resistive value (R_t = total resistance) of a certain number of resistors in series is equal to the sum of the individual values of every resistor, that is:

$$R_1 + R_2 + R_3 \text{ etc.} = R_t$$

RESISTORS IN PARALLEL

The total resistive value (R_t = total resistance) of a certain number of resistors in parallel is:

$$R_t = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \text{ etc.}}$$

In the event of only two resistors in parallel, the Ohms value (R_t = total resistance) is equal to:

$$R_t = \frac{R_1 \times R_2}{R_1 + R_2}$$

CAPACITORS IN SERIES

The total value (C_t = total capacity) of a certain number of capacitors in series $C_1 + C_2 + C_3$ etc. is the following:

$$C_t = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \text{ etc.}}$$

In the event of only two capacitors in series the total capacity (C_t = total capacity) is equal to:

$$C_t = \frac{C_1 \times C_2}{C_1 + C_2}$$

CAPACITORS IN PARALLEL

The total value (C_t = total capacity) of a certain number of capacitors in paralles ($C_1 + C_2 + C_3$ etc.) correspond to the sum of the values of each individual capacitor $C_t = C_1 + C_2 + C_3$ etc.

The power (Watts) measured in a three-phase balanced circuit is equal to the voltage measured between phases, multiplied by the current (Ampere) absorbed by a phase by 1.73 x cos-fi.

VALUE OF THE VOLTAGES AND SINUSOIDAL CURRENTS

R.M.S. VALUE	$= 0.707 \times$ peak value	$= 1.11 \times$ average value
AVERAGE VALUE	$= 0.637 \times$ peak value	$= 0.9 \times$ R.M.S. value
PEAK VALUE	$= 1.414 \times$ R.M.S. value	$= 1.57 \times$ average value

AC RESPONSE OF TESTER 680 R 4th SERIES

Range	2 V a.c.	from	10 Hz	to	1 MHz	± 0,5 dB
»	2 V a.c.	»	30 Hz	»	20 KHz	± 1,5 dB
»	250 μA a.c.	»	10 Hz	»	1 MHz	± 1 dB
»	2,5 mA a.c.	»	10 Hz	»	200 KHz	± 1 dB
»	25 mA a.c.	»	10 Hz	»	1 MHz	± 1 dB
»	250 mA a.c.	»	10 Hz	»	10 KHz	± 1 dB
»	10 V a.c.	»	10 Hz	»	300 KHz	± 1 dB
»	10 V a.c.	»	30 Hz	»	20 KHz	± 1,5 dB
»	50 V a.c.	»	10 Hz	»	30 KHz	± 1 dB
»	50 V a.c.	»	30 Hz	»	20 KHz	± 4 dB
»	250 V a.c.	»	10 Hz	»	5 KHz	± 1 dB
»	1.000 V a.c.	»	10 Hz	»	1,5 KHz	± 1 dB

GUARANTEE

I.C.E. - Industria Costruzioni Elettromeccaniche of Milan, Italy guarantees that all instruments which leave its factory are free from defects of manufacture or materials in relation to normal conditions of use and service. This guarantee is limited to an undertaking to restore to complete working order any instrument or other apparatus which within 180 days from delivery to the original customer is returned freight paid and intact to the works or to one of our authorised agencies and which in the opinion of our technicians proves to be of faulty workmanship. This guarantee replaces any other expressely, stated or implied or any other obligation or responsability. I.C.E. - Industria Costruzioni Elettromeccaniche does not assume or authorise third parties to assume on its account any other responsability in relation to the sale of its products.

The present guarantee will not be applicable to instruments or apparatus the guarantee seal of which has been tampered with or that have been repaired or have alterations made outside our works or the workshops of our authorised agencies. The same may be said in the case of instruments that have not be treated properly or with due regard or that have been damaged or connected up incorrectly or installed and operated not in accordance with the instructions given at the works.

We cannot be held in any way responsable for any harm direct or indirect from any cause or accident to people or things during the employment of our apparatus or materials manufactured in our works. In the case of any controversy, the Foro di Milano is the competent authority.

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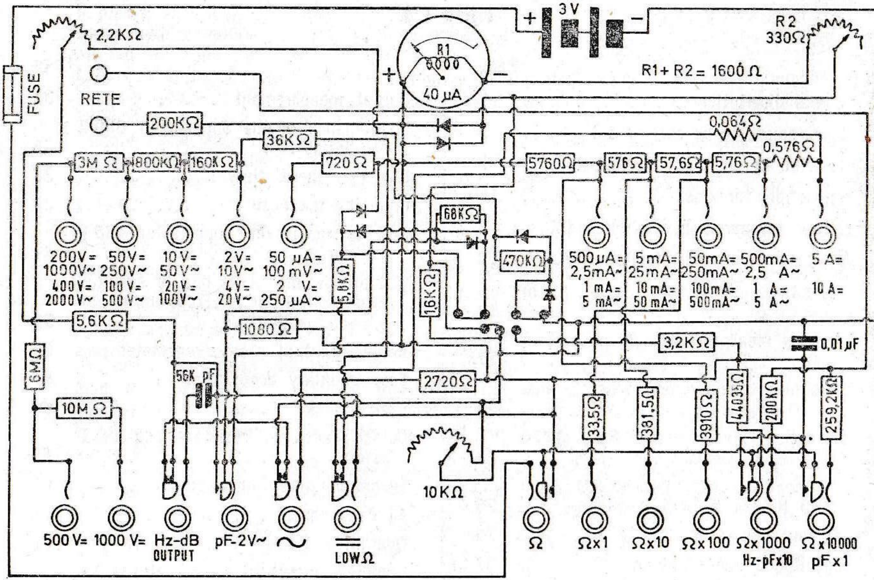
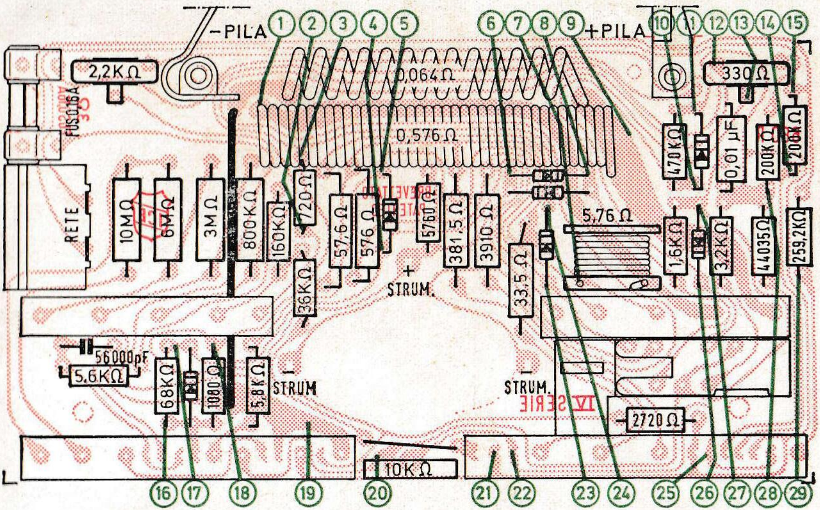


ELECTRICAL CIRCUIT OF THE SUPERTESTER 680/R



PRINTED IN BLACK: Diagram showing the location of the various components under the printed circuit board (see illustration on page 40).

PRINTED IN RED: Diagram of the printed circuit as it appears when the printed circuit is tilted as in the illustration on page 40.

PRINTED IN GREEN: Reference points for checking the components (see guide on how to repair the Test Meter 680 R on page 42).

The **I.C.E.** also manufactures:

- Ammeters
- Clamp Volt-Ammeters
- Milliammeters
- Microammeters
- Galvanometers
- Voltmeters
- Antishock instruments
- Wattmeters
- Instantaneous termometers
- Pyrometers
- Pointer frequency - meters
- Luxmeters
- Insulation meters
- Hermetic seal instruments
- Vibration frequency meters
- Power - factor meters
- Exposure meters « Multilux »
- Self - regulating instruments
- Large - angle instruments (250°)
- Relais
- Instruments transformers
- Shunts
- Photoeletric swiches
- Decade resistance boxes
- Standard resistances
- Wheatstone-bridges
- Recording instruments from 1 to 6 curves
- Tester - 100.000 Ω x V
- Fluxmeters
- Standard instruments for laboratory

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