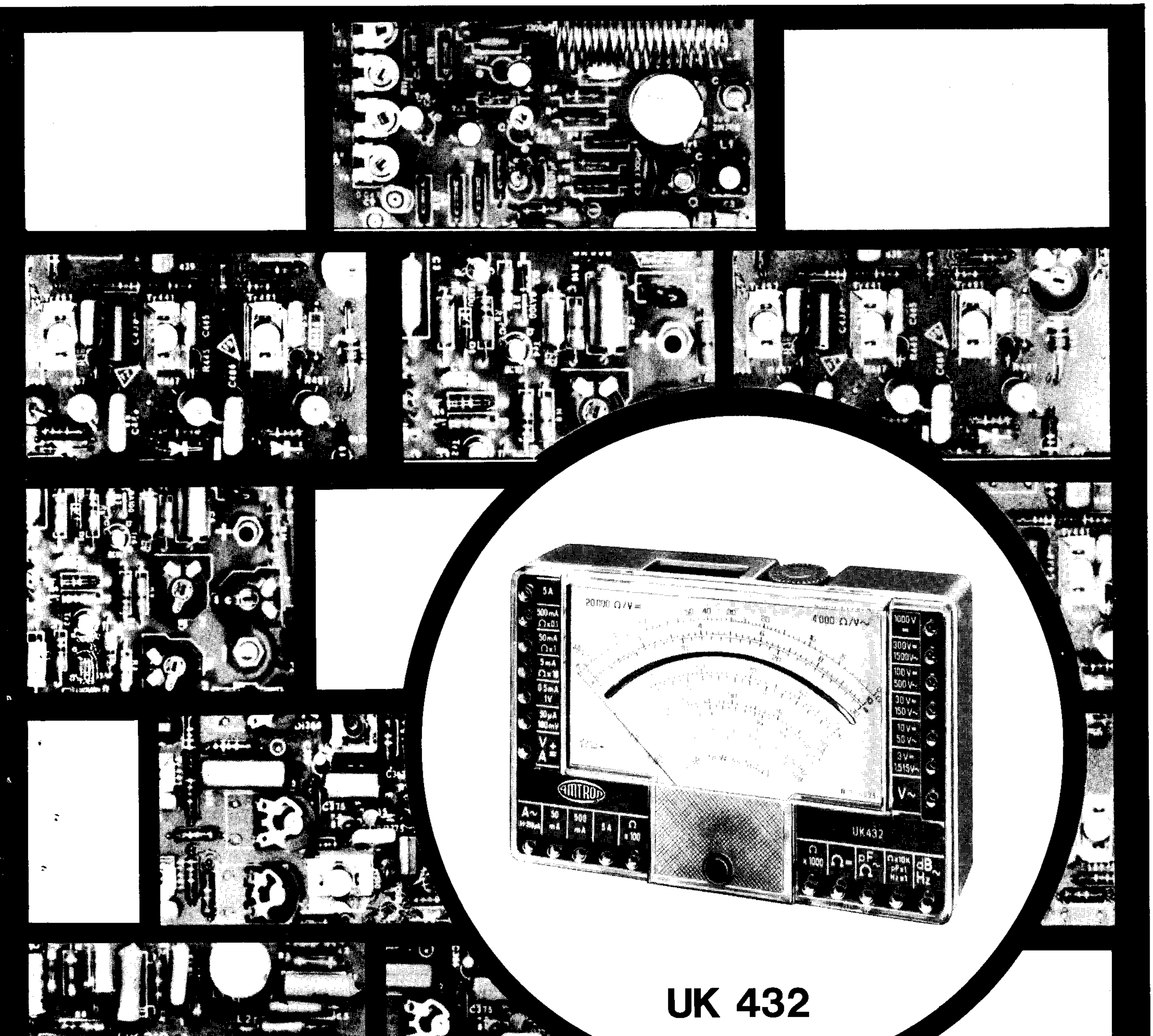
AMTRON

UNIVERSAL TEST METER



UK 432

RATINGS & CHARACTERISTICS

Measurement ranges:	10
Meter ranges:	48
Sensitivity: DC	20,000 Ω/V
AC	20,000 Ω/V
Volts	
DC: 8 ranges	0.1, 1, 3, 10, 30, 100, 300, 1,000 V
AC: 8 ranges:	1.5, 15, 50, 150, 500, 1,500 V
Amperes	
DC: 6 ranges	50 μA, 0.5 mA, 5 mA, 500 mA, 5 A
AC: 4 ranges	250 μA, 50 mA, 500 mA, 5 A
Ohms - 6 ranges:	Ωx0.1, Ωx1, Ωx10, Ωx100, Ωx1k, Ωx10k
Reactance - 1 range:	0 to 10 MΩ
Frequency - 1 range:	0 to 50 Hz 0 to 500 Hz (external capacitor)
Output Volts - 6 ranges:	1.5 V (with external capacitor) 15 V, 50 V, 150 V, 500 V, 1,500 V
Decibels - 6 ranges:	−10 to +70 dB
Capacitance 4 ranges:	0 to 0.5 μF (mains supply) 0 to 50 μF, 0 to 500 μF 0 to 5,000 μF (battery supply)

The AMTRON UK 432 UNIVERSAL TEST METER is an indispensable instrument to all those professional or amateurs who work in the field of Electrical or Electronic applications, Radio or Television. The large size of the dial, its clarity, lightness of the instrument, accuracy, make it a first class piece of test apparatus.

The idea of a technician or an amateur building their own tester may seem at first slightly preposterous, considering the wide choice of these instruments offered by the market. Yet, before passing any hasty judgment, we should not overlook the fact that both professionals and amateurs, by assembling their own measuring instruments — the more elementary ones at least — gain a sound knowledge of the way these are built and work, which will enable them to spot unerringly any sort of malfunctioning, detect its cause and remedy it quickly and effectively.

ELECTRIC CIRCUIT

Figure 1 illustrate the electric circuit of the AMTRON UK 432 Universal Tester Meter.

We do not think it would be worthwhile to embark upon a detailed analysis of the circuit, as such an undertaking would entail reviewing a large share of the notions concerning electrical measurements. Almost everybody is familiar with the principles governing the measurements of voltage, current or resistance: those that are not, can turn

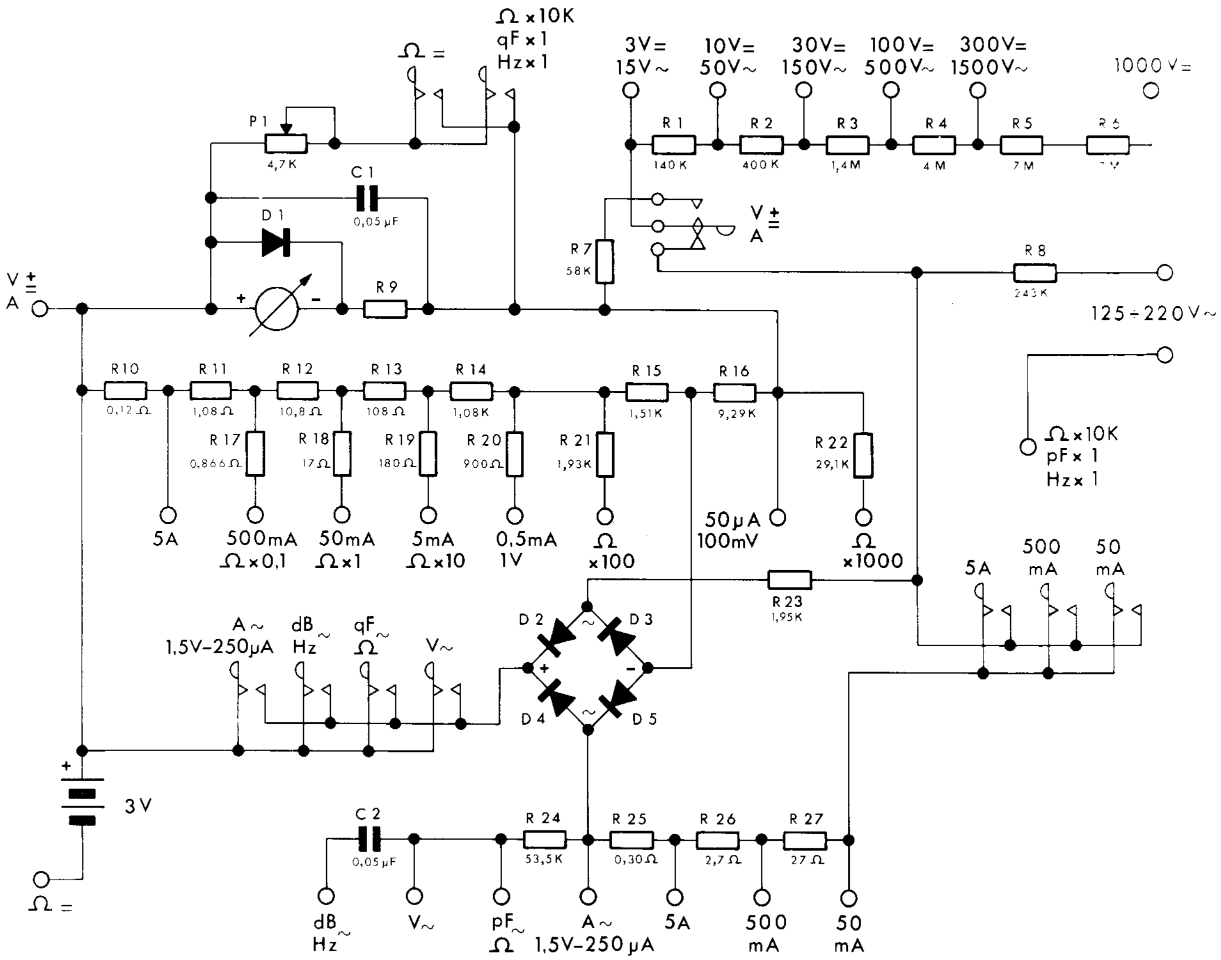


Figure 1 - Circuit Diagram.

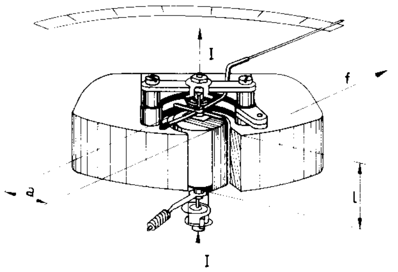


Figure 2 - Electro-magnetic Instrument.

to any manual dealing with such matters for enlightment.

However, some hints are given below on the theory of the working of an electro-magnetic instrument, such as the one used in the UK 432 Tester.

MAGNETO-ELECTRIC INSTRUMENT

As shown in Figure 2, the electro-magnetic instrument consists of a permanent magnet and a coil, called **«moving coil»,** which rotates within the poles of the magnet.

The rotating element, of which the coil is an integral part, is provided with a case-hardenend steel shaft, whose tips rest upon extra-smooth jewels, such as agats, rubies or sapphires. The rotating element can thus rotate without practically any friction, just like the balance wheel of a watch.

The rotating element is also provided with two small spiral springs which perform the double task of acting as conductors to allow the current to pass through the coil, and of opposing the movement of the rotating element when the latter is made to move by the current.

If the value of the induction of the magnetic field in the air gap is indicated as **B,** the number of turns of the coil as **N,** and the value of the current passing through the coil as **I** (refer to Figure 2), each side of the coil will be subjected to an electro-magnetic force:

$$f = BLNI$$

Because of the radial pattern of the induction lines of the field over the whole center area of the poles, these two forces of equal value but opposite sign, acting on each side of the coil, will always be normal to the plane of the coil, thus forming a constant couple **«a»,** which basically constitutes the deflecting torque **«Cm»** of the instrument. The value of **Cm** is expressed by the relation:

$$Cm = fa = BLNIa$$

But since **L.a = S,** S being the area encompassed by each spiral spring the relation can also be expressed as follows:

$$Cm = BSNI$$

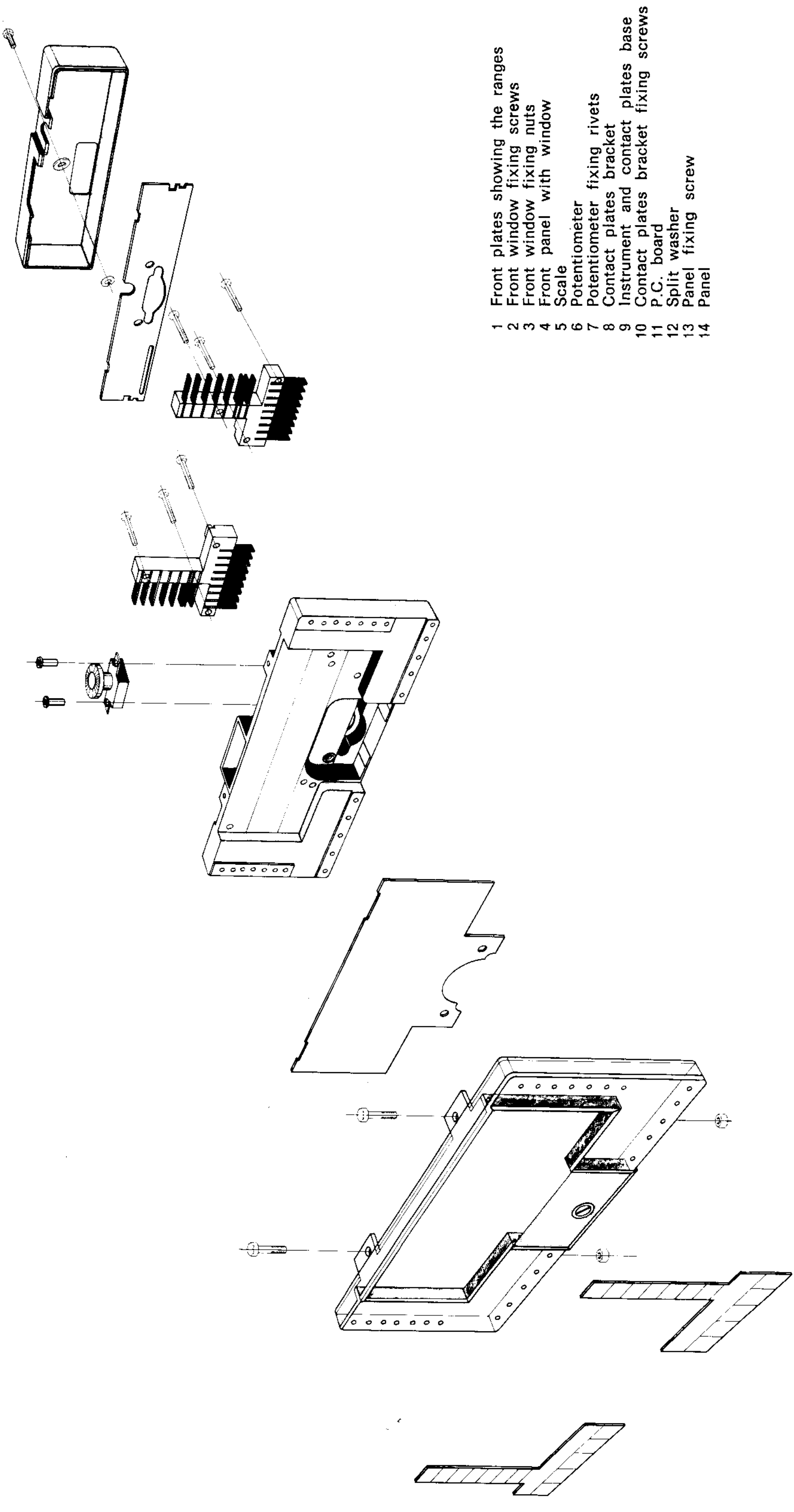
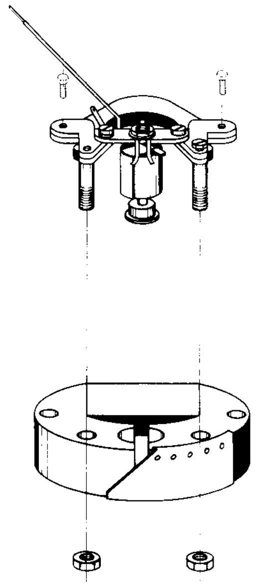


Figure 3 - Exploded view of some sub-assemblies which are supplied already assembled.



1 Moving element
2 Magnet
3 Fixing nut (moving element to magnet)
4 Scale fixing screws
5 Magnetic shunt for calibration adjustment

Figure 4 - Exploded view of instrument (supplied in assembled form).

The above relation applies to coils of any form, provided their windings have a flat contour.

The deflecting torque is opposed by the restoring torque **«Ca»**, which originates from the elastic rotation of the two spiral springs, and is proportional in value to the deflection angle δ.

If $\mathbf{K_t}$ is the coefficient of elastic rotation of the spiral springs, the restoring torque will be $\mathbf{Ca = K_t \delta}$.

Therefore the condition of balance of the coil is defined by the Cm = Ca equality, according to the relation:

$$\mathbf{BSNI = K_t\ \delta}$$

From the relation above, we gather that:

$$\delta = \frac{\mathbf{BSN}}{\mathbf{K_t}}\ \mathbf{I\ and\ I} = \frac{\mathbf{K_t}}{\mathbf{BSN}}\ \delta$$

Since the values of **B, S, N,** and $\mathbf{K_t}$ are constant for a given type of galvanometer, it can be assumed that the deflection angle δ of the coil is proportional to the current passing through the coil or, reciprocally, that the intensity of the current through the coil is proportional to the deflection angle.

ASSEMBLY OF THE TESTER

In developing the UK 432 kit, special care was taken to make its assembly possible even to people lacking a sound technical background. All the sub-assemblies that are used to fasten the printed circuit board, as well as the potentiometer and the instrument itself come already mounted on the bottom panel.

All you have to do is solder the components to the p.c. board and make the necessary connections. These operations are made easier by the wealth of illustrations in this booklet, such as the circuit schematic, exploded view, component layouts, and by the screen-printing of the p.c. board.

Furthermore, the exploded view in Figures 3 and 4 illustrate the way the sub-assemblies that come already assembled in the kit are put together at our factory.

Step 1 - Preliminary wiring

Refer to Figure 5. The numbers between brackets refer to the numbers in the figure.

☐ Connect the terminal «+» of the battery holder to the first two terminals of the potentiometer with a length of red lead (1).

☐ Connect the other terminal of the potentiometer to its contact plate with a length of black lead (4).

☐ Connect the terminal «+» of the battery holder to its contact plate with a length of red lead (3).

☐ Connect the right-hand terminal of the household current socket to its contact plate with a length of red lead (5).

☐ Solder a length of black lead (9) to the other terminal of the socket. The other end of this lead will be soldered later to the p.c. board.

☐ Connect the terminal «−» of the battery holder to the battery with a length of white lead.

Step 2 - Preliminary soldering of the components

Refer to the exploded view in Figure 6.

First select and value carefully the components: 27 resistors, 2 capacitors and 5 diodes. In case of doubt as to their correct value, refer to the colour code.

A misplaced component might cause the unit to operate improperly, or even damage it beyond repair.

The reference number and rating of each component are listed in Figure 6.

☐ Solder the coil-type resistor 24 to its two contact plates. Make sure not to alter its length.

☐ Solder the leads of resistors 21, 22, 23, 25, 26 and 27 to the corresponding contact plates. Fit resistor 27 vertically.

☐ Solder resistors 3 and 31 to the corresponding contact plates.

☐ Solder one lead of resistor 15 to its contact plate, leaving the other lead free for the time being.

Step 3 - Fitting the components to the p.c. board
Refer to Figures 5 and 6

Before fastening the p.c. board, pass the black lead (9) from the household current socket through the hole provided in the board.

☐ Push down the board until it rests firmly with the contact plates protruding through the slots. The side with the copper tracks should face upwards.

☐ Solder the contact plates to the printed circuit, as shown in figure 6. Take care not to damage the circuit or cause shorts between adjacent plates.

☐ Solder the free end of lead 9 to the printed circuit. Figure 5.

☐ Solder the free end of the red lead from the «+» terminal of the instrument to point A. Figure 5.

☐ Solder the free end of the black lead from the «−» terminal to point B. Figure 5.

☐ Connect the anchoring point of the two diodes to the corresponding contact plate with an 11 cm length of black lead (33).

☐ Connect the contact plate to which resistor 24 is soldered to the spot indicated in Figure 6 with a 5 cm length of black lead (34).

☐ Solder the free lead of resistor 15 to the corresponding contact plate.

☐ Solder the leads of resistors 19 and 20 to the corresponding contact plates.

☐ Solder the leads of resistors 1 and 2 to the p.c. board and the corresponding contact plates. Do the same for resistor 4.

☐ Insert capacitor 30 vertically into the hole provided and connect it to the corresponding contact plates with two stiff wire lengths, covered with green sleeving.

☐ Connect by soldering resistors 5, 6, 7, 9, 11, 12, 13, 14, 16, 17, 18 and 32. Trim their leads to the proper length and take care to avoid short-circuits.

☐ Connect diode 10 and the other four diodes 29. Make sure of their correct polarity.

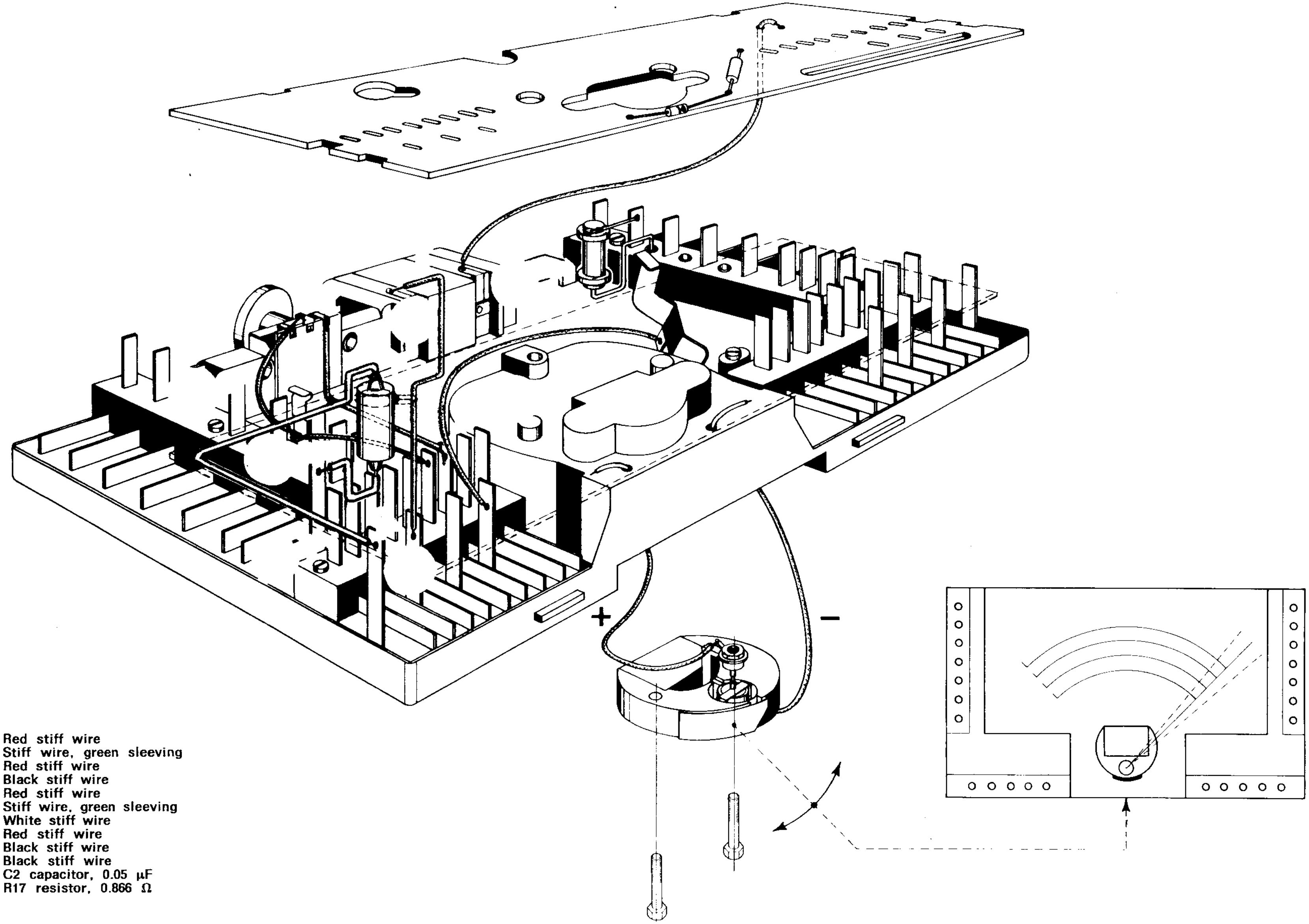
☐ Solder the leads of the disk capacitor 8.

The instrument is now assembled. Go over it carefully to make sure of the correct value of each component, and check the connections against «dry-joints» and short-circuits.

Place the 3 V battery in its housing, and put the instrument into the cabinet making it fast with the screw provided.

OPERATING INSTRUCTIONS

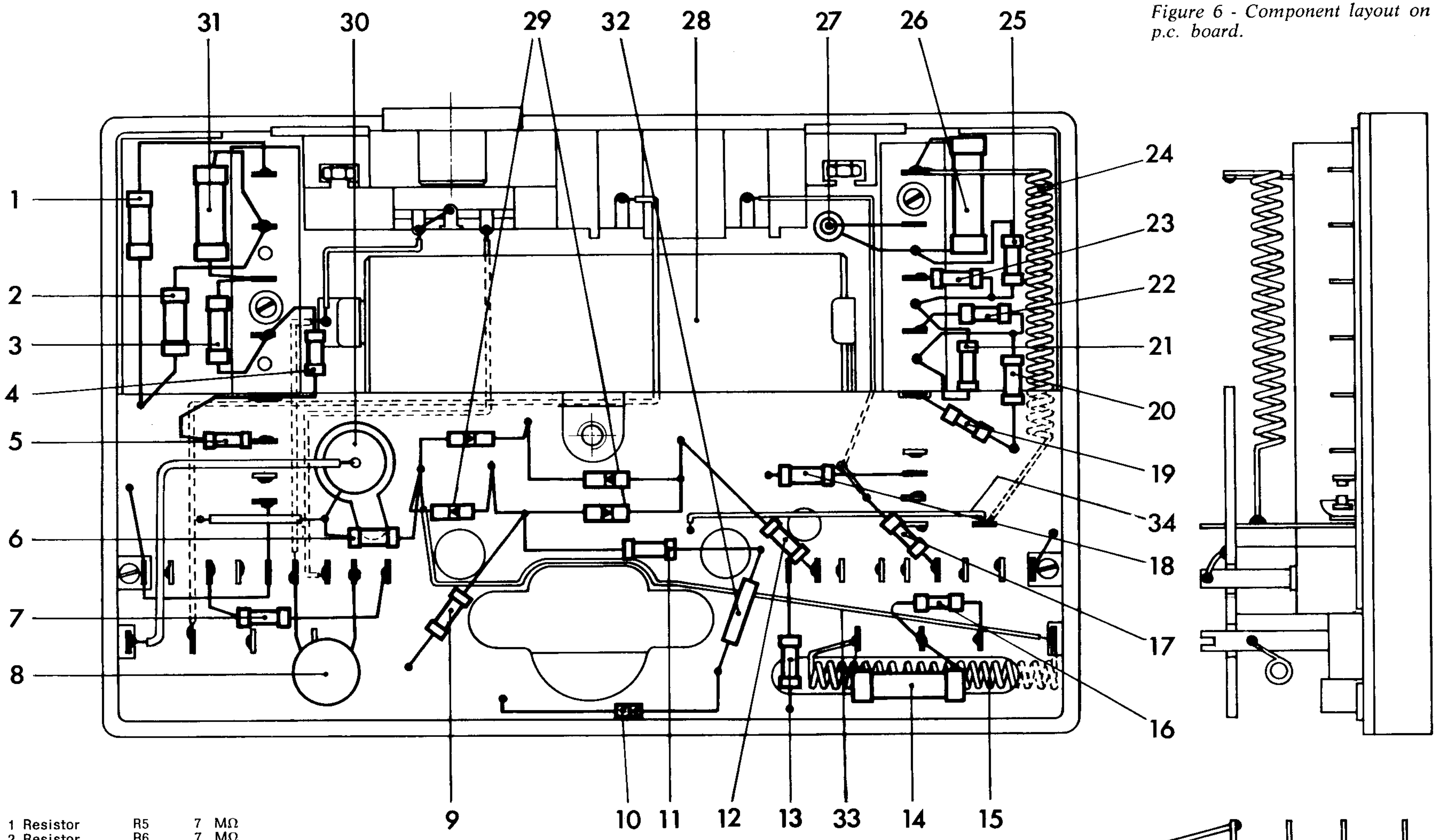
Follow carefully the instructions, and remember that for any type of measu-

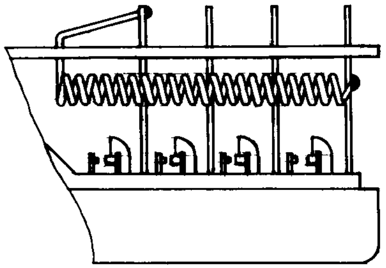


1 Red stiff wire
2 Stiff wire, green sleeving
3 Red stiff wire
4 Black stiff wire
5 Red stiff wire
6 Stiff wire, green sleeving
7 White stiff wire
8 Red stiff wire
9 Black stiff wire
10 Black stiff wire
11 C2 capacitor, 0.05 μF
12 R17 resistor, 0.866 Ω

Figure 5 - Preliminary connections.

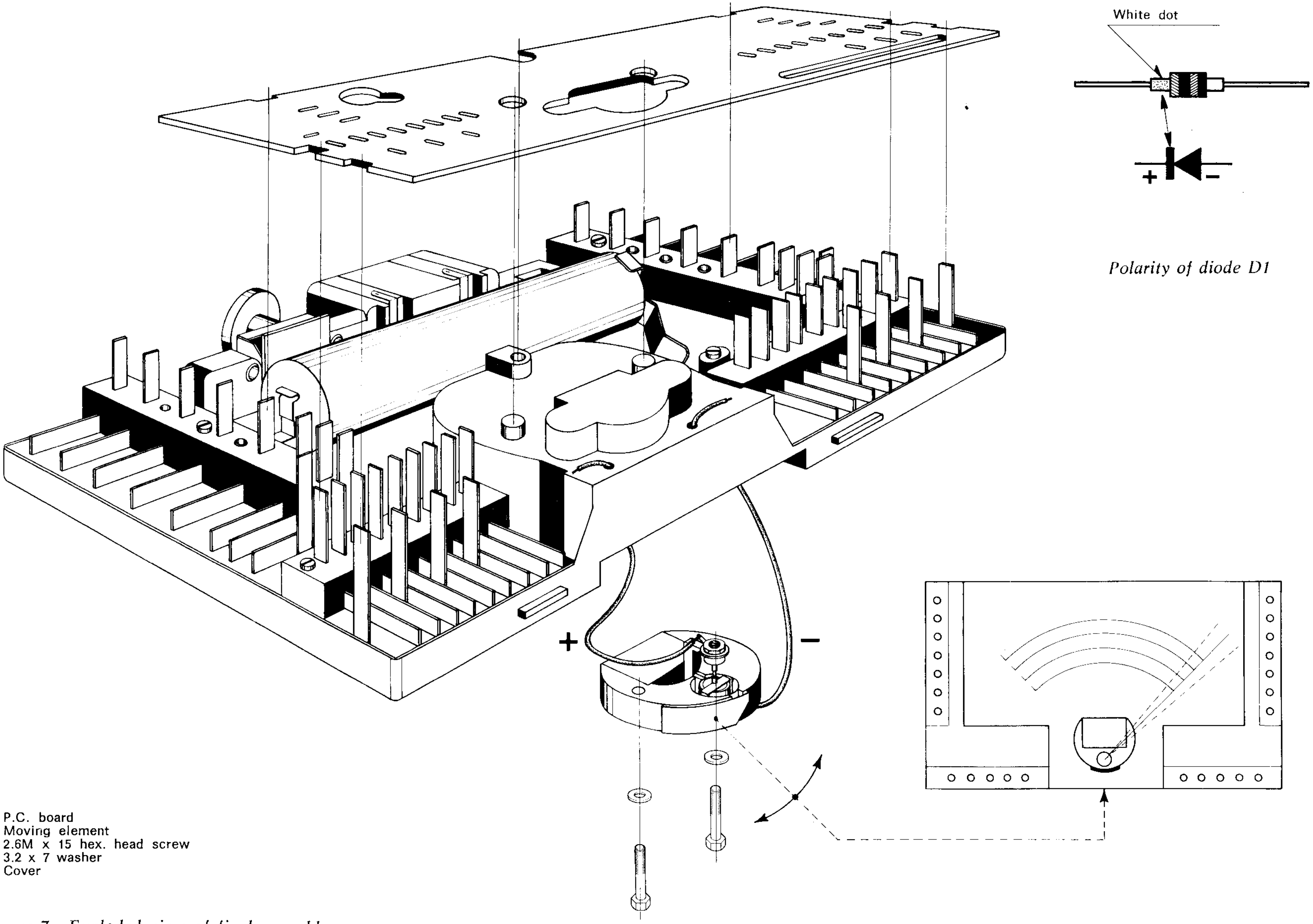
Figure 6 - Component layout on p.c. board.





1 Resistor	R5	7	MΩ
2 Resistor	R6	7	MΩ
3 Resistor	R3	1.4	MΩ
4 Resistor	R2	400	kΩ
5 Resistor	R1	140	kΩ
6 Resistor	R24	53.5	kΩ
7 Resistor	R22	29.1	kΩ
8 Capacitor	C1	0.05	µF
9 Resistor	R15	1.51	kΩ
10 Diode	D1	1N914	
11 Resistor	R16	9.29	kΩ
12 Resistor	R23	1.95	kΩ
13 Resistor	R21	1.93	kΩ
14 Resistor	R26	2.7	Ω
15 Resistor	R25	0.30	Ω
16 Resistor	R27	27	Ω
17 Resistor	R8	243	kΩ
18 Resistor	R7	58	kΩ
19 Resistor	R20	900	Ω
20 Resistor	R14	1.08	kΩ
21 Resistor	R13	108	Ω
22 Resistor	R19	180	Ω
23 Resistor	R18	17	Ω
24 Resistor	R10	0.12	Ω
25 Resistor	R12	10.8	Ω
26 Resistor	R11	1.08	Ω
27 Resistor	R17	0.866	Ω

28 Battery	3 V
29 Diode	D2-D3-D4-D5 OA95
30 Capacitor	C2 0.05 µF
31 Resistor	R4 4 MΩ
32 Resistor	R9
550 Ω 675 Ω 600 Ω 700 Ω 625 Ω 725 Ω 650 Ω 750 Ω	800 Ω alignement instrument
33 Stiff wire, black sleeving	
34 Stiff wire black sleeving	



Polarity of diode D1

1 P.C. board
2 Moving element
3 2.6M x 15 hex. head screw
4 3.2 x 7 washer
5 Cover

Figure 7 - Exploded view of final assembly.

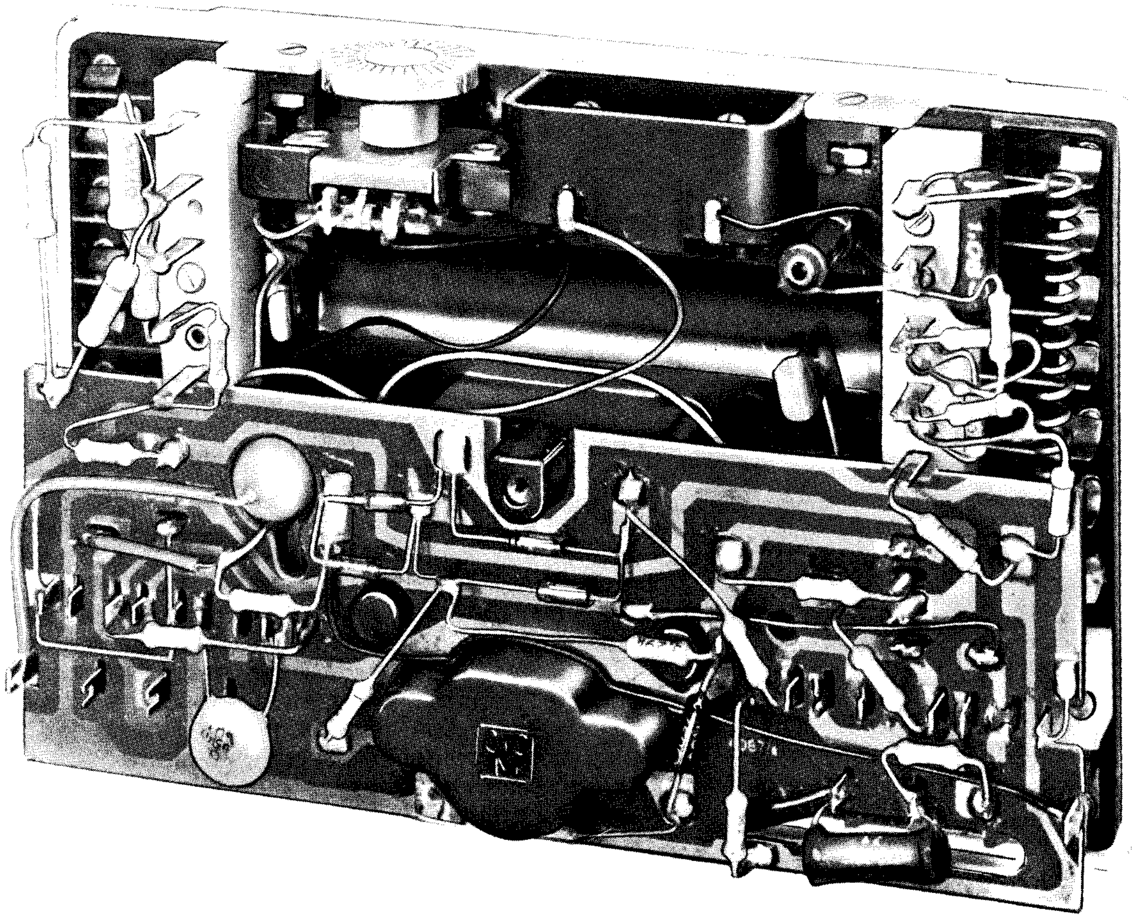


Figure 8 - Assembled UK 432 Universal Test Meter.

rement you must first push the plugs of the two test leads all the way into the jacks corresponding to the value of the measurement you are going to take.

DC voltage: 0.1, 1, 3, 10, 30, 100, 300, 1,000 V.

Insert the red plug into the jack marked $\frac{V+}{A=}$, and the black plug into the jack corresponding to the desired scale.

Direct current: 50 µA, 0.5 mA, 5 mA, 50 mA, 500 mA, 5 A.

Insert the red plug into the jack marked $\frac{V+}{A=}$, and the black plug into the jack corresponding to the desired Ampere scale.

AC voltage: 15, 50, 150, 500, 1,500 V. (For 1.5 V, see alternating current).

Insert the red plug into the jack marked Vc.a., and the black plug into the jack corresponding to the desired AC scale.

To measure the 2.500 V AC voltage, insert the plug into the 1,000 V jack. Since the full-scale capacity is 5,000 V AC, for safety's reasons the half-scale value (2.500 V AC) should never be exceeded. For the same reasons, never keep the probes in your hand or touch the connecting cords or the tester itself when the voltage exceeds 1,000 V.

Alternating current: 250 µA, 50 mA, 500 mA, 5 A.

Insert the red plug into the 1.5 V - 250 µA jack, and the black plug into the desired AC Amperes scale jack.

For the 1.5 V - 250 µA rating insert the black plug into the jack marked 1.5 - 3 Vc.c. - 15 Vc.a.

Direct current resistances: Ωx0,1, Ωx1, Ωx10, Ωx100, Ωx1,000.

Insert the red plug into the jack marked Ω =, and the black plug into the desired DC scale.

Then shourt-circuit the two probes, while adjusting the potentiometer until the pointer reaches the full-scale value. Bring the two probes into contact with the terminals of the resistance to be measured.

For the Ωx0.1 the measurement must be made as quickly as possible and with a fully charged battery.

Alternating current resistances: Ωx10 k.

Insert the red plug into the jack marked pF ~ Ω, and the black plug into the jack marked Ωx10 k - pFx1 - Hzx1. Short-circuit the probes, then after connecting the Tester to the household current socket (125/220 V AC) by means of the side socket, adjust the potentiometer to full-scale.

The scale is marked: Ω =.

Warning - Both probes and resistor are live during these measurements.

Direct current capacitances: Ωx1,000, Ωx100, Ωx10.

Insert the red plug into the jack marked Ω =, and the black plug into the jack corresponding to DC V.

Short the probes, then adjust the potentiometer to full scale. Probe the discharged capacitor to be measured, and watch the maximum value reached on the DC scale, then read the value of the capacitor by means of the comparison scale.

Alternating current capacitances: pFx1.

Insert the red plug into the jack marked pF ∼ Ω, and the black plug into the jack marked Ωx10k - pFx1 - Hzx1. Feed the tester a 125 — 220 V voltage and short the probes.

Adjust the potentiometer to full-scale and place the capacitance between the probes.

Warning - Both probes and capacitors are live.

Reactance: proceed in the same way as for the measurement of capacitors, but apply the following formula:

$$Xe = \sqrt{301.000^2 + XL^2 - - (301.000 + RL_2)}$$

in which XL = reactance reading, RL = ohmic reactance, Xe = exact reactance.

Frequency: Hzx1 (Hzx10) with external capacitor.

Insert the red plug into the jack marked pF ∼ Ω, and the black plug into the jack marked Ωx10k - pFx1 - Hzx1. Short the probes, then after feeding the tester the voltage with the frequency to be measured, adjust the potentiometer to full-scale. Measure the frequency by inserting the red plug into the jack marked dB Hz without interrupting the short-circuit between the probes. By opening the probes and placing a capacitor with a 0.05 μF ± 1% rating between them, the Hz capacity can be multiplied.

Warning - The probes are live.

Decibels and output V: 25 dB (15 V); 36 dB (50 V); 45 dB (150 V); 56 dB (500 V); 65 dB (1,500 V); 70 dB (2500 V).

Insert the red plug into the jack marked dB ∼ Hz, and the black plug into the jack marked V.c.a. Since the dB scale is referred to the 15 V AC range, add to the reading on the scale the following values in dB: +11 dB; +20 dB; +36 dB; +40 dB; +45 dB, respectively.

For the measurement of the output Volts the 1.5 V AC capacity can be used, placing a capacitor with a minimum capacitance of 1 μF in series to the external circuit.

PART LIST

Qty.	Symbol	Description
1	R19	180 Ω resistor
1	R13	108 Ω resistor
1	R18	17 Ω resistor
1	R10	0.12 Ω resistor
1	R11	1.08 Ω resistor
1	R12	10.8 Ω resistor
1	R17	0.866 Ω resistor
1	R4	4 MΩ resistor
1	R9	500 Ω resistor (or 600, 625, 650, 675, 700, 725, 750, 800 supplied according to the calibration of the instrument)
1	—	3 V battery
4	D2, D3, D4, D5	diodes OA95
1	C2	0.05 μF capacitor
1	—	bottom panel
1	—	cabinet
1	CS	p.c. board
1	R5	7 MΩ resistor
1	R3	1.4 MΩ resistor
1	R6	7 MΩ resistor
1	R2	400 kΩ resistor
1	R1	140 kΩ resistor
1	R24	53.5 kΩ resistor
1	R22	29.1 kΩ resistor
1	C1	0.05 μF capacitor
1	R15	1.51 kΩ resistor
1	D1	diode 1N914
1	R16	9.29 kΩ resistor
1	R23	1.95 kΩ resistor
1	R21	1.93 kΩ resistor
1	R26	2.7 Ω resistor
1	R25	0.30 Ω resistor
1	R27	27 Ω resistor
1	R8	243 kΩ resistor
1	R7	58 kΩ resistor
1	R20	900 Ω resistor
1	R14	1.08 kΩ resistor
2	—	probes
1	—	solder dispenser