INSTRUCTION AND OPERATING MANUAL

FOR

Type MM1 n

MULTIMETER

These instructions apply
to model MM1 only

eMM1
front page

MULTIMETER
Type MM1

The Multimeter has 23 measuring ranges and can be used for measuring the self-inductance, capacitance or resistance of practically any component used in radio and amplifier circuits.

The instrument measures both on high frequency and low frequency (50 cps) according to the most common uses of the components.

Low capacitances and self-inductances are measured at high frequency which offers considerable advantages over low frequency. Thus, ultrashort-wave coils of tenths of a microhenry and capacitors of a few picofarads are measured without difficulty.

On the low frequency ranges the instrument can also measure losses in electrolytic condensers, LF transformers and filter coils.

DESCRIPTION

On the left of the front panel of the instrument will be seen dial, switch and terminals for the HF ranges. Symmetrically mounted on the right are dial, switch and terminals for the LF ranges. In the middle are the magic eye, the sensitivity control and the dissipation factor knob for the LF ranges.

The Multimeter has the following HF ranges:

0 - 5	μH	0 - 500	pF
5 - 55	"	500 - 5500	"
50 - 550	"	5000 - 55000	"
0.5 - 5.5	mH		
5 - 55	"		

The measuring accuracy on the HF ranges, is better than 2%.

The LF ranges are:

0 - 100	Ω	0 - 0.1	μF	0 - 1	Henry
0 - 1000	"	0 - 1	"	0 - 10	"
0 - 10	kΩ	0 - 10	"	0 - 100	"
0 - 100	"	0 - 100	"	0 - 1000	"
0 - 1	MΩ	0 - 1000	"		
0 - 10	"				

The measuring accuracy on the LF ranges is better than 4% for self-inductance and capacitance. The dissipation factor dial ranges from 0 to 0.6 and the accuracy is 5%. (The dissipation factor is defined as the ratio between series resistance and reactance).

As will be seen the LF ranges for capacitance form a natural continuation of the series of HF ranges. This is only apparently the case with the self-inductance ranges. The fact is that at 50 cps an "HF coil" will generally have a dissipation factor which is considerably above 0.6 so that it cannot be measured. Conversely an "LF coil" measured at HF will generally have a dissipation factor so high that it makes measurement impossible.

On the HF ranges the Multimeter measures by the resonance method. The magic eye must consequently give maximum deflection. The measuring frequency varies from about 10 Mc to about 30 kc so that the smallest components are measured at the highest frequency. The curve sheet appended to the instructions shows the measuring frequency as a function of the component under measurement.

On the LF ranges the Multimeter operates in a bridge circuit. The magic eye is used as null indicator and must give minimum deflection. The measuring frequency is equal to the line frequency (50 cps). The bridge voltage is 5 volts, but the voltage across the component under measurement is limited so that the load cannot exceed 1/4 watt.

When a coil is measured, the voltage across it varies with the position of the dial knob and is maximum (about 4 volts) when the pointer is set at 100. As the self-inductance and the dissipation factor of transformers and filter coils with iron core is very much dependent on the induction in the iron, it means that a measurement made in two different ranges can give differing results. Consequently this is not due to an error in the instrument but is a property of the components concerned. The said deviation is, of course, not present when a coil without iron core is being measured.

Due to the said properties of LF coils with iron core the most important use of the Multimeter is determination of the approximate self-inductance and exact comparison of uniform components. The dissipation factor dial is useful for this purpose, because a component with a dissipation factor considerably above the average most likely has short-circuited windings or other defects.

Capacitors of 5000 pF to 55,000 pF can be measured either on HF or LF. The capacitance of some capacitors (e.g. many paper capacitors) is not the same at high frequency as at low frequency because the dielectric constant of the dielectric applied varies with the frequency. The capacitance of a mica capacitor or a polystyrene capacitor does not vary with the frequency, and the Multimeter gives the same value whether the capacitor is measured at HF or LF.

The Multimeter can be driven from a vibrator in which case it will operate in the normal way on the HF ranges. On the LF ranges the impedance measurement will be normal while the reading of the dissipation factor scale will be wrong. The reading of this scale is only true at 50 cps (the frequency of a vibrator will generally be about 100-150 cps).

OPERATING PROCEDURE

Connect the Multimeter to an a-c voltage which corresponds to the position of the voltage selector (110-127-150-200-220 or 240 volts) and switch on the power. Let the instrument warm up for some minutes.

MEASURING CAPACITANCE ON THE HF RANGES:

1) Connect the capacitor to the terminals C on the left
2) Set the HF range switch to the proper capacitance range
3) Turn the sensitivity control to the extreme right
4) Rotate the HF knob until the magic eye gives maximum deflection
5) Turn the sensitivity control somewhat backwards. (In most cases this will increase the sensitivity).
6) Readjust the HF knob so that the magic eye gives maximum deflection again
7) Read the capacitance on the scale corresponding to the measuring range

Small capacitors should be connected to the terminals directly or by means of short leads, otherwise errors will arise due to the capacity of the leads.

It will often be possible to measure large capacitors even if they are connected with other components. Thus a coupling capacitor from the anode to the grid of an a-f amplifier can be measured without being unsoldered. The end of the capacitor which is connected with the lowest resistance (the anode resistor) is connected to the grounded terminal (on the left) to which the chassis of the amplifier is also connected. The Multimeter will then measure the coupling capacitor in parallel with the grid leak which, however, will not affect the result of measurement except that it may lower the setting accuracy.

You will have to decide in each case whether capacitors can be measured in this way without being unsoledered. This method can be applied on the HF ranges only.

MEASURING SELF-INDUCTANCE ON THE HF RANGES:

1) Connect the coil to the terminals L on the lower left
2) Set the HF switch to the proper self-inductance range
3) Turn the sensitivity control to the extreme right
4) Rotate the HF knob until the magic eye gives maximum deflection
5) Turn the sensitivity control somewhat back. (In some cases this will increase the setting accuracy).
6) Readjust the HF knob so that the magic eye gives maximum deflection again
7) Read the self-inductance on the proper scale

The measuring accuracy is highest for coils with a self-capacitance of 7 pF but variations from 2 to 12 pF can be allowed for without greater errors than 1%. Almost all HF coils are within this range. At higher self-capacitances corrections can be made as the Multimeter reads 1% high for every 6 pF the self-capacitance exceeds 7 pF.

MEASURING RESISTANCE ON THE LF RANGES:

1) Set the HF switch to position LF
2) Connect the resistor to the terminals L-R on the right
3) Turn the sensitivity control to the extreme right
4) Set the LF switch to the proper range
5) Rotate the LF knob until the magic eye gives minimum deflection
6) Read the resistance on the LF scale

Large resistors should be connected by means of short leads to prevent a voltage from the power line from being induced in the measuring circuit. If this happens, the measuring accuracy will decrease.

As resistance is measured at 50 cps a-c, it is not possible to measure the ohmic resistance of filter coils, line transformers and similar components.

MEASURING CAPACITANCE ON THE LF RANGES:

1) Set the HF switch to position LF

2) Connect the capacitor to the terminals C on the right

3) Set the LF switch to the proper range

In the case of paper and mica capacitors:

4) Set the dissipation factor knob to 0

5) Turn the sensitivity control to the extreme right

6) Rotate the LF knob until the magic eye gives minimum deflection (If it is not possible to have a sharp minimum, rotate the dissipation factor knob, until the minimum becomes sharp)

7) Read the capacitance on the LF scale

In the case of electrolytic capacitors:

4) Set the dissipation factor dial to 0.06.
The dissipation factor of electrolytic capacitors is always perceptibly above zero. Therefore it is useful to begin the measurement with the knob set at 0.06.

5) Turn the sensitivity control half-way on

6) Alternately rotate the LF knob and the dissipation factor knob until the magic eye gives sharp minimum deflection

7) Turn the sensitivity control to the extreme right and repeat the measurement

8) Read the capacitance on the LF scale

To a certain degree the dissipation factor is a measure of the quality of the electrolytic capacitor. Generally the dissipation factor increases as the capacitor grows older.

During the measurement a capacitor of 8 μF is exposed to 1.6 volts on the measuring range 0-10 μF. Larger capacitors are exposed to lower voltages so that there is no risk of damaging electrolytic capacitors during measurements with the Multimeter.

MEASURING SELF-INDUCTANCE ON THE LF RANGES:

1) Set the HF switch to position LF
2) Connect the coil to the terminals L-R on the right
3) Set the LF switch to the correct range
4) Alternately rotate the LF knob and the dissipation factor knob until the magic eye gives sharp minimum. Use a low sensitivity at the first coarse setting, otherwise it is very difficult to find the absolute minimum deflection.
5) Read the self-inductance on the LF scale

Coils with a dissipation factor higher than 0.6 (such as coils without a core or with a powdered iron core, which are too large to be measured on the HF ranges) can be measured on the LF ranges in the following way:

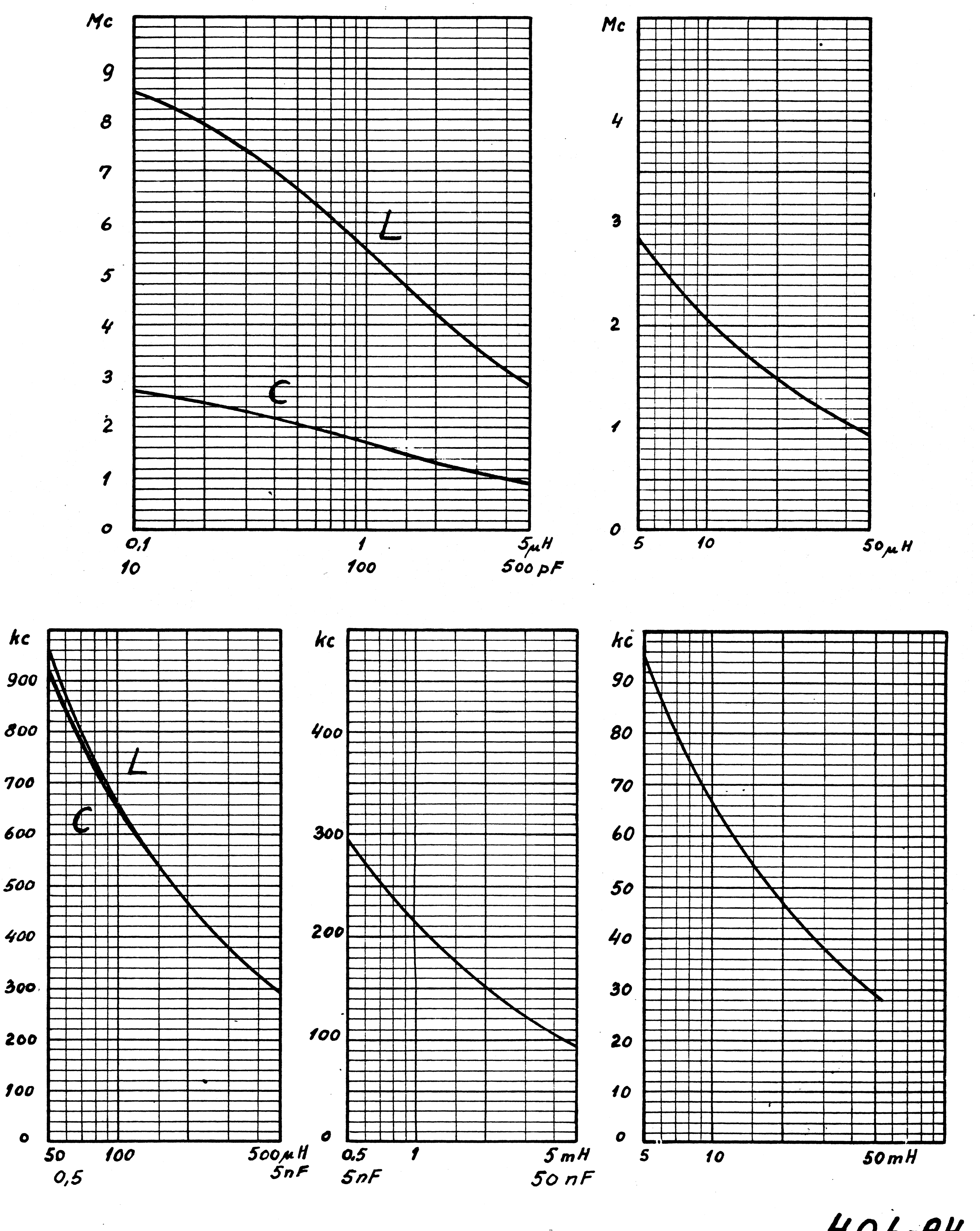
1) Connect a variable resistor 0-2000 Ω between the upper right-hand terminal and the chassis
2) Set the dissipation factor dial to 0
3) Alternately rotate the LF dial and the variable resistor until the magic eye gives minimum deflection (the losses are outbalanced by means of the variable resistor)
4) Read the self-inductance on the LF scale

This measurement requires some practice because the minimum settings affect each other. Therefore readings should not be taken until the absolute minimum has been reached. This coupling requires no correction for the losses.

At accurate self-inductance measurements it is necessary to correct the reading of the LF scale. The correction is dependent on the dissipation factor. If the dissipation factor is t, the correct self-inductance is had by dividing the measured self-inductance by $1 + t^2$. The correction can also be taken from the table below:

dissipation factor	correction	dissipation factor	correction
0.00	0%	0.35	-11%
0.05	0%	0.40	-14%
0.10	-1%	0.45	-17%
0.15	-2%	0.50	-20%
0.20	-4%	0.55	-23%
0.25	-6%	0.60	-26%
0.30	-8%		

MEASURING FREQUENCY OF MM1



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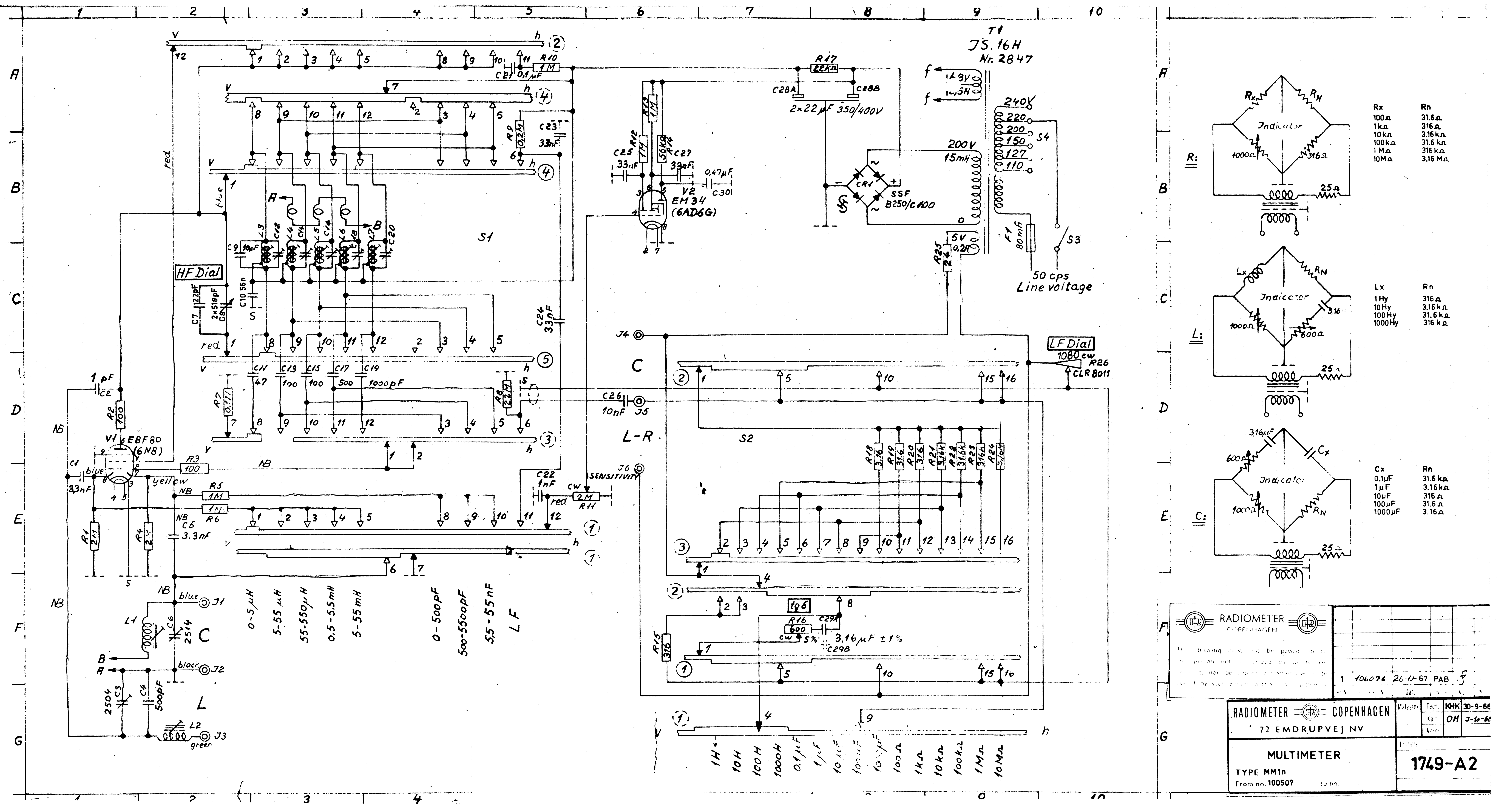

HF Dial
LF Dial
1080 cw
R26
CLR 8011
S1
S2
S3
S4
T1
JS. 16H
Nr. 2847
240V
220
200
150
127
110
200V
15mA
5V
0,2A
6,3V
1,5A
F1
80 mA
50 cps
Line voltage
2×22 µF 350/400V
C28A
C28B
R17
22kΩ
CR1
SSF
B250/C100
V1
EBF80
(6N8)
V2
EM 34
(6AD6G)
SENSITIVITY
J1
J2
J3
J4
J5
J6
blue
black
green
red
yellow
L-R
C
L
LF
tgδ
3,16 µF ±1%
0-5 µH
5-55 µH
55-550µH
0,5-5,5mH
5-55 mH
0-500pF
500-5500pF
5,5-55 nF
1H
10H
100H
1000H
100Ω
1kΩ
10kΩ
100kΩ
1MΩ
10MΩ
Indicator
R:
L:
C:
Rx
Rn
100Ω
31.6Ω
1kΩ
316Ω
10kΩ
3.16kΩ
100kΩ
31.6kΩ
1MΩ
316kΩ
10MΩ
3.16MΩ
Lx
Rn
1Hy
316Ω
10Hy
3.16kΩ
100Hy
31.6kΩ
1000Hy
316kΩ
Cx
Rn
0.1µF
31.6kΩ
1µF
3.16kΩ
10µF
316Ω
100µF
31.6Ω
1000µF
3.16Ω
RADIOMETER
COPENHAGEN
1 106076 26-1-67 PAB
Tegn. KHK 30-9-66
Kont. OM 3-10-66
RADIOMETER COPENHAGEN
72 EMDRUPVEJ NV
MULTIMETER
TYPE MM1n
From no. 100507
to no.
1749-A2