SANWA

OPERATOR'S MANUAL

FOR

N-401

MULTITESTER

SANWA ELECTRIC INSTRUMENT CO., LTD.
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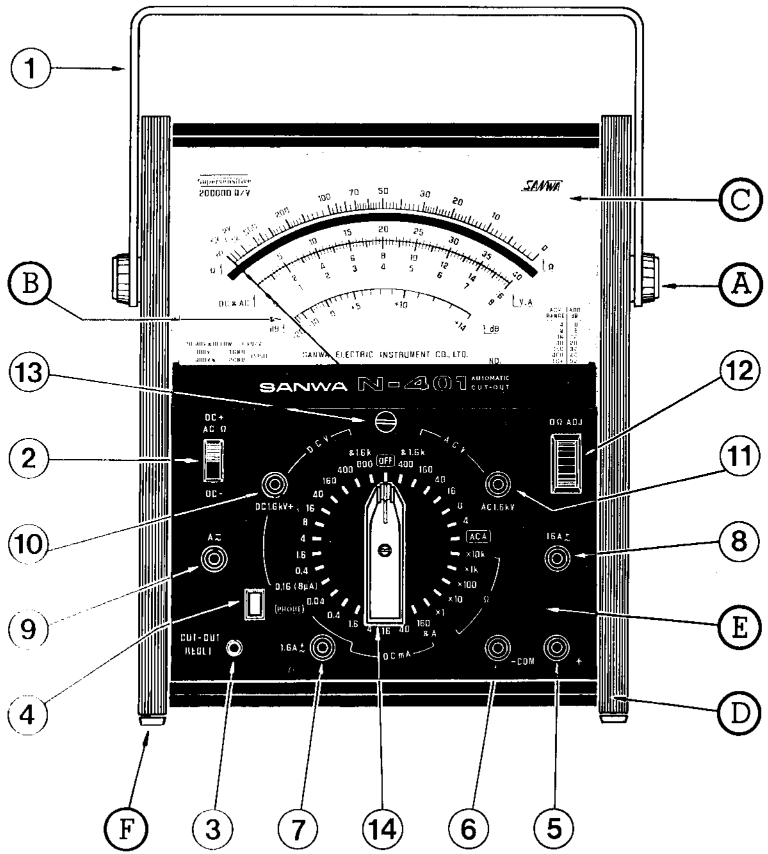


WARNING

TO BE SURE, a tester is a very useful instrument capable of measuring voltage, current and resistance. Naturally the object of measurement that it covers varies widely from high voltage to minute current. In addition, the input impedance across the measuring terminals ranges from a few ohms up to high megohm level as a measurement range is cut over.

CONSEQUENTLY, UTMOST CARE SHOULD BE USED IN THE OPERATION AND MAINTENANCE OF THE INSTRUMENT NOT TO BRING ON DANGER TO THE OPERATOR AS WELL AS TO THE INSTRUMENT ITSELF. ESPECIALLY WHEN A HIGH POWER SYSTEM IS MEASURED, NO OPERATION MISTAKE WHATEVER SHOULD BE ALLOWED. AN INSTRUMENT LONG LAID AWAY UNUSED OR AS DEFECTIVE SHOULD NEVER BE USED.

CONTENTS

1 GENERAL DESCRIPTION

1.1 Introduction.

The N-401 Multitester is furnished with two outstanding advantages over common multitesters. In the first place, a taut-band meter movement of 5μA is introduced in the instrument which is close in sensitivity to a galvanometer. Secondly an original automatic cut-out device provides the instrument with added performance ability. Familiar as you may be with test equipment, you are requested to read this manual carefully so that you may be fully acquainted with the eminent substance of this fine instrument, and turn to account the benefits that it can offer you for your engineering achievement.

1.2 Benefits and Advantages.

Automatic cut-out device. The moment there is an accidental overload at the input terminal, the circuit breaker functions and cuts it off from the internal circuit, thus safeguarding the instrument from damage.

The level action of the breaker is effected by equalizing the starting current by means of a diode circuit of multiple connection acting along with the breaker interconnected with the range selector switch.

Plain and simplified scale dial. The scale dial is tidied up by making the characteristic of the scale reading AC linear to be identical with the scale for reading DC. Usually a separate scale is provided for AC measurement on account of the non-linear characteristic of the rectifying diode. The rectifying circuit of the N-401 has a diode equalizer inserted which enables both DC and AC to be read on a common single scale.

80-division wide scale. Abolishing the usual 60-division scaling system of 3-6-12, the N-401 has, going a step ahead, adopted 80-division system of 4-8-16. The spacious scale dial is a distinctive feature of a large-size instrument.

Protective flank boards. The walnut tone flank boards of 9mm thick provide double safety to the instrument protecting it from shock and adding stability on the bench. They characterize the unique design of the N-401 Multitester.

30-position range selector switch. The N-401 is equipped with a 30-position selector switch with OFF setting. It was specifically made for use in this instrument covering almost all measurement needs.

Ultrasensitive 5μA indicator. The N-401 uses a taut-band suspension meter movement of 5μA full scale. Its minimal sensitivity resolution is 0.06μA

for voltage measurement providing the instrument with ultrahigh sensitivity towering about conventional testers with by far the less measurement loss. The input impedance of 200kΩ/V for the DCV range will be the highest ever expected of a tester.

On the other, the moving element of the indicator is held in position suspended by platinum-iridium alloy bands instead of usual point-contact suspension by bearings. Furthermore, hysteresis error which is maximum near the midscale is practically nil, and stable reading is always obtained.

Easy-to-read scale with intermediary markings. Usually, a tester scale is read in three ways marking the arc with identical lines, which naturally makes it hard to take readings along some scale line, for instance, 21 and 21.5 as illustrated. The N-401 has adopted dual scaling marking the divisions along the arc with alternate long and short lines making the reading a lot easier.

1.3 Specifications.

Measurement Ranges Available.

DCV: (±)0.16 0.4 1.6 4 8 16 40 160
400 800 1.6k
Input impedance—200kΩ/V for 40V and below
16MΩ for 160V
40MΩ for [redacted] 1.6KV
20MΩ for 400V & 800V

DCA: (±)8μ 0.04m 0.4m 1.6m 4m 16m
40m 160m 1.6 16
Voltage drop—Abt. 400mV (500mV for 160m)

ACV: 4 8 16 40 160 400 1.6k
Input impedance—5kΩ/V for 16V & above at 50Hz

ACA: 1.6 16
Voltage drop—400mV

Ω: Range—×1 ×10 ×100 ×1k ×10k

Note. Underlined ranges are protected by the circuit breaker.

Allowance (level position).
Within ±2% f.s.d. for DC ranges.
Within ±3% f.s.d. for AC ranges.
Within ±2% of scale length for Ω ranges.

Error due to frequency.
Within ±1dB for 4V and 8V (AC)
50kHz~250kHz
For other ranges—50Hz~5kHz

Batteries. One each 1.5V (UM-2) and 9V (006P)

Size & Weight. 252×191×107mm & abt. 1.95kg

1.4 Framework (See inside of the front cover).

① Carrying handle. The rigid carrying handle may be used to position the instrument at a convenient viewing angle.

② Polarity switch. A turn of the switch measures positive and negative DC saving the trouble of reversing the test lead connections. This switch is now a must for inspecting FM and transistor circuits.

③ CUT-OUT RESET. When there is an overload at the input terminal, the circuit breaker acts and cuts it off totally from the external power. The breaker does not recover automatically, and the RESET button must be pressed to return the instrument to normal operating condition. Make a habit of pressing the botton before measurement: the breaker may, though rare, be activated unawares.

④ Neon lamp. When the circuit breaker acts against an overload, the lamp lights to make it known to the operator. It goes out as overload is removed.

⑤ ⑥ Measurement terminals. These are the terminals used for most measurements. Except 1.6kV, DC and AC, the test leads are connected to them. The HV probe also uses these jacks.

⑦ ⑦ <u>Exclusive terminals for 1.6A.</u> Used exclusively for 1.6A, DC and AC. The circuit breaker is not connected to these terminals.

⑧ ⑨ <u>Exclusive terminals for 16A, DC and AC.</u> The circuit breaker is not connected to these terminals, too.

⑩ <u>Exclusive terminal for 1.6kV DC.</u> The positive lead is connected to this jack for 1.6kV DC. For the negative lead, use the −COM jack.

⑪ <u>Exclusive terminal for 1.6kV AC.</u> The positive lead is connected to this jack for 1.6kV AC. The other lead goes to the −COM jack.

Note. For maximum safety to the operator in the event of misuse, the current measurement controlled by the range switch is limited to 160mA on the panel. If a current above 160mA is measured using the usual terminals, because the internal shunt resistance is very small (0.5Ω for 500mA DC), AC voltage erroneously applied to the current range of such a low impedance will allow several hundred amperes to flow into the instrument to the possible danger to the operator. It is beyond control of such a small capacity circuit breaker as accommodated in the instrument. Due consideration of safety to the operator necessitates separate jacks to be used for current measurement above 160mA.

⑫ <u>0Ω ADJ.</u> For resistance measurement, the pointer must be adjusted to 0Ω each time the range is moved. The 0Ω adjuster is one of the most useful devices of a tester because it checks the consumption of the internal batteries at the same time. The pointer is adjusted by turning the adjuster with the + and −COM jacks shorted together.

⑬ <u>Corrector screw.</u> As a rule, a tester should be used in a level position. When the position is changed, the pointer may become unbalanced moving away from zero. It must then be corrected to be exactly on 0 by turning this screw with a screwdriver.

⑭ <u>Range selector knob.</u> Measurements are generally controlled by this knob. The coloured knob is to select a range without mistake from among so many provided. When this knob is on the range specified below, the circuit breaker is ready to function.

Ω range −×1 ×10 ×100
DCV range–0.16V
DCA range–8μA 0.04mA 0.4mA 1.6mA 4mA 16mA 40mA 160mA

1.5 Function of the Circuit Breaker.

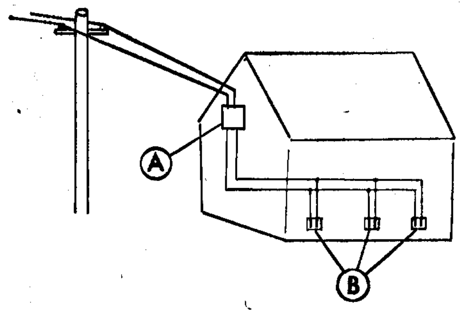
Equalized sensitivity. The circuit breaker of the N-401 is started to action by the current of 1A applied. It is six times as much as the full scale current for 160mA DC. For other ranges the difference between the starting current and each full scale current is so big that a specific circuit is provided interlocked with the range selector switch to equalize the starting current for the breaker to act uniformly for all the ranges specified to be protected effectively.

The impedance of this control circuit is quite low, and it will exert bad influence on the regular circuit of the instrument. To remove the interference with the indicator circuit, an electronic switch is composed of multiple-connection silicon diodes of which the zener effect is 0.5V. This is again one of the most noteworthy achievements of the N-401 Multitester.

Small power and the breaker. The breaker does not act against a small power as may be obtained from a transformer. The high impedance of the rectifier or the resistance of the power transformer does not allow the current above 1A to flow into the tester even when a voltage is measured erroneously on a current range. If the measurement is dropped the instant the mistake is noticed, no damage will be done either to the instrument or to the power source.

However, care should be used all the more because the breaker does not function in this case. It will be the power source that suffers damage.

High power and the breaker. While measuring a power voltage at home or in a factory, the same type of mistake made at the point A and point B produces quite a big difference of current flowing into the instrument. (Fig. 2) In the case of B, current is restrained by the resistance of a switch or indoor wiring, and the breaker functions effectively against such current. While in the case of A, there is practically nothing to restrain the current, and a power voltage above 200V is perilous to the breaker itself. Though a safety fuse (3A) inserted in series with the breaker circuit may temporarily save the instrument from damage, no measurement mistake whatever should be allowed in the case of B measurement at A. Be sure to confirm the position



of the range selector switch to be corretcly on an ACV range before the test prod is connected to the power.

Note. (1) For the sake of safety, the use of Fused Test Lead is recommended for measurement of high power voltage. The probe is available extra.

(2) When the safety fuse of the breaker is blown, the tester circuit remains open despite the RESET button pressed. It is a little troublesome to replace the fuse, but the rear cover is removed and the fuse on the breaker is replaced. Use a 3A fuse available on the market. 1A fuse would be blown away prior to the breaker to act, while a fuse above 5A might cause the breaker to burn. Anyhow, so long as measurement is not abnormal, the breaker functions unfailingly against an overload and safeguards the instrument without blowing the fuse. At all events, used utmost care not to apply AC voltage to a low impedance circuit like resistance and current ranges of the instrument.

2.1 Preliminaries.

After the pointer is calibrated to zero of the scale left, the test leads are connected to the instrument and the battery voltage is checked. Continuity of the test leads and ready action of the circuit breaker can be confirmed by shorting the test leads together placing the range selector switch at a resistance range. If the pointer deflects, the instrument is ready for operation.

When resistance measurement is to follow, also adjust 0Ω reading. Exhausted batteries should be immediately replaced. Remove the cover plate on the rear where the batteries are housed. Take note of the polarity when replacing them.

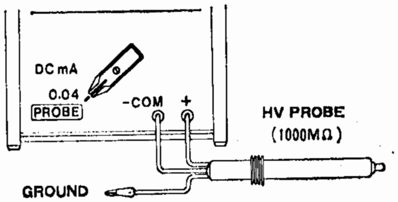
2.2 Measuring ±DCV.

The polarity switch is turned to either DC+ or DC− according to the polarity of the voltage being measured. For 800V and below, the + and −COM jacks are used for test lead connections. For 1.6kV, the red lead goes to the DC 1.6kV jack Ⓓ.

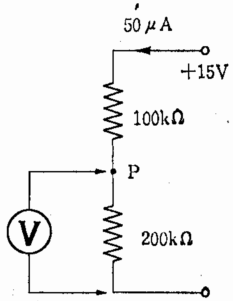
DCV is measured on the 11 ranges from 0.16V through 1.6kV. In the data relating to each range:

Range	Full scale	Input impedance	Minimum	Scale	Multiplied by:
0.16	0.16V (160mV)	32 kΩ	2mV	0 – 16	0.01 for V 10 for mV
0.4	0.4V (400mV)	80 kΩ	5mV	0 – 40	0.01 for V 10 for mV
1.6	1.6V	320 kΩ	20mV	0 – 16	0.1 for V
4	4V	800 kΩ	50mV	0 – 40	0.1 for V
8	8V	1.6MΩ	0.1V	0 – 8	1 for V
16	16V	3.2MΩ	0.2V	0 – 16	1 for V
40	40V	8MΩ	0.5V	0 – 40	1 for V
160	160V	16MΩ	2V	0 – 16	10 for V
400	400V	20MΩ	5V	0 – 40	10 for V
800 & 1.6k	800V	20MΩ	10V	0 – 8	100 for V
〃	1.6kV	40MΩ	20V	0 – 16	100 for V
0.04 PROBE	*30kV	1000MΩ	500V	0 – 40	1 for kV

* High voltage measurement of the anode and focusing voltage of CRT for television use, etc. The range switch is placed at PROBE/0.04 and the HV probe (1000MΩ) is connected as shown in Fig. 3. The 0 – 40 line is used, but the reading is effective up to 30(kV).



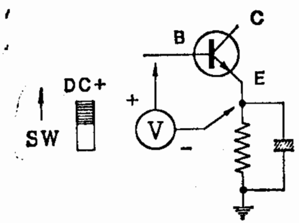
Powerful 5μA instrument. In the circuit illustrated, the clear voltage at P is 10V, which only a voltmeter of infinite impedance would read. The N-401 reads the most approximate value of 9.79V with an error of −2%. A so-called high sensitivity instrument of 20kΩ/V will read it 7.5V with an error of −25%. For a low sensitivity tester, the error will be −63% reading it 3.73V.

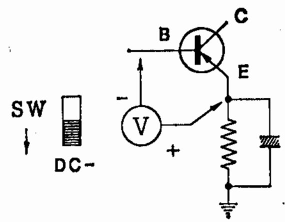


The ability of a 200kΩ/V instrument is most eloquently demonstrated in the measurement of a high impedance load voltage of minute current most efficiently checking the voltage of a transistor circuit, DC amplifier, oscillating circuit, AVC and AGC circuits, etc. without disturbing the condition of the circuit being measured.

Polarity reversing switch. If the pointer deflects to the opposite direction across 0, just reverse the switch position; it is not necessary to reverse the connections of the test leads, and yet the −COM jack is always in negative potential. It is essential in the alignment of transistor and FM circuits to determine the potential of the voltage checked correctly.

<u>Testing transistors and their discrimination.</u> The simplest way of judging the quality of a transistor is to check its voltage drop across base and emitter on a DCV range and see if it is normal. The factors that group transistors into silicon and germanium, or PNP and NPN, are the size of the voltage drop and the polarity determination. They are classified as follows:





Voltage drop and polarity	Classified
0.1V – 0.3V 0.5V – 1.0V	Germanium Silicon
DC+ DC–	NPN PNP

In this measurement, the plus potential of the tester is always connected to the base (B) and the minus potential to the emitter (E) of the transistor being checked. The position of the polarity switch readily defines whether it is PNP or an NPN transistor.

2.3 Measuring ACV.

For 400V and below, the + and the –COM jacks are used for test lead connections. For 1.6kV, the positive lead goes to the AC1.6kV jack on the right. The polarity switch is turned to DC (AC·Ω).

Quality germanium diodes of small reverse current loss compose the all-wave, symmetrical rectifying circuit. It has an equalizer incorporated to match the characteristic of the AC scale with that of the DC scale.

There are seven ACV ranges from 4V through 1.6kV. Refer to the following table for the data relating to the input impedance, frequency characteristic, etc. of each measurement range:

Full scale	Input impedance		Scale	Multiplied by	*2 Max. freq.	*3 dB to correspond
	for 1kHz	for 10kHz				
4V	15kΩ	15kΩ	0 – 40	0.1	500kHz	–20～+14
8V	32kΩ	32kΩ	0 – 8	1	250kHz	–14～+20
16V	80kΩ	80kΩ	0 – 16	1	18kHz	– 8～+26
40V	200kΩ	200kΩ	0 – 40	1	6kHz	0～+34
160V	800kΩ	500kΩ	0 – 16	10	5kHz	+12～+46
400V	1.8MΩ	1MΩ	0 – 40	10	5kHz	+20～+54
*1 1.6kV	7MΩ	4MΩ	0 – 10	100 for V	5kHz	——

*1 The switch position is common with 400V.
*2 Threshold frequency measurable with ±1dB allowance.
*3 0dB corresponds to 0.775V (AC): 1mW into 600Ω.

As the table above shows, the frequency coverage of the lower ranges extends over audio zone, so that the instrument is available as an output voltmeter and a monitor meter in place of an electrotester. Joint use of the dB scale will obtain better result.

0dB of the instrument is established at a voltage when 1mW is dissipated across a 600Ω line, and the dB scale directly reads the output of a circuit coupled at the uniform impedance of 600Ω. For a circuit other than 600Ω, the dB value read on the instrument must be compensated according to the following table to obtain true output:

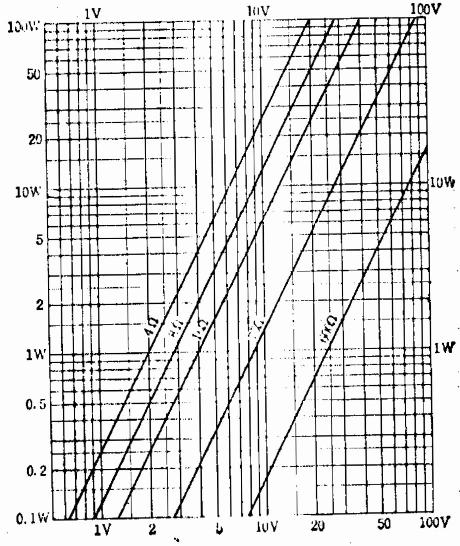
Load (Ω)	Add dB	Load (Ω)	Add dB
2k	−5.2	150	+6
1k	−2.2	75	+9
600	0	50	+10.8
500	+0.8	16	+15.8
300	+3	8	+18.8
200	+4.8	4	+21.8

The input and output impedances of audio equipment are not necessarily uniform, and the volume level of each circuit read on the dB scale is nothing but each AC voltage read in dB corresponding to it. However, since the dB scale can express voltage ratio, the relative difference of the dB read may be available to record or compare in dB the ratio of the voltage variation; for example, input/output voltage ratio, frequency response, etc.

Output (W) measurement. Wattage is obtained from the following formula.

$$\text{Output(W)} = \frac{V^2}{\text{Impedance}}$$

Providing the tester reads 4V on its 10V AC range for a line impedance of 8Ω, $W = \frac{4^2}{8} = 2\text{(W)}$. Refer to the graph below.



2.4 Measuring High Voltage—1kV and up, AC/DC.

The following instructions should be strictly observed when measuring a circuit voltage above 1kV and that allied with high power source:

Before the instrument is connected to the circuit, be sure to turn off the power. A smoothing condenser in the circuit must be discharged so that no voltage could be present.

Reconfirm the correct position of the range switch and the proper connection of the test leads.

When the power switch is turned on and reading is noted on the scale, keep your hands off the instrument.

As the measurement is over, the power switch is turned off, but the test leads should not be removed until after the pointer returns to 0.

The instrument may be operated as usual when measuring the voltage of a high impedance circuit of television and communication equipment of small current capacity.

2.5 Measuring ±DCA—μA, mA, A.

Voltage is measured in parallel with the load, but current is measured in series with it, for which the circuit under test must be opened and the instrument is connected in series with the load.

If the pointer moves to the opposite direction across 0, the polarity switch is turned to the other side.

There are current ranges available from 8μA through 16A. Refer to the following table for the scale reading, voltage drop, etc. of each measurement range:

Range	Full scale	Minimum	Voltage drop	Scale	Multiplied by	Breaker
0.16(8μA)	8μA	0.1μA	160mV	0 - 8	1 for μA	Yes
0.04	40μA	0.5μA	400mV	0 - 40	〃 〃 〃	〃
0.4	400μA	5μA	〃	〃	10 for μA	〃
1.6	1.6mA	20μA	〃	0 - 16	0.1 for mA	〃
4	4mA	50μA	〃	0 - 40	〃 〃 〃	〃
16	16mA	200μA	〃	0 - 16	1 〃 〃	〃
40	40mA	0.5mA	〃	0 - 40	〃 〃 〃	〃
160 & A	160mA	2mA	500mV	0 - 16	〃 〃 〃	〃
〃	*1.6A	20mA	400mV	0 - 16	0.1 for A	No
〃	*16A	0.2A	〃	0 - 16	1 for A	〃

* Exclusive jacks are used.

From μA up to A level, the current ranges of the N-401 cover practically all measurement needs.

8μA sharing the range with 160mV on the selector switch consumes so small current that it is well available as a galvanometer and zero detector, while the 1.6A and 16A ranges are capable of checking power transistor circuits.

With more and more ICs introduced now, electronic circuits are increasingly liable to be split into blocks, and the current consumption check of each block is now considered to be a conclusive factor of diagnosing them. A good many current ranges the N-401 is provided with will be found very useful for this measurement.

2.6 Measuring ACA—1.6A, 16A.

The range switch is rotated to the ACA position.

The same jacks and the same scale are used as for 1.6A and 16A DC measurement.

Current is measured connecting the instrument in series with the load opening the circuit under test.

The N-401 uses the same shunts for 1.6A and 16A DC for measurement of 1.6A and 16A AC. Here the uniqueness of the SANWA Multitester is most freely displayed giving full play to its excellent performing ability despite the obligation of using a moving coil type indicator in a restricted space. Various characteristics of the common scale are well stabilized, and the AC current range can be extended by enlarging the shunts for DC measurement. This outstanding feature not only checks home electrical appliances, but it affords the instrument to be used for checking AC current consumption of various electric appliances and for experimental and adjusting purposes.

2.7 Measuring Ω.

For preliminary operation, see 1.4 (12) for 0Ω adjustment, replacement of batteries, etc.

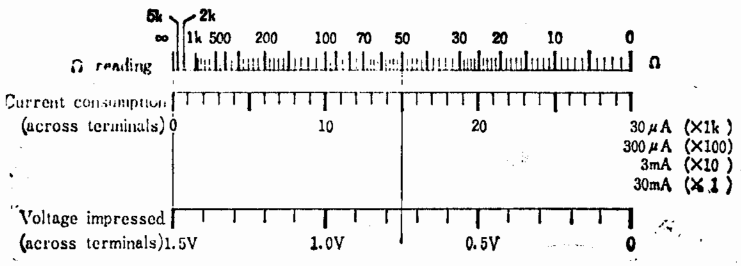
Five ranges are provided from ×1 through ×10k for resistance measurement. Refer to the following table for the data relating to the measurement range, midscale reading, current consumption, etc. of each range:

Range	Minimum	Mid-scale	Full scale	Max. current consumption	Max. voltage applied	Breaker
×1	1Ω	50Ω	5kΩ	30mA	1.5V	Yes
×10	10Ω	500Ω	50kΩ	3mA	〃	〃
×100	100Ω	5kΩ	500kΩ	300μA	〃	〃
×1k	1kΩ	50kΩ	5MΩ	30μA	〃	No
*×10k	10kΩ	500kΩ	50MΩ	18μA	9V	〃

* Uses 9V(006) battery; 1.5V(UM-2) for others.

As the schematic diagram shows, the polarity of the ohmmeter circuit is reversed, the + jack furnishing negative voltage, and the −COM jack positive voltage. It must be noted when testing the leakage of an electrolytic capacitor, polarized resistance of semiconductors like diodes and transistors.

The following graph shows how the scale reading, current consumption and the voltage applied for measurement are related each other:



3 REFERENCE INFORMATION

3.1 Unknown Quantity. When in doubt as to the voltage or current present, always start with the highest range. After the first reading, the switch can be reset to a lower range for a more accurate reading.

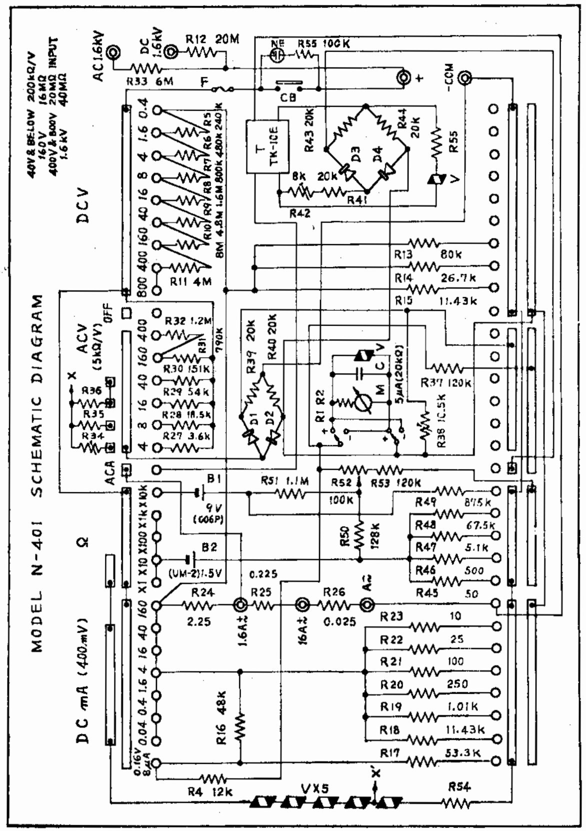
3.2 Selecting a Proper Range. For voltage and current measurements, try to use a range which will allow the pointer to fall within the right hand half of the scale. For resistance, accurate reading is obtained around in the middle of the scale.

3.3 Taut-band and Pivot-held Movements Compared. The N-401 is equipped with a supersensitive meter movement of 5μA. In order to raise accuracy making the best of its high sensitivity, the moving element is suspended by taut bands. Its merit and demerit as compared with a usual pivot-bearing movement will be as follows:

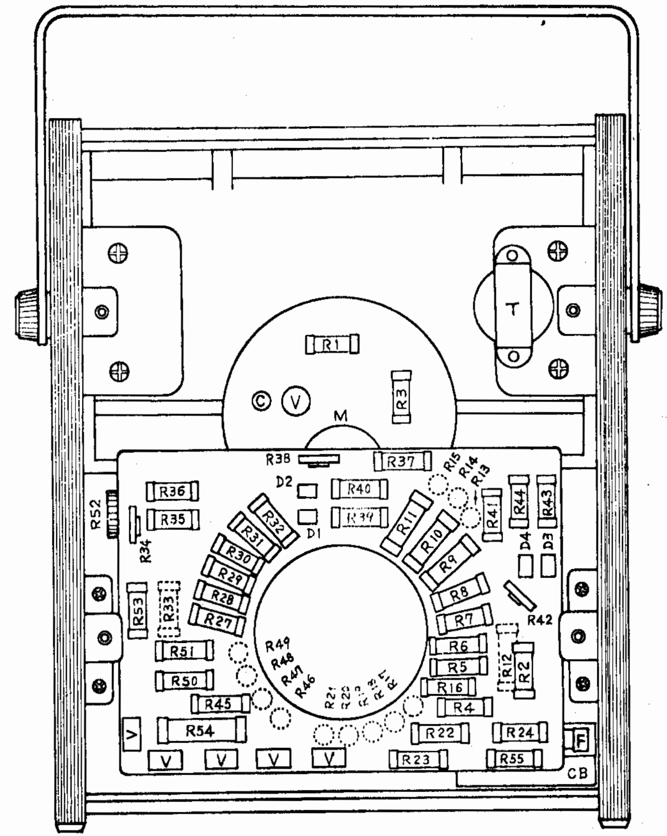
	Merit	Demerit
Pivot suspension	Good balance because of the stabilized contact suspension.	Friction error is liable; unsuitable for movement above 10μA.
Taut-band suspension	No contact friction and no hysteresis error possible.	Balance taking difficult especially for large-size movement. Big transposition error.

4 SUPPLEMENTARY DATA

4.1 Schematic Diagram



4.2 Arrangement of Parts



4.3 List of Parts

Part No.	Description	R.S.
N4R01	Resistor (2.5kΩ~3.5kΩ) for mV calibration	R1
N4R02	Resistor (10kΩ) for mV calibration	R2
N4R03	Resistor (500kΩ~800kΩ) shunt	R3
N4R04	Resistor (12kΩ) series	R4
N4R05	Resistor (240kΩ) 1.6V DC multiplier	R5
N4R06	Resistor (480kΩ 4V DC multiplier	R6
N4R07	Resistor (800kΩ 8V DC multiplier	R7
N4R08	Resistor (1.6MΩ) 16V DC multiplier	R8
N4R09	Resistor (4.8MΩ) 40V DC multiplier	R9
N4R10	Resistor (8MΩ) 160V DC multiplier	R10
N4R11	Resistor (4MΩ) 400V & 800V DC multiplier	R11
N4R12	Resistor (20MΩ) 1.6kV DC multiplier	R12
N4R13	Resistor (80kΩ) 160V DC shunt	R13
N4R14	Resistor (26.7kΩ) 400V DC shunt	R14
N4R15	Resistor (11.43kΩ) 800 V DC shunt	R15
N4R16	Resistor (48kΩ) series	R16
N4R17	Resistor (53.3kΩ) 8μA DC shunt	R17
N4R18	Resistor (11.43kΩ) 0.04mA DC shunt	R18
N4R19	Resistor (1.01kΩ) 0.4mA DC shunt	R19
N4R20	Resistor (250Ω) 1.6mA DC shunt	R20
N4R21	Resistor (100Ω) 4mA DC shunt	R21
N4R22	Resistor (25Ω) 16mA DC shunt	R22
N4R23	Resistor (10Ω) 40mA DC shunt	R23
N4R24	Resistor (2.25Ω) 160mA DC shunt	R24
N4R25	Resistor (0.225Ω, wire) 1.6A DC & shunt	R25
N4R25	Resistor (0.225Ω, wire) 1.6A DC & AC shunt	R25

N4R27	Resistor (abt. 3.6kΩ) 4V AC multiplier	R27
N4R28	Resistor (abt. 18.6kΩ 8V AC multiplier	R28
N4R29	Resistor (abt. 54.6kΩ) 16V AC multiplier	R29
N4R30	Resistor (abt. 152.4kΩ) 40V AC multiplier	R30
N4R31	Resistor (790kΩ) 160V AC multiplier	R31
N4R32	Resistor (1.2MΩ) 400V AC multiplier	R32
N4R33	Resistor (6MΩ) 1.6kV AC multiplier	R33
N4R34	Resistor (7kΩ~13kΩ) shunt	R34
N4R35	Resistor (20kΩ) shunt	R35
N4R36	Resistor (40kΩ) shunt	R36
N4R37	Resistor (120kΩ) ACV series	R37
N4R38	Resistor (8kΩ~12kΩ) shunt	R38
N4R39	Resistor (20kΩ) for rectifier circuit	R39
N4R40	Resistor (20kΩ) for rectifier circuit	R40
N4R41	Resistor (20kΩ) for ACA	R41
N4R42	Resistor (5kΩ~11kΩ) for ACA	R42
N4R43	Resistor (20kΩ) for rectifier circuit	R43
N4R44	Resistor (20kΩ) for rectifier circuit	R44
N4R45	Resistor (50Ω) Ω ×1 shunt	R45
N4R46	Resistor (500Ω) Ω ×10 shunt	R46
N4R47	Resistor (5.1kΩ) Ω ×100 shunt	R47
N4R48	Resistor (67.5kΩ) Ω ×1k shunt	R48
N4R49	Resistor (875kΩ) Ω ×10k shunt	R49
N4R50	Resistor (128kΩ) Ω series	R50
N4R51	Resistor (1.1MΩ) Ω ×10k series	R51
N4R52	Potentiometer (100kΩ) for 0Ω adjustment	R52
N4R53	Resistor (120kΩ) shunt	R53
N4R54	Resistor (5.5Ω) for protection circuit	R54
N4R55	Resistor (abt. 100kΩ) neon lamp series	R55

FR05	Germanium diode, 4 required	D1–D4
B002	Drycell (1.5V, UM-2)	B1
B005	Drycell (9V, 006P)	B2
TR03	Transformer	T
M016	Meter movement (5μA, taut-band type)	M
N4SW1	Range selector switch w/resistor holder	
N4P01	Front panel (N-401 type)	
X018	Rear case (N-401 type)	
N4T01	Terminal metal for UM-2 dry cell, 2 required	
N4T02	Studded terminal for 006P dry cell	
N4BC1	Battery case cover	
V001	Varister, 7 required	V
T002	Terminal jack, 7 required	
K013	Knob for range selector switch	
C050	Capacitor (0.05μF)	C
PSW1	Polarity reversing switch	
C019	Meter movement cover	
S007	Flank board w/holding metal, 2 required	
H002	Carrying handle w/fixing bolt (2)	
L001	Test lead, pair	
BA02	Meter movement base	
NE01	Neon lamp w/holder	
CB01	Circuit breaker w/fuse (3A)-F	NE
V003	Rear case bolt, 4 required	CB

R.S. Reference symbol