sanwa

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sanwa

YX-360TR MULTITESTER

OPERATOR'S MANUAL

第1図　各部名称

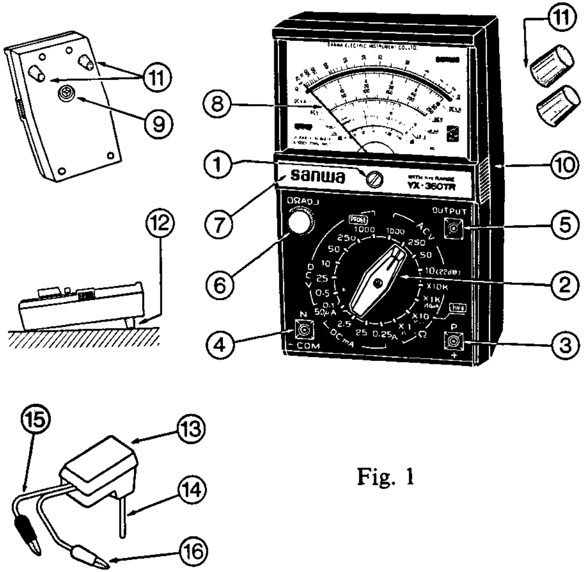


Fig. 1

1 Indicator zero corrector
2 Range selector switch knob
3 Measuring terminal +
4 Measuring terminal −COM (common)
5 OUTPUT (series condenser) terminal
6 0Ω adjusting knob
7 Name plate
8 Indicator pointer
9 Rear case bolt
10 Rear case
11 Non-skid rubbers
12 Rubbers fitted
13 Connector for h_{FE} test
14 Connection pin to tester
15 Transistor base clip
16 Transistor collector clip

for safety operation and maintenance

To be sure, a circuit tester is a very useful device capable of measuring voltage, current, resistance, and various other electric and electronic quantities. Accordingly, the object of measurement it covers varies widely from minute current to high voltage. Furthermore, the input impedance changes from a few ohms up to high megohm level with the measurement range cut over. These properties of a circuit tester demand the operator to use utmost care in the operation and maintenance of his instrument to ward himself off danger and damage to the meter. Especially when checking high power equipment, no operation mistake should be committed. Remember a circuit tester needs periodical inspection and calibration to maintain it in good condition. A tester known to be defective, or laid away unused for many months must not be used to measure a voltage above 100V. Be certain for a tester to undergo warrantable inspection at least once a year, when correct indication of the range must be ascertained and withstand voltage test not be omitted.

general description

Viewed in the light of a circuit tester measuring voltage, current, resistance, etc., the YX-360TR is no more than a standard multitester in function. But the added versatility of performing as a transistor analyzer distinguishes it from average meters. For the particulars of its bounds of hidden possibility, you can examine for yourself the specification data along with the benefits and advantages the instrument offers.
For all this, the YX-360TR is by no means a large-built equipment, but it is a lightweight and handy-sized device to be seated anywhere on your bench. As a matter of fact, it is suitable for carrying service. From beginners to professionals, you can enjoy a good command of it so as to get the best of the instrument on your original idea according to your own service design.

contents

features

1 All-purpose function.

The YX-360TR will entertain you with expanded vision of application. Optional use of the connector readily transfers the meter to a regular transistor tester to directly read h_{FE} (DC amplification factor) of transistors for you to determine if they are suitable for circuit use. Few testers perform such unique double service.

2 Ability no less better than a large-sized tester.

Excellent resolution factor of 0.2mV and above, and widened resistance measurement range reading from 0.2Ω up to 20MΩ, and that energized by the small-size internal batteries, compare the instrument favorably with a bulky test gear.

3 Series condenser terminal (OUTPUT).

Applied use of this extra terminal serves to check TV circuits for detecting AC signals with DC element present mixed isolated.

4 3-volt internal battery power.

It is impossible for a usual handy tester with a 1.5-volt battery built-in to check the linear continuity of semiconductors like LED whose forward voltage exceeds 1.5V, being unable to read either their forward or backward resistance. In this respect, the 1.5-volt batteries lined up in series spread the measurement range of semiconductors.

5 One-handed operation control and rational arrangement of ranges.

All measurements are controlled by a single knob. Into the bargain, the 1000V DC and AC ranges lie adjacent each other on the selector switchboard to evade possible danger caused by misplaced range selection. In most testers are found these ranges adjoined at the ohm range, and there is a fair chance of the circuit resistors being burnt out rendering the instrument out of service. In the worst case, it might bring on serious accident to the operator.

6 Non-skid rubber support.

The rubbers supplied may be fitted in the pits on the rear to tilt the meter to a convenient viewing angle on the bench. They also serve to prevent the meter to skid.

7 Glass indicator cover.

In consideration of the portable use of the instrument, scratch-, heat- and dust-proof glass is used for the protection of the indicator instead of a soft metacrylic-resin cover.

measurement ranges and performance

1 As a circuit tester.

Measurement	Measurement ranges	Allowance	Remarks
DC voltage (DCV)	0–0.1V-0.5V-2.5V-10V-50V–250V 1000V-(25kV) 25kV with HV probe extra	±3% fs except 25kV	Input impedance 20kΩ/V
AC voltage (ACV)	0–10V–50V–250V–1000V Frequency { 30Hz~30kHz ±3dB 50Hz~ 6kHz ±3%	±4% fs	Input impedance 8kΩ/V
DC current (DCA)	0–50uA–2.5mA–25mA–0.25A 50uA at 0.1VDC position	±3% fs	Voltage drop 250mV (100mV for 50uA)
Resistance (Ω)	Range X1–X10–X1k–X10k Minimum 0.2– 2 –200–200k(Ω) Midscale 20 –200–20k–200k(Ω) Maximum 2k –20k–2M–20M (Ω)	±3% of arc	Internal batteries UM-3 x 2 0061 x 1
AF output (dB)	–10dB~+22dB for 10VAC 0dB/0.775V (1mW through 600Ω)	±4% fs	8kΩ/V for OUTPUT terminal

2 As a transistor tester.

Leakage current (I_{CEO}) (LI)	0~150uA at X1k range 0~15mA at X10 range 0~150mA at X1 range	±5% of arc	Current across terminals
DC current amplification factor (h_{FE})	0~1000 at X10 range ($\frac{I_C}{I_B}$)	±3% of arc	With connector extra

operation I – as a circuit tester

1 Zero correction of indicator.

Zero corrector ① is adjusted to place the pointer ⑧ on 0 of the scale left. It need not be repeated at each measurement, but the position of the pointer on zero must be confirmed before starting measurement.

2 Test lead connections.

The test leads attached are inserted well down, the red lead going to the + jack and the black lead to the –COM jack.

3 Selection of range.

When selecting a range, the white mark on the knob is correctly positioned at the prescribed range.

3-1 DC voltage (DCV).

DC voltages of batteries, amplifier circuits, power source of communication equipment, tube and transistor circuit biases, etc. are measured. Each of the 7 range notations (0.1~1000) indicates the maximum voltage reading for that range.

3-2 AC voltage (ACV).

Voltages of commercial AC supply, AC powered circuits, AF signal level, etc. are measured. Each of the 4 range notations (10~1000) indicates the maximum voltage reading for that range.

3-3 DC current (DCA).

Current consumption of DC power operated equipment, bias current of tube and transistor circuits, etc. are measured. Each of the 4 range notations (50uA~0.25A) indicates the maximum current reading for that range. (uA=10^{-3}mA and A–10^3mA)

3-4 Resistance (Ω)

Resistance is measured, and line and circuit continuity (∞ or 0Ω) tested. Each of the 4 range notations indicates the multiplication of the reading for that range, where k stands for 1000.

4 Measurement ranges and scale reading.

Scale mark	Measurement	Scale reading
(1) Ω (black)	Resistance	X1 range directly reads 0.2Ω~2kΩ. For X10, X1k and X10k ranges, multiply readings by the multiples.
(2) Mirror		For accuracy reading, the pointer itself and its image in the mirror must be lined up.
(3) DCV·A (black)	DC voltage and current	0–10, 0–50 and 0–250 lines each reading 0~10V, 0~50V and 0~250V fs. 0.1V, 0.5V, 2.5V and 1000V are read multiplied. For current, 0-250(A) line reads 0~0.25A, 0~25mA and 0~2.5mA. 0~50uA is read on 0–50 line.
(4) ACV (red)	AC voltage	Common scale with DCV reads 0~250V, 0~50V and 0~10V directly. For 0~1000V, multiply the reading on 0–10 line.
(5) h_{FE} (blue)	DC amplification factor	Extra connector reads 0~1000 on X10(Ω) range.
(6) LEAK, I_{CEO}, LI (blue)	Reverse leakage current of transistors	Reads current flow across + and –COM while measuring resistance, X10 range reading 0~15mA. Emitter and collector connected instead read I_{CEO}. 0~150uA for X1k and 0~150mA for X10k ranges.
(7) LV (blue)	Voltage across terminals	Reads reverse DC voltage of 3V~0 while measuring resistance; X1k through X1.
(8) dB (red)	AF output	–10~+22dB for 10VAC range. 0dB is established at 0.775V (1mW through 600Ω) $dB=20\log_{10}\frac{\text{ACV rdg}}{0.775V}$

5 Difference between voltage and current measurements.

Fig. 2-A is a standard voltage measurement, where the potential difference between 2 points is checked, for which the meter is connected in parallel with load, while −B checks the current supplied by power and consumed by load, where the meter is connected in series with the circuit. Basically, the difference is whether the meter is connected in parallel or in series with load. The latter connection accompanies the trouble of cutting open the circuit being checked.

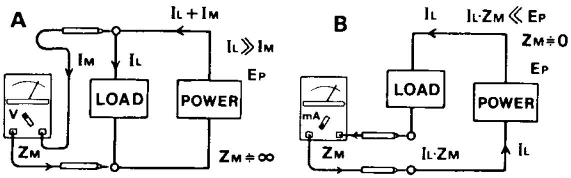


Fig. 2

In respect of measurement loss, the bigger the impedance of the meter (Z_M) is, the smaller is the current (I_M) required for measurement for the former, and, on the contrary, the smaller the impedance of the meter is, the voltage loss (drop) by $I_L \times Z_M$. (I_L − current consumption) Thus, high accuracy data are obtained by the YX-360TR because of its very small current loss of 50uA for DCV and 125uA for ACV measurements at full scale, the voltage drop for current measurement being 250mV.

6 Voltage measurement and internal impedance.

There are 2 instances of voltage measurement by parallel connection. In case of Fig. 2-A, there exists no high impedance corresponding to R_A of Fig. 3. Power supply source has its own internal resistance, but it is so small as can be ignored for voltage measurement, and the loss of current consumption by a tester is practically nil the meter reading Ep. But, as can be noted in Fig. 3, the circuit condition changes on account of R_A present and 200kΩ of the tester connected in parallel for measurement. Consequently, the meter reads 3.77V against the actual 4V resulting in some error. Therefore, when measuring such a circuit, where R is usually replaced with a tube or a transistor, the circuit impedance and internal resistance of the voltage range of the tester used for measurement must be referred to each other in reading the data obtained. In Fig. 3, the circuit impedance is about 1/10 of the impedance of the tester, and reading error of within −5% can be ignored, though the bigger the internal impedance of a tester, the better.

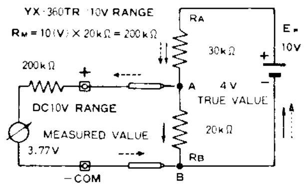


Fig. 3

The high impedance of 20kΩ/V for DCV and 8kΩ/V for DCV of this instrument displays its full ability in the voltage measurement of high impedance voltage amplifying circuit, AVC, AGC and transistor bias circuit to obtain high accuracy data.

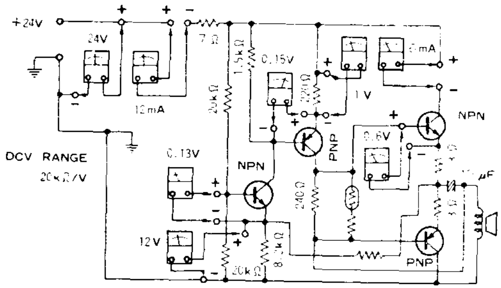


Fig. 4

Fig. 4 above is a sample measurement of a transistor circuit. It will be useful for trouble-shooting and discrimination of the type of the transistors used if you are acquainted in advance with the proper use of NPN and PNP transistors and the fact that Ge type shows low V_{BE} and Si type high V_{BE}.

7 Use of HV probe for TV servicing.

25kV HV probe is available extra. It is connected as shown in Fig. 5 placing the range selector switch at the position marked PROBE. The DCV 0–250 scale is used reading 25kV at full scale. This probe can only be used for measurement of high impedance circuit voltage like the anode and focusing voltages of a CRT for television use.

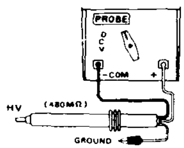


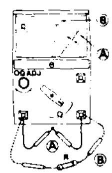
Fig. 5

8 ACV measurement on OUTPUT terminal.

The negative lead is connected as usual to the –COM and the positive lead to the OUTPUT terminal. A condenser is interconnected in series with the OUTPUT and + terminals to cut off DC element present on the circuit to read AC signal alone on the meter.
Besides checking AF output voltage, this terminal is available to detect signals in TV servicing. For instance, on the AC 50V range is detected the presence of the horizontal signal on the horizontal amplifying circuit and, similarly, the presence of the input signal on the synchronous detaching and synchronous amplifying circuits.

9 Resistance measurement and 0Ω adjustment.

Resistance measurement is powered by internal batteries. They wear by use resulting in reading error of the measured value. For correct reading of resistance, the sensitivity of the indicator must be adjusted according to the voltage supplied by batteries. This is what is called 0-ohm adjustment for the indicator to read 0Ω at full scale. It is adjusted in the following way:
As shown in Fig. 6, the range selector is placed at the range being used. With the + and –COM terminals shorted together, the pointer moving toward 0Ω is adjusted by turning 0ΩADJ to the right or left in order to place it exactly on 0 of the scale right. The pointer must be adjusted each time the range is moved.



A ... 0Ω ADJ
B ... Reading Ω

Fig. 6

Polarity of terminals for resistance measurement

As shown in Fig. 7, the polarity of terminals is reversed for resistance measurement, the + jack being in negative and −COM jack in positive potential, the battery terminals being inverted in the meter. It must be remembered when testing polarized resistance like transistors and diodes (junction type), etc. So must it be when testing the leakage of electrolytic capacitors.

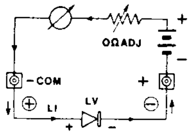


Fig. 7

Current consumption in resistance masurement

Subject to the unit being tested, its impedance changes while measuring resistance on account of the current flowing in the unit, or the voltage it is impressed with. Some abnormal state may be recognized due to self-heating. It must be well noted for each range used when, for instance, measuring the DC resistance of a thin-wire coil and a bulk-type semiconductor like a thermistor. The LI and LV scales provided check current consumption and voltage load very effectively in these measurements.

Sw. position	Max. current consumption	Max. voltage across terminals
X1	150mA	3V
X10	15mA	3V
X1k	150 uA	3V
X10k	(60uA)	(12V)

Replacement of batteries

When the internal 1.5V batteries are worn out, it becomes impossible to make 0Ω adjustment for the X1 range because it dissipates current most. So is it for the X10k range where 9V battery (006P) is consumed. The batteries needs immediate replacement. Uncover the meter by moving the rear bolt. Fig. 8 shows how to replace the worn-out batteries.

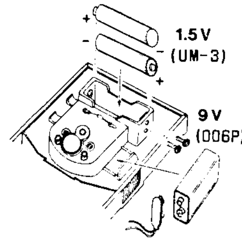


Fig. 8

10 dB scale.

dB (decibel) is measured in the same way as ACV measurement reading the dB scale instead.
Because the human ear is analogous to logarithmic variation, the input/output ratio of an amplifier and transistor circuit is expressed by logarithmic value dB to save complicated calculation. For a coupled circuit of a definite impedance, power can be compared by simply expressing the voltage (current) ratio by dB. The dB scale provided is graduated to read from 0dB to +22dB on the reference of 0dB at 0.775V which is the voltage when 1mW is dissipated across 600Ω.
Most frequently, the input and output circuit impedances of audio amplifiers are not necessarily stand-

ardized for 600Ω, and the dB values measured by a tester are nothing but voltage values read in dB corresponding to them. However, when comparing AF voltage levels by dB, the scale provided will surely save the trouble of making complicated calculation when it is necessary to convert them into dB values.

dB measurement on 50V and 250V ranges

For measurement on the 10V range, the dB scale (−10dB~+22dB) is read directly, but, when measured on the 50V range, 14dB is added to the reading on the scale, and on the 150V range, 28dB is added. Thus, the maximum dB readable is 22+28=50(dB) measured on the 250V range.

operation II — as transistor tester

1 Preliminaries.

This instrument uses its resistance range for transistor tests, and so the pointer must be exactly adjusted to zero before connecting a transistor for measurement, for which the P and N terminals are shorted together and the pointer is adjusted by 0ΩADJ.

2 Measurement of I_{CEO} (leakage current).

2-1 A small-size TR (hereinafter a transistor is referred to as TR) is checked on the X10 Ω(15mA) range, and a large-size TR on the X 1 Ω range.

2-2 An NPN TR is connected as shown in Fig. 9-A, and a PNP TR, -B.

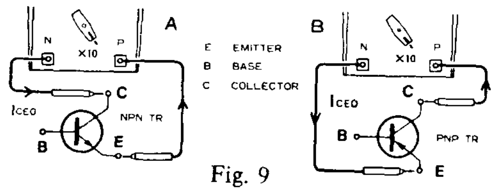


Fig. 9

Represented electrically, Fig. 9 may otherwise be as Fig. 10, where the section on the right of the N and P terminals enclosed in the dotted line corresponds to the internal circuit of the tester.

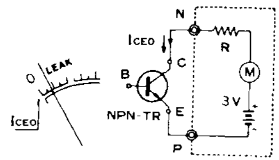


Fig. 10

2-3 In Fig. 10, the current flowing across the P and N terminals is I_{CEO} (reverse leakage current) of the TR, and the quantity of the leakage current is read on the LEAK scale in mA.

2-4 For a Si TR, this current is too small to read.

2-5 There will be some leakage current read even for a good quality Ge TR, though there is some difference subject to its type. It will be 0.1mA~2mA for a small- and medium-size TR, and 1mA~5mA for a large-size one.

2-6 If the reading falls within the red LEAK zone of the I_{CEO} scale, the TR tested is passable, but if it goes beyond the zone coming near to the full scale, the TR is definitely defective.

2-7 Leakage current is little to do with voltage value showing constant current characteristic, but it is a great deal subject to temperature. Be aware of temperature rise while testing; it reads twice as much for +10°C.

3 Measurement of h_{FE} (DC amplification factor) 0~1000.

3-1 Besides reverse leakage current, the amplification degree of a TR kinetically measured also determines the quality of a TR on a very simple theory. As a TR is connected to the tester as shown in Fig. 11, there flows I_{CEO}. A certain resistance (R) connected across the N terminal and the base of the TR causes the current I_A to flow

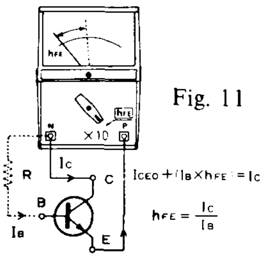


Fig. 11

determined by R. For a good TR, $I_C \times h_{FE}$ is led to the collector resulting in so much current increase and higher reading of the meter. The quantity of the current change can be scaled out as h_{FE} on the meter to read the amplification degree.

3-2 Extra connector for h_{FE} measurement.

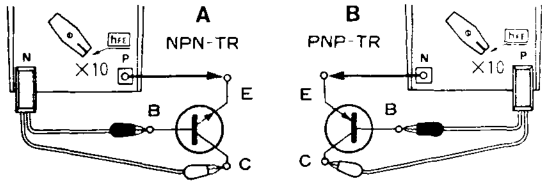


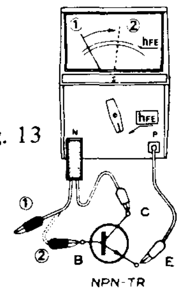
Fig. 12

The connector is connected either to the N or P terminal subject to the polarity of the TR. To the other P or N terminal unemployed is connected the emitter of the TR. The range switch is set for X10.

3-3 The clips of the connector are connected to the collector and base, and the lead from the other terminal of the tester, to the emitter.

3-4 For a good TR, there will be a big difference of reading between ① and ② of Fig. 13. In ①, when $I_B=0$ and with base open, only a little I_{CEO} is read, and in ②, I_B flows and Ic changes reading an increased value by $I_B \times h_{FE}$.

Fig. 13



For a faulty TR:

(a) No reading at all for the connection ②;
(b) No difference of reading between ① and ②;
(c) For the ①, reading goes beyond the h_{FE} scale and near to full scale.

3-5 Under the condition of Fig. 12-②, reading is noted on the blue h_{FE} scale. The value read is $\frac{I_C}{I_B}$ which is the DC amplification degree of the TR tested.

3-6 Speaking exactly of a Ge TR, leakage current always flows to the collector resulting in so much reading error. Therefore, true value is obtained by deducting from h_{FE} the value corresponding to I_{CEO} read.

4 Measurement of diode including LED.

4-1 The connections of Fig. 14 read I_F (forward current) or I_R (reverse current) on the LI scale provided. For the 1k range, the scale reads 0~150uA, for the X10 range 0~15mA, and for the X1 range 0~150mA.

4-2 I_F reads high close to full scale, and I_R very low practically no current flowing.

4-3 While measuring I_F, the LV scale reads the linear (forward) voltage of the diode tested. For a Ge diode, it is usually 0.1~0.2V, and for Si diode, 0.5~0.8V.

4-4 The forward voltage of LED is generally more than 1.5V, while average testers will fail to check it by the connections of Fig. 14 to measure I_F; it is impossible to have light emitted. The 3-volt internal battery layout of the instrument effectively checks it on the X1 range. While light is being emitted, the LI scale reads the current I_F, and the LV scale the forward volage V_F.

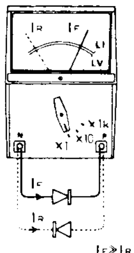


Fig. 14

maintenance

1 Choosing a proper range.

For increased accuracy, use the range nearest in value to the value being checked. For instance, a 1.5V dry cell should be checked on the DC 2.5V range. Error will be bigger on the left half of the scale. For resistance measurement, reading is most accurate around in the middle of the scale.

2. Measurement of unknown values.

When measuring an unknown value, start with the highest range. After the first reading, the switch can be reset to a lower range for a more accurate reading.

3 Protection of tester.

A tester is a precision instrument, and severe shock or vibration should be avoided. Do not leave it long where there is high temperature or moisture.

4 Burnout damage through misapplication.

4-1 Misapplication occurs most burning out some internal resistor when high AC voltage of 100~200V is inadvertently applied to a resistance or current range with the selector switch placed on them unawares.

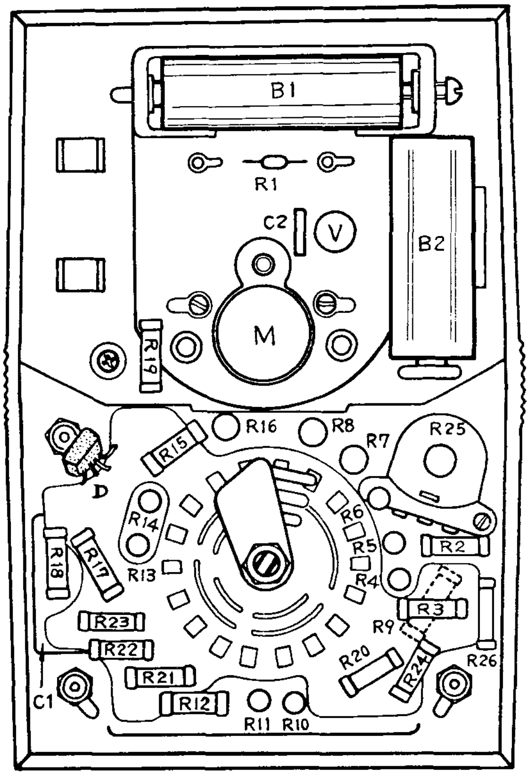
4-2 By virtue of the automatic protection circuit by Si diodes placed in parallel with the meter movement, the pulse current flowing into the movement is absorbed by them to safeguard the moving coil from getting burnt.

4-3 A resistor may be burnt out on account of a high voltage of about 100V misapplied, but it can be replaced to restore the instrument to normal performance. Resistors most liable to burn are 19Ω (R21) for the X1 (Ω) range, and 1Ω (R12) for 0.25A range. Refer to "**supplementary data**" at the end of the manual.

4-4 For a high power circuit of more than 200V, sparking can cause some abnormality in the tester. Be certain to have the meter damaged repaired and undergo regular inspection and calibration by a warrantable test facility.

supplementary data

1 Arrangement of parts



2 Parts list

Part No.	Description	R. S.
Y X R 01	Resistor (1.2kΩ), mV calibration	R 1
Y X R 02	Resistor (240Ω), series	R 2
Y X R 03	Resistor (5 kΩ), 0.5V DC multiplier	R 3
Y X R 04	Resistor (40kΩ), 2.5V DC multiplier	R 4
Y X R 05	Resistor (150kΩ), 10V DC multiplier	R 5
Y X R 06	Resistor (800kΩ), 50V DC multiplier	R 6
Y X R 07	Resistor (4 MΩ), 250V DC multiplier	R 7
Y X R 08	Resistor (15MΩ), 1000V DC multiplier	R 8
Y X R 09	Resistor (3 kΩ), series	R 9
Y X R 10	Resistor (92Ω), 2.5mA DC shunt	R 10
Y X R 11	Resistor (9 Ω), 25mA DC shunt	R 11
Y X R 12	Resistor (1 Ω), 0.25A DC shunt	R 12
Y X R 13	Resistor (74kΩ), 10V AC multiplier	R 13
Y X R 14	Resistor (320kΩ), 50V AC multiplier	R 14
Y X R 15	Resistor (1.6MΩ), 250V AC multiplier	R 15
Y X R 16	Resistor (6 MΩ), 1000V AC multiplier	R 16
Y X R 17	Resistor (2k~4kΩ), ACV sensitivity calibration	R 17
Y X R 18	Resistor (41kΩ), shunt	R 18
Y X R 19	Resistor (2 kΩ), diode series	R 19
Y X R 20	Resistor (44kΩ), ohm series	R 20
Y X R 21	Resistor (19Ω), Ω ×1 shunt	R 21
Y X R 22	Resistor (200Ω), Ω ×10 shunt	R 22
Y X R 23	Resistor (33.3kΩ), Ω ×1k shunt	R 23
Y X R 24	Resistor (194kΩ), Ω ×10k series	R 24
Y X R 25	Resistor (10kΩ), 0 Ω adjuster	R 25

Part No.	Description	R. S.
Y X R 26	Resistor (16kΩ), shunt	R 26
R F 01	Rectifier (copper-oxide)	D
C049	Capacitor	C 1
C050	Capacitor	C 2
V001	Varister	V
B001	Dry cell UM-3 (1.5V), 2 required	B 1
B005	Dry cell 006P (9 V)	B 2
	Meter movement (44μA/2 k)	M
P016	Panel frame (YX-360TR)	
P017	Panel dial (YX-360TR)	
X016	Rear case (YX-360TR)	
MB10	Meter movement base	
T001	Terminal jack (2φ), 3 required	
SW15	Range selector switch	
K015	Range selector knob	
K007	0 Ω adjuster knob	
	Name plate (YX-360TR)	
L002	Test leads pair (2φ)	
V005	Rear case bolt (4φ)	

R. S.—Reference Symbol