HIOKI

INSTRUCTION MANUAL

SM-8000 Series

SM-8001
Resistance Tester

SM-8203
Super Megohm Meter

SM-8205
Super Megohm Meter

SM-8206
Super Megohm Meter with Alarm Unit

SM-8207
Super Megohm Meter

SM-8210
Ultra-Super Megohm Meter

HIOKI E. E. CORPORATION

Instruction Manual for SM-8000 Series

Applicable models

SM-8001	Resistance Tester
SM-8203	Super Megohm Meter
SM-8205	Super Megohm Meter
SM-8206	Super Megohm Meter with Alarm Unit
SM-8207	Super Megohm Meter
SM-8210	Ultra-Super Megohm Meter

Contents

1. Handling Precautions

- Check the commercial supply voltage to be used for this instrument by the supply voltage selector switch ⑮ on the rear panel. If the setting needs to be changed, follow the CAUTION printed on the rear panel since it may require the changing of fuse ⑭ . (See Section 6.2.)
- Before turning the AC power ON, confirm that the charge/discharge switch ⑤ has been set to DISCHARGE. Confirm that no sample is connected to the Rx terminal ④ .
- When the charge/discharge switch ⑤ is set to CHARGE or MEASURE, never touch the Rx terminal or sample because the measurement voltage set by the VOLTAGE switch ⑥ is applied to it. Any contact with it may result in electrical shock and is very dangerous.
- Do not turn the power switch ② ON with a sample connected to the Rx terminal ④ and the charge/discharge switch ⑤ set to MEASURE. This may cause mainframe failure or sample breakage because of transient phenomena.
- When the mechanical zero-point ③ of the instrument needs to be adjusted, always turn the power OFF before performing the adjustment.
- The sample to which voltage has once been applied needs to be thoroughly discharged before measurement. If voltage is switched to low voltage after the sample has been applied with high voltage, the indicator pointer deflects inversely, disabling measurement.
- When CAL. operation is executed using the RANGE switch, always set the charge/discharge switch lever (TIME switch for SM-8001) to MEASURE (TEST for SM-8001).
- Since the panel of the instrument is made of acrylic resin, avoid unnecessary rubbing of the panel surface. Excessive, rubbing of the surface causes electrification. This affects indicator ① and results in error. If the pointer moves even when simply touching the surface of the indicator ① , electrification prevention measures need to be taken.
- Keep the instrument in a place of minimal humidity as far as possible when not in use.

> Note . For the numbers circled in this manual, see Section 4 Section Names.

2. Specifications

The specifications of the SM-8000 Series are as shown in Table 1.

Table 1 Specifications of SM-8000 Series

Specifications	SM-8001	SM-8203	SM-8205	SM-8206Alarm	SM-8207	SM-8210
Measured voltage Measuring range	5V: 5–2×10⁹Ω (8 ranges)	5V: 0.05×10⁶–2×10¹¹Ω 10V: 0.05×10⁶–2×10¹¹Ω 15V: 0.05×10⁶–2×10¹¹Ω 25V: 0.05×10⁶–2×10¹¹Ω 50V: 0.05×10⁶–2×10¹¹Ω 100V: 0.05×10⁶–2×10¹¹Ω (6 ranges)	50V: 0.25×10⁶–10×10¹¹Ω 100V: 0.5×10⁶–20×10¹¹Ω 250V: 1.25×10⁶–50×10¹¹Ω 500V: 2.5×10⁶–100×10¹¹Ω 1,000V: 5×10⁶–200×10¹¹Ω (6 ranges)		10–99V: 0.05×10⁷–2×10¹²Ω 100–1,000V: 0.05×10⁸–2×10¹³Ω Voltage to be measured can be arbitrarily specified for five ranges.	10V: 0.05×10⁶–2×10¹⁴Ω 15V: 0.125×10⁶–5×10¹⁴Ω 50V: 0.25×10⁶–10×10¹⁴Ω 100V: 0.5×10⁶–20×10¹⁴Ω 250V: 1.25×10⁶–50×10¹⁴Ω 500V: 2.5×10⁶–100×10¹⁴Ω 1,000V: 5×10⁶–200×10¹⁴Ω (9 ranges)
Accuracy to voltage to be measured	±3% of set value					
Measuring accuracy	±10% (5 to 50 scale graduations)	±10% (0.05 to 0.5 scale graduations)	±10% (1,000 V, 5 to 50 scale graduations)		±10% (0.05 to 0.5 scale graduations)	×1–×10⁷: ±10% ×10⁸: ±20% (at 20°C) (1,000 V, 5 to 50 scale graduation)
Service temperature range	0–40°C					5–35°C
Service humidity range	0–85% max.					
Power supply	AC100/120/220/240V 50, 60Hz					
External size	About 280 (W) x 190 (H) x 222 (D) mm					
Weight	About 5 kg					

Option	SM-8001	SM-8203	SM-8205	SM-8206	SM-8207	SM-8210
Alarm unit	O	O	O	Provided as standard	O	×
Provided as standard	O	O	O	O	O	O
DC output (1/R output)	O	O	O	O	O	O
HV-EV (High-voltage enable) function	O	O	O	O	O	O

Standard accessories

- Measuring rod (red, black) ..... 1 set
- Power cord ..... 1 set
- Instruction manual ..... 1 set

○: Option available

×: Option not available

For DC output, however, only 1/R or resistance value proportioning is available and both items cannot be used simultaneously.
The SM-8206 has an alarm unit as standard.

3. Overview

3.1 Operation Principle

The operation principle of the SM-8205 is given in Figure 1 as an example.

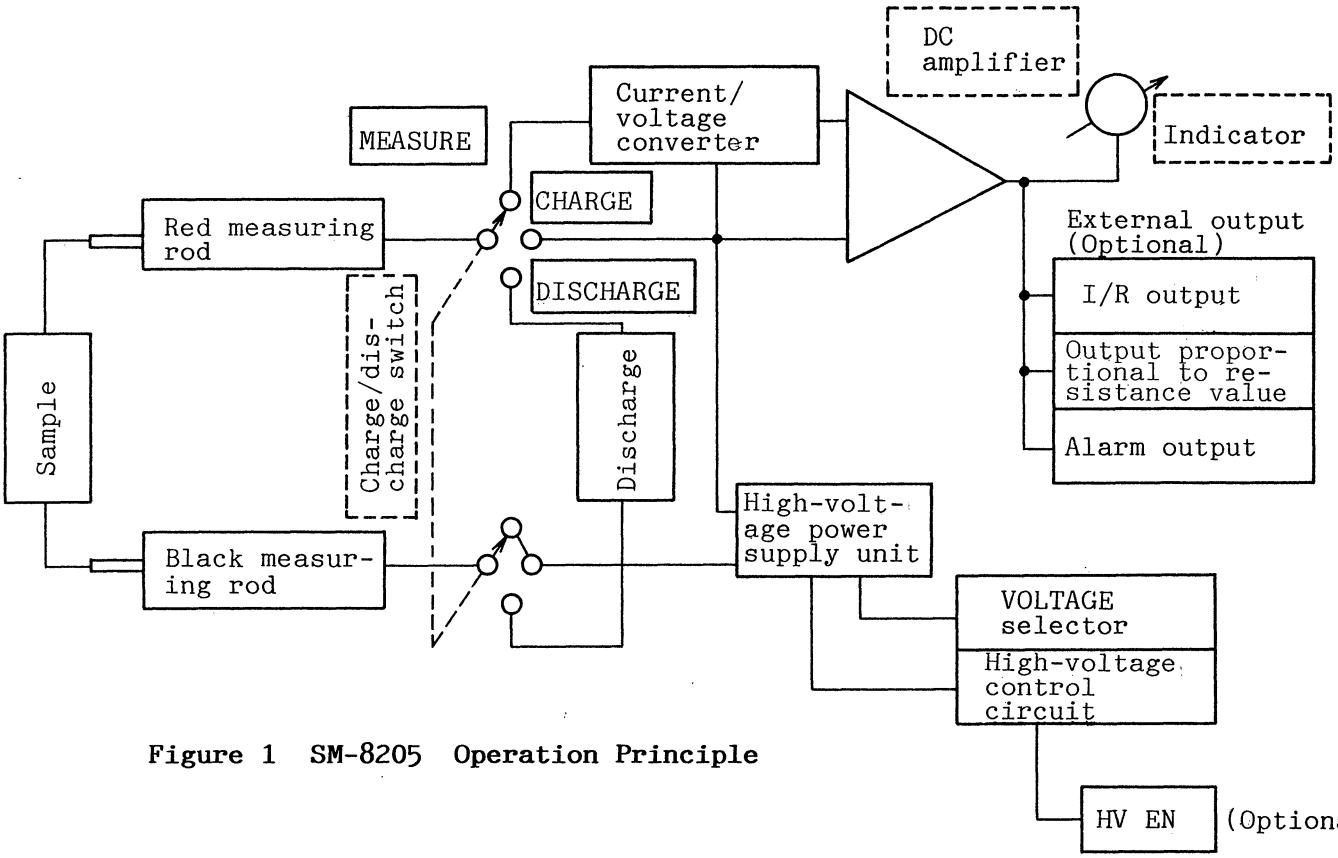
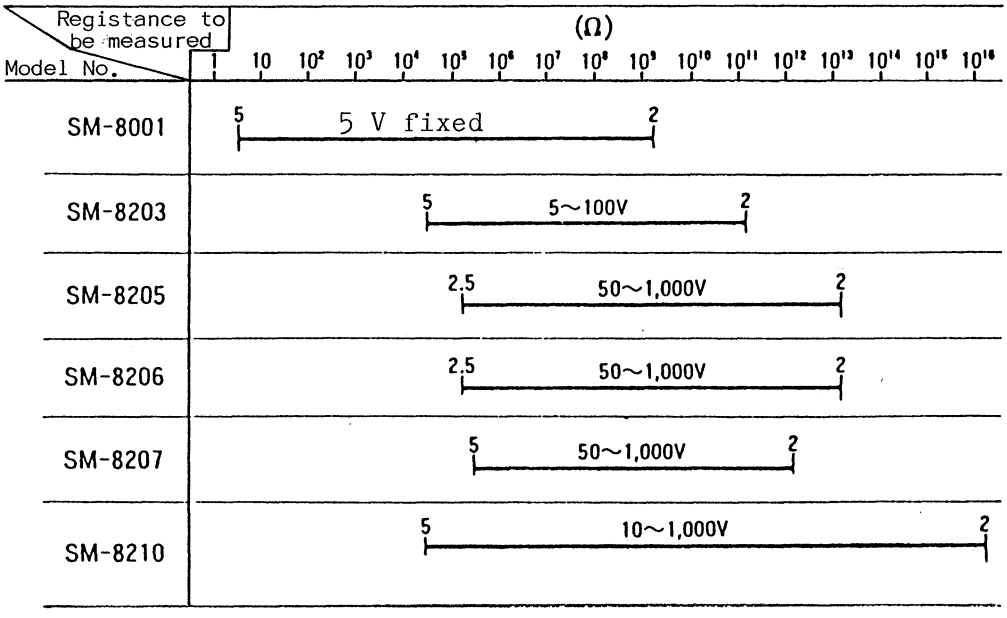


Figure 1 SM-8205 Operation Principle

Thumbnail Guide for Selecting SM-8000 Series Model



3.2 Features

. Consideration for measurement safety

All models (not including the SM-8001) are provided with a DISCHARGE switch, allowing a sample to be safety discharged. The HV-EN external voltage output control (high-voltage enable) (option) of the measurement power supply can be operated such that no measurement voltage is output if the measurement conditions are not satisfactory.

Use of these two functions allows residual voltage to be discharged or measurement voltage to be applied only at measurement, enabling safe measurement.

. Provision of the charge/discharge switch as standard

The serial operation of charging, measurement, and discharging is available using only one switch. Its operability has also been improved remarkably.

. In addition to traditional liquid sample electrodes and mercury electrodes, the electrodes corresponding to flat plate samples and continuous liquid insulation resistance test are newly provided. This significantly broadens the application range.

. A variety of commercial power supplies acceptable

Use of the voltage selector switch for selecting 100 V AC, 120 V AC, 220 V AC, or 240 V AC allows the instrument to easily handle the commercial power to be supplied.

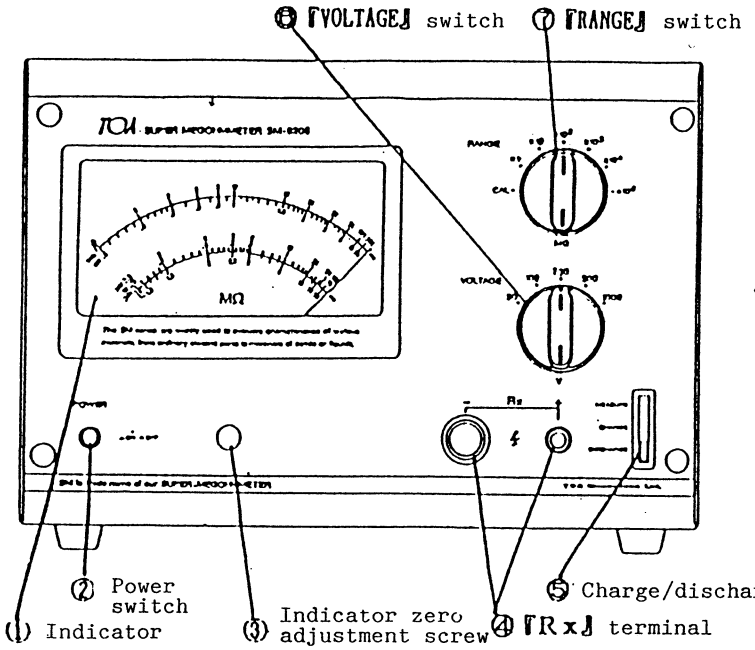
This feature allows the equipment to be readily transferred from a domestic plant to an overseas plant.

. Versatile options to improve functions

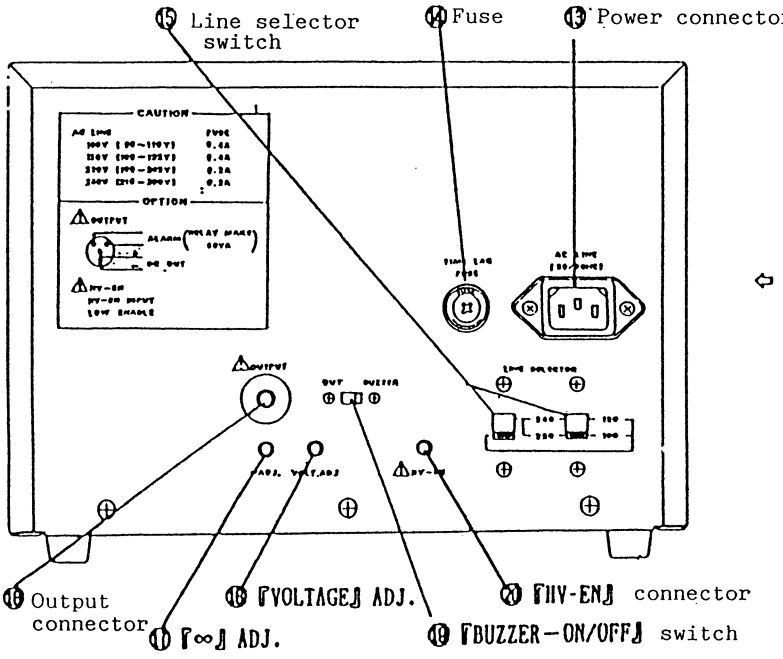
Options such as an alarm unit, DC output, HV-EN, etc. are provided, and the provision of these options for the instrument enables the main frame functions to be considerably improved, thus allowing easy insulation measurement.

4. Section Names

For section names of the SM-8000 Series, Figures 2 and 3 show the front view (SM-8205) and the rear view respectively. Figures 4, 5, 6, and 7 show the front views of the SM-8001, SM-8206, SM-8207, SM-8210 respectively. The part arrangement and functions of the SM-8203 are the same as the SM-8205 in Figure 2, though the indicator scale graduation and panel-printed characters are different.

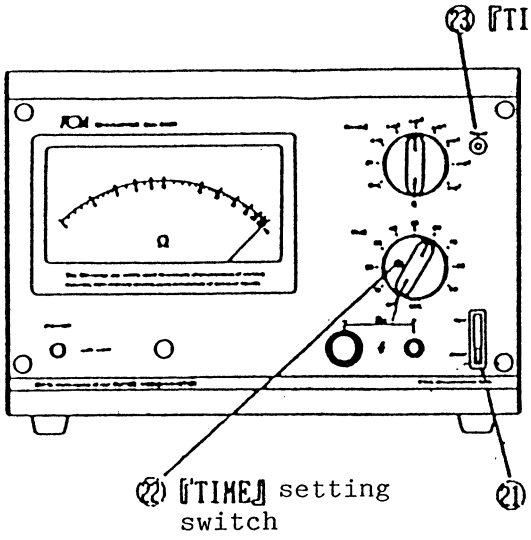


⇦ Figure 2 Plan View

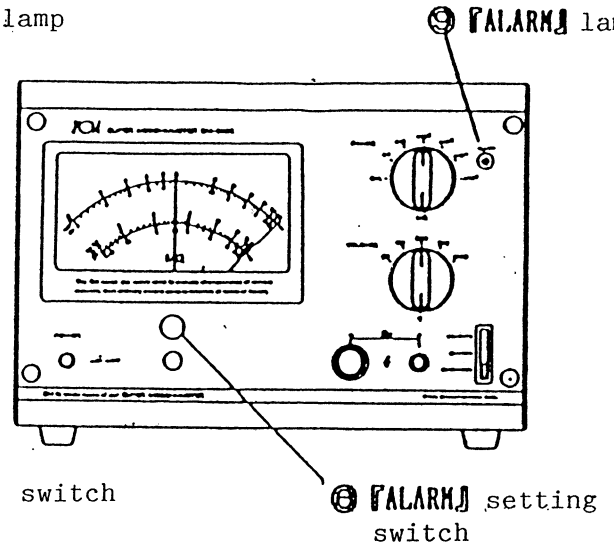


⇦ Figure 3 Rear View

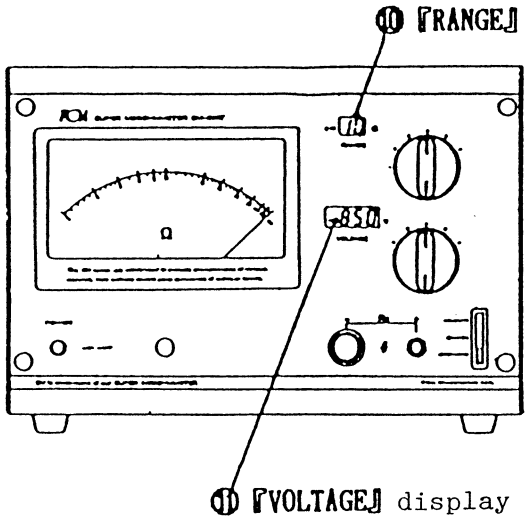
* Sections 18 and 20 are available when options are installed.
Read and understand the functions of each section well.



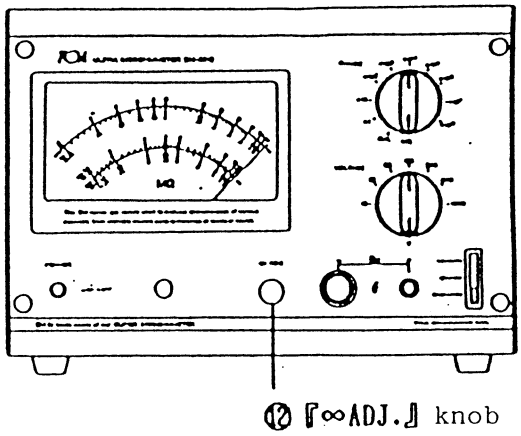
⇧ Figure 4 SM-8001



⇧ Figure 5 SM-8206



⇧ Figure 6 SM-8207



⇧ Figure SM-8210

5. Description of Each Section

Sections in Figures 2 to 7 are described.

① Indicator — Indicates the measured value. The SM-8001, SM-8203, and SM-8207 have only one arc scale graduation curve. The reading of the indicator ① is multiplied by the multiplying factor of the RANGE ⑦ to obtain the measured value. For the SM-8205, SM-8206, and SM-8210, reading the value of the arc curve corresponding to the VOLTAGE switch ⑧ and multiplying it by the multiplying factor of the RANGE ⑦ allows the measured value to be obtained. For the SM-8207, the number indicated by the RANGE indication ⑩ is the multiplying factor. The scale graduation of each model is shown in Figures 8 to 11.

Figure 8 SM-8001/8207 Scale Graduation

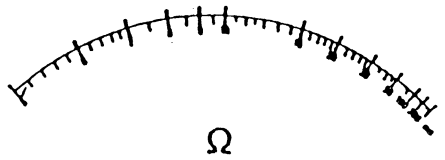


Figure 9 SM-8203 Scale Graduation

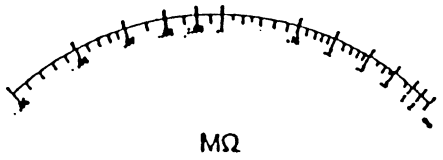


Figure 10 SM-8205/8206 Scale Graduation

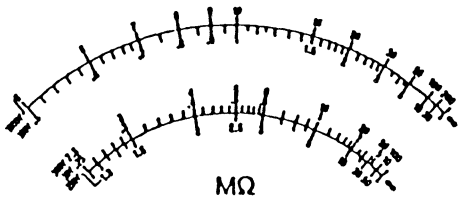
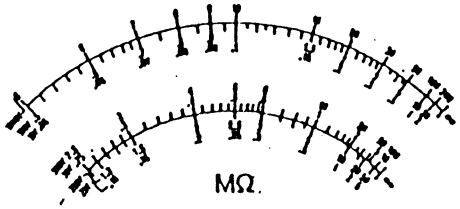


Figure 11 SM-8210 Scale Graduation



② Power switch — Used to turn ON/OFF the AC power fed to the instrument. When the switch is set to ON, the green lamp lights.

③ Indicator zero adjustment screw — Capped with a black rubber cap. This screw is used to adjust deviation if the pointer of the indicator ① does not agree with ∞ when the power switch ② is OFF. (See Figure 12.)

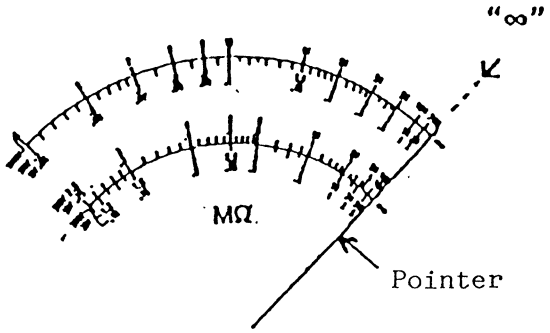


Figure 12 Position of the ∞ Point

④ Rx terminal — Used to connect the cable connector provided for a measuring rod or electrode when the insulation resistance of sample is measured.

⑤ Charge/discharge switch — This must always needs to be set to DISCHARGE before turning the power ON. When set to discharge, measurement voltage is not output to the Rx terminal and it is safe. After turning the power ON, connect a sample to the Rx terminal ④, set this switch to CHARGE at the center, and leave the switch there for a few sec. (the time varies with the capacitance of the sample) to thoroughly charge the sample. Then, set the switch to MEASURE for measurement.
For details of items such as CHARGE, see Section 6.5.
Figure 13 shows the charge/discharge switch.

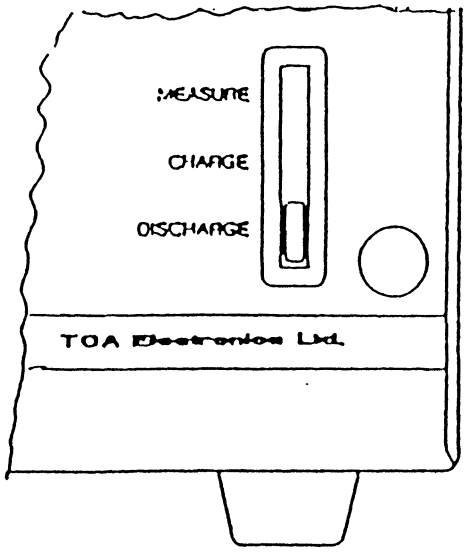


Figure 13 Charge/Discharge Switch

For the SM-8001, the charge/discharge switch is replaced by the TIME switch ㉑.

⑥ VOLTAGE switch — Used to select the voltage output to the Rx terminal ④ . The printed character at the position indicated by the index of the knob shows the voltage to be output. For the SM-8207, the voltage is digitally (LED) displayed by the VOLTAGE display unit ⑪ .
. Measurement voltage polarities are:
[(-) voltage at the red measuring rod]
[(+) voltage at the black measuring rod]
For the SM-8001, the TIME setting switch ㉒ is installed instead of this switch.

⑦ RANGE switch — Used to select the multiplying factor of the measured value. The printed character indicated by the index of the knob is the multiplying factor. Note that the unit varies between M ohm or ohm, depending on the model. Further, CAL. is used for self-calibration. For details, see section 7. For the SM-8207, the index is digitally (LED) displayed by the RANGE display unit ⑩ . The indication of CAL. is as shown in Figure 14.

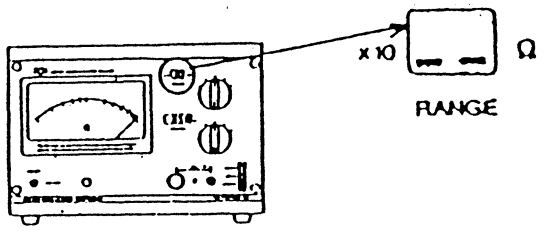


Figure 14 SM-8207 (CAL.) ⇨ Display

⑧ ALARM knob — Provided when the alarm unit is installed as an option. The SM-8206 has the alarm unit as standard. This knob is used to set the value desired to generate an alarm.

⑨ ALARM lamp — Provided when the alarm unit is installed as an option. The SM-8206 has the alarm unit as standard. This lamp lights when an alarm is generated if the value indicated by the indicator ① falls below the value set by the ALARM knob ⑧ .

⑩ RANGE display (SM-8207) — This function is provided only for the SM-8207. It digitally displays the position of the knob of the RANGE switch ⑦ .

⑪ VOLTAGE display (SM-8207) — This function is provided only for the SM-8207. It digitally displays the position indicated by the index of the knob of the VOLTAGE switch ⑥ .

⑫ ∞ ADJ. knob (SM-8210)

This is available only for the SM-8210. If the indicator ① pointer has deviated from the ∞ point a few min. after the power switch ② has been turned ON, use this knob to adjust the pointer. For other models, the ∞ ADJ. knob ⑰ on the rear panel corresponds to this.

㉑ TIME switch (SM-8001)

This is only applicable to the SM-8001. When the switch is moved from the RESET (bottom) to TEST (top), measurement is available only for the time set by the TIME setting switch ㉒. When the measurement time is reached, the TIME UP lamp ㉓ lights; causing the value indicated by the indicator ① to be held. To release this hold, move the switch to RESET (bottom).
Voltage to be measured is not output under the RESET status.

㉒ TIME setting switch (SM-8001)

This is the setting switch for TIME and is applicable only to the SM-8001. When this switch is set to OFF, the timer does not work and continuous measurement is applied. When the time set by this switch has elapsed, the value of the indicator ① is held and the TIME UP lamp ㉓ lights.

㉓ TIME UP lamp (SM-8001)

This is the time up display function and is applicable only to the SM-8001. The lamp lights after the time set by the TIME setting switch ⑩ has elapsed. When the lamp is lit, the indication of the indicator ① is held.

[Rear panel]

⑬ Power connector

Used to connect the power cord provided. The standard is of the 2P type, but the 3P type is available as an option.

⑭ Fuse

A glass tube containing a 0.4 A time-lag fuse is used. 100 V AC to 120 V AC are at 0.4 A, while 220 V AC to 240 V AC are at 0.2 A. If supply voltage needs to be changed after purchasing the instrument, always check the value of the fuse.

⑮ Supply voltage selector

Used to select the supply voltage of the AC power to be used. When the instrument is used in Japan, 100 V AC is almost always used. However, when it is used in other areas (overseas), select the supply voltage with reference to Section 6.7.

⑯ VOLT.ADJ.

If an error in the voltage set by the VOLTAGE knob ⑥ is large, use this control to adjust voltage using a screwdriver. For details, see Section 7.

⑰ ∞ ADJ.	If the indicator ① pointer has deviated from the ∞ point several min. after the power switch ② has been turned ON, adjust the pointer using a screwdriver. For details, see section 7. This control is not installed for the SM-8210, but the ∞ ADJ. control ⑫ on the SM-8210 panel has the same function.
⑱ Output connector	Provided for SM-8206 alarm output or other options. For details, see Section 8.1.3.
⑲ BUZZER ON/OFF	Provided for the SM-8206, or as an option it is used to select the built-in alarm buzzer or contact output. When the switch is set to OUT, alarm output fed from the output connector ⑱ and when set to BUZZER, the built-in buzzer can be activated.
⑳ HV-EN connector	This is an external control connector for the voltage output to the Rx terminal ④. Externally inputting contact signals to this connector enables output voltage to be turned ON/OFF. (Option) This is used in linkage with the SME-8310 or SME-8350.

6. Handling Method

6.1 Selection of Super Megohm Meter

Measurement of insulation resistance is quite difficult, though it appears to be simple. This is because insulation resistance is not real resistance, but is capacitive and shows dielectric absorption phenomena in almost all the cases. Therefore, insulation resistance requires that a good super megohm meter be used and thus the measuring method suitable for the meter be selected.

Prepare the instrument and attachments in the following order.

- What is the object to be measured?
- How to conduct the measurement? — Selection of electrodes and jigs
- What is the voltage to be measured?
- What will be the MΩ of the measured value? — Selection of measuring instrument

The actual approach of selecting electrodes and jigs is quite troublesome. Generally, since the insulation resistance of an insulator is unstable, there is no absolute value. Further, since insulation resistance changes with the measuring conditions and the surrounding environment, the equipment used for measurement should have good reliability.

From this viewpoint, TOA super megohm meters can be used with confidence.

6.2 Preparation

Perform confirmation in the following order to make preparation:

- Confirm that the supply voltage selector switch ⑮ has been set to the commercial supply voltage to be used.
  For details, see Section 6.7.
- Confirm that the power switch ② of the instrument is set to OFF. When the switch has been pushed forward, it is set to ON.
- Connect the power cord provided to the power connector ⑲ and insert the separable attachment plug to the AC receptacle.
- Confirm that the indicator ① pointer agrees with the ∞ point.

. Confirm that nothing is connected to the Rx terminal ④ .
. Confirm that the charge/discharge switch ⑤ is set to DISCHARGE.
. Set the RANGE switch ⑦ to the minimum range × 1.
. Set the VOLTAGE switch ⑧ to the voltage to be measured.
Turn the power switch ② ON. This lights the power switch green lamp to indicate that AC power has been fed to the instrument.
. Leave the instrument under this condition for a few min. prior to measurement.
. Confirm that the indicator pointer indicates ∞ as shown in Figure 12. If the pointer has deviated from ∞ , make adjustment in accordance with Section 7.
. Set the charge/discharge switch ⑤ to MEASURE. (For the SM-8001, set the TIME switch 21 to TEST.)
. Set the RANGE switch ⑦ to CAL. In this case, it is acceptable if the indicator pointer is within the range shown in Figure 22.
If it has deviated, follow Section 7 to make adjustment.
. Use the VOLTAGE switch ⑥ to select the measurement voltage to be used. If it is unclear as to what voltage to select as the measurement voltage, first make measurement at the minimum voltage of the instrument.
. Select the range corresponding to the measured value using the RANGE switch ⑦ . If the insulation resistance is unknown, select the × 1 range and switch the range to a higher range in turn after starting measurement.
For the SM-8207, no marking is provided for the RANGE switch ⑦ . An index is displayed on the RANGE display unit ⑩ and the minimum range corresponding to × 1 is located at the 2nd place from the left.

Note

When the charge/discharge switch ⑤ is set to CHARGE or MEASURE, do not touch the Rx terminal ④ or the sample because the measurement voltage set by the VOLTAGE switch ⑥ has been applied to it. Touching it will result in dangerous electrical shock.

6.3 Measurement

The following describes the measurement method using the cable connector attached for the measuring rod or electrodes provided.

. Connect the cable connector to the Rx terminal ④ .
Connect the sample to the measuring rod or electrode.
Connect the black measuring rod to the sample to be measured whose one side has been grounded or which has a large surface area with substantial area exposed to the atmosphere.

. Move the charge/discharge switch ⑤ from DISCHARGE to CHARGE and leave the switch there for several sec. (this varies with the capacity of the sample) to sufficiently charge the sample. Then, set the switch to MEASURE. This causes the indicator ① pointer to move to indicate the insulation resistance value. Turn the RANGE switch in accordance with the deflection of the indicator ① to select the range for easy reading. The insulation resistance value of the sample is obtained by multiplying the reading of the indicator ① (exercise care for the model whose scale graduation arc line to be applied differs with the voltage to be measured) by the multiplying factor the RANGE switch ⑦ .
In this case, the value indicated by the indicator ① varies with the time. Therefore, the elapsed time following the application of the voltage is important as the measuring conditions. In many cases, the value obtained 1 min. after voltage application is used and it is called "one min. value."

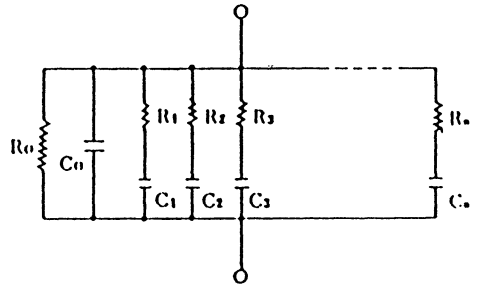
. If a measurement jig is fabricated and used, use of the optional HV-EN function provides safety measures. That is, the condition that measurement voltage cannot be output if the cover of the jig is open, can be easily achieved. See Section 8.4.

6.4 Changes in Current Flowing in Insulator

When insulation resistance is measured, a considerable large current flows at the same time as the application of the voltage, which gradually decreases, but it does not easily reach a fixed level.

This is caused by the charging current, absorption current, and leakage current and it is generally called dielectric absorption phenomena. The equivalent circuit of an insulator is considered as shown in Figure 15. When voltage is applied as in Figure 15, charging current flows in the order of C_o, C_1, C_2, ... C_n, and first C_o is charged, then charging occurs in the order of C_1, C_2, C_3, ... C_n, which causes current to fall. Eventually, only leakage current R_o remains. (See Figure 16.)

Figure 15 Insulator's Equivalent Circuit



In fact this R_o is insulation resistance. However, since C_1, C_2, C_3, ... C_n include very high resistances R_1, R_2, ... R_n in series, measuring only R_o is not simple.

It is generally said that the time taken for convergence is a few hours to a few days. Thus, though just for convenience, it has actually been said for a long time that the resistance value obtained one min. after the application of voltage is regarded as the insulation resistance of an insulator. This value is called the one min. value of insulation resistance and is widely adopted in the standards, etc.

Since the value measured for the first time is naturally different from those obtained by measuring second and third times continuously when measuring the one min. value of insulation resistance, the sample to which voltage has once been applied needs to be sufficiently discharged for measurement.

Discharge time needs to be generally five to six times longer than the time during which voltage was applied, though it varies with voltage and the intensity of C_o in Figure 15.

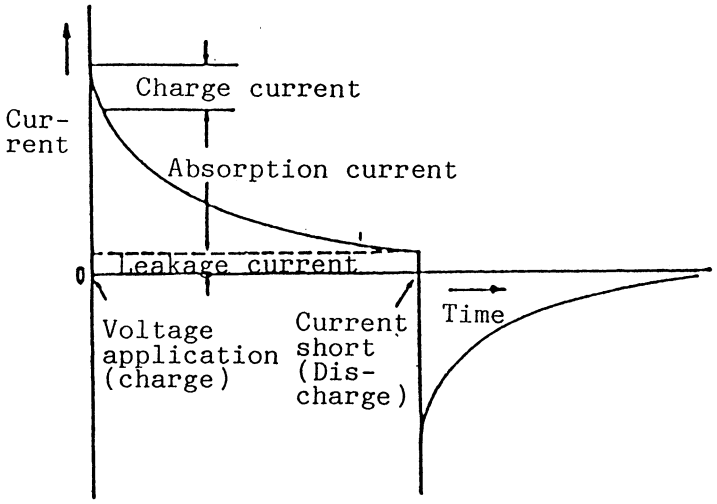
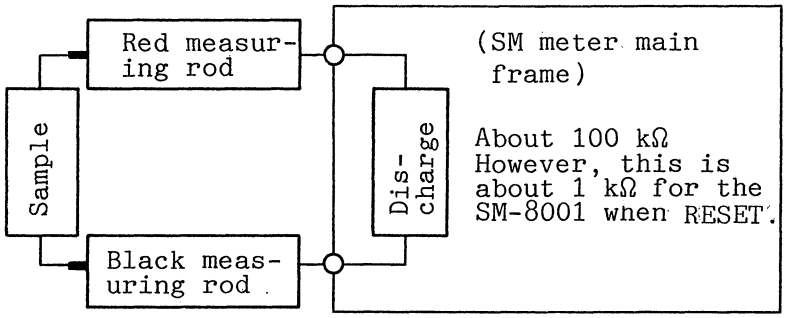
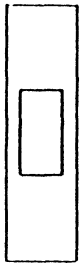
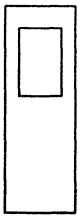


Figure 16 **Dielectric Absorption Phenomena**

6.5 How to Use the Charge/Discharge Switch ⑤

As described in the Section Name, this switch has the following three functions.

DISCHARGE 	Always set this switch to this position before feeding the power to the instrument. After the power has been turned ON, set the switch to this position when sample measurement is complete and the sample needs to be taken out. Internally, a resistor of about 100 kΩ is connected to this position to allow voltage remaining in the sample to be discharged. Though discharge time cannot be collectively said since it is determined by the relationship with the capacity of a sample, if capacity is assumed to be 1 μF, residual voltage reaches to a level of 5% of less of applied voltage for abut 5 sec. Figure 17 shows the discharge status.  **Figure 17 Diagram Indicating Discharge Status**
CHARGE 	When the switch is set to this position, the charge function is available. For the measurement of capacitive sample, leaving the switch to this position for several sec after measurement has started allows the sample to be charged. Although no regulations are determined for leaving the charge/discharge switch at this position, it is recommended that charging time be determined for measurement to unify the measurement conditions. Since measurement voltage is output to the Rx terminal ④ under this condition, take great care in handling the instrument.
MEASURE 	When the switch is set to this position, the measurement function is available. This position allows charging by guard tip (see Section 6.6), achieving an increase in measurement speed. Since measurement voltage is output to the Rx terminal ④ under this conditions, take great care in handling the instrument.

[Note] The DISCHARGE circuit is not activated when the power switch ② is set to OFF. Even when the charge/discharge switch is set to DISCHARGE, do not turn the power switch ② ON with a sample connected to the instrument.

6.6 How to Use Guard Tip

The SM-8000 series allows the sample to be easily charged as one of the functions of the charge/discharge switch ⑤ . In addition to charging sample, this function also allows charging by a measuring rod, which is the traditional function of the TOA super megohm series.

The red measuring rod is constructed as shown in Figure 18 (a). The thick tip at the center of the rod is called measurement tip and the thin tip at the periphery, guard tip. If the guard tip is not necessary, it can be removed as shown in Figure 18 (b). This guard tip is used as a charging tongue piece when the insulation resistance of a capacitive sample is measured or is used to remove guard when high insulation resistance is measured. For charging, connect the black measuring rod to a sample and contact the guard tip of the red measuring rod to the sample. Exercise care in doing this since sparks may be generated, though the generation of sparks depends on the voltage to be measured or the capacitance of the sample. Although no regulations are especially provided for the contact time, always testing under the same measurement conditions is important and, therefore, it is preferable that the contact time is always constant. After an appropriate time has elapsed, replace the tip of the red measuring rod with the measurement tip.

This allows measurement to be conducted without causing the indicator pointer to exceed the limit.

Use of the charge/discharge switch ⑤ on the panel instead of the guard tip allows capacitive insulation resistance to be measured. For details, see Section 6.5.

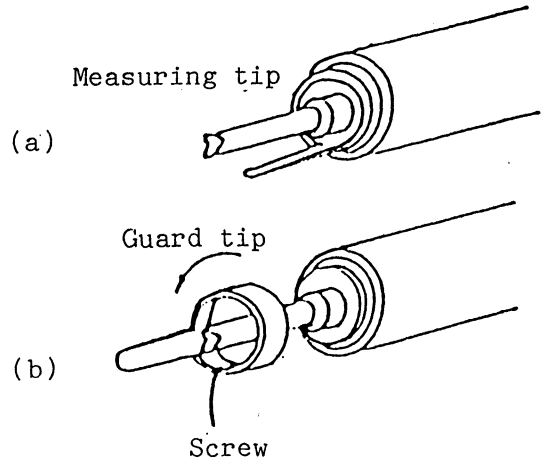


Figure 18 Construction of Measuring Rod of Usage of Guard Tip

Note To remove the guard tip, first disconnect the plug from the Rx terminal ④ .

Note

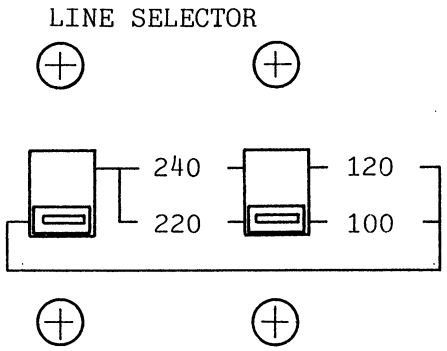
Since the internal impedance of a capacitive sample is low, inadvertently touching the area charged with voltage causes the electric charge remaining in the sample to be discharged at once. This generates strong electrical shock and can be very dangerous.
Exercise great care especially when the measurement voltage is high and sample capacitance is large.
Therefore, after measurement is complete, always discharge the electric charge and then remove the sample.

6.7 Line Selector Switch ⑮ and Fuse

The instrument needs to be supplied with AC power. Set the LINE SELECTOR switch to the commercial supply voltage to be used.

Commercial supply voltage should be used within ± 10% of the input voltage selected. However, when 240 V is selected, 250 V is the maximum input voltage.

When setting the line selector switch, see the rear of the instrument (Figure 3) and Figure 19.



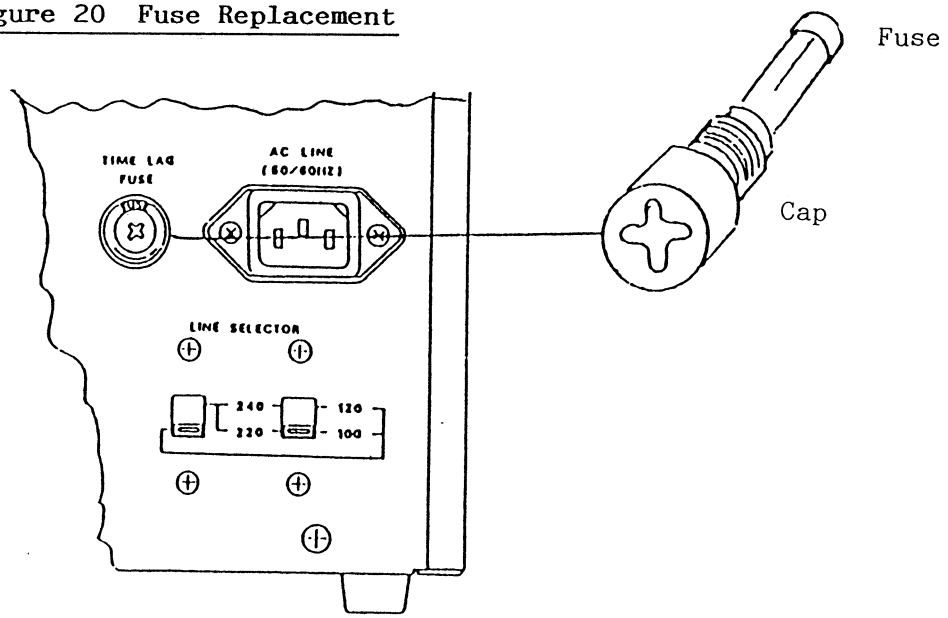
	LINE SELECTOR
100 V	
120 V	
220 V	
240 V	

Figure 19 Line Selector and Fuse Usage

When supply voltage is changed, change the fuse ⑭ as necessary. A time-lag fuse contained in a glass tube is used for this instrument.

To replace the fuse, turn the power switch ② OFF, disconnect the plug from the power connector ⑲ , and turn the + area of the fuse holder using a Phillip's screwdriver. This allows the fuse cap to be removed for fuse replacement. (See Figure 20.)

Figure 20 Fuse Replacement



6.8 Movement of SM-8001 Indicator

The overcurrent protection circuit for the power to be measured of the SM-8001 Resistance Taster has the ㄱ-shaped characteristics (Figure 21). Since the minimum measurement resistance value is 5 ohm at 5 V, a flowing current of 1 A is needed. In the SM-8001, the control circuit is activated to reduce output voltage and current when a current exceeding 1.8 A flows. When the resistance value of the sample to be measured is less than 2.5 ohm, note that the voltage to be measured becomes inconstant as described above, disabling correct measurement.

Further, take great care in handling the sample which causes a current of 1 A to flow because this means that a power of 5 W is consumed, which may damage the sample by burn.

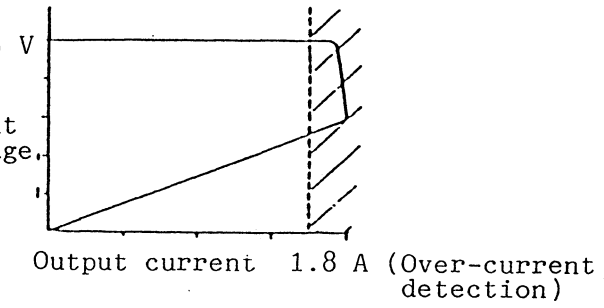


Figure 21 ㄱ-Shaped Characteristic

The deflection of the indicator pointer ① where the sample is shorted

If the sample is shorted or resistance value is very low, voltage at that point is almost 0, but current flows. Note that this causes the indicator ① to indicate the results as if the indicator showed the measured value.

6.9 How to Use the SM-8001 TIME Switch ㉑ and TIME Setting Switch ㉒

The TIME setting switch ㉒ is OFF when set to the left end. That is, the instrument enters the continuous measurement status. Changing the TIME switch ㉑ from RESET to TEST with the TIME setting switch ㉒ set to 10 sec. starts the timer and, 10 sec later, the TIME UP lamp lights up, causing measurement to complete. At the same time, the indicated value of the indicator ① is held. Holding time is up to about 30 min.

To release the holding of the indicator's ① indicated value, set the TIME switch ㉑ to RESET (bottom). This also extinguishes the TIME UP lamp ㉓ . (See Figure 4.)

6.10 SM-8207 RANGE ⑩ and VOLTAGE ⑪ Display

The SM-8207 Super Megohm Meter displays measuring range by LEDs. The value to be displayed differs even at the same position due to the relationship with the measurement voltage, but this is not abnormal. The left end of the RANGE switch ⑩ is CAL., which is displayed as shown in Figure 14.

The SM-8207 Super Megohm Meter allows the measurement voltage to be specified in five ranges. For example, voltage setting of 12 V, 25 V, 50 V, 75 V, and 125 V or 50 V, 200 V, 300 V, 750 V, and 900 V is available. These voltages specified are displayed by LEDs.

The measurement voltage is set in accordance with designation at ordering at our factory and delivered.

6.11 SM-8210's Indicator ① ∞ and Handling of the ∞ ADJ. Knob ⑫

. For the SM-8210, the VOLTAGE switch ⑧ allows 10 V to 1000 V to be selected. However, when the set voltage is changed from a higher to a lower value, the indicator ① pointer may exceed the limit or goes further right than the ∞ depending on the setting position of the RANGE switch ⑦ . In this case, move the RANGE switch ⑦ to a point lower than the current set range or leave the pointer for a while, which allows the pointer to return to ∞ .

Therefore, to change the measurement voltage using the VOLTAGE switch ⑨ , set the RANGE switch ⑦ to a smaller range as much as possible. Also, wait for a few min. to use the indicator's ∞ ADJ.

. When × 10^8 of the RANGE switch ⑦ is used, sóme time is needed to confirm the indicator's ∞ point. For measurement that requires a short time, use the ∞ ADJ. knob ⑫ to align the pointer to the ∞ of the indicator.

As long as the indicator's ∞ is aligned by × 10^7 or less, the effect on an error in measurement is not extreme even though RANGE ⑦ is changed to adjust the ∞ later.

7. Calibration

. Before turning the instrument power ON, confirm that the indicator ① mechanically indicates the zero point.
Confirm that the pointer agrees with the ∞ point as shown in Figure 12 and, if deviated, use the indicator zero adjusting screw ③ to adjust the position of the pointer. The indicator zero adjusting screw is found when its rubber cap is removed. Gently turn the screw using a screwdriver.

. Turn the instrument power ON in accordance with Section 6.2 and wait for about 30 min. Then, carry out the following calibration work.

. Set the charge/discharge switch ⑤ to MEASURE. For the SM-8001, set the TIME switch 21 to TEST.

. Before setting RANGE switch ⑦ to CAL., confirm that the indicator pointer matches with the ∞ as shown in Figure 12.
If the pointer is deviated, turn the ∞ ADJ. ⑰ on the rear panel to adjust the pointer to the ∞ correctly. For the SM-8210, this is accomplished using the ∞ ADJ. ⑫ on the front panel.

. Next, set RANGE switch ⑦ to CAL. This causes the indicator ① to indicate the full scale red line. If the pointer deviates from the red line, use the VOLT ADJ. ⑯ on the rear panel of the instrument to correctly adjust the pointer.
This operation is common for each voltage and thus performing calibration at any voltage also performs calibration for other voltages. However, the pointer does not always align with the red line because of the relationship between the measurement voltage and amplifier gain. For the tolerance of deviation, see Figure 22. As long as the pointer is within the range shown in Figure 22, it falls within the standard of the instrument.

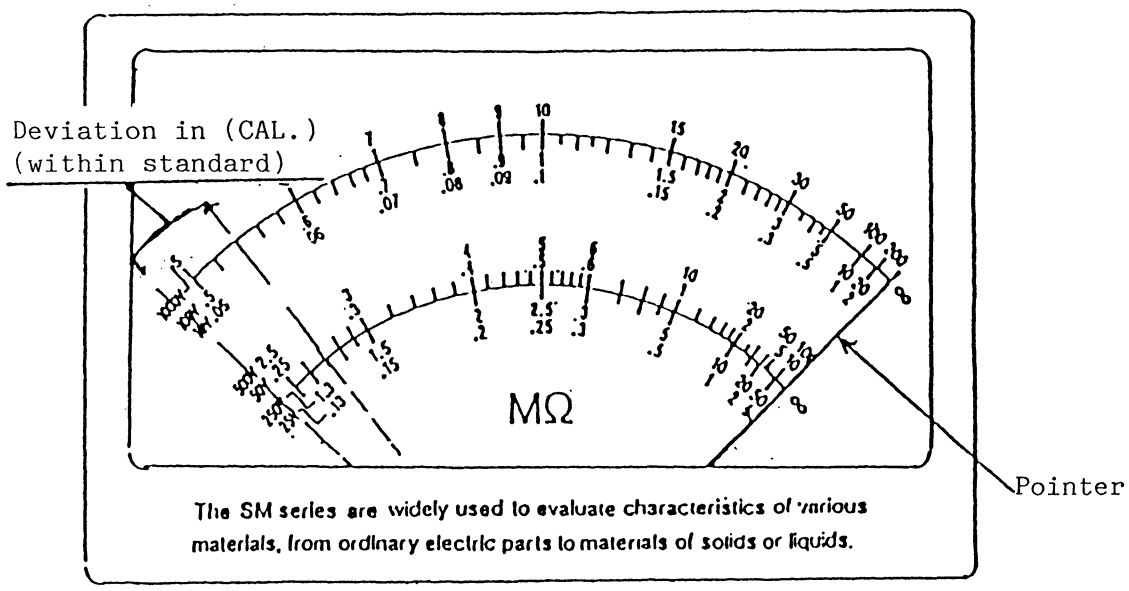


Figure 22 The Tolerance of Deviation in (CAL.)

It is recommended that ∞ and CAL. checks be incorporated into the daily operation checking items conducted before starting operation. This will be the operation check of the instrument. If the pointer considerably deviates from the ∞ point or the CAL. function does not accomplish red line agreement, contact our nearest sales office or agent.

8. Variety of Options

The SM-8000 Series includes the following options.

Alarm unit (AL-8000)	The indicator is provided with a pointer for setting the alarm. The alarm setting pointer is linked with the ALARM (AL-8000) setting knob ⑧. Setting the pointer to the value desired generates an alarm if the measured value falls below the set value.
DC output (PR-8000) (RI-8000)	When insulation resistance is continuously measured, its data sometimes needs to be recorded. In such case, two outputs are available; one is DC output (linear output) proportional to the insulation resistance and the other is DC output (1/R output) of inverse proportion to the insulation resistance.
HV-EN (EN-8000)	Measurement is achieved by feeding the measurement voltage to a jig, etc. externally connected. This function prevents measurement voltage from being output if the measuring conditions are not met. For example, it stops feeding the measurement voltage if the jig or the cover of the measuring box is open.

8.1 Alarm Unit, AL-8000

When insulation is measured, the indicator ① value is not necessarily read, but sometimes it is used to determine if the resistance is more than or less than a certain value, i.e., a GO/NO determination test. This unit is used for such purpose.

8.1.1 Specifications

Alarm setting range: Full area of the meter scale graduation

Alarm setting accuracy: Within ±10% of the set value (in the range of the meter's full scale to 10 times scale graduation)

Alarm contact output: 110 V allowable contact voltage, 2 A allowable contact current, 60 W (DC)/60 VA (AC) allowable contact power

8.1.2 Handling method

The SM-8205 Super Megohm Meter provided with an alarm unit is called the SM-8206 Super Megohm Meter with Alarm Unit. Its appearance is shown in Figure 5.

First, turn the ALARM setting knob ⑧ to set the alarm point to the desired value. In this case, the value at which the alarm is set is determined by:

The product of the scale value of the indicator ① and the RANGE switch ⑦ or ⑩

Note that some models with an alarm unit use a different scale graduation for the indicator ① depending on VOLTAGE switch ⑥ .

An alarm is generated if the indicator pointer (black pointer) falls below the set value. Exercise care in that an alarm is generated if the pointer falls below the alarm set point when measurement is made without charging.

When an alarm is generated, the ALARM lamp ⑨ on the front panel lights. Selection of built-in buzzer or contact output is available.

The alarm is released if the measured value rises above the alarm set point or, by canceling measurement when the indication of the indicator ① rises higher than the alarm set point (indicator ① indicates ∞).

8.1.3 Alarm Output

Built-in buzzer or contact output can be selected for alarm output using the BUZZER-ON/OFF switch ⑱ on the rear panel. The built-in buzzer is activated when the BUZZER-ON/OFF switch is set to BUZZER, while contact output is output to the output connector ⑱ when it is set to OUT. The maximum usage condition of contact is 110 V at 2 A. Figure 23 shows the pin used by the output connector ⑱ and its usage example.

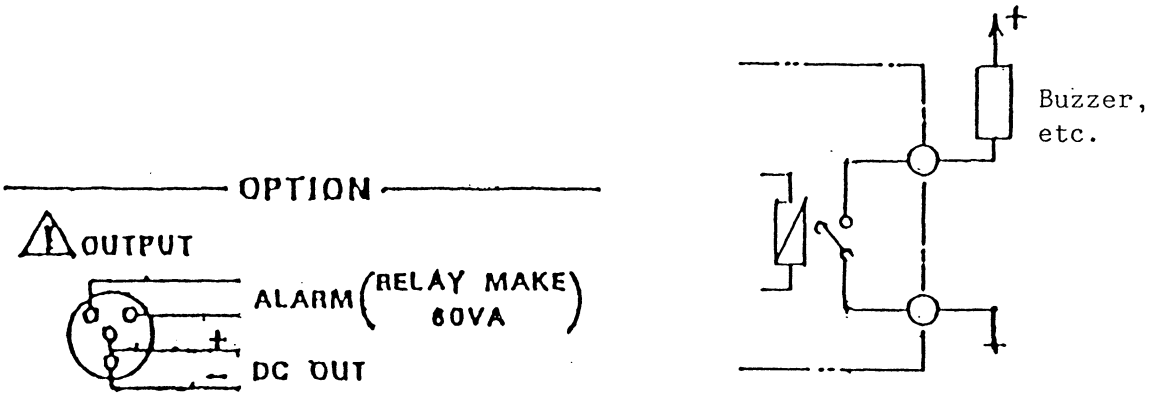


Figure 23 Output Connector Pin and Usage Example

8.2 DC Output RP-8000 (Proportional to Resistance Value)

Insulation resistance is obtained by dividing the measurement voltage by current flow. If the measurement voltage is constant, and if the measured insulation resistance doubles, current flow becomes half. This option converts the insulation resistance to the DC output in proportion to the measured insulation resistance.

8.2.1 Specifications

Output range : From the indicator full scale to 10 times that value

Output voltage : 1 V at full scale, 10 V for the 10-fold value

Output accuracy: Within $\pm$10% of full scale

8.2.2 Handling method

Conduct measurement in accordance with the measuring method in Section 6. There is no special restriction in provision of this option.

Figure 24 shows the connection method.

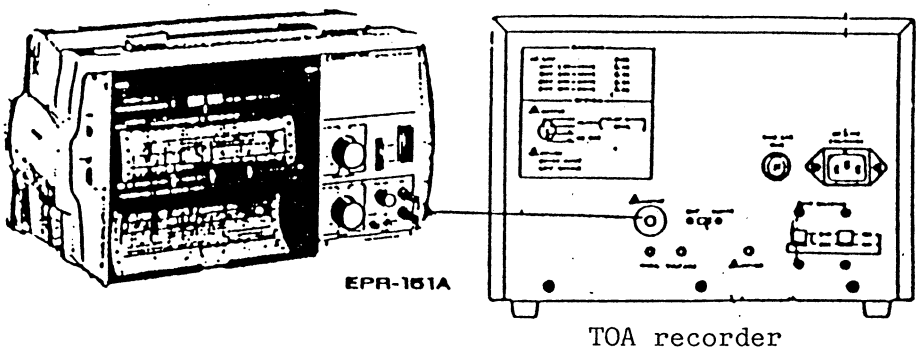


Figure 24 Connection of Recorder

8.2.3 Output connector and recorder

See Figure 23 for the pin of the output connector ⑱ .

A DC instrument can be connected to this output. Apply 1 M Ω or higher for the input impedance of the instrument to be used. When recording is needed, it is advisable that selection be made from among our various recorders. We provide a recorder chart that meets the output, and promptly service if any malfunction occurs.

Figure 25 shows the usage example of the TOA EPR-151A. This indicates the correspondence to the 1000 V scale graduation of the SM-8205 when the ±5 V range of the EPR-151A is set to the left end, or 0 (full span: 0 to 10 V).

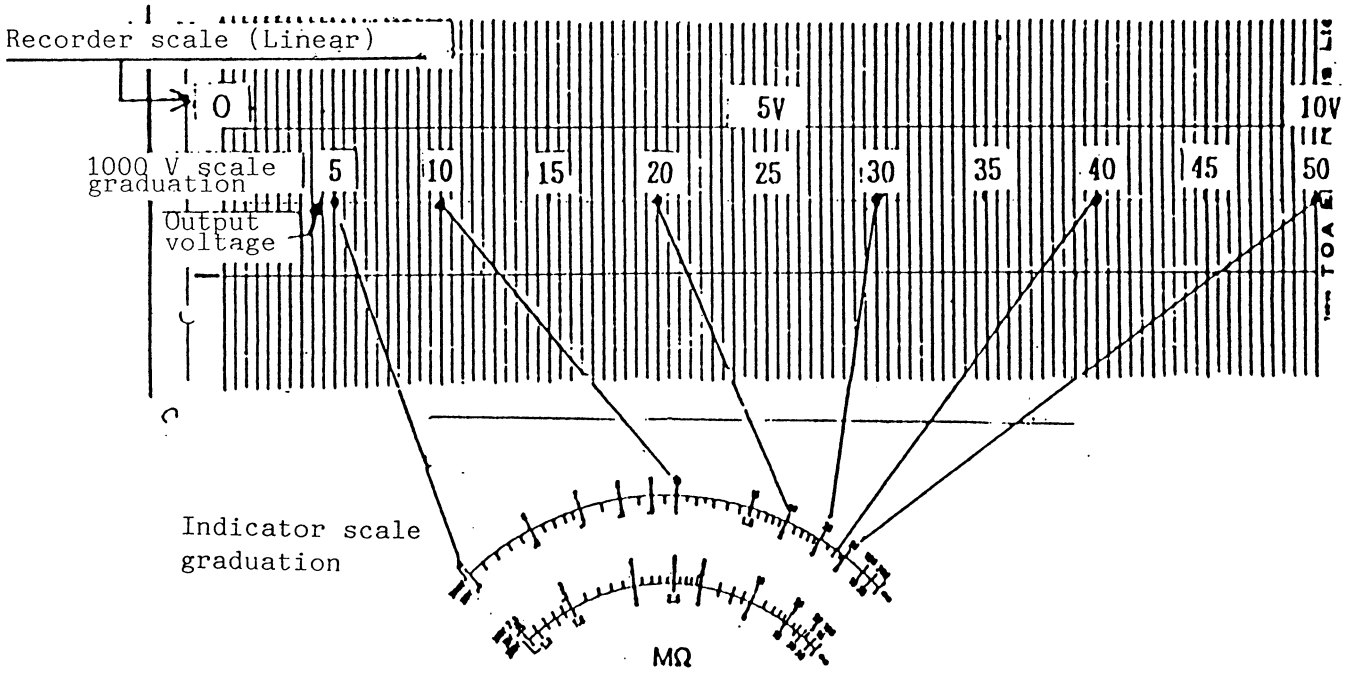


Figure 25 Example of DC Output (Proportional)

8.3 DC Output (1/R), RI-8000

As described in Section 8.2 "DC Output and Proportioning," if the measurement voltage is regarded as constant for insulation resistance measurement, and if the insulation resistance (R) doubles, the current flow becomes half. This is called 1/R DC output.

This output is not available together with the linear output in Section 8.2.

8.3.1 Specifications

Output range : Full area of the indicator scale range

Output voltage : 10 V at indicator full scale, 1 V for 10 times scale graduation

Output accuracy: ±10% of the indicated value in the range of the indicator full scale to 10 times the scale graduation

8.3.2 Handling method

Conduct measurement in accordance with the measurement method in Section 6. There are no special restrictions for option attachment.

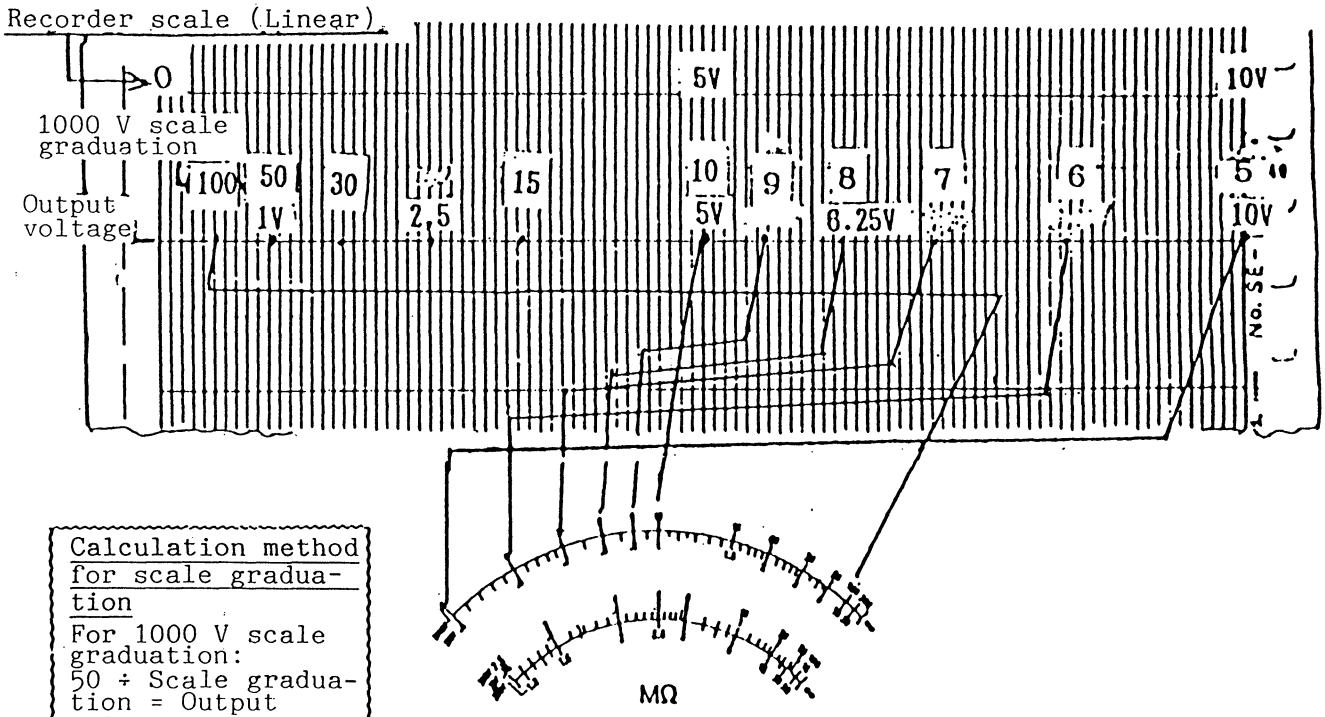
Connection and the pin used for output connector ⑱ is shown in Figure 23.

8.3.3 Output connector and recorder

The same steps can be taken as in Section 8.2.3. However, note that the relationship of the output voltage and insulation resistance value differs.

Figure 26 shows the usage example of the TOA EPR-151A. This indicates the correspondence to the 1000 V scale graduation of the SM-8205 when the ±5 V range of the EPR-151A is set to the left end, or 0 (full span: 0 to 10 V).

Figure 26 DC Output (1/R)



Calculation method for scale graduation

For 1000 V scale graduation:
50 ÷ Scale graduation = Output voltage

Figure 26 DC Output (1/R)

8.4 HV-EN, EN-8000

Super megohm meters use high voltage as the measurement power source. Output of the measurement voltage prior preparation of items such as measurement jigs, etc., presents danger such as electrical shock. This option, the HV-EN (High Voltage Enable), can be used to prevent electrical shock.

8.4.1 How to use the option

For use, connect the provided plug to the HV-EN connector 20 on the rear panel. Figure 27 shows the connection wiring. In specific usage, this option is linked with the SME-8320 flat sample electrode and the SME-8350 measuring box. It can also be connected to an automatic unit, jig, etc. provided by the user.

This switch is incorporated in the SME-8310 and SME-8350 such as switch boxes.

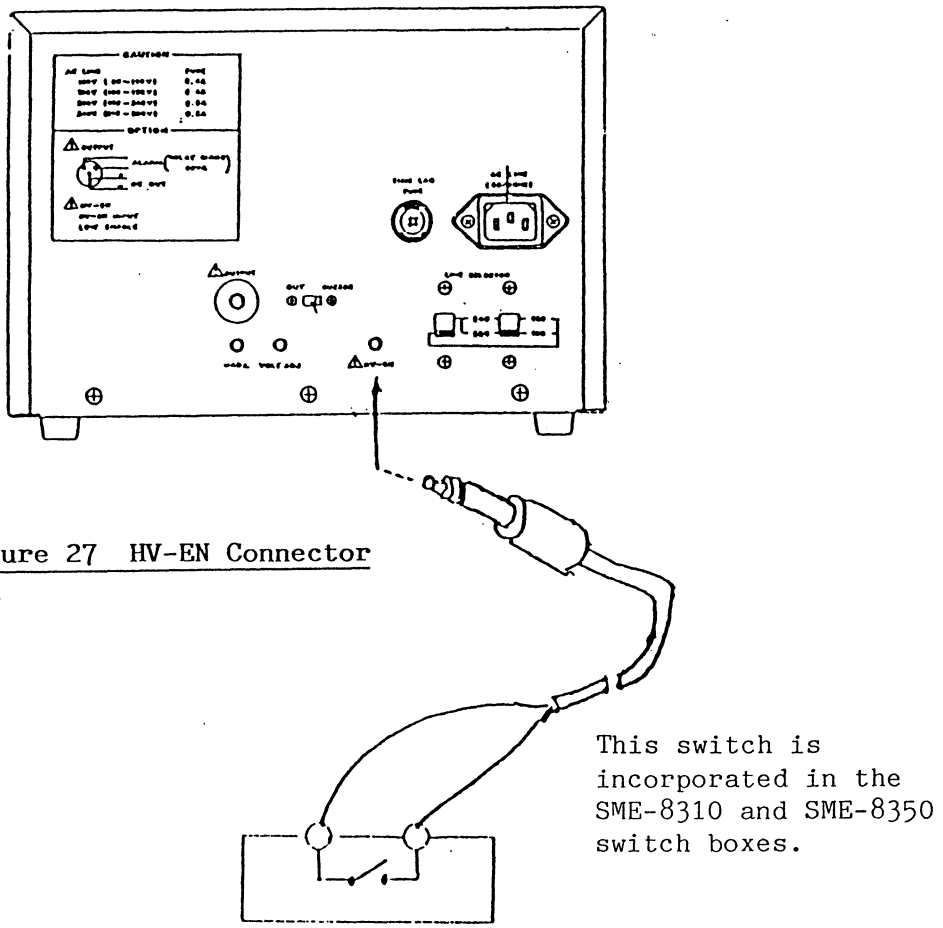
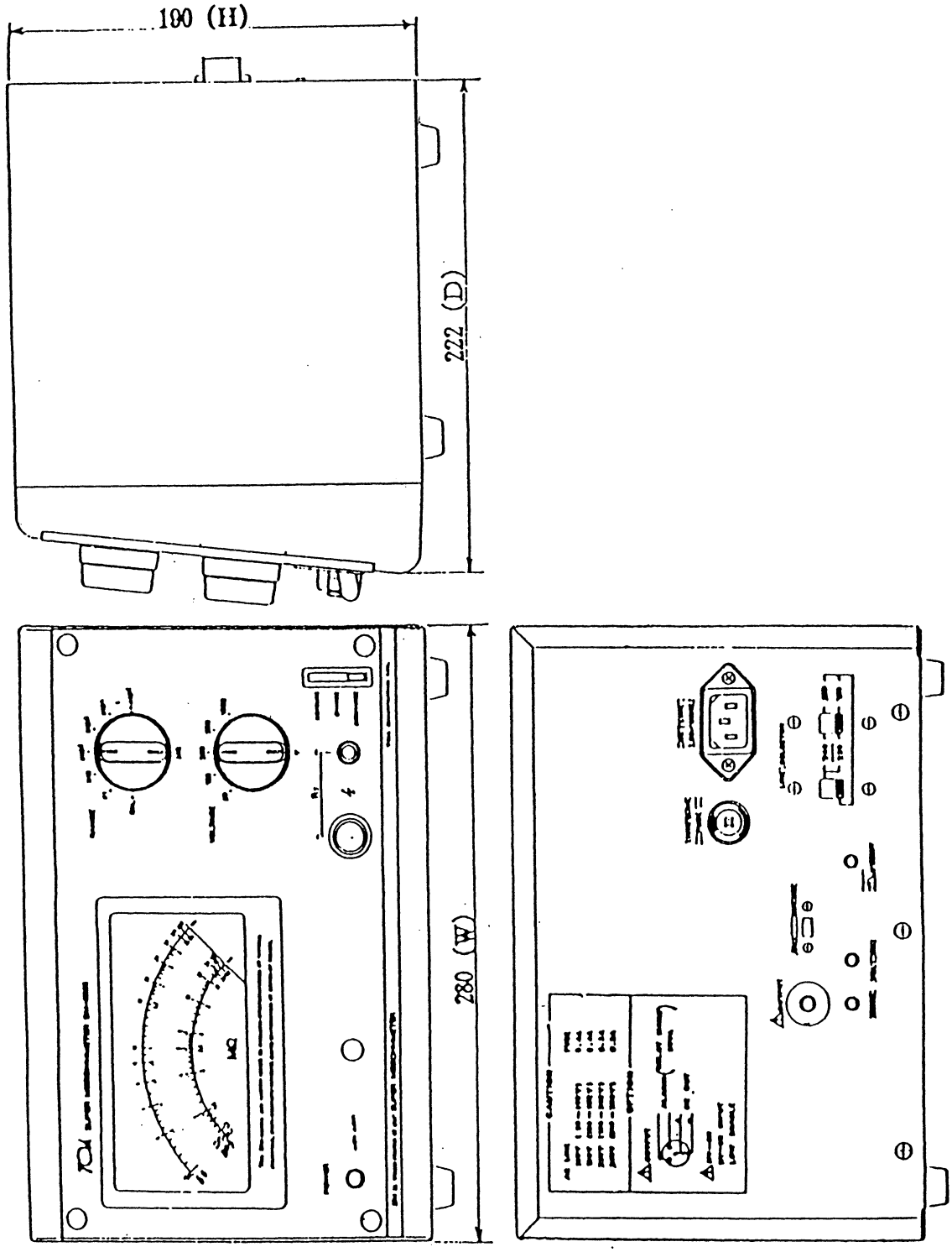


Figure 27 HV-EN Connector

Note The HV-EN electronically drops the output of the measurement voltage. Thus, a residual voltage of a few volts may actually be generated.

Appearance Figure This shows the SM-8205. For other models, see the section of Section Name (Figures 4 to 7).

Dimensions: Approx. 280 (W) x 190 (H) x 222 (D) mm



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